

**Oracle® Communications  
Billing and Revenue Management**

Developer's Guide

Release 7.5

**E16702-17**

December 2019

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## Part V Localizing BRM

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# Preface

This book describes how to customize your Oracle Communications Billing and Revenue Management (BRM) system.

## Audience

This guide is intended for developers.

## Downloading Oracle Communications Documentation

Product documentation is located on Oracle Help Center:

<http://docs.oracle.com>

Additional Oracle Communications documentation is available from the Oracle software delivery Web site:

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<http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs> if you are hearing impaired.

## Document Revision History

The following table lists the revision history for this book.

| Version   | Date          | Description   |
|-----------|---------------|---|
| E16702-01 | November 2011 | Initial release.  |
| E16702-02 | May 2012      | Documentation updates for BRM 7.5 Patch Set 1. <ul style="list-style-type: none"><li>■ Made minor formatting and text changes.</li><li>■ Added "load_config" section.</li></ul> |

| Version   | Date          | Description  |
|-----------|---------------|--|
| E16702-03 | August 2012   | Documentation updates for BRM 7.5 Patch Set 2. <ul style="list-style-type: none"> <li>Updated the following sections: <ul style="list-style-type: none"> <li><a href="#">Guidelines for Customizing BRM load_config</a></li> </ul> </li> </ul>   |
| E16702-04 | December 2012 | Documentation updates for BRM 7.5 Patch Set 3. <ul style="list-style-type: none"> <li>Added BRM field ID information to the following sections: <ul style="list-style-type: none"> <li><a href="#">Creating Custom Fields</a></li> <li><a href="#">About Defining Storable Classes</a></li> <li><a href="#">Creating Custom Fields</a></li> </ul> </li> <li>Added the "About Adding Virtual Column Support to Your Applications" section.</li> </ul>         |
| E16702-05 | March 2013    | Documentation updates for BRM 7.5 Patch Set 4. <ul style="list-style-type: none"> <li>Replaced multidatabase information with multischema information.</li> </ul>  |
| E16702-06 | July 2013     | Documentation updates for BRM 7.5 Patch Set 5. <ul style="list-style-type: none"> <li>Added the following sections: <ul style="list-style-type: none"> <li><a href="#">Customizing Event Searches</a></li> <li><a href="#">Customizing Balance Group Searches</a></li> <li><a href="#">Customizing Product/Discount Searches</a></li> <li><a href="#">Customizing Service Searches</a></li> </ul> </li> </ul>  |
| E16702-07 | August 2013   | On HP-UX IA64, BRM 7.5 is certified as of BRM 7.5 Patch Set 5.<br>Documentation added for HP-UX IA64.  |
| E16702-08 | October 2013  | Documentation updates for BRM 7.5 Patch Set 6. <ul style="list-style-type: none"> <li>Added the following sections: <ul style="list-style-type: none"> <li><a href="#">Hiding the Password Fields in Customer Center</a></li> <li><a href="#">Configuring the Data Manager for Oracle ZT PKI Encryption</a></li> <li><a href="#">Enabling Password Restriction for /service Objects</a></li> </ul> </li> <li>Updated the "pin_crypt_app" section.</li> </ul> |
| E16702-09 | May 2014      | Documentation updates for BRM 7.5 Patch Set 8. <ul style="list-style-type: none"> <li>Added minor notes about extended architecture (XA) transactions to "Using Transactions".</li> <li>Updated information about implementing timeout for requests in client applications (in the chapters "Adding New Client Applications" and "Creating Client Applications by Using Java PCM").</li> </ul>   |
| E16702-10 | August 2014   | Documentation updates for BRM 7.5 Patch Set 9. <ul style="list-style-type: none"> <li>Added the following section: <ul style="list-style-type: none"> <li><a href="#">Setting Up Customer Verification for Your Applications</a></li> </ul> </li> </ul>  |



| Version   | Date          | Description  |
|-----------|---------------|--|
| E16702-11 | October 2014  | Documentation updates for BRM 7.5 Patch Set 10. <ul style="list-style-type: none"> <li>Updated the following sections: <ul style="list-style-type: none"> <li><a href="#">Converting Storable Class Files from Previous Versions</a></li> <li><a href="#">Testing Payment Tool</a></li> </ul> </li> </ul>  |
| E16702-12 | June 2015     | Documentation updates for BRM 7.5 Patch Set 12. <ul style="list-style-type: none"> <li>Updated the following sections: <ul style="list-style-type: none"> <li><a href="#">About Adding Virtual Column Support to Your Applications</a></li> <li><a href="#">Localizing and Customizing Strings</a></li> </ul> </li> <li>Made minor formatting and text changes.</li> </ul>   |
| E16702-13 | August 2015   | Documentation updates for BRM 7.5 Maintenance Patch Set 1. <ul style="list-style-type: none"> <li>Added the "<a href="#">Limiting Search Results by Using the PIN_FLD_MIN_ROW and PIN_FLD_MAX_ROW Fields</a>" section.</li> <li>Updated the following sections: <ul style="list-style-type: none"> <li><a href="#">Defaults for Validating Customer Registration Information</a></li> <li><a href="#">Defaults for Tax Calculation</a></li> <li><a href="#">Accessing pin.conf Files in Custom Code</a></li> <li><a href="#">About the Search Input Flist</a></li> <li><a href="#">Localizing BRM</a></li> <li><a href="#">Localizing and Customizing Strings</a></li> </ul> </li> </ul> |
| E16702-14 | December 2015 | Documentation updates for BRM 7.5 Patch Set 14. <ul style="list-style-type: none"> <li>Updated the following section: <ul style="list-style-type: none"> <li><a href="#">Encrypting the Data</a></li> <li><a href="#">pin_crypt_app</a></li> </ul> </li> <li>Added the following sections: <ul style="list-style-type: none"> <li><a href="#">Generating a Root Encryption Key</a></li> <li><a href="#">Modifying a Root Encryption Key</a></li> </ul> </li> <li>Made minor formatting and text changes.</li> </ul>  |
| E16702-15 | April 2016    | Documentation updates for BRM 7.5 Patch Set 15. <ul style="list-style-type: none"> <li>Updated the following section: <ul style="list-style-type: none"> <li><a href="#">Using Localized Client Applications</a></li> </ul> </li> </ul>  |

| Version   | Date          | Description  |
|-----------|---------------|--|
| E16702-16 | August 2016   | <p>Documentation updates for BRM 7.5 Patch Set 16.</p> <ul style="list-style-type: none"> <li>■ Added or updated the following sections: <ul style="list-style-type: none"> <li><a href="#">Adding and Modifying Policy Facilities Modules</a></li> <li><a href="#">About Storable Class Editor</a></li> <li><a href="#">Modifying the pin.conf File to Enable Changes</a></li> <li><a href="#">Reading Fields in an Object</a></li> <li><a href="#">Creating Custom Storable Classes</a></li> <li><a href="#">Java Client Applications</a></li> <li><a href="#">Enabling the Use of Regular Expressions in the Event Notification List</a></li> <li><a href="#">Configuring EAI Manager to Publish to an HTTP Port</a></li> </ul> </li> </ul> |
| E16702-17 | December 2019 | <p>Documentation updates for BRM 7.5 Patch Set 23.</p> <ul style="list-style-type: none"> <li>■ Added the following sections: <ul style="list-style-type: none"> <li><a href="#">Enabling Copy and Paste of Service ID for Read-Only Access</a></li> </ul> </li> </ul>   |

# Part I

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## Introduction to Customizing BRM

Part I provides an overview of customizing Oracle Communications Billing and Revenue Management (BRM). It contains the following chapters:

- [About Customizing BRM](#)
- [Implementation Defaults](#)
- [Understanding Flists and Storable Classes](#)
- [Understanding the PCM API and the PIN Library](#)
- [Understanding the BRM Data Types](#)
- [Understanding API Error Handling and Logging](#)
- [Using BRM Developer Tools](#)
- [Testing Your Applications and Custom Modules](#)



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# About Customizing BRM

This guide introduces the types of customizations you can make to Oracle Communications Billing and Revenue Management (BRM), the structure of BRM from the programming perspective, the BRM programming model, and the tools and programming languages you can use for customizing BRM.

This guide contains general procedures for implementing the different types of customization. Because BRM is highly flexible and each implementation is unique, this guide provides general procedures for creating and modifying BRM components and applications. It does not provide specific instructions for creating custom applications or components for specific implementations.

Read this chapter if you are a programmer customizing BRM.

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**Note:** Customizing BRM does not always require programming. You can change most of the default settings by using the client tools or the configuration files. See "[Implementation Defaults](#)".

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To understand the basic BRM concepts and system architecture, see "Introducing BRM" in *BRM Concepts*.

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**Caution:**

- Always use the BRM API to manipulate data. Changing data in the database without using the API can corrupt the data.
  - Do not use SQL commands to change data in the database. Always use the API.
- 
- 

## About Customizing BRM

BRM includes a set of client applications, business policies, Data Managers (DMs), and storable objects. You can customize BRM to add new client applications, to add new features and functionality, to change the default behavior, or to integrate with third-party software.

There are different levels at which you can customize BRM:

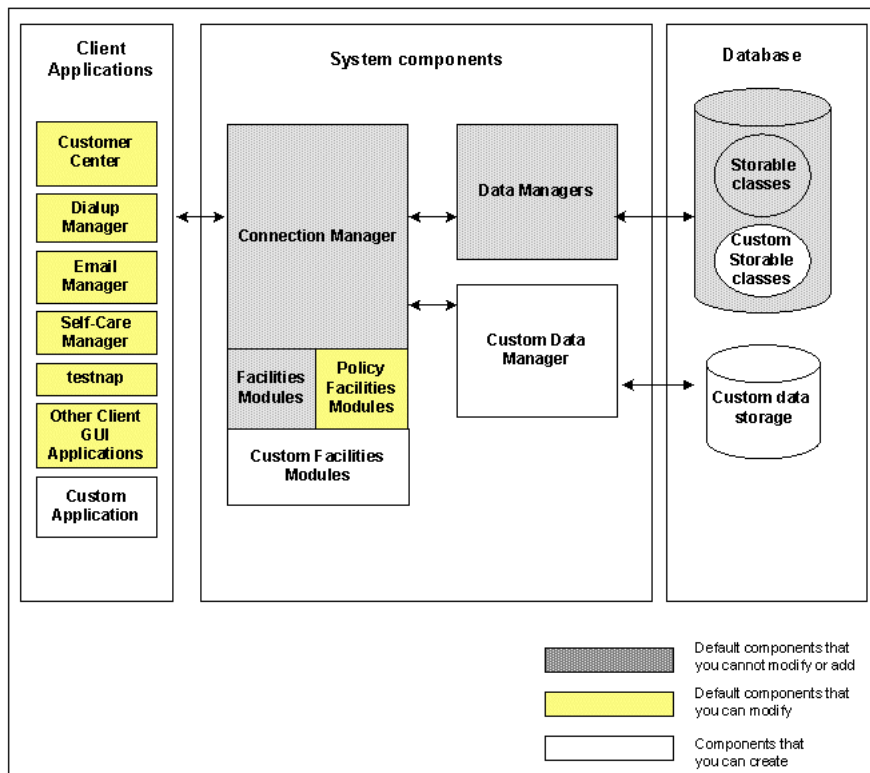
- You can write custom client applications that communicate with BRM. For example, you can add applications that pass service usage information to BRM for rating.
- You can change the default policies or write new policies to implement your business objectives.

- You can create a new storable class to hold information needed for your business. For example, if you provide a new type of service, such as online gaming, you need to create a storable subclass of type `/service` to hold gaming-related information.
- You can write a new Facilities Modules (FM) to add new business logic to BRM. For example, you can add a new FM to manage specific types of information, such as email, Web pages, or ftp archives.
- You can write a new DM to access data in a custom storage system.

Figure 1-1 shows the basic structure of BRM and the different levels of customization.

**Note:** A specific customization may involve changes to one or more of the components.

Figure 1-1 BRM Structure and Levels of Customization



Every type of customization requires you to work with:

- Field lists (flists). See "[Understanding Flists and Storable Classes](#)".
- Portal object IDs (POIDs). See "[Portal Object ID \(POID\)](#)".
- Storable classes. See "[About Storable Classes and Storable Objects](#)".
- PCM (Portal Communication Module) opcodes and (Portal Information Network) PIN library routines. See "[Understanding the PCM API and the PIN Library](#)".

## Customizing Service Integration

When you integrate your services, you can:

- **Create new services.** BRM already supports a basic set of services, but you can integrate your own services such as fax, disk storage, voice mail, and different types of Internet access such as DSL.
- **Customize existing services** to capture additional data. For example, you can extend the existing IP service to charge different amounts for different types of access.
- **Customize how you charge for services;** for example, by time or quantity.

For more information, see "[Adding Support for a New Service](#)".

## Planning Your Customization

Before you change the default BRM implementation or add new features and functionality to BRM, you need to plan your customization. For your customization to work properly, changes you make to one component might require changes to other components. For example, if you want to support a new service such as online gaming, you need to consider making the following additions or changes to BRM:

- Create a new service object to define the service and to define events associated with the service that you want to rate.
- Develop a pricing model to define rates for the service.
- Specify resources for events generated by the service and include them in a pricing plan.
- Map attributes of the events to rate plans and impact categories by using the rate plan selector in Pricing Center.
- Define different configurations for the service and rate each configuration by using product-level provisioning.
- Set up authentication and authorization for users to log in to the service.
- Extend client applications, such as Customer Center, and the registration interface to process information specific to the service and to display information related to the service.
- Optionally, write client applications to load the events specific to the service or define templates for processing log files related to the service by using Universal Events Loader.
- Customize the default policy FMs to process information specific to the service, or write new system FMs and policy FMs if necessary.

In addition, depending on the level of customization, you need to determine whether you can implement your changes by using a client tool, by using a configuration file, or by programming.

## Guidelines for Customizing BRM

Here are some general guidelines that you should follow when customizing BRM:

- **Performance:** Assess how the proposed solution will impact the performance of the system. Review the sizing of the system to comply with existing performance requirements. The proposed solution should limit the number of products, resources, Extended rating attributes (ERAs), and iScripts affected during the customization.

- **Manageability:** Verify that the proposed solution is easy to maintain. Customizations should be kept as few as possible because:
  - There could be interferences between customizations and product upgrades, making the move to a newer version difficult.
  - There could be interferences between customizations and patches, leading to side effects or the need to check and possibly change the customization whenever a new patch is released.

Before implementing the customization, save the copies of unedited configuration files, properties files, policy code, registry files, or any other files changed in the customization. Include comments explaining the customizations in the policy code or configuration file.

- **Resource utilization:** Review how the proposed solution will impact the resource utilization and sizing of the system.
- **Cross-feature impact:** Plan for the impact of the proposed solution on other features. For example, when customizing Accounts Receivable (A/R), consider how General Ledger (G/L) is affected. When creating a price list, consider how products are purchased and how they are managed after being purchased.

## About the BRM Client Access Libraries

BRM client applications communicate with Connection Manager (CM) by using any of the following client libraries:

- **PCM C API.** Use this API (Application Programming Interface) to build any C client application.  
See ["Understanding the PCM API and the PIN Library"](#) and ["Adding New Client Applications"](#).
- **PCM C++ API.** Use this API to build any C++ client application.  
See ["Creating Client Applications by Using PCM C++"](#).
- **PIN library.** Use this library to manipulate data in any C or C++ applications. This library includes functions for creating and manipulating input data for the PCM API calls and functions for manipulating strings and decimal data.  
See "PIN Libraries" in *BRM Developer's Reference*.
- **Java PCM API.** Use this API to write client applications in Java that communicate with BRM.  
See ["Creating Client Applications by Using Java PCM"](#).
- **Customer Center SDK.** Use this SDK (Software Development Kit) to customize the Customer Center and Self-Care Manager customer self-care interfaces.  
See ["Customizing the Customer Center Interface"](#) and ["Customizing the Self-Care Manager Interface"](#).
- **PCMIF.** Use this Perl extension to the PCM (Portal Communication Module) library in your Perl scripts to interact with the BRM database.  
For the documentation, see "Perl Extensions to the PCM Libraries" in *BRM Developer's Reference*.

All of the client libraries are included in the BRM SDK. See ["About BRM SDK"](#) for more information.



Table 1–1 shows the APIs you can use to customize the BRM components:

**Table 1–1 APIs Used to Customize BRM Components**

| BRM component           | PCM C | PCM C++ | Java PCM | Customer Center SDK | Perl |
|-------------------------|-------|---------|----------|---------------------|------|
| Client applications     | Yes   | Yes     | Yes      | NA                  | Yes  |
| Self-Care Manager       | NA    | NA      | NA       | Yes                 | NA   |
| BRM client tools        | Yes   | NA      | NA       | NA                  | NA   |
| Customer Center         | NA    | NA      | NA       | Yes                 | NA   |
| Policy Facility Modules | Yes   | NA      | NA       | NA                  | NA   |
| Facility Modules        | Yes   | NA      | NA       | NA                  | NA   |
| Data Manager            | Yes   | NA      | NA       | NA                  | NA   |

## Skills Required for Customizing BRM

Depending on your level of customization, to add new applications or to modify the default options in BRM, you require:

- Knowledge of the BRM system architecture, especially flists, storable classes, and the PCM API.

For information on these concepts, see the following documents:

- BRM System Architecture
- [Understanding Flists and Storable Classes](#)
- [Understanding the PCM API and the PIN Library](#)
- If you are developing client applications, skills in one of the following programming languages:
  - C
  - C++
  - Java
  - Visual Basic
  - Perl
- If you are customizing BRM server components, such as DMs, FMs, or policy FMs, skills in the C or C++ programming languages.

## BRM Programming Tools

You can use the following tools and utilities for customizing BRM:

- BRM SDK, which contains the APIs and libraries you need to write BRM applications, to write and customize BRM components such as FMs and DMs, and to customize BRM applications such as Customer Center. It also includes sample applications and sample code that you can use as examples for your own work.  
See "[About BRM SDK](#)".
- PCM SDK, which contains 64-bit PCM libraries.  
See "[About PCM SDK](#)".

- Developer Center, which includes developer applications that you use to create and modify storable classes and fields, test opcodes, view objects in the database, view opcode specifications, test opcodes, and create templates that control how event data is imported into the BRM database.

See "[About Developer Center](#)".

- A set of utilities for managing and manipulating data, handling errors, and using configuration files.

See "[Developer Utilities](#)".

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## Implementation Defaults

This chapter describes the default implementation of Oracle Communications Billing and Revenue Management (BRM) for business policies, such as those used for registration and billing. It also describes the methods used for changing the default behavior. For more information, see "Ways to Use and Customize BRM" in *BRM Concepts*.

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**Caution:** Do not use or modify this product except as explicitly instructed in this documentation. Assumptions should not be made about functionality that is not documented or use of functionality in a manner that is not documented. Use or modification of this software product in any manner or for any purpose other than as expressly set forth in this documentation may result in voidance or forfeiture of your warranties and support services rights. Please consult your software license agreement for more details. If you have any questions regarding an intended use or modification of this product, please contact your BRM account executive.

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### Defaults for Offering Plans and Deals to Customers

[Table 2-1](#) lists the default settings for plans and deals provided by BRM:

**Table 2–1 BRM Default Settings**

| Business Decision  | Default Behavior  | How to Customize  |
|--|---|---|
| Control which plans a customer can register with on the Web.                                   | Customers can register with plans in the default plan list. | <p>When implementing Web-based registration, write a script that presents plans based on user input. See "Controlling Which Plans and Deals are Available to Customers" in <i>BRM Managing Customers</i>.</p> <p>To customize the source code, see PCM_OP_CUST_POL_GET_PLANS.</p> |
| Control which deals are available to customers.  | The customer can purchase all deals.                        | <p>When implementing Web-based registration, write a script that presents deals based on user input. See "Controlling Which Plans and Deals are Available to Customers" in <i>BRM Managing Customers</i>.</p> <p>To customize the source code, see PCM_OP_CUST_POL_GET_DEALS.</p> |
| Change the amount of time during which you can cancel a product without charging a cancel fee. | Cancel fees are applied.                                    | <p>Change the <b>cancel_tolerance</b> entry in the Connection Manager (CM) configuration file.</p> <p>See "Canceling Products Without Charging a Cancel Fee" in <i>BRM Managing Customers</i>.</p>  |
| Set a credit limit in a plan.  | Credit limits are set to 0.                                 | <p>Change the credit limit in Pricing Center.</p> <p>See "About Applying Credit Limits to Resources" in <i>BRM Setting Up Pricing and Rating</i>.</p> <p>To customize the source code, see PCM_OP_CUST_POL_PREP_LIMIT.</p>  |

## Defaults for Creating Customer Accounts

Table 2–2 lists the default settings for customer accounts:

**Table 2–2 Default Settings for Customer Accounts**

| Business Decision  | Default Behavior  | How to Customize  |
|--|---|---|
| Specify the default country, in case the customer doesn't enter a country name.  | USA.  | Change the <b>country</b> entry in the CM configuration file. See "Specifying the Default Country" in <i>BRM Managing Customers</i> .<br><br>To customize the source code, see PCM_OP_CUST_POL_PREP_NAMEINFO. |
| Specify how to assign the merchant to each account. See "About Merchant Numbers and Account Identifiers" in <i>BRM Configuring and Collecting Payments</i> .   | Use the merchant name from the <code>/config/ach</code> object.   | To use multiple merchant names, customize the PCM_OP_CUST_POL_PREP_BILLINFO source code.  |
| Specify the numbering scheme for account numbers.  | Account numbers are created by combining the database number with the object ID from the account POID, for example, 0.0.0.1-1482. | To change how account numbers are generated, customize the PCM_OP_CUST_POL_PREP_ACCTINFO source code.   |
| Standardize data for account names. For example, to ensure consistent display and formatting of account names, you can capitalize the first and last name, regardless of how the customer entered the information. | The name is formatted exactly how the customer entered it.  | Customize the PCM_OP_CUST_POL_PREP_NAMEINFO source code.  |

## Defaults for Login Names and Passwords

Table 2–3 lists the default settings for login names and passwords

**Table 2–3 Default Settings for Login Names and Passwords**

| Business Decision   | Default Behavior   | How to Customize  |
|---|--|---|
| Specify the characteristics of a valid login name and password. | At least 1 character but no more than 255 characters.  | To specify login requirements, including a list of "naughty words," use the Field Validation Editor. See "Setting up Login Name and Password Defaults" in <i>BRM Managing Customers</i> .<br><br>To edit the source code, see PCM_OP_CUST_POL_VALID_LOGIN and PCM_OP_CUST_POL_VALID_PASSWD. |
| Specify how to encrypt passwords.                               | Passwords for IP services are not encrypted. AES encryption is used for non-service passwords. | Customize the PCM_OP_CUST_POL_ENCRYPT_PASSWD source code.   |

**Table 2–3 (Cont.) Default Settings for Login Names and Passwords**

| Business Decision   | Default Behavior  | How to Customize  |
|---|---|---|
| Specify requirements for email login names.                       | Customers must use all lowercase characters for email logins.<br><br>The login name must include the domain name. | Customize the PCM_OP_CUST_POL_PREP_LOGIN source code.   |
| Specify whether the customer or the system picks the password.    | Customer must specify a password.   | To supply an algorithm for generating passwords, customize the PCM_OP_CUST_POL_PREP_PASSWD source code.   |
| Specify the number of days before a CSR password must be changed. | CSR passwords expire after 90 days.   | Edit the <b>passwd_age</b> entry in the CM configuration file.<br><br>See "Setting the Default Password Expiry Duration" in <i>BRM System Administrator's Guide</i> . |

## Defaults for Validating Customer Registration Information

Table 2–4 lists the default settings for validating customer registration information:

**Table 2–4 Default Settings for Customer Registration Validation**

| Business Decision  | Default Behavior   | How to Customize   |
|--|--|--|
| Specify the minimal information a CSR or customer must enter to create an account.                 | Customer must enter: <ul style="list-style-type: none"> <li>■ Last name</li> <li>■ Address</li> <li>■ City</li> <li>■ State</li> <li>■ ZIP code</li> <li>■ Country</li> <li>■ Service logins and passwords</li> </ul>  | To change the required entries, use the Field Validation Editor. See "Specifying Which Information is Required for Registration" in <i>BRM Managing Customers</i> .<br><br>To customize the source code, see PCM_OP_CUST_POL_VALID_NAMEINFO. |
| Specify the formats a CSR or customer must use when entering state, phone number, and postal code. | <ul style="list-style-type: none"> <li>■ State: two uppercase letters, for example, CA.</li> <li>■ Phone number: either a TAPI-compliant number or (xxx) xxx-xxxx.</li> <li>■ Postal code: (USA only); 5 digits, or 5 digits followed by a hyphen and 4 digits.</li> </ul> | To change the required format, use the Field Validation Editor.<br><br>To customize the source code, see PCM_OP_CUST_POL_VALID_NAMEINFO.   |
| Validate state and ZIP code for tax calculation.   | Do not validate state and ZIP code.  | Edit the <b>tax_valid</b> entry in the CM configuration file.<br><br>See "Specifying Whether to Validate ZIP Codes" in <i>BRM Calculating Taxes</i> .<br><br>To customize the source code, see PCM_OP_CUST_POL_VALID_NAMEINFO.               |

## Defaults for Validating Payment Information

Table 2–5 lists for validating payment information:

**Table 2–5 Defaults to Validate Payment Information**

| <b>Business Decision</b>   | <b>Default Behavior</b>   | <b>How to Customize</b>  |
|--|---|--|
| Specify what registration information to validate when creating an account.  | BRM validates the credit card only. An error in the street address is allowed. The following errors are not allowed: <ul style="list-style-type: none"> <li>▪ Wrong postal code</li> <li>▪ Bad credit card number</li> <li>▪ Failed credit check</li> </ul>   | Customize the PCM_OP_PYMT_POL_VALIDATE source code.  |
| Specify how to validate payment information, such as credit card type, expiration date, and debit account information.   | For credit cards, verifies the type as: <ul style="list-style-type: none"> <li>▪ Amex</li> <li>▪ Carte Blanche</li> <li>▪ Diners</li> <li>▪ Discover</li> <li>▪ JBC</li> <li>▪ Mastercard</li> <li>▪ Optima</li> <li>▪ VISA</li> </ul> Validates that the credit card number has the required number of digits, and verifies the expiration date.<br><br>For direct debit, validates the number of digits in bank, branch, and account numbers. | Customize the PCM_OP_CUST_POL_VALID_PAYINFO source code.   |
| Specify whether to validate the customer's billing information during registration.  | Validates credit card information.  | Change the <b>cc_validate</b> entry in the CM configuration file. See "Specifying How to Validate Customer Contact Information" in <i>BRM Managing Customers</i> .<br><br>To customize the source code, see PCM_OP_PYMT_POL_SPEC_VALIDATE. |
| Specify whether to validate direct debit information during registration.  | Validates direct debit information.   | Change the <b>dd_validate</b> entry in the CM configuration file. See "Enabling Direct Debit Processing" in <i>BRM Configuring and Collecting Payments</i> .   |
| Specify the time between validations of the same credit card. For example, you can allow two members of the same family to register for the same service without validating the credit card the second time. | Does not validate a credit card that has been validated within the last hour.   | Edit the <b>cc_revalidation_interval</b> entry in the CM configuration file. See "Revalidating Credit Cards" in <i>BRM Managing Customers</i> .<br><br>To customize the source code, see PCM_OP_PYMT_POL_SPEC_VALIDATE.                    |

**Table 2–5 (Cont.) Defaults to Validate Payment Information**

| Business Decision  | Default Behavior  | How to Customize  |
|--|---|---|
| Specify the valid format for entering a credit card or debit number.       | Strips spaces between groups of digits.   | Customize the PCM_OP_CUST_POL_PREP_PAYINFO source code. See "Using Customer Security Codes" in <i>BRM Managing Customers</i> .                    |
| Specify the valid date format for credit card or debit card expiration.    | BRM stores expiration dates as 4-character strings in the format <i>MMYY</i> . BRM is Y2K compliant, for example, 02 is the same as 2002.<br>Valid formats are: <ul style="list-style-type: none"> <li>▪ <i>MMYY</i></li> <li>▪ <i>MM/YY</i></li> <li>▪ <i>M/YY</i></li> <li>▪ <i>MM/YYYY</i></li> </ul> All formats are converted to <i>MMYY</i> . | Customize the PCM_OP_CUST_POL_PREP_PAYINFO source code. See "Specifying the Valid Expiration-Date Format" in <i>BRM Managing Customers</i> .      |
| Run a checksum validation on the customer's credit card during validation. | Use a checksum to validate the credit card during registration.   | Change the <b>checksum</b> entry in the CM configuration file.<br><br>See "Disabling the Credit Card Checksum" in <i>BRM Managing Customers</i> . |

## Defaults for Displaying and Sending Introductory Messages

Table 2–6 lists the default settings used to display and send introductory messages:

**Table 2–6 Default Settings for Introductory Messages**

| Business Decision   | Default Behavior                                 | How to Customize  |
|---|--|---|
| Specify whether to display an HTML introductory message to customers during registration. | The introductory message is disabled by default. | Customize the default introductory message and configure your Web registration to display it. See "Setting up Introductory Messages" in <i>BRM Managing Customers</i> .<br><br>To enable the introductory message, customize the PCM_OP_CUST_POL_GET_INTRO_MSG source code. |
| Specify whether to send a welcome email message to customers after they register.         | The welcome email message is enabled by default. | Customize the welcome message. See "Sending Welcome Messages to Customers" in <i>BRM Managing Customers</i> . To customize the source code, see PCM_OP_CUST_POL_POST_COMMIT.  |

## Defaults for Billing

Table 2–7 lists the default settings for billing:



Table 2-7 Billing Defaults

| Business Decision  | Default Behavior   | How to Customize   |
|--|--|--|
| Set the default billing type to open item accounting or balance forward accounting.  | Balance forward accounting.  | Change the <b>actg_type</b> entry in the CM configuration file. See "Setting the Default Accounting Type" in <i>BRM Configuring and Running Billing</i> .<br><br>To customize the source code, see PCM_OP_CUST_POL_PREP_BILLINFO.  |
| For open item accounting, set whether to include or exclude the previous total (PIN_FLD_PREVIOUS_TOTAL) of the bill from the pending amount due (PENDING_RECV) of the current bill unit.   | The previous total is not included.  | Change the <b>open_item_actg_include_prev_total</b> entry in the CM configuration file.  |
| Set the default accounting day to a specific day of the month, or to the day that the account was created.   | The day that the account was created. For example, if a customer registers on the 15th, the accounting for that customer is done on the 15th.<br><br>By default, if the account was created on day 29 - 31, the accounting day is the 1st of the next month. You can change this to be able to use any day of the month. | To set the default accounting day of month, change the <b>actg_dom</b> entry in the CM configuration file. See "Setting the Default Accounting Day of Month (DOM)" in <i>BRM Configuring and Running Billing</i> . To customize the source code, see PCM_OP_CUST_POL_PREP_BILLINFO.<br><br>To use 31-day billing, see "Using 31-day Billing" in <i>BRM Configuring and Running Billing</i> . |
| Set the default number of accounting cycles in a billing cycle.<br><br>The billing cycle must be a whole-number multiple of accounting cycles. See "About Accounting and Billing Cycles" in <i>BRM Configuring and Running Billing</i> . | Monthly billing (one accounting cycle per billing cycle).  | Change the <b>bill_when</b> entry in the CM configuration file. See "Setting the Default Billing-Cycle Length" in <i>BRM Configuring and Running Billing</i> .<br><br>To edit the source code, see PCM_OP_CUST_POL_PREP_BILLINFO.  |
| Specify the system currency.   | US dollars.  | You must set the system currency when you install BRM. See "Setting the System Currency" in <i>BRM Managing Customers</i> .  |
| Specify the default account currency for new accounts.   | US dollars.  | Change the <b>currency</b> entry in the CM configuration file. See "Setting the Default Account Currency" in <i>BRM Managing Customers</i> .<br><br>To edit the source code, see PCM_OP_CUST_POL_PREP_BILLINFO.  |
| Specify whether to create a long cycle or a short cycle when creating an account or changing the billing date. See "Specifying How to Handle Partial Accounting Cycles" in <i>BRM Configuring and Running Billing</i> .                  | If the short accounting cycle is 15 days or greater, create a short cycle.<br>If the short accounting cycle is less than 15 days, create a long cycle.   | Customize the PCM_OP_CUST_POL_PREP_BILLINFO source code.   |
| Specify a numbering scheme for bills.  | Creates the bill number B-sequence number, for example, "B-81".  | Customize the PCM_OP_BILL_POL_SPEC_BILLNO source code.   |

**Table 2–7 (Cont.) Billing Defaults**

| Business Decision   | Default Behavior  | How to Customize  |
|---|---|---|
| <p>Change the cutoff time for billing, accounting, and promotion start times.</p> <p>For example, if your cutoff time is 10:00:00 a.m., any events that take place after 10:00:00 a.m. on that date will be included in the next billing run.</p> | <p>The cutoff time is midnight.</p>   | <p>Edit the <code>/config/business_params</code> object. See "Configuring the BRM Cutoff Time" in <i>BRM Configuring and Running Billing</i>.</p>   |
| <p>Bill sponsor group member accounts.</p>  | <p>Sponsor group member accounts are not billed.</p>                              | <p>Change the <code>billing_flow_sponsorship</code> and <code>billing_flow_discount</code> parameters in <code>/config/business_params</code> object.</p> <p>See "Setting up Billing for Sponsorship" in <i>BRM Configuring and Running Billing</i>.</p>                  |
| <p>Change the number of days to delay billing.</p>  | <p>Billing is not delayed.</p>  | <p>Change the <code>config_billing_delay</code> entry in the CM configuration file and the billing utility configuration file (<code>BRM_Home/apps/pin_billd/pin.conf</code>).</p> <p>See "Setting up Delayed Billing" in <i>BRM Configuring and Running Billing</i>.</p> |
| <p>Change how proration is calculated:</p> <ul style="list-style-type: none"> <li>■ The number of days in the cycle.</li> <li>■ The number of days in the month.</li> </ul>   | <p>Number of days in the cycle.</p>   | <p>Change the <code>use_number_of_days_in_month</code> entry in the CM configuration file.</p> <p>See "Calculating Prorated Cycle Fees" in <i>BRM Configuring and Running Billing</i>.</p>  |
| <p>Apply cycle fees in parallel for multiple services in an account.</p>  | <p>Cycle fees is applied sequentially for each of the services in an account.</p> | <p>Change the <code>StagedBillingFeeProcessing</code> business parameter.</p> <p>See "About Applying Cycle Forward Fees in Parallel" in <i>BRM Configuring and Running Billing</i>.</p>   |
| <p>Align the purchase, cycle, usage start and end times with the accounting cycle if you set up products with delayed fees.</p>   | <p>Start and end times are not aligned.</p>                                       | <p>Change the <code>cycle_delay_align</code> entry in the CM configuration file.</p> <p>See "Aligning Account and Cycle Start and End Times" in <i>BRM Configuring and Running Billing</i>.</p>   |

## Defaults for Tax Calculation

Table 2–8 lists the default settings for tax calculations:

**Table 2–8 Tax Calculation Settings**

| <b>Business Decision</b>   | <b>Default Behavior</b>                           | <b>How to Customize</b>   |
|--|---|---|
| Enable or disable tax calculation.   | Both real-time and deferred taxation are enabled. | Change the <b>taxation_switch</b> entry in the CM configuration file.<br>See "Enabling Taxation During Real-Time Rating or Billing" in <i>BRM Configuring and Running Billing</i> .   |
| Specify whether deferred taxes are calculated separately for a parent and its subordinate child accounts, or consolidated into a single tax item for both the parent and child accounts. | Taxes are calculated separately.                  | Change the <b>cycle_tax_interval</b> entry in the CM configuration file.<br>See "Specifying How to Calculate Taxes" in <i>BRM Configuring and Running Billing</i> .   |
| Change the default ship-from locale for tax calculation.   | No default: must be set, or disabled.             | Change the <b>provider_loc</b> entry in the CM configuration file.<br>See "Defining a Default Ship-From Locale" in <i>BRM Calculating Taxes</i> .   |
| Defer tax calculation for all adjustments that occur at account level until the end of the billing cycle.  | Tax calculation is deferred.                      | Change the <b>tax_now</b> entry in the CM configuration file.<br>See "Configuring the Default Tax Method for Account-Level Adjustments" in <i>BRM Managing Accounts Receivable</i> .  |
| Perform tax reversals for adjustments, disputes, and settlements that occur at the bill and account level.   | Taxes are not reversed.                           | Change the <b>tax_reversal_with_tax</b> entry in the CM configuration file. This entry is used if the opcode does not explicitly specify the tax behavior.<br>See "Configuring the Default Tax Method for Account-Level Adjustments" in <i>BRM Managing Accounts Receivable</i> . |
| Report zero tax amounts.   | Zero tax amounts are not reported.                | Change the <b>include_zero_tax</b> entry in the CM configuration file.<br>See "Reporting Zero Tax Amounts" in <i>BRM Calculating Taxes</i> .  |
| Summarize or itemize taxes by jurisdiction.  | Summarize taxes by jurisdiction.                  | Change the <b>tax_return_juris</b> entry in the CM configuration file.<br>See "Itemizing Taxes by Jurisdiction" in <i>BRM Calculating Taxes</i> .   |

## Defaults for Payments and A/R

Table 2–9 lists the default settings for payments and A/R:

**Table 2–9 Payment and A/R Defaults**

| <b>Business Decision</b>   | <b>Default Behavior</b>   | <b>How to Customize</b>   |
|--|---|---|
| Specify the minimum due amount that the <b>pin_collect</b> utility searches for when collecting online payments.   | 2.00 (expressed in the account currency).   | Change the <b>minimum</b> entry in the billing utility configuration file ( <i>BRM_Home/apps/pin_billd/pin.conf</i> ).<br><br>See "Specifying the Minimum Payment to Collect" in <i>BRM Configuring and Running Billing</i> . |
| Specify the minimum due amount that custom billing utilities search for.   | 2.00 (expressed in the account currency).   | Change the <b>minimum_payment</b> entry in the CM configuration file.   |
| Specify the minimum credit card charge.  | 2.00 (expressed in the account currency).   | Edit the PCM_OP_PYMT_POL_PRE_COLLECT source code.   |
| Specify the minimum refund amount.   | 2.00 (expressed in the account currency).   | Change the <b>minimum_refund</b> entry in the CM configuration file.  |
| Use CVV fraud protection for Paymentech transactions. See "Requiring Additional Protection Against Credit Card Fraud" in <i>BRM Configuring and Collecting Payments</i> .  | Disabled.   | Change the <b>cvv2_required</b> entry in the CM configuration file.   |
| Use card identification data (CID), a method of fraud prevention for American Express card transactions. See "Requiring Additional Protection Against Credit Card Fraud" in <i>BRM Configuring and Collecting Payments</i> . | Disabled.   | Change the <b>cid_required</b> entry in the CM configuration file.  |
| Specify whether to collect cycle forward and purchase fees when the customer registers.  | Collects cycle-forward and purchase fees on registration only for credit card customers.  | Change the <b>cc_collect</b> entry in the CM configuration file. See "Charging Customers at Registration" in <i>BRM Managing Customers</i> .<br><br>To customize the source code, see PCM_OP_PYMT_POL_SPEC_COLLECT.           |
| Specify the payment methods your customers can use. If you use a payment method that is not included in the defaults, you must create a new payment method.  | Accepts these payment methods: <ul style="list-style-type: none"> <li>■ Credit card</li> <li>■ Invoice</li> <li>■ Nonpaying child</li> <li>■ (Subordinate)</li> <li>■ Undefined</li> <li>■ Prepaid</li> <li>■ Debit card</li> <li>■ Direct debit</li> <li>■ Smart card</li> <li>■ Beta</li> </ul> | To create a new payment method, customize the PCM_OP_CUST_POL_PREP_PAYINFO source code.<br><br>To validate payment methods, use the Field Validation Editor.  |
| Set the payment due date for invoice payments.   | 30 days.  | Customize the PCM_OP_CUST_POL_PREP_PAYINFO source code.   |

Table 2–9 (Cont.) Payment and A/R Defaults

| Business Decision  | Default Behavior   | How to Customize   |
|--|--|--|
| Set the default invoice type to summary invoice.   | Detailed invoices are generated.   | Change the value of the PIN_FLD_INV_TYPE field in the /payinfo object to 1. <ul style="list-style-type: none"> <li>■ When creating a customer account, pass it in the input flist of PCM_OP_CUST_COMMIT_CUSTOMER.</li> <li>■ When adding or changing a payment method, pass it in the input flist of PCM_OP_CUST_SET_PAYINFO.</li> </ul> |
| Specify how to handle underpayments. See "Handling Overpayments and Underpayments" in <i>BRM Configuring and Collecting Payments</i> .               | For balance forward accounting, BRM applies the payment to the oldest items first. If the remainder doesn't match the amount due for any one item, BRM requires that the remainder must be allocated manually.<br><br>For open item accounting, BRM requires that the payment must be allocated manually.  | Customize the PCM_OP_PYMT_POL_UNDER_PAYMENT source code.   |
| Specify how to handle overpayments. See "Handling Overpayments and Underpayments" in <i>BRM Configuring and Collecting Payments</i> .                | For balance forward accounting, BRM closes all open items and applies the overpayment as a credit balance. By default, you must allocate the resulting credit balance to future open items manually.<br><br>For open item accounting, BRM requires that the payment must be allocated manually.  | Customize the PCM_OP_PYMT_POL_OVER_PAYMENT source code.  |
| Specify what to do if a credit card customer doesn't pay. See "Handling Late or Missed Payments" in <i>BRM Configuring and Collecting Payments</i> . | Inactivates the account if the account has an item more than 30 days past due and a credit card transaction receives one of these failures: <ul style="list-style-type: none"> <li>■ Soft decline</li> <li>■ Wrong address</li> <li>■ Wrong ZIP code</li> <li>■ No connection</li> </ul> Inactivates the account immediately if a credit card transaction receives one of these failures: <ul style="list-style-type: none"> <li>■ Bad card</li> <li>■ Hard decline</li> </ul> | Customize the PCM_OP_PYMT_POL_COLLECT source code.   |

**Table 2–9 (Cont.) Payment and A/R Defaults**

| <b>Business Decision</b>  | <b>Default Behavior</b>   | <b>How to Customize</b>   |
|---|---|---|
| Change the euro conversion error tolerance.                                   | When the conversion result is less than the amount due: Apply tolerance values only if the amount applied to the item is in secondary currency.<br><br>When the conversion result is more than the amount due: Do not apply tolerance values defined for resources. | Change the <b>overdue_tolerance</b> and <b>underdue_tolerance</b> entries in the CM configuration file.<br><br>See "Handling Euro Conversion Rounding Errors" in <i>BRM Managing Customers</i> .  |
| Collect the current direct debit balance of each account during registration. | Collect the balance.  | Change the <b>dd_collect</b> entry in the CM configuration file.<br><br>See "Enabling Direct Debit Processing" in <i>BRM Configuring and Collecting Payments</i> .  |
| Specify how to handle write-off reversals.                                    | Apply write-off reversals at the account level.   | Modify the <b>ar</b> instance of the <b>/config/business_params</b> object. See "Enabling Automatic Write-Off Reversals During Payment Collection" in <i>BRM Managing Accounts Receivable</i> .<br><br>You can also modify the <b>PCM_OP_AR_POL_REVERSE_WRITEOFF</b> opcode. See "Customizing Write-Off Reversals" in <i>BRM Managing Accounts Receivable</i> . |

## Defaults for Maintaining an Audit Trail of BRM Activity

Table 2–10 lists the defaults for maintaining an audit trail of BRM activity.

**Table 2–10 Maintaining Audit Trail of BRM Activity**

| <b>Business Decision</b>  | <b>Default Behavior</b>   | <b>How to Customize</b>   |
|---|---|---|
| Specify the BRM activity for which you want to keep an audit trail. | Keeps an audit trail of changes to customer credit card numbers and credit card expiration dates, and changes to BRM price lists. For more detailed information, see "Fields Marked for Auditing by Default". | Enable or disable BRM object fields for auditing by using BRM Storable Class Editor. See "Enabling Auditing for a Field". |

---

---

## Understanding Flists and Storable Classes

This chapter provides an introduction to flists (field lists), which pass data between Oracle Communications Billing and Revenue Management (BRM) processes and storable objects that store data in the BRM database.

For instructions on creating storable classes, see "[Creating Custom Fields and Storable Classes](#)".

### About Flists

The flist is a fundamental data structure used in BRM. Flists are containers that hold fields, each of which is a pair consisting of a data field name and its value. Flists do not contain actual data, but instead provide links to where the data is located. The one exception to this is integers, which are stored in flists.

Here is a simple flist example:

```
LAST_NAME      STR      "Smith"
FIRST_NAME     STR      "Joe"
COMPANY        STR      "XYZ Corporation"
```

Many BRM processes interpret data in flist format. For example, the storage manager in the Data Manager (DM) translates flists to a format that the database can process and then translates the data from the database into an flist before passing it to the Connection Manager (CM).

BRM uses flists in these ways:

- Storable objects are passed in the form of flists between opcodes or programs that manipulate the storable objects.
- Opcodes use flists to pass data between BRM applications and the database. For each opcode, an input flist is passed to **pcm\_op** and the return flist is passed back from this routine.

### Contents of an Flist

In an flist, you can use any data type such as decimals, buffers, arrays, and substructures. Flists can contain any number of fields. You can place flists within other flists. Remember though, that except for integers, data is not stored in the flist, just links to where the data is located.

For a description of the BRM data types you can use in an flist, see "[Understanding the BRM Data Types](#)". For a list of data type abbreviations used in flists, see "[Flist Field Data Types](#)".

The following example shows a partial input flist for the PCM\_OP\_CUST\_COMMIT\_CUSTOMER opcode:

**Note:** [0] after the field type represents the element ID. The numbers 0, 1, 2, and so on at the beginning of each line indicate the nesting level of the field; 0 indicates the top level.

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /plan 11950 0
0 PIN_FLD_CREATED_T          TSTAMP [0] (937336272) 09/14/99 12:11:12
0 PIN_FLD_MOD_T              TSTAMP [0] (937336272) 09/14/99 12:11:12
0 PIN_FLD_ACCOUNT_OBJ        POID [0] 0.0.0.1 /account -1 0
0 PIN_FLD_DEAL_OBJ           POID [0] 0.0.0.0 0 0
0 PIN_FLD_DESCR              STR [0] "IP with 10 Free hrs per month"
0 PIN_FLD_NAME               STR [0] "Basic"
0 PIN_FLD_LIMIT              ARRAY [840] allocated 3, used 3
1   PIN_FLD_CREDIT_FLOOR     NUM [0] 0.000000
1   PIN_FLD_CREDIT_LIMIT     NUM [0] 100.000000
1   PIN_FLD_CREDIT_THRESHOLDS INT [0] 0
0 PIN_FLD_SERVICES           ARRAY [0] allocated 4, used 4
1   PIN_FLD_DEAL_OBJ         POID [0] 0.0.0.1 /deal 9390 0
1   PIN_FLD_SERVICE_OBJ      POID [0] 0.0.0.1 /service/ip -1 0
1   PIN_FLD_LOGIN            STR [0] "aac4"
1   PIN_FLD_PASSWD_CLEAR     STR [0] "aac4"
0 PIN_FLD_NAMEINFO           ARRAY [1] allocated 10, used 10
1   PIN_FLD_CONTACT_TYPE     STR [0] "Billing"
1   PIN_FLD_LAST_NAME        STR [0] "aac1"
1   PIN_FLD_FIRST_NAME       STR [0] "aac1"
1   PIN_FLD_TITLE            STR [0] "aac1"
1   PIN_FLD_COMPANY          STR [0] "aac1"
1   PIN_FLD_ADDRESS          STR [0] "aac1"
1   PIN_FLD_CITY             STR [0] "aac1"
1   PIN_FLD_STATE            STR [0] "CA"
1   PIN_FLD_ZIP              STR [0] "99999"
1   PIN_FLD_COUNTRY          STR [0] "USA"
0 PIN_FLD_BILLINFO           ARRAY [1] allocated 3, used 3
1   PIN_FLD_ACCESS_CODE1     STR [0] "aac1"
1   PIN_FLD_ACCESS_CODE2     STR [0] "aac1"
1   PIN_FLD_BILL_TYPE        ENUM [0] 10001
0 PIN_FLD_ACTGINFO           ARRAY [1] allocated 0, used 0
0 PIN_FLD_LOCALES            ARRAY [1] allocated 1, used 1
1   PIN_FLD_LOCALE           STR [0] "ENU"
.
.
.

```

### Flist Field Data Types

When you include a field in an flist, you must also include an abbreviation of the field's data type. [Table 3-1](#) lists the valid BRM field types and their abbreviation.

**Table 3-1 Flist Field Types**

| Field Type      | Abbreviation |
|-----------------|--------------|
| PIN_FLDT_ARRAY  | ARRAY        |
| PIN_FLDT_BINSTR | BINSTR       |
| PIN_FLDT_BUF    | BUF          |



**Table 3–1 (Cont.) Flist Field Types**

| Field Type         | Abbreviation |
|--------------------|--------------|
| PIN_FLDT_DECIMAL   | DECIMAL      |
| PIN_FLDT_ENUM      | ENUM         |
| PIN_FLDT_ERRBUF    | ERR          |
| PIN_FLDT_INT       | INT          |
| PIN_FLDT_POID      | POID         |
| PIN_FLDT_STR       | STR          |
| PIN_FLDT_SUBSTRUCT | SUBSTRUCT    |
| PIN_FLDT_TSTAMP    | TSTAMP       |

## About Creating and Using an Flist

You create and manipulate flists with the flist manipulation macros in the Portal Information Network (PIN) library. You can add, remove, and modify fields in an flist by using the flist field-handling macros. For more information, see "Flist Management Macros" and "Flist Field-Handling Macros" in *BRM Developer's Reference*.

Each opcode has an input and output flist specification. For each opcode you call, you must create an flist for the data you want to pass in. Follow the flist specifications for the opcode when you create an input or an output flist for an opcode. See the flist specifications in the individual opcode descriptions.

Flists are dynamically allocated data structures. When a field is added to an flist, the field value is either already dynamically allocated in memory, or is copied into dynamic memory as it is added.

---

**Important:** You must destroy the flist you create in your programs to reclaim the memory that the flist occupied. For details, see "[About Destroying Flists](#)".

---

## About Adding Information to Flists

You add data to flists by replacing pointers to data using these flist management macros:

- PIN\_FLIST\_ELEM\_PUT
- PIN\_FLIST\_FLD\_PUT
- PIN\_FLIST\_SUBSTR\_PUT

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

You add data to flists by replacing the data itself using these flist management macros:

- PIN\_FLIST\_ELEM\_SET
- PIN\_FLIST\_FLD\_SET
- PIN\_FLIST\_SUBSTR\_SET

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

## About Removing Data (Pointers) from an Flist

You remove a pointer to data from an flist and add it to another flist by using these flist management macros:

- PIN\_FLIST\_ELEM\_TAKE
- PIN\_FLIST\_FLD\_TAKE
- PIN\_FLIST\_SUBSTR\_TAKE

---

---

**Important:** These macros overwrite existing *pointers* to data, not the data itself. To free the memory used by the old data, you must destroy the memory location using PIN\_FLIST\_DESTROY\_EX otherwise, a memory leak may occur.

---

---

You usually use the TAKE macros when you want to take data from an flist and change it.

---

---

**Important:** When you use a TAKE macro to remove a pointer to data, you must free the memory when finished. If the memory is not freed, memory leaks may occur.

---

---

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

## About Copying Data from an Flist

You copy a pointer to data from one flist to another by using these flist management macros:

- PIN\_FLIST\_ELEM\_GET
- PIN\_FLIST\_FLD\_GET
- PIN\_FLIST\_SUBSTR\_GET

You usually use the GET macros when you want to copy data, but not change it.

---

---

**Important:** You should treat any data that you GET by using these macros as read-only because the original program may also need this data.

---

---

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

## Flist Creation Samples

BRM SDK includes flist creation samples in C, C++, Java, and Perl. Three samples are provided for each language: one to create a simple flist, another to create an flist with a nested array, and a third to create an flist with a substructure. For information about installing and using BRM SDK, see "[About BRM SDK](#)".

You can view the following sample programs in *BRM Developer's Reference*:

- About Using the PCM C Sample Programs

- About Using the PCM C++ Sample Programs
- About Using the PCM Java sample programs
- About Using the PCM Perl sample programs

These documents also include information about compiling and running the programs.

## About Destroying Flists

You destroy an flist and free its memory by using these flist management macros in *BRM Developer's Reference*:

- PIN\_FLIST\_DESTROY
- PIN\_FLIST\_DESTROY\_EX

Flists use dynamically allocated memory and must be destroyed to free that memory and prevent memory leaks. These macros first determine whether the flist has a NULL value. If so, they do nothing. If the flist exists, these macros destroy the entire contents of the flist, including all fields.

PIN\_FLIST\_DESTROY\_EX sets the reference to the flist to a NULL value after it destroys the flist.

PIN\_FLIST\_DESTROY frees the memory for the flist field-value pairs, but does not set a reference to that flist to NULL. If another program subsequently attempts to destroy this flist (with freed memory, but a valid flist pointer), unexpected behavior and core dumps can result.

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

## Flist Management Rules

Follow these rules when creating programs that manipulate flists:

- The calling applications are responsible for allocating memory for *input* flists. This includes cases where you use a wrapper opcode to call another opcode.
- The opcode being called is responsible for allocating memory for *output* flists. For more information, see "[About Creating and Using an Flist](#)".
- The calling applications are responsible for destroying both input and output flists.
- The opcode being called is responsible for destroying both input and output flists if the opcode utilizes a wrapper opcode to call another opcode. For more information, see "[About Destroying Flists](#)".
- You should never destroy an input flist within an opcode, because a calling application may need it.
- These flist management macros in *BRM Developer's Reference* allocate new memory:
  - PIN\_FLIST\_CREATE
  - PIN\_FLIST\_COPY

You must explicitly de-allocate the memory allocated unless it is used for an output flist.

- Memory allocation behavior depends on whether the opcode is called through a network (client/server) connection or within an internal Connection Manager (CM) process.
  - If the opcode is called through a client/server connection, the calling application and the CM do not share the same memory. An opcode with memory allocation issues may work if called by a Portal Communications Protocol (PCP) connection, but core dumps if called internally by another opcode.

### Example

You use the following syntax to copy an flist:

```
*out_flistpp = PIN_FLIST_COPY(in_flistp, ebufp);
```

## Flist Field Memory Management Guidelines

You use the following guidelines when creating your programs to avoid memory problems:

- The following macros in *BRM Developer's Reference* allocate new memory for a passed value before putting it in an flist:
  - PIN\_FLIST\_CONCAT
  - PIN\_FLIST\_ELEM\_ADD
  - PIN\_POID\_LIST\_ADD\_POID
  - PIN\_FLIST\_ELEM\_COPY
  - PIN\_FLIST\_FLD\_COPY
  - PIN\_FLIST\_SUBSTR\_ADD
  - PIN\_FLIST\_ELEM\_SET
  - PIN\_FLIST\_FLD\_SET
  - PIN\_FLIST\_SUBSTR\_SET

These macros add or replace items in an flist by copying them; no memory ownership is transferred. When you use the SET macros, memory is allocated to copy the values and is owned by the flist. Do not explicitly free this memory.

- The following macros do *not* allocate new memory for a value before putting that value in an flist:
  - PIN\_FLIST\_FLD\_PUT
  - PIN\_FLIST\_SUBSTR\_PUT
  - PIN\_FLIST\_ELEM\_PUT

These macros add or replace items in the flist, storing the data previously owned by the caller. The allocation memory is transferred to the flist. These macros link the memory occupied by the value to the named flist. You *cannot* apply these for local scope (auto) variables if you want to put them into the return flist.

- The following macros take ownership of the memory owned by the flist for a retrieved value:
  - PIN\_FLIST\_FLD\_TAKE
  - PIN\_FLIST\_SUBSTR\_TAKE

- PIN\_FLIST\_ELEM\_TAKE
- PIN\_FLIST\_ELEM\_TAKE\_NEXT
- PIN\_POID\_LIST\_TAKE\_NEXT\_POID
- PIN\_POID\_LIST\_REMOVE\_POID

These macros remove items from the flist, return pointers, and turn ownership of the allocated memory over to the caller.

- The following macros do *not* allocate new memory for a retrieved value:

- PIN\_FLIST\_ELEM\_DROP
- PIN\_FLIST\_FLD\_DROP
- PIN\_FLIST\_SUBSTR\_DROP
- PIN\_FLIST\_ANY\_GET\_NEXT
- PIN\_FLIST\_FLD\_GET
- PIN\_FLIST\_ELEM\_GET
- PIN\_FLIST\_ELEM\_GET\_NEXT
- PIN\_FLIST\_SUBSTR\_GET

A pointer to the allocated segment of memory that belongs to the flist returns. To maintain the integrity of the flist, you should *never* apply the PIN\_FLIST\_DESTROY macro to an flist pointer returned by these macros. The flist retains ownership of its allocated memory.

- The following macros move fields from one flist to another:

- PIN\_FLIST\_FLD\_MOVE
- PIN\_FLIST\_ELEM\_MOVE

Memory ownership of the field changes from the source flist to the destination flist.

- The following field management macros allocate new memory:

- pbo\_decimal\_abs
- pbo\_decimal\_add
- pbo\_decimal\_copy
- pbo\_decimal\_divide
- pbo\_decimal\_from\_double
- pbo\_decimal\_from\_str
- pbo\_decimal\_multiply
- pbo\_decimal\_negate
- pbo\_decimal\_round
- pbo\_decimal\_subtract
- pbo\_decimal\_to\_str
- PIN\_POID\_COPY
- PIN\_POID\_CREATE
- PIN\_POID\_DESTROY

- PIN\_POID\_LIST\_COPY
- PIN\_POID\_LIST\_COPY\_NEXT\_POID
- PIN\_POID\_LIST\_COPY\_POID
- PIN\_POID\_LIST\_CREATE
- PIN\_POID\_LIST\_DESTROY

All of the preceding macros return the memory owned to the caller.

- The memory allocated by the macros in these guidelines is owned by the flist. Typically, all flists created by code must be destroyed using PIN\_FLIST\_DESTROY or PIN\_FLIST\_DESTROY\_EX.
- Any memory allocated using pin\_malloc must be freed unless it is added to an flist using a PUT macro.
- All flists must be destroyed eventually, either directly or by nesting them in another flist as a child and giving memory ownership to that flist.
- In Functional Modules (FMs), the output flist is the only flist that does not need to be explicitly destroyed by the FM, because the Connection Manager (CM) framework destroys it after use.

For details on these macros, see "Flist Management Macros" in *BRM Developer's Reference*.

## Handling Errors

All flist routines take a pointer to **pin\_ebuf\_t** as the final argument. This pointer, called **ebufp**, must point to a preallocated **pin\_ebuf\_t** into which error information is written.

The BRM APIs use the **pin\_ebuf\_t** structure to pass back detailed information about the error. BRM includes standard logging routines that print formatted log messages using the date in **pin\_ebuf\_t**. You can use these log messages to determine where the error occurred.

See "[Understanding API Error Handling and Logging](#)" for more information on how BRM handles error messages.

## About Storable Classes and Storable Objects

Storable classes are used to store data in the BRM database. A storable class is a template consisting of a collection of fields in the BRM database. Storable objects are instances of storable classes.

Storable objects are stored persistently in SQL tables in the BRM database. To understand how storable objects are mapped to SQL tables, see "Storable Class-to-SQL Mapping" in *BRM Developer's Reference*.

Storable objects are passed in the form of flists between opcodes or programs that use the storable objects. For detailed information about flists, see "[About Flists](#)".

You manipulate the storable objects by using opcodes in the Portal Communication Module Application Programming Interface (PCM API). For more information about the PCM API, see "[Understanding the PCM API and the PIN Library](#)".

Each storable object has a unique Portal object ID (POID).

For a description of the BRM POIDs, see "[Portal Object ID \(POID\)](#)".

## Class Naming and Formatting Conventions

BRM uses the following conventions for class names and definitions:

- A class name begins with a forward slash (/). For example: **/config**.
- Each slash in a class name represents a level of class inheritance. For example **/config/adjustment** is a subclass of **/config** and **/config/adjustment/event** is a subclass of **/config/adjustment**.

## Class Inheritance

You can subclass a storable class to extend its functionality. When you subclass a storable class, the subclass inherits all the fields defined in the parent class and can have additional fields specific to the subclass. For example, the **/service/email** storable class contains all the information in the **/service** class plus additional information, such as login name and email address, specific to the email service.

## Subclassing

Base classes are parent classes predefined in BRM from which you can create subclasses to add new functionality. Subclasses of storable classes can be extended or unextended:

- An *extended subclass* inherits all the fields defined in its base class and contains new fields that add functionality specific to the subclass, as illustrated by the **/service/email** subclass.

You can create a subclass of an extended subclass to add functionality to an extended subclass. An example of this type of subclass is **/config/adjustment/event**.

- An *unextended subclass* inherits all the fields defined in its base class but does not contain any new fields for additional functionality. The only difference between an unextended subclass and its base class is the class type.

The unextended subclasses are primarily used for tracking and for grouping subclasses with similar functionality. For example, **/event/billing** is a subclass of **/event**, but it does not contain any additional fields. It is primarily used to group different BRM billing events, such as charge, debit, and payment.

When you subclass a predefined base class or a subclass by adding new fields, your new class has the following characteristics:

- The same fields as its original base class with the attributes of that class.
- Any new fields you add.
- The common defined behavior and functionality of storable classes in BRM.

## About Defining Storable Classes

You use fields to define storable classes. Fields in storable classes have corresponding fields in opcode input flists. The fields in the objects receive specific instructions and behavior from the corresponding fields in the opcode that manipulates the object.

Each field has the following parts:

- A mnemonic *name* that describes its function. For example, **PIN\_FLD\_LOGIN**. Field names are unique within an flist. Applications must use this name to refer to the field.

The default fields used in BRM start with `PIN_FLD_`. You can use a different prefix for your custom fields to distinguish them from the default fields.

- A *type* that specifies its data type and defines the range of values it can accept. For example, `PIN_FLDT_STR` for string type.

For information on the BRM data types, see ["Understanding the BRM Data Types"](#)

- *Permission*, which specifies if the field is optional, mandatory, writable, and so on.
- An *ID number* that establishes it in the data dictionary. When you define a new field, the field is added to the data dictionary and is assigned the next consecutive ID number in the ranges reserved for customer use. For example, if the ID of the last field you created is 10,500, your new field's ID number will be 10,501.

The following table lists the field ID ranges for Oracle-only use and for customer use:

**Table 3–2 BRM Field ID Restrictions**

| Field ID Range              | Reserved For    |
|-----------------------------|-----------------|
| 0 through 9999              | Oracle use only |
| 10,000 through 999,999      | Customer use    |
| 1,000,000 through 9,999,999 | Oracle use only |
| Over 10,000,000             | Customer use    |

For information on creating fields, see the Storable Class Editor Help.

### Fields Common to All Storable Classes

Every BRM storable class requires the following fields for its storable object to be created in the system:

- `PIN_FLD_POID`, which contains the POID. See ["Portal Object ID \(POID\)"](#) for more information.
- `PIN_FLD_NAME`, which contains the name of the class.
- `PIN_FLD_CREATED_T`, which contains the date the object was created.
- `PIN_FLD_MOD_T`, which contains the date the object was modified.
- `PIN_FLD_READ_ACCESS`, which specifies the read permissions for the object.
- `PIN_FLD_WRITE_ACCESS`, which specifies the write permissions for the object.

These fields are available to the BRM applications and Facilities Modules (FMs), but you cannot write to them. They can be manipulated only by a Data Manager (DM).

## Defining New Fields for Storable Classes

You define new fields and add them to the data dictionary by using the Storable Class Editor. After you define a field, you use the `PIN_FLD_MAKE` macro to create an encoded number for the field. You use this number to build flists for opcode and object manipulation in C code. The `PIN_FLD_MAKE` macro is defined in `BRM_Home/include/pcm.h`, where `BRM_Home` is the directory in which you installed BRM components.

For information on how to define fields, see the Storable Class Editor Help. For more information on creating custom fields and storable classes, see ["Creating Custom Fields"](#).



For information on defining new fields in C++, see ["Creating Custom Fields"](#).

For information on defining new fields in Java, see ["Using Custom Fields in Java Applications"](#).

## Reading Objects

There are two ways to read the contents of storable objects in a BRM database:

- You can execute opcodes either programmatically or in a test application such as **testnap** or Opcode Workbench. See ["Reading Objects by Using Opcodes"](#).
- You can use the Object Browser application in Developer Center. See ["Reading Objects by Using Object Browser"](#).

## Reading Objects by Using Opcodes

You can read storable objects in the database by using the read operations included in BRM. These opcodes are optimized for the most frequently used operations in BRM. You can read only a portion of the fields in a storable object instead of the complete object.

Use one of these opcodes to read objects:

- "PCM\_OP\_READ\_OBJ" loads and returns the entire object, no matter how many rows and tables the object spans. See ["Reading an Entire Object"](#).
- "PCM\_OP\_READ\_FLDS" loads only the fields requested. It accesses fewer tables than when an entire object is read. See ["Reading Fields in an Object"](#).

### Improving Performance when Reading Objects

To improve performance when reading objects by using PCM\_OP\_READ\_OBJ and PCM\_OP\_READ\_FLDS, set the PCM\_OPFLG\_CACHEABLE flag. See ["Improving Performance when Working with Objects"](#).

### Locking Objects when Reading them

You can lock an object to avoid an extra round trip to the database. To lock an object while the PCM\_OP\_READ\_OBJ or PCM\_OP\_READ\_FLDS opcode reads it, use the PCM\_OPFLG\_LOCK\_OBJ flag. The query is turned into the equivalent of a select for update, which places an exclusive lock on the rows in the database.

When using the PCM\_OPFLG\_LOCK\_OBJ flag during an opcode process, the flag works as follows:

- If the Facilities Module (FM) opcode opens a read/write transaction, the PCM\_OPFLG\_LOCK\_OBJ flag locks the object for a PCM\_OP\_READ\_OBJ or PCM\_OP\_READ\_FLDS operation.
- If the FM opcode opens a read-only transaction and then tries to use PCM\_OPFLG\_LOCK\_OBJ in any subsequent read calls, the DM returns an error.
- If the FM opcode does not open a transaction and then tries to use PCM\_OPFLG\_LOCK\_OBJ in any subsequent read calls, the DM returns an error.

### Improving Performance when Locking Objects

Most opcode operations lock the account when they begin processing. Though this provides reliable data consistency, locking an account locks all of its associated objects and can prevent other opcodes from operating on them. This can decrease the throughput of the system. To alleviate this problem in affected systems, you may

choose to lock the specific objects an opcode will change instead of the whole account; the objects an opcode does not change can still be accessed by other opcodes. See ["Locking Specific Objects"](#).

### Reading an Entire Object

To read an entire storable object from the database, use the `PCM_OP_READ_OBJ` opcode. Specify the POID of the object to read in the input list. The POID of the object and all fields in the object return, including array elements and substructures.

#### Audit trail information

`PCM_OP_READ_OBJ` checks for an audit flag to see whether the read request is for an audited object. If an audit flag is set in the call to this opcode, a search for the audit trail is performed.

For information about accessing audit trails, see ["Accessing Audit Trail Information"](#).

When a field is marked for auditing, a shadow object is created every time the field is modified. A shadow object is a replica of the original object that contains the POID revision number of the object before it was modified.

For more information about shadow objects, see ["About Shadow Objects"](#).

To retrieve audit-trail revisions from the database, use these flags in the call to this opcode to send a request to the database DM:

- `PCM_OPFLG_USE_POID_GIVEN`  
Executes a search-and-read operation for the POID you specify, which is the POID of the shadow object in the audit trail.
- `PCM_OPFLG_USE_POID_NEAREST`  
Executes a search-and-read operation for the audit-trail revision number that you specify (the POID of the shadow object). If the exact POID is not found, it finds the POID with the revision number immediately preceding the revision number of the POID you specify.
- `PCM_OPFLG_USE_POID_NEXT`  
Executes a search-and-read operation for the shadow object POID that contains the revision number next higher than the revision number in the POID you specify.
- `PCM_OPFLG_USE_POID_PREV`  
Executes a search-and-read operation for the shadow object POID that contains the revision number immediately preceding the revision number in the POID you specify.

### Reading Fields in an Object

To read one or more fields in a storable object, use the `PCM_OP_READ_FLDS` opcode. This opcode returns the POID of the object from which the fields were read, along with the specified fields and their values.

`PCM_OP_READ_FLDS` allows a client application to read specified fields in a storable object. Specify the POID of the storable object along with the list of fields to be read in the input list. The POID is mandatory; the fields are optional. If there are no fields present, only the POID is read and returned.

To read an array element, specify the element in the input list. If the array element contains a substructure that contains fields you want to read, you must also specify the substructure elements in the input list.

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**Note:** To improve performance, some storable object arrays are stored in a special serialized format. When a client application requests fields from a serialized array, `PCM_OP_READ_FLDS` returns the entire array rather than just the specified fields.

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You can read all the fields of a substructure or array in the following ways:

- To read an entire substruct, put the substruct field in the input flist with a **NULL** value.
- To read all the fields in an array element, put the array element in the input flist with a **NULL** value. This returns all fields, including those from substructs.
- To read all the elements of an array, put the array element in the input flist with an element ID of `PIN_ELEMID_ANY`.

### Examples

- This opcode can be used with a read-only transaction to obtain a frozen view of an object. When a read-only transaction is open, all reads are performed on fields in the state they are in when the transaction is opened. This is an important consideration when you perform multiple reads and must ensure that the data does not change between reads, such as when adding up fields for a balance.

For information about opening a read-only transaction, see "`PCM_OP_TRANS_OPEN`" in *BRM Developer's Reference*.

- You can use this opcode to find the value of a flag. This example shows the input and output flists for reading the value of the `PIN_FLD_FLAGS` field in the `PIN_FLD_BALANCES` array element in a `/balance_group` object:

```
CM input flist: op PCM_OP_READ_FLDS, flags 0x0
# number of field entries allocated 20, used 2
0 PIN_FLD_POID                POID [0] 0.0.0.1 /balance_group 685398 3
0 PIN_FLD_BALANCES            ARRAY [840] allocated 20, used 1
1     PIN_FLD_CREDIT_PROFILE    INT [0] 0
```

```
CM output flist: op PCM_OP_READ_FLDS
# number of field entries allocated 20, used 2
0 PIN_FLD_POID                POID [0] 0.0.0.1 /balance_group 685398 1
0 PIN_FLD_BALANCES            ARRAY [840] allocated 20, used 1
1     PIN_FLD_CREDIT_PROFILE    INT [0] 22
```

## Reading Objects by Using Object Browser

Use Object Browser, part of Developer Center, to view storable objects in the BRM database. You can see a list of all the objects in a class as well as the contents of objects that you select. You can also save and print object contents. For complete instructions, see the Object Browser Help.

For more information about Developer Center, see "[About Developer Center](#)".

### Starting Object Browser

To start Object Browser:

1. Start Developer Center and log in to the database schema you want to use. See "[About Developer Center](#)" for instructions.
2. Click the Object Browser toolbar button or choose **Tools - Object Browser**.

## Viewing an Object in the Database

To view an object in the database:

1. Enter or choose a class name and then click **Browse**.  
A list of storable objects appears in the Objects area.
2. Select a storable object in the list of objects.  
The contents of the object are displayed as an flist.

## Disabling Granular Object Locking

By default, granular object locking is enabled in BRM. You can disable this feature by modifying the **LockConcurrency** field in the **multi\_bal** instance of the **/config/business\_params** object.

The default behavior, which corresponds to the **LockConcurrency** value of **high**, allows you to call opcodes with the **PCM\_OPFLG\_LOCK\_OBJ** and **PCM\_OPFLG\_LOCK\_DEFAULT** flags to determine the locking procedure. See "[Locking Specific Objects](#)".

When you disable granular locking, the following rules apply:

- There is no differentiation of the **PCM\_OPFLG\_LOCK\_OBJ** and **PCM\_OPFLG\_LOCK\_DEFAULT** flags.
- A given balance group object will be locked as is.
- All other objects will be translated to lock its associated account (if any).
- The root or master login account will be ignored.
- The object that has no account association will be locked as is.

Performance is better when you use granular object locking.

You modify the **/config/business\_params** object by using the **pin\_bus\_params** utility.

To disable granular object locking:

1. Use the following command to create an editable XML file from the **multi\_bal** instance of the **/config/business\_params** object:

```
pin_bus_params -r multi_bal financial/config/xml_utils/bus_params_multi_bal.xml
```

This command creates the XML file named **financial/config/xml\_utils/bus\_params\_multi\_bal.xml.out** in your working directory. If you do not want this file in your working directory, specify the path as part of the file name.

2. Search the XML file for following line:

```
<LockConcurrency>high</LockConcurrency>
```

3. Change **high** to **normal**.

---

---

**Caution:** BRM uses the XML in this file to overwrite the existing **multi\_bal** instance of the **/config/business\_params** object. If you delete or modify any other parameters in the file, these changes affect the associated aspects of the BRM multischema configuration.

---

---

4. Save the file with the file name **financial/config/xml\_utils/bus\_params\_multi\_bal.xml**.

5. Use the following command to load this change into the `/config/business_params` object:

```
pin_bus_params financial/config/xml_utils/bus_params_multi_bal.xml
```

You should execute this command from the `BRM_Home/sys/data/config` directory, which includes support files used by the utility.

6. Read the object with the `testnap` utility or the Object Browser to verify that all fields are correct.
7. Stop and restart the Connection Manager (CM). For more information, See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.
8. (Multischema systems only) Run the `pin_multidb` script with the `-R CONFIG` parameter. For more information, see `pin_multidb` in *BRM System Administrator's Guide*.

## Creating, Editing, and Deleting Objects

Use the following opcodes to create, edit, and delete objects:

- To create an object, use the `PCM_OP_CREATE_OBJ` opcode. See "[Creating Objects](#)".
- To write fields in an object, use the `PCM_OP_WRITE_FLDS` opcode. See "[Writing Fields in Objects](#)".
- To increment fields in an object, use the `PCM_OP_INC_FLDS` opcode. See "[Incrementing Fields in Objects](#)".
- To delete an object, use the `PCM_OP_DELETE_OBJ` opcode. See "[Deleting Objects](#)".
- To delete fields in an object, use the `PCM_OP_DELETE_FLDS` opcode. See "[Deleting Fields in Objects](#)".

## Creating Objects

To create an object, use the `PCM_OP_CREATE_OBJ` opcode. This opcode creates a new storable object of the type specified in the input flist. You must specify the database type and class type subfields of the object POID on the input flist. The POID ID is ignored unless you use the `PCM_OPFLG_USE_POID_GIVEN` flag.

The `PCM_OP_CREATE_OBJ` input flist must include all the fields that the storable object requires. The fields required in the input flist depend on the type of object; for example, an `/account` object includes security code, account number, account type, balances, and credit fields.

This opcode returns the POID of the object created. If you use the `PCM_OPFLG_READ_RESULT` flag, it also returns all fields from the created object, including array elements and substructures.

### Flags

- `PCM_OPFLG_USE_POID_GIVEN`  
If you use the `PCM_OPFLG_USE_POID_GIVEN` flag, `PCM_OP_CREATE_OBJ` uses the POID ID you specify on the input flist. If the ID is a duplicate, a new POID ID is assigned. If you do not use the `PCM_OPFLG_USE_POID_GIVEN` flag, this opcode assigns a new POID ID.

Not all storable object POID IDs can be assigned by a user. For information on which storable object POID IDs can be assigned, see the object specifications in "Storable Class Definitions" in *BRM Developer's Reference*.

- **PCM\_OPFLG\_READ\_RESULT**  
Returns all fields from the created object, including array elements and substructures.
- **PCM\_OPFLG\_CACHEABLE**  
Enables caching each transaction's objects in the Connection Manager (CM) instead of writing them immediately to the database. See "[Improving Performance when Working with Objects](#)".  
  
If the **PCM\_OPFLG\_CACHEABLE** flag is not set, the opcode writes the input flist to the database immediately and writes it to the cache for future use.

## Writing Fields in Objects

To write fields in an object, use the **PCM\_OP\_WRITE\_FLDS** opcode. This opcode returns the POID of the object whose fields were written, including the new revision number. This opcode allows a client application to set the values of fields in a storable object. Specify the fields and values to set, along with the POID of the object, on the input flist. You must update at least one field.

The field values are absolutely set to the values you provide. To make a relative change to a numeric field value, use the **PCM\_OP\_INC\_FLDS** opcode.

Update array element fields by specifying the array element ID and the field element ID in the input flist. If there is no array element for the fields you want to update, you must create the element by using the **PCM\_OPFLG\_ADD\_ENTRY** flag.

---

---

**Note:** This flag is required because BRM allocates space for array elements only when they are created and assigned a value. If you do not use the **PCM\_OPFLG\_ADD\_ENTRY** flag, you receive an error when you try to update array fields in an element that doesn't exist.

---

---

The **PCM\_OPFLG\_ADD\_ENTRY** flag is required only for array fields. Fields that are not part of an array element must already exist (assuming the storable object exists) so they are updated as requested.

If you set an array element in the input flist and use the element ID **PIN\_ELEMID\_ASSIGN**, the element is created with an element ID numbered next higher than the highest existing element ID for that array.

Not all fields in each storable object are writable by the application. For details on which fields are writable, see "Storable Class Definitions" in *BRM Developer's Reference*.

### Flags

- **PCM\_OPFLG\_ADD\_ENTRY**  
Creates an array element and updates fields as requested. If the array element already exists, this flag is ignored. **PCM\_OPFLG\_ADD\_ENTRY** cannot be used to create ordinary fields.
- **PCM\_OPFLG\_READ\_RESULT**  
Returns all fields from the created object, including array elements and substructures.

- PCM\_OPFLG\_NO\_RESULTS

Although this flag can be included, the PCM\_OP\_WRITE\_FLDS opcode ignores it and returns the POID.

- PCM\_OPFLG\_CACHEABLE

Enables caching each transaction's objects in the CM instead of writing them immediately to the database. See "[Improving Performance when Working with Objects](#)".

If the PCM\_OPFLG\_CACHEABLE flag is not set, the opcode writes the input flist to the database immediately and writes it to the cache for future use.

If an array element in the input flist has an **element ID** of PIN\_ELEM\_ID\_ASSIGN, the element is not cached, even if the PCM\_OPFLG\_CACHEABLE flag is set.

If neither PCM\_OPFLG\_CACHEABLE nor PCM\_OPFLG\_ADD\_ENTRY is set, and the array entry does not exist, the opcode fails. If PCM\_OPFLG\_CACHEABLE is set but PCM\_OPFLG\_ADD\_ENTRY is not set, and the array entry does not exist, the opcode also fails, but it does not return the error immediately. The delayed error appears when the fields are actually written to the database.

## Incrementing Fields in Objects

To increment fields in an object, use the PCM\_OP\_INC\_FLDS opcode. This opcode returns the POID of the object whose fields were updated, including the new revision number. It also returns the revised values of the selected fields unless the PCM\_OPFLG\_NO\_RESULTS flag is used.

This opcode increments or decrements fields specified in the input flist. Only fields of type PIN\_FLDT\_INT and PIN\_FLDT\_DECIMAL can be incremented or decremented, and both types must be signed in the input flist. The signed value of the field in the input flist determines whether the field is incremented or decremented.

You must update at least one field. Specify the POID of the object that contains the fields to update, along with at least one field, in the input flist.

Update array element fields by specifying the array element ID along with the field element ID in the input flist. If there is no array element for the fields you want to update, you must create the element by using the PCM\_OPFLG\_ADD\_ENTRY flag.

---



---

**Note:** This flag is required because BRM allocates space for array elements only when they are created and assigned a value. If you do not use the PCM\_OPFLG\_ADD\_ENTRY flag, you receive an error when you try to update array fields in an element that doesn't exist. An error also occurs if the array contains any non-incremental fields or mandatory fields of a non-incremental type.

---



---

The PCM\_OPFLG\_ADD\_ENTRY flag is required only for array fields. Fields that are not part of an array element must already exist (assuming the storable object exists) so they are updated as requested.

If you set an array element on the input flist and assign the element ID a value of PIN\_ELEMID\_ASSIGN, the element is created with an element ID that is numbered next higher than the highest existing element ID for that array.

### Updating Decimal Data Types

When you increment or decrement fields of decimal data type, the result depends on the value of the field both in the database and in the input list. If the value of the field in the database is NULL, BRM converts that value to 0 before updating. If the value of the field in the input list is NULL or 0, no action is taken on the value in the database. This prevents a non-NULL value in the database from being converted to NULL.

Table 3–3 shows the three possible results of an increment (0, NULL, or non-NULL) for all possible field value combinations. These results apply only to decimal data types:

**Table 3–3 Incrementing Database Field Values**

| Database Field Value | Flist Increment Value | Result of Increment |
|----------------------|-----------------------|---------------------|
| NULL                 | NULL or 0             | NULL                |
| NULL                 | Non-NULL              | Non-NULL            |
| 0                    | NULL or 0             | 0                   |
| 0                    | Non-NULL              | Non-NULL            |
| Non-NULL             | NULL or 0 or non-NULL | Non-NULL            |

If you want a field value to remain open (such as a credit limit), you should increment the field by a value of either 0 or NULL.

You can prevent the conversion of the field value in the database from NULL to 0 by using the PCM\_OPFLG\_USE\_NULL flag. This flag assigns a NULL value to the field in the input list, which prevents a change to the database value.

### Updating Integer Data Types

You cannot assign a NULL value to fields of type INT in the input list. If you update an INT data type, the PCM\_OPFLG\_USE\_NULL flag is ignored. To maintain a NULL value in the database for a field of type INT, you must increment with 0. If the increment value is non-zero in the input list, the result is always non-zero.

Not all fields in each storable object can be incremented by an application. For information on which fields can be incremented, see "Storable Class Definitions" in *BRM Developer's Reference*.

### Flags

- PCM\_OPFLG\_ADD\_ENTRY  
Creates an array element, if it doesn't already exist, and updates the specified fields as requested. It cannot be used to create non-array fields. If the array element already exists, this flag is ignored.
- PCM\_OPFLG\_READ\_RESULT  
Returns all fields from the created object, including array elements and substructures.
- PCM\_OPFLG\_USE\_NULL  
Prevents a NULL field value in the database from being converted to 0 and updated.
- PCM\_OPFLG\_NO\_RESULTS  
Returns only the POID, without the updated data. This flag provides higher performance by skipping the extra processing of returning updated data.



## Deleting Objects

To delete an object, use the PCM\_OP\_DELETE\_OBJ opcode. Specify the POID of the storable object to delete in the input flist. This opcode ignores the field values of the object to be deleted. When a storable object is deleted, its POID ID cannot be reused.

This opcode deletes only the storable object passed in. No integrity checks are performed to ensure that the storable object is not referenced in any way.

---

**Important:** To maintain database consistency, you must make sure that your application deletes any other storable objects that reference or are referenced by the storable object you delete.

---

This opcode returns the POID of the deleted object.

## Deleting Fields in Objects

To delete fields in an object, use the PCM\_OP\_DELETE\_FLDS opcode. This opcode returns the POID of the object from which an element was deleted, including the new revision number.

You must delete at least one array element. Specify the POID of the object from which to delete elements in the input flist. Also specify the array element ID for each element to be deleted. To delete an entire array, put the array in the input flist and use the element ID PCM\_RECID\_ALL.

The value for each array element to be deleted must be NULL. The value of fields within an array element to be deleted are ignored. You cannot delete fields within an array element without deleting the array element.

Only optional arrays and array elements can be deleted. Attempting to delete a mandatory element will return an error. You cannot delete fields that are not part of an array element, and you cannot delete arrays or array elements within a substructure.

For a list of fields that can be deleted, see the relevant object specifications in "Storable Class Definitions" in *BRM Developer's Reference*.

## Managing a Large Number of Objects

In addition to working with individual objects, you can use base opcodes to perform the following operations on a large number of objects in one database operation instead of accessing the database for every object:

- Create a large number of storable objects of the same type. See "[Creating a Large Number of Objects](#)".
- Update fields in a large number of storable objects. See "[Editing a Large Number of Objects](#)".
- Delete a large number of storable objects of the same type. See "[Deleting a Large Number of Objects](#)".

## Creating a Large Number of Objects

To create a large number of storable objects of the same type, use the PCM\_OP\_BULK\_CREATE\_OBJ opcode.

The PCM\_OP\_BULK\_CREATE\_OBJ input flist must include all the fields that the objects of the storable class requires. The required input flist fields depend on the type

of objects that you are creating; for example, an **/account** object includes security code, account number, account type, balances, and credit fields. You can use the `PIN_FLD_COMMON_VALUES` array in the input flist for fields that have common values for all objects being created.

---



---

**Note:** You cannot use this opcode to create a new storable class. You can use it only to create objects in an existing storable class.

---



---

You can use the same flags with this opcode as you can with the `PCM_OP_CREATE_OBJ` opcode, except that the following flags are not supported:

- `PCM_OPFLG_USE_POID_GIVEN`
- `PCM_OPFLG_READ_RESULT`

This opcode returns the type-only POID of the objects created, but it does not return the full POIDs of the individual objects created.

## Editing a Large Number of Objects

To update fields in a large number of storable objects of the same type, use the `PCM_OP_BULK_WRITE_FLDS` opcode.

This opcode updates the values of the fields or adds new fields in the objects that meet the conditions you specify in the input flist. It returns the POID type and count of the objects.

To update array element fields, specify the array element ID and the field element ID in the input flist. You can update first- and second-level array fields. If there is no array element for the fields you want to update, you must create the element by using the `PCM_OPFLG_ADD_ENTRY` flag.

---



---

**Note:** This flag is required only for array elements because BRM allocates space for array elements only when they are created and assigned a value. If you do not use the `PCM_OPFLG_ADD_ENTRY` flag, you receive an error when you try to update array fields in an element that doesn't exist.

Fields that are not part of an array element must already exist for an object, and they are updated.

---



---

If you set an array element in the input flist and use the element ID `PIN_ELEMID_ASSIGN`, the element is created with an element ID higher than the highest existing element ID for that array.

## Deleting a Large Number of Objects

To delete a large number of storable objects of the same type, use the `PCM_OP_BULK_DELETE_OBJ` opcode. This opcode deletes the objects of the type that meet the conditions you specify in the **where** clause of the query. It returns the POID type and the count of the objects deleted.

**Note:**

- You cannot use the opcode to delete specific fields in an object, only to delete complete objects.
- You cannot use the opcode to delete an entire storable class, only to delete objects in that class.

## Locking Objects when Editing or Deleting a Large Number of Objects

To enforce the data integrity of bulk operations (the PCM\_OP\_BULK\_WRITE\_FLDS and PCM\_OP\_BULK\_DELETE\_OBJ opcodes), specify the PCM\_OPFLG\_LOCK\_OBJ flag for the opcodes.

**Note:** The PCM\_OP\_LOCK\_DEFAULT flag is ignored by the bulk opcodes.

When the PCM\_OPFLG\_LOCK\_OBJ flag is specified, the balance groups of the known objects or the unknown objects will be locked. The rules for identifying which balance groups are locked are identical to the rules used in "[Locking Specific Objects](#)".

## Improving Performance when Working with Objects

Some of the opcodes used for searching and manipulating objects use the PCM\_OPFLG\_CACHEABLE flag. This flag enables caching each transaction's objects in the Connection Manager (CM) instead of writing them immediately to the database. Caching makes both the CM and the DM more efficient because the CM doesn't request the data Manager (DM) to write the same object to the database multiple times.

Objects to be written are cached until the end of the transaction unless they need to be written to the database earlier. For example, a search causes immediate execution of all pending writes, so the search can work on the most current data.

If the PCM\_OPFLG\_CACHEABLE flag is not set, the opcode writes the input flist to the database immediately and writes it to the cache for future use.

The CM writes flist fields to the database when the application does the following:

- Executes one of the following opcodes:
  - PCM\_OP\_CREATE\_OBJ
  - PCM\_OP\_SEARCH
  - PCM\_OP\_STEP\_SEARCH
  - PCM\_OP\_STEP\_NEXT
  - PCM\_OP\_GLOBAL\_SEARCH
  - PCM\_OP\_GLOBAL\_STEP\_SEARCH
  - PCM\_OP\_GLOBAL\_STEP\_NEXT
  - PCM\_OP\_READ\_OBJ
  - PCM\_OP\_READ\_FLDS
  - PCM\_OP\_WRITE\_FLDS

- Executes PCM\_OP\_INC\_FLDS and the fields are part of the object in writable cache.

Sometimes, the object can be partially available in the cache due to previous executions of PCM\_OP\_READ\_FLDS or PCM\_OP\_WRITE\_FLDS. If the partial object is in read-only cache, the CM destroys it and reads a complete object from the database through the DM. The CM caches that object before returning it to the application. If the partial object has been updated and therefore is in the writable cache, the CM writes it to the database before reading and caching the complete object.

The scope of a transaction cache is one transaction.

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**Note:** Transaction caching is not always beneficial. For example, if a transaction reads a given object only once, it should not use the PCM\_OPFLG\_CACHEABLE flag.

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## Locking Specific Objects

Locking on an account level (higher object hierarchy) can cause contention between opcodes and therefore create a bottleneck, reducing the throughput of the BRM system. Because the default locking process locks at the account level, performance can be improved by locking only the working objects rather than the account.

You can lock balance groups for the specific operations that are impacting performance. If you do not specify a more granular locking procedure, transactions lock account objects; no code change is required.

There are some frequently used operations that can take advantage of granular locking on balance group objects. They may lock the object's default or associated balance group to improve performance.

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**Important:** Exercise caution when customizing locking strategies. Changes to lower-level locking on balance group objects may cause a deadlock if you are not familiar with the execution paths of the Facilities Module (FM) utility subroutines.

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BRM supports balance group locking for transactions and opcodes that open the following known objects:

- A given account
- A given service
- A given group
- A given billinfo
- A given bill
- A given balance group
- A given profile
- A given reservation (including **/reservation/active**)
- A given reservation list
- A purchased product
- A purchased discount

- An event
- A journal

You use the following flags to lock balance groups:

- Use the `PCM_TRANS_OPEN_LOCK_OBJ` flag to lock all the associated balance groups (multiple balance groups) during the opening of a transaction. The equivalent flag for use with the other base opcodes is `PCM_OPFLG_LOCK_OBJ`.

For example:

```
fm_utils_trans_open(ctxp, opflags|PCM_TRANS_OPEN_LOCK_OBJ, pdp, ebufp);
```

- Use the `PCM_TRANS_OPEN_LOCK_DEFAULT` flag to lock the default balance group during the opening of a transaction. The equivalent flag for use with the base opcode is `PCM_OPFLG_LOCK_DEFAULT`.

For example:

```
PCM_OP(ctxp, PCM_OP_READ_FLDS, PCM_OPFLG_LOCK_OBJ, s_flistp, &o_flistp, ebufp);
```

Using these flags can improve your system's performance if many balance groups are associated with the object you are targeting with the lock request. Each flag locks balance groups according to the object type opened by the opcode or utility as shown in [Table 3-4](#):

**Table 3-4 Balance Locking Flags**

| Object Types       | PCM_TRANS_OPEN_LOCK_OBJ  | PCM_TRANS_OPEN_LOCK_DEFAULT   |
|--------------------|--|---|
| Account            | Generate a SQL template to do bulk locking on all the account's balance groups.  | Lock the account's default balance group.   |
| BillInfo           | Generate a SQL template to do bulk locking on all the bill unit's balance groups.  | Lock the bill unit's default balance group.   |
| Balance Group      | Lock the balance group.<br><b>Note:</b> This rule is identical to that of <code>PCM_TRANS_OPEN_LOCK_DEFAULT</code> .   | Lock the balance group.   |
| Service            | Lock the service's default balance group.<br><b>Note:</b> This rule is identical to that of <code>PCM_TRANS_OPEN_LOCK_DEFAULT</code> .   | Lock the service's default balance group.   |
| Profile            | Lock all the parent account's balance groups (alternatively).<br><b>Note:</b> There may be some ambiguity in this rule.  | Lock the parent's default balance group.  |
| Group              | Lock all the owner account's balance groups.   | Lock the owner account's default balance group.   |
| Bill               | Lock all bill unit's balance groups.   | Lock the bill unit's default balance group.   |
| Reservation        | Lock the reservation's default balance group.<br><b>Note:</b> This rule is identical to that of <code>PCM_TRANS_OPEN_LOCK_DEFAULT</code> .   | Lock the reservation's default balance group.   |
| Reservation/active | Determine the reservation list using the POID of the default balance group and lock the reservation list.<br><b>Note:</b> This rule is identical to that of <code>PCM_TRANS_OPEN_LOCK_DEFAULT</code> . | Determine the reservation list using the POID of the default balance group and lock the reservation list. |

**Table 3–4 (Cont.) Balance Locking Flags**

| Object Types              | PCM_TRANS_OPEN_LOCK_OBJ  | PCM_TRANS_OPEN_LOCK_DEFAULT   |
|---------------------------|--|---|
| <b>Item</b>               | Lock the item's default balance group.<br><b>Note:</b> This rule is identical to that of PCM_TRANS_OPEN_LOCK_DEFAULT.  | Lock the item's default balance group.  |
| <b>Reservation List</b>   | Lock the reservation-list object as is by returning its POID.<br><b>Note:</b> This rule is identical to that of PCM_TRANS_OPEN_LOCK_DEFAULT.   | Lock the reservation-list object as is by returning its POID.   |
| <b>Journal</b>            | Lock the journal object as is by returning its POID.<br><b>Note:</b> This rule is identical to that of the PCM_TRANS_OPEN_LOCK_DEFAULT   | Lock the journal object as is by returning its POID.  |
| <b>Event</b>              | Lock the event object as is by returning its POID.<br><b>Note:</b> This rule is identical to that of PCM_TRANS_OPEN_LOCK_DEFAULT.  | Lock the event object as is by returning its POID.  |
| <b>Purchased Product</b>  | Lock all of the service's default balance groups (if any) or parent account's default balance groups (alternatively).<br><b>Note:</b> This rule is identical to that of PCM_TRANS_OPEN_LOCK_DEFAULT.                               | Lock the all the service's default balance groups (if any) or parent account's default balance groups (alternatively).  |
| <b>Purchased Discount</b> | Lock all of the service's default balance groups (if any) or parent account's default balance groups (alternatively).<br><b>Note:</b> This rule is identical to that of PCM_TRANS_OPEN_LOCK_DEFAULT.                               | Lock the all the service's default balance groups (if any) or parent account's default balance groups (alternatively).  |
| <b>Active Session</b>     | Objects of this kind will never be locked. The lock request will be ignored.<br><b>Note:</b> This is a temporary rule and may be revoked in the further. It is recommended that you remove code to lock the active session object. | Objects of this kind will never be locked. The lock request will be ignored.  |
| <b>Others</b>             | Lock all the balance groups of the parent account, provided the account is not the root or the PCM login account. Otherwise, lock the object as is.<br><b>Note:</b> BRM assumes that the login user ID is an account POID.         | Lock the default balance group of the parent account provided that the account must not be the root or the PCM login account. Otherwise, lock the object as is. |

---

**Important:** When using either flag, be aware of what is locked and what is not locked. A deadlock can occur when two different transaction contexts lock on a common set of objects and the lock sequences are not synchronized.

---

Oracle can detect the database-level deadlocks and throws an error to the DM. Users may also dump the CM lock map to determine the object that caused the deadlock. The technique is as follows:

1. Obtain the lock map flist using PCP\_GET\_TRANS\_FLIST.
2. Use PIN\_ERR\_LOG\_FLIST to display the lock map flist.

There are many opcodes that can lock based on the objects in the list. In some cases, it should be okay to leave things as they are. If you decide not to change anything, things should still work as before and performance should not degrade.

Some sample strategies that may be employed to assist performance are:

- Change `PCM_OPFLG_LOCK_OBJ` to `PCM_OPFLG_LOCK_DEFAULT` in an operation you already use. This may change its locking behavior but typically if you were not experiencing deadlocks with this operation before, it can be changed safely.
- Change the object to lock. If an opcode works on only the `/service` object, try using the `PCM_OPFLG_LOCK_DEFAULT` flag on the `/service` object if it is provided in the input flist. In this way, objects that are not changed are not locked and therefore a given opcode will not interfere with objects that it does not change.

You can lock only when you are in a read-write transaction. Otherwise, your lock flags will be ignored or may result in a fatal PCM error.





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## Understanding the PCM API and the PIN Library

This chapter introduces two libraries that you need to understand if you are customizing the Oracle Communications Billing and Revenue Management (BRM) system:

- The PIN (Portal Information Network) libraries, which you use to handle errors and to manipulate flists, POIDs, fields, strings, and decimal data types.
- The Portal Communication Module (PCM) Application Programming Interface (API), which you use to interact with the BRM database.

Before you read this document, read the following documents in *BRM Concepts* to familiarize yourself with the basic concepts and components of BRM:

- Introducing BRM
- BRM System Architecture

BRM provides several Software Development Kits (SDKs) and APIs that you use to create custom client applications for BRM. For information on those SDKs and APIs and how to use them, see "[About the BRM Client Access Libraries](#)".

### About the PIN Library

The PIN library contains macros and functions that manipulate flists, fields, and data types. These functions are different from PCM operations in that they are implemented locally in the programs; they do not pass data over the communication channel. The PIN library is required to build custom applications and FMs.

The PIN library contains macros and functions that you use to perform the following tasks:

- Manage and manipulate flists and fields in flists. For detailed information, see "Flist Management Macros" and "Flist Field-Handling Macros" in *BRM Developer's Reference*.
- Detect and log errors and log messages. For detailed information, see "Error-Handling Macros" in *BRM Developer's Reference*.
- Manage and manipulate POIDs. For detailed information, see "POID Management Macros" in *BRM Developer's Reference*.
- Perform arithmetic functions on decimal data types. For detailed information, see "Decimal Data Type Manipulation Functions" in *BRM Developer's Reference*.

- Manipulate strings. For detailed information, see "String Manipulation Functions" in *BRM Developer's Reference*.

## About the PCM API

All access to the data in the BRM database is through the PCM API. Client applications as well as custom Facilities Modules (FMs) use this library to manipulate objects in the database.

The API consists of three classes of functions:

- Context management. You use context management opcodes to control communication channels to the database.
- Basic object manipulation. You use base opcodes to create, search for, delete, and modify objects in the database.
- FM object manipulation. You use FM opcodes to implement business policies and processes

You make BRM API calls by using a macro interface instead of directly through functions. When an API macro is called, the macro records the file name and line number of the source code where the API was called. If an error occurs, the macro logs a message including the file name and source code line number, making it easy to locate and correct the error.

For details on the return status of PCM functions and the error messages returned, see "[Understanding API Error Handling and Logging](#)".

The API definitions are independent of the underlying storage model. The C data structures are opaque, and the opcodes are designed to appear much like object methods.

## Header Files

Each set of related opcodes has a corresponding header file. Your custom code and applications must include the header files that correspond to the opcodes you use.

Context management opcodes use the **pcm.h** header file. Always include this file in your applications.

Header files for base opcodes and Facilities Module (FM) opcodes are located in the **include/ops** directory. To include one of these header files, use this syntax:

```
#include "ops/file.h"
```

Where *file* is the name of the header file.

For example, if your application calls `PCM_OP_CUST_COMMIT_CUSTOMER`, you must include the **ops/cust.h** header file.

## Opcode Input and Output Specifications

Each PCM opcode requires certain data to successfully perform its operation. The opcodes take input and output data in the form of field lists (flists), which are lists of field name and value pairs. (For more information on flists, see "[About Flists](#)".)

Each opcode requires its input flist to contain certain fields to perform the operation. For example, to create an object, the `PCM_OP_CREATE_OBJECT()` opcode requires an input flist that includes all the fields that an object of that class requires.

The information for each opcode in *BRM Developer's Reference* includes the input and output flist specifications, defining the following parameters for each field in the flist:

- The mnemonic field names used by applications to reference the field
- The data type and size for the field
- The permissions, which specify if a field is mandatory (M) or optional (O) for the opcode. See the next section, "[Field Permissions](#)", for more information.

The flist specifications use the following syntax to define each field in an flist:

```
class depth field (
    type = data_type
    perms = permission permission ...
);
```

Where *class* specifies whether it is a field, array, or a substruct, *depth* contains an asterisk for each nesting level of the field, and *field* specifies the name of the field.

Examples:

```
field PIN_FLD_NAME (
    type    =    PIN_FLDT_STR(255) ,
    perms   =    M,
);
array * PIN_FLD_INHERITED_INFO (
    type    =    PIN_FLDT_ARRAY,
    perms   =    O,
);
```

### Field Permissions

For fields in opcode input and output flists, the flist specifications specify if a field is mandatory or optional.

## About Opcode Usage

**Recommended:** opcodes are designed specifically for you to call from your custom applications. They are not expected to change from release to release.

**Limited:** opcodes should only be called in special cases. They may change from release to release.

**Last Resort:** opcodes should only be called if absolutely necessary. Calling these opcodes means that you are either on the wrong track or rewriting major portions of code. BRM will change these opcodes as necessary.

## About Transaction Usage

Each opcode uses one of the following types of transaction handling:

- [Transaction Handling: Required](#)
- [Transaction Handling: Requires New](#)
- [Transaction Handling: Supports](#)

### Transaction Handling: Required

The transaction for this opcode can be wrapped in a transaction opened by another opcode.

If a read-write transaction is already open when this opcode is executed, all data modifications take place within the open transaction. The modifications are committed or aborted along with all other changes when the transaction is committed or aborted.

If no transaction is open when the opcode is called, a read-write transaction is opened. All actions are performed within this transaction, ensuring that the entire operation is performed atomically. If an error occurs during the execution of the opcode, all changes are aborted when the transaction is aborted. If no error occurs, the transaction is committed at the end of the operation.

This opcode requires a read-write transaction. It is therefore an error to have a read-only transaction open when this opcode is called.

### **Transaction Handling: Requires New**

This opcode manages transactions internally to ensure absolute integrity of the database. A transaction for this opcode cannot be wrapped in another transaction.

If no transaction is open when the opcode is called, a read-write transaction is automatically opened and all actions are performed within this transaction.

If a transaction is already open when the opcode is called, an error occurs.

### **Transaction Handling: Supports**

This opcode does not modify object data. If it is called while a transaction is not already open, the operation is executed without transactional control.

If a read-write or read-only transaction is already open when this opcode is called, the opcode is executed as part of the transaction and reads the in-process state of the data.

If the opcode is called when a separate, unrelated transaction is taking place, it reads the last saved state of the database.

## **Calling PCM Opcodes**

You call the base and FM opcodes by using `PCM_OP`. You pass the opcode you want to call as one of the input parameters. `PCM_OP()` executes the opcode in its input parameters list in an open communication channel or a context.

You use the following parameters and flags with `PCM_OP()`:

#### **pcm\_ctxp**

- Pointer to an open PCM context.

#### **opcode**

- Name of the opcode you want to call.

#### **flags**

- **(int32)NULL**

No flags specified. Use only when there are no flags defined for this operation.

- **PCM\_OPFLG\_READ\_RESULT**

Returns all the fields in the storable object from the output flist, not just the POID. Valid only for opcodes that create storable objects.

- **PCM\_OPFLG\_CALC\_ONLY**

Calculate only. Valid only for opcodes that create storable objects. No fields in the database are changed and the storable object is not actually created. Instead, fields

that would have been used to create the storable object are returned to the caller on the output flist.

#### **in\_flistp**

- An input flist specification for the opcode defining the required and optional input fields for the opcode to function properly. Each opcode has an input flist specification that you must use to create the input. See the input flist specification in an individual opcode description for details.

#### **ret\_flistp**

- An output flist specification defining what you expect the opcode to return. Each opcode has an output flist specification that you must use to create the input. You must explicitly destroy the return flist to free memory. See the output flist specification in an individual opcode description for details.

#### **ebufp**

- Pointer to an error buffer. Used to pass status information back to the caller.

The following example shows how to call the policy opcode `PCM_OP_CUST_POL_GET_PLANS` to get pricing plans:

```
/*Declarations*/
pin_errbuf_t *ebufp
input_flistp = PIN_FLIST_CREATE(ebufp);
return_flistp = PIN_FLIST_CREATE(ebufp);

PCM_OP(ctxp, PCM_OP_CUST_POL_GET_PLANS, 0, input_flistp, &return_flistp, ebufp);
```

## **Manipulating Objects in Custom Applications**

There are three basic steps to manipulating objects in a custom application or module:

1. Open a context by calling `PCM_CONTEXT_OPEN` or `PCM_CONNECT` in an application.
2. Call opcodes with `PCM_OP`.
3. Close the context by using `PCM_CONTEXT_CLOSE`.

## **Context Management Opcodes**

The context management opcodes open and close a communication channel to the BRM database by opening and closing a context to the Connection Manager (CM). The context structure is opaque to the application. It contains state data used by the PCM library to manage the communication channel.

The context management opcodes include functions for synchronous and asynchronous transactions. All transactions must follow these rules:

- Each application can connect to only one CM at a time.
- Only one connection can be open to a DM at a time.
- All object manipulation functions performed within a transaction must apply to the same BRM database schema.

When a context is opened, you can call additional functions to open, close, and commit or abort transactions within the open context.

When you open a PCM context, a connection is established between your application and the BRM server. This connection adds significant overhead to the system because

of the security and auditing checks performed by BRM. Therefore, to maximize performance, make sure your application keeps the context open until all the operations are performed. If your application opens and closes contexts frequently, performance will be affected.

If you are writing applications, such as Web-based Active Server Pages or CGI scripts, that cannot maintain an open context for a long time, use CM Proxy. CM Proxy allows your application to access the database with a pre-authorized connection and avoid the system overhead of a login for each connection.

For more information on CM Proxy, see "Using CM Proxy to Allow Unauthenticated Log On" in *BRM System Administrator's Guide*.

For a list of context management opcodes, including links to the documentation for each opcode, see "Context Management Opcodes" in *BRM Developer's Reference*.

## Base Opcodes

You use base opcodes to perform operations such as creating and manipulating objects, searching, and transaction handling. Base opcodes are implemented in the Data Manager, unlike the other opcodes, which are implemented in the Connection Manager.

Base opcodes require an open communication context and an input flist as parameters. The input flist specifies the input field arguments, and is not modified during execution.

You call the object manipulation opcodes with PCM\_OP. The opcode you want to call is an input parameter.

Base opcodes pass back a return flist as a parameter. The return flist contains the result field arguments. The memory for the return flist is dynamically allocated.

You can run basic object manipulation macros in any combination within a transaction, depending on the resources available.

### Search and Global Search Opcodes

Some base opcodes are used for searching in BRM. "Searching" in this context means looking in your BRM database for objects that meet a criteria that you specify. That is, you want the POIDs of all the classes that share certain characteristics. The PCM\_OP\_SEARCH\_\* and PCM\_OP\_GLOBAL\_SEARCH\_\* opcodes are designed for this purpose. They search single or multiple database schemas for accounts that match the criteria you specify and return the POIDs of those accounts.

After you know the POIDs of accounts, you can call other base opcodes designed to read or change data, such as PCM\_OP\_READ\_OBJ, PCM\_OP\_WRITE\_OBJ, or PCM\_OP\_DELETE\_OBJ.

See "[Searching for Objects in the BRM Database](#)" for a discussion of searching and a list of the SEARCH opcodes. This document explains the BRM searching strategy, including the types of searching that BRM does by default and what you need to know if you are writing custom applications to use on the BRM database.

When you write a custom DM, depending on your needs, you implement opcodes from the following set:

- Base opcodes for LDAP DM. See "LDAP Base Opcodes" in *BRM Developer's Reference*.
- Base opcodes for Email DM. See "Email Data Manager Opcodes" in *BRM Developer's Reference*.

## FM Opcodes

FMs (Facilities Modules) are shared libraries that implement higher-level opcodes. Each FM implements a set of opcodes to perform operations specific to that module. FMs create online accounts, manage customer-related information, charge customers for resource usage, and allow third-party systems to be integrated with BRM. In the billing FM, for example, opcodes perform advanced billing-related operations on user accounts.

You call the FM opcodes using `PCM_OP`, with the FM opcode you are calling as the input parameter.

FM opcodes are divided into the following types:

- **Standard FM opcodes** perform specific BRM operations. You cannot change the standard opcodes. However, if you want to add new functionality, you can write new opcodes.

For more information, see ["Writing a Custom Facilities Module"](#).

- **Policy FM opcodes** contain the BRM business logic. You can modify the default behavior of policy opcodes to suit your business needs. BRM includes the source code for all the policy opcodes.

For example, you can bill customers on their anniversary date or on the first day of each month by modifying the default implementation of the `PCM_OP_CUST_POL_PREP_ACTINFO` policy opcode.

For more information on customizing policy opcodes, see ["Adding and Modifying Policy Facilities Modules"](#).

BRM includes a set of policy opcodes, including source code, as hooks for you to add your code. These opcodes do not have a default implementation.

Standard FMs that use business logic to process requests have policy FMs associated with them. A few FMs, such as the SDK FM and the Group FM, which are internal to BRM and do not need business logic for processing data, do not have associated policy FMs.

Each of the BRM optional managers has its own FM. See the appropriate optional manager documentation for more information.

## About the PREP and VALID Opcodes

Many opcodes, for example, `PCM_OP_CUST_SET_LOGIN` and `PCM_OP_CUST_PREP_CUSTOMER`, call policy PREP and VALID opcodes, such as `PCM_OP_CUST_POL_PREP_PASSWD` and `PCM_OP_CUST_POL_VALID_PASSWD`. You can use PREP and VALID opcodes to customize how data is processed.

- Use the PREP opcodes to process data before it is validated. Typical processing includes adding missing fields whose values are derived or generated by the PREP operation, and forcing fields to predefined values independent of what the customer specified. PREP opcodes are given a set of customer-specified fields on the input flist, and return the processed version of the same data on the output flist.

If a PREP opcode cannot derive all the necessary fields because the customer-specified values used in the derivation are incorrect, no error is returned. Instead, the derived fields are put on the output flist with a default value, and the corresponding VALID call detects the incorrect data and returns the validation error to the calling application. This approach allows the calling application to see

the details of the validation error rather than receiving a less precise **ebuf** error passed up from the PREP opcode.

If a PREP opcode cannot generate a necessary field or some other internal problem is encountered, an **ebuf** error is returned.

- Use the VALID opcodes to validate field values. Typical checks include formatting tests for data integrity, tests for illegal values and tests for required information that is missing. VALID opcodes are given a set of related fields and values on the input flist, and return a list of fields that failed the validation tests on the output flist. The VALID opcodes cannot alter the value of a field that is not suitable, that is the purpose of the PREP opcodes.

If one or more fields fail the validation tests, they are returned using the PIN\_FLD\_FIELDS array on the output flist. This array is structured to allow fields nested within arrays or substructs to be accurately represented. All fields that failed validation are returned by the operation, so the caller can correct all errors at once and retry the operation.

### Validating Fields by Using Field Validation Editor

To validate the field validations that you specify in the Field Validation Editor, use PCM\_OP\_CUST\_VALID\_FLD.

## Supporting an Older Version of BRM

The PIN\_FLD\_VERSION flag on the PCM\_OP\_CUST\_COMMIT\_CUSTOMER input flist specifies whether the flist complies with the current version of BRM. If it doesn't, new BRM objects are created. This supports backward compatibility. The current version is this version of BRM.

Possible flag values are:

- PIN\_PORTAL\_VERSION\_CURRENT (a value of **0**) specifies this version of BRM.
- PIN\_PORTAL\_VERSION\_LEGACY (a value of **1**) specifies a legacy version of BRM. This is the default. If PIN\_PORTAL\_VERSION\_LEGACY is specified, the input flist is converted to the current version and all necessary objects, including the **/billinfo**, **/balance\_group**, and **/payinfo** objects are created for the account.

## Creating Customization Interfaces

You can create or customize features without programming:

- You can use events to trigger programs. See "[Using Events to Trigger Operations](#)".
- You can use configuration options set by **pin.conf** files. See "[Accessing pin.conf Files in Custom Code](#)".
- You can use **/config/business\_params** objects to configure custom features. See "[Using /config/business\\_params Objects](#)".

## Accessing pin.conf Files in Custom Code

You can use the PCM C++ **PinConf** class to enable your code to read values from a **pin.conf** file. For example, this code is from the policy source file **fm\_rate\_pol\_tax\_loc.c**. This code gets the value of the customer's tax locale from the Connection Manager (CM) **pin.conf** file:

```
/******
```



```

* Look up the ISP city from pin.conf
*****/

pin_conf("fm_rate_pol", "provider_loc", PIN_FLDT_STR,
(caddr_t *)&locale, &perr);

```

The entry in the **pin.conf** file looks like this:

```

=====
# provider_loc
#
# City, state, ZIP code, and country where you provide services to
# your customers.
#
# This information is used to determine tax rates.
=====
- fm_rate_pol provider_loc Cupertino, CA 95014 USA

```

In the following example, this code in the **fm\_subscription\_pol\_spec\_cancel.c** policy source code file gets a value (0 or 1) from an entry in the CM **pin.conf** file:

```

/* * For all products without a provisioning tag cancel and
* delete product from table.
*/

if (pin_conf_keep_cancelled_products_or_discounts == 0){
    PIN_FLIST_FLD_SET(p_arrayp, PIN_FLD_ACTION,
    PIN_BILL_CANCEL_PRODUCT_ACTION_CANCEL_DELETE, ebufp);
} else {
    PIN_FLIST_FLD_SET(p_arrayp, PIN_FLD_ACTION,
    PIN_BILL_CANCEL_PRODUCT_ACTION_CANCEL_ONLY, ebufp);
}

```

The following example shows the entry in the **pin.conf** file.

```

=====
# keep_cancelled_products_or_discounts
#
# Specifies whether to keep canceled products and discounts in the
# accounts products and discounts array.
#
# The value for this entry can be:
# 0 = (Default) Deletes the canceled products or discounts from
# the accounts products and discounts array.
# 1 = Keep the deleted products or discounts in the accounts
# products and discounts array
#
=====
- fm_subscription_pol keep_cancelled_products_or_discounts 1

```

In addition to retrieving a value from a **pin.conf** file, you can hard code a default value that is used if the entry is not present in the **pin.conf** file.

For information about the PinConf class, see ["Accessing Configuration Values by Using pin.conf"](#).

## Using /config/business\_params Objects

You can customize BRM by adding new business parameters to control various aspects of BRM operations and calling these business parameters from policy opcodes. You can also add completely new business parameter classes to BRM.

## Adding and Loading New Parameters

Adding parameters is useful if you are customizing existing functionality; for example, to expand the criteria used to determine whether a payment should be suspended. To do this, you customize `PCM_OP_PYMT_POL_VALIDATE_PAYMENT`, the policy opcode that validates payments, to filter any payments below a specified amount.

For added flexibility, you may also want the ability to turn off this filter at certain times. One way to do this is to add a parameter to the `/config/business_params` object for the `ar` parameter class and have `PYMT_POL_VALIDATE_PAYMENT` check that parameter.

To implement the `/config/business_params` part of this process, you create a new parameter that you enable or disable depending on whether you want to filter payments below a specified amount so that these payments do not get suspended. This parameter will be called `payment_suspense_amount_filter` in the `/config/business_params` object and `PaymentSuspenseAmntFilter` in the supporting XML file set. You add the parameter as follows:

1. Modify the `bus_params_AR.xsd` file in the `BRM_Home/sys/data/config/` directory to add the new parameter. (*BRM\_Home* is the directory in which you installed BRM components.)

```
<xs:element name="PaymentSuspenseAmntFilter" type="switch">
  <xs:annotation>
    <xs:documentation xml:lang="en">Enable/Disable filtering
      of payment suspense based on payment amount. The parameter
      values can be 0 (disabled) or 1 (enabled). The default is 0
      (disabled).</xs:documentation>
  </xs:annotation>
</xs:element>
```

2. Modify the `bus_params_AR.xsl` file in the `BRM_Home/sys/data/config/` directory to add the new parameter:

```
<xsl:template match="bc:PaymentSuspenseAmntFilter">
  <xsl:element name="Param">
    <xsl:element name="Name">
      <xsl:text>payment_suspense_amount_filter</xsl:text>
    </xsl:element>
    <xsl:element name="Desc">
      Enable/Disable filtering of payment suspense based on
      payment amount. The parameter values can be 0 (disabled)
      or 1 (enabled). The default is 0(disabled).
    </xsl:element>
    <xsl:element name="Type">INT</xsl:element>
    <xsl:element name="Value">
      <xsl:choose>
        <xsl:when test="text() = 'enabled'">
          <xsl:text>1</xsl:text>
        </xsl:when>
        <xsl:otherwise>
          <xsl:text>0</xsl:text>
        </xsl:otherwise>
      </xsl:choose>
    </xsl:element>
  </xsl:element>
</xsl:template>
```

3. Modify the `bus_params_to_AR.xsl` file in the `BRM_Home/sys/data/config/` directory to add the new parameter:

```

<xsl:when test="$name = 'payment_suspense_amount_filter'">
  <xsl:element name="PaymentSuspenseAmntFilter">
    <xsl:choose>
      <xsl:when test="$value = '1'">
        <xsl:text>enabled</xsl:text>
      </xsl:when>
      <xsl:when test="$value = '0'">
        <xsl:text>disabled</xsl:text>
      </xsl:when>
    </xsl:choose>
  </xsl:element>
</xsl:when>

```

4. Use the `pin_bus_params` utility to retrieve the `ar` instance of the `/config/business_params` object:

```
pin_bus_params -r BusParamsAR bus_params_AR.xml
```

5. Modify the resulting XML file to add the new parameter:

```
<PaymentSuspenseAmntFilter>disabled</PaymentSuspenseAmntFilter>
```

6. Use the `pin_bus_params` utility to load the object from the modified XML file:

```
pin_bus_params bus_params_AR.xml
```

For information on using the `pin_bus_params` utility, see `pin_bus_params`.

### Adding and Loading New Parameter Classes

Adding parameter classes is useful if you are creating entirely new BRM features or customizing existing functionality that has no associated parameter class. For example, there are a number of ways that you could customize BRM to control whether or not certain types of resources are eligible for resource reservation. Typically, these implementations require that you customize one of more Resource Reservation policy opcodes.

If you want the ability to switch back and forth between resources when BRM makes this decision, you could call a business parameter from the customized policy opcode. Because BRM doesn't have a parameter class dedicated to resource reservation, you create a new `/config/business_params` object for this parameter class. You name the parameter class `resource-res`.

To support this new parameter class, you create a set of four files:

- `bus_params_reservation.xml`: Contains the parameter settings from the `/config/business_params` object for `resource-res`. Parameter settings in this file are loaded into the object by using the `pin_bus_params` utility.
- `bus_params_reservation.xsd`: Validates the contents of the `bus_params_reservation.xml` file when loading the object.
- `bus_params_reservation.xsl`: Translates the contents of the `bus_params_reservation.xml` file into the correct format for the `/config/business_params` object. The `pin_bus_params` utility calls this file when loading the object.
- `bus_params_to_reservation.xsl`: Translates the contents of the `/config/business_params` object into XML format during object retrieval.

This parameter class you create will be called `BusParamsReservation` in XML. The class will include one parameter to control which resource is eligible for resource reservation-US dollars or free minutes. This parameter will be called

**reserve-currency-noncurrency** in the `/config/business_params` object and **ReserveCurrencyNoncurrency** in the supporting XML file set.

To implement the `/config/business_params` part of this process:

1. Copy one of the `bus_params_ParameterClassName.xsd` sample files in `BRM_Home/sys/data/config/` and save it as `bus_params_reservation.xsd`. Modify the file as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>

<xs:schema targetNamespace="http://www.portal.com/schemas/BusinessConfig"
  xmlns:businessConfig="http://www.portal.com/schemas/
    BusinessConfig"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified">

  <xs:annotation>
    <xs:documentation xml:lang="en"
      </xs:documentation>
  </xs:annotation>

  <xs:complexType name="BusParamsReservationType">
    <xs:sequence>
      <xs:element name="ReserveCurrencyNoncurrency" type="switch">
        <xs:annotation>
          <xs:documentation xml:lang="en">
            The resource to reserve. The parameter values can be
              0 (USDollars) or 1 (FreeMinutes). The default is
              1 (USDollars).
          </xs:documentation>
        </xs:annotation>
        <xs:simpleType name="resoption">
          <xs:restriction base="xs:string">
            <xs:enumeration value="USDollars" />
            <xs:enumeration value="FreeMinutes" />
            <xs:whiteSpace value="collapse" />
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>

</xs:schema>
```

2. Copy one of the `bus_params_ParameterClassName.xsl` sample files in `BRM_Home/sys/data/config/` and save it as `bus_params_reservation.xsl`. Modify the file as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>

<xsl:stylesheet
  version="1.0" xmlns="http://www.portal.com/schemas/BusinessConfig"
  xmlns:bc="http://www.portal.com/schemas/BusinessConfig"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  exclude-result-prefixes="bc">

  <xsl:output method="xml" indent="yes" />

  <xsl:template match="/">
```

```

<BusinessConfiguration
  xmlns="http://www.portal.com/schemas/BusinessConfig"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.portal.com/schemas/
    BusinessConfig business_configuration.xsd">
  <BusParamConfiguration>
  <BusParamConfigurationList>
    <ParamClass desc="Business logic parameters for Resource
      Reservation" name="resource-res">
      <xsl:apply-templates select="/bc:BusinessConfiguration/
        bc:BusParamConfigurationClass/
          bc:BusParamsReservationType/bc:*" />
    </ParamClass>
  </BusParamConfigurationList>
</BusParamConfiguration>
</BusinessConfiguration>
</xsl:template>

<xsl:template match="bc:ReserveCurrencyNoncurrency">
  <xsl:element name="Param">
    <xsl:element name="Name">
      <xsl:text>reserve_currency_noncurrency</xsl:text>
    </xsl:element>
    <xsl:element name="Desc">
      The resource to reserve. The parameter values can be
        0 (USDollars) or 1 (FreeMinutes). The default is
        1 (USDollars).
    </xsl:element>
    <xsl:element name="Type">INT</xsl:element>
    <xsl:element name="Value">
      <xsl:choose>
        <xsl:when test="text() = 'FreeMinutes'">
          <xsl:text>1</xsl:text>
        </xsl:when>
        <xsl:otherwise>
          <xsl:text>0</xsl:text>
        </xsl:otherwise>
      </xsl:choose>
    </xsl:element>
  </xsl:element>
</xsl:template>

</xsl:stylesheet>

```

3. Copy one of the `bus_params_to_ParameterClassName.xml` sample files in `BRM_Home/sys/data/config/` and save it as `bus_params_to_reservation.xml`. Modify the file as follows:

```

<?xml version="1.0" encoding="UTF-8" ?>

<xsl:stylesheet
  version="1.0"  xmlns="http://www.portal.com/schemas/BusinessConfig"
  xmlns:bc="http://www.portal.com/schemas/BusinessConfig"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  exclude-result-prefixes="bc">

  <xsl:output method="xml" indent="yes" />

  <xsl:template match="/">
    <BusinessConfiguration

```

```

xmlns="http://www.portal.com/schemas/BusinessConfig"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.portal.com/schemas/
  BusinessConfig business_configuration.xsd">
<BusParamConfigurationClass>
  <BusParamsReservation>
    <xsl:apply-templates          select="/bc:BusinessConfiguration/
      bc:BusParamConfiguration/bc:BusParamConfigurationList/
      bc:ParamClass/bc:Param" />
  </BusParamsReservation>
</BusParamConfigurationClass>
</BusinessConfiguration>
</xsl:template>

<xsl:template match="//bc:Param">
  <xsl:variable name="name">
    <xsl:value-of select="bc:Name/text()" />
  </xsl:variable>
  <xsl:variable name="value">
    <xsl:value-of select="bc:Value/text()" />
  </xsl:variable>
  <xsl:choose>
    <xsl:when test="$name = 'reserve_currency_noncurrency'">
      <xsl:element name="ReserveCurrencyNoncurrency">
        <xsl:choose>
          <xsl:when test="$value = '1'">
            <xsl:text>FreeMinutes</xsl:text>
          </xsl:when>
          <xsl:when test="$value = '0'">
            <xsl:text>USDollars</xsl:text>
          </xsl:when>
        </xsl:choose>
      </xsl:element>
    </xsl:when>
  </xsl:choose>
</xsl:template>

</xsl:stylesheet>

```

4. Copy one of the `bus_params_ParameterClassName.xml` sample files in `BRM_Home/sys/data/config/` and save it as `bus_params_reservation.xml`. Modify the file as follows:

```

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>

<BusinessConfiguration
  xmlns="http://www.portal.com/schemas/BusinessConfig"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.portal.com/schemas/Business
  Config business_configuration.xsd">

  <BusParamConfigurationClass>
    <BusParamsReservation>
      <ReserveCurrencyNoncurrency>
        USDollars
      </ReserveCurrencyNoncurrency>
    </BusParamsReservation>
  </BusParamConfigurationClass>

</BusinessConfiguration>

```

5. Modify the **bus\_params\_conf.xsd** file in the *BRM\_Home/xsd* directory to add the new parameter class.

- a. Add the following line to the schema location segment of the file:

```
<xs:include schemaLocation="bus_params_reservation.xsd"/>
```

- b. Add the following line to the parameter class selection segment of the file:

```
<xs:element name="BusParamsReservation" type="BusParamsReservationType"/>
```

6. Use the **pin\_bus\_params** utility to load this file, creating a new **resource-res** parameter instance of the **/config/business\_params** object:

```
pin_bus_params bus_params_reservation.xml
```

For information on using the **pin\_bus\_params** utility, see **pin\_bus\_params**.

### Examples of Accessing Business Parameters in Custom Code

Opcodes read configuration values from **/config/business\_params** objects to determine whether to execute various functions. The following examples show how several BRM policy opcodes call values from **/config/business\_params** objects.

#### Calling Business Parameters from **PCM\_OP\_PYMT\_POL\_VALIDATE\_PAYMENT**

In its default implementation, the **PCM\_OP\_PYMT\_POL\_VALIDATE\_PAYMENT** policy opcode checks whether payment suspense management is enabled. If so, it places payments that could not be validated into suspense.

This code in the **fm\_pymt\_pol\_validate\_payment.c** policy source file determines whether to suspend payments that can't be validated. To make this determination, BRM calls the **psiu\_bparams\_get\_int()** function and uses the **psiu\_business\_params.h** header file to retrieve specific parameters from the appropriate **/config/business\_params** object. This information is used to determine whether payment suspense management is enabled (**PSIU\_BPARAMS\_AR\_PYMT\_SUSPENSE\_ENABLED**):

```

/*****
* Check if Payment Suspense Management feature is enabled
*****/
pymt_suspense_flag = psiu_bparams_get_int(ctxp, PSIU_BPARAMS_AR_PARAMS,
    PSIU_BPARAMS_AR_PYMT_SUSPENSE_ENABLE, ebufp);
if ((pymt_suspense_flag != PSIU_BPARAMS_AR_PYMT_SUSPENSE_ENABLED)&&
    (pymt_suspense_flag != PSIU_BPARAMS_AR_PYMT_SUSPENSE_DISABLED))
{
    pin_set_err(ebufp, PIN_ERRLOC_FM,
        PIN_ERRCLASS_SYSTEM_DETERMINATE,
        PIN_ERR_INVALID_CONF, 0, 0, 0);
    PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_ERROR,
        "bad param value for \"payment_suspense_enable\" in /config/business_
params",
        ebufp);
}

```

The segment that enables payment suspense management in the **/config/business\_params** object looks like this:

```

0 PIN_FLD_PARAMS          ARRAY [2] allocated 4, used 4
1  PIN_FLD_DESCR          STR [0] "Enable/Disable payment suspense management.
                               The parameter values can be 0 (disabled),
                               1 (enabled). Default is 0 (disabled)."
```

```

1 PIN_FLD_PARAM_NAME STR [0] "payment_suspense_enable"
1 PIN_FLD_PARAM_TYPE INT [0] 1
1 PIN_FLD_PARAM_VALUE STR [0] "1"

```

### Calling Business Parameters from PCM\_OP\_BILL\_POL\_REVERSE\_PAYMENT

In its default implementation, the PCM\_OP\_BILL\_POL\_REVERSE\_PAYMENT policy opcode reverses payments applied to accounts that were written off; it does not reverse the payment if the write-off reversal was anything other than an account-level write-off.

This code in the `fm_bill_pol_reverse_payment.c` policy source code determines whether the write-off was at the account level. To make this determination, BRM calls the `psiu_bparams_get_str()` function and uses the `psiu_business_params.h` header file to retrieve specific parameters from the appropriate `/config/business_params` object. This information is used to determine whether write-off level is `PSIU_BPARAMS_AR_PYMT_SUSPENSE_ENABLED`. If so, it reverses the payment, again writing off the account:

```

/*****
* Verify if write off level set to "a" (account) in
* /config/business_params and Call PCM_OP_AR_ACCOUNT_WRITEOFF
*****/

psiu_bparams_get_str(ctxp, PSIU_BPARAMS_AR_PARAMS,
PSIU_BPARAMS_AR_WRITEOFF_LEVEL, writeoff_rev_level, 2, ebufp);

if ( status_flag && ( *status_flag == PIN_PYMT_WRITEOFF_SUCCESS ) &&
writeoff_rev_level &&
!strcmp(writeoff_rev_level, PIN_WRITEOFF_REV_LEVEL_ACCOUNT) )
{
    i_flistp = PIN_FLIST_CREATE(ebufp);

    vp = PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_POID, 0, ebufp);
    PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_POID, vp, ebufp);

    vp = PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_PROGRAM_NAME, 0, ebufp);
    PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_PROGRAM_NAME, vp, ebufp);
    vp = PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_START_T, 1, ebufp);
    if (vp)
    {
        PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_START_T,
        (void *) vp, ebufp);
    }
}

```

The segment that determines the write-off level in the `/config/business_params` object looks like this:

```

0 PIN_FLD_PARAMS ARRAY [2] allocated 4, used 4
1 PIN_FLD_DESCR STR [0] "Selection of level of writeoff to be tracked
for the
purpose of writeoff reversal. Values can be
a(Account),
b(Bill), i(Item), *(Any)."
```

```

1 PIN_FLD_PARAM_NAME STR [0] "writeoff_level"
1 PIN_FLD_PARAM_TYPE INT [0] 5
1 PIN_FLD_PARAM_VALUE STR [0] "a"

```

For information about the `/config/business_params` object, see `/config/business_params` and `pin_bus_params`.



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## Understanding the BRM Data Types

This chapter describes the data types that Oracle Communications Billing and Revenue Management (BRM) supports. The data types described here are defined in the `pcm.h` file.

### About the BRM Data Types

BRM supports a set of data types that you use to define fields in a storable class or in field lists (flists). For information on flists and storable classes, see ["Understanding Flists and Storable Classes"](#).

[Table 5–1](#) lists the data types that BRM supports. Some of the BRM data types are simple data types, which map to data types in programming languages such as C and C++. The others hold more complex data and point to C structures as their value. The complex data types that are specific to BRM or used in a special way in BRM, such as the Portal object ID (POID), arrays, and substructs, are explained in detail in the following sections. See ["Flist Field Data Types"](#) for a list of the data type abbreviations used in flists.

**Table 5–1 BRM Supported Data Types**

| Data Type            | Description  | C Value       |
|----------------------|--|---------------|
| PIN_FLDT_INT         | Signed 32-bit integer.<br>Contains four bytes of data represented by a number.<br>BRM considers an integer value that begins with 0 as octal, and an integer value that begins with 0x as hexadecimal and converts the value into decimal. | int32         |
| PIN_FLDT_ENUM        | Enumerated value. Contains a list of well-known values.  | enum          |
| PIN_FLDT_DECIMAL     | Decimal data type, number of decimal places determined by MAX.   | pin_decimal_t |
| PIN_FLDT_STR(len)    | ASCII character string terminated with a \0 (NULL). <b>len</b> = max length in bytes, not including \0.<br>It uses UTF-8 encoding.   | char *        |
| PIN_FLDT_BINSTR(len) | A string of binary data. <b>len</b> = max length in bytes.   | pin_binstr_t  |
| PIN_FLDT_TSTAMP      | UNIX timestamp with one second accuracy.<br>Contains integer data. This number is interpreted as the number of seconds past January 1, 1970.   | time_t        |

**Table 5–1 (Cont.) BRM Supported Data Types**

| <b>Data Type</b>   | <b>Description</b>  | <b>C Value</b>             |
|--------------------|---|----------------------------|
| PIN_FLDT_POID      | Portal object identifier. See "Portal Object ID (POID)".  | <code>poid_t *</code>      |
| PIN_FLDT_ARRAY     | Array element. See "Arrays".  | <code>pin_flist_t *</code> |
| PIN_FLDT_SUBSTRUCT | Embedded substructure. See "Substructure".  | <code>pin_flist_t *</code> |
| PIN_FLDT_BUF       | Buffer with an arbitrary size of any large data such as text, image, or any other kind of data. | <code>pin_buf_t</code>     |
| PIN_FLDT_ERRBUF    | Structure for error holding error information.  | <code>pin_errbuf_t</code>  |

## Simple Data Types

BRM supports the following simple data types that map to data types in the C programming language:

- PIN\_FLDT\_INT
- PIN\_FLDT\_ENUM
- PIN\_FLDT\_DECIMAL
- PIN\_FLDT\_STR(len)
- PIN\_FLDT\_BINSTR(len)
- PIN\_FLDT\_TSTAMP

See [Table 5–1](#) for the C values.

## Portal Object ID (POID)

The POID data type identifies a storable object in the BRM database. Each storable object has a unique POID in BRM. You use the POID to locate a storable object in the database.

Use the POID management macros in the PIN Library to manipulate the POIDs.

The POID contains the following information:

*database\_number object\_type object\_id object\_revision\_level*

Example:

**0.0.0.1 /account 1234 0**

You can specify a type-only POID when you want to perform an action on all objects of a particular type. For example, if you want to search for all **/device/sim** objects, the input flist for the search opcode would contain the following field:

1 PIN\_FLD\_POID POID [0] 0.0.0.1 /device/sim -1 0

[Table 5–2](#) describes each entry in the POID:

**Table 5–2 POID Entries**

| Entry                 | Description   |
|-----------------------|---|
| database number       | An arbitrary 64-bit number assigned to a particular BRM database by the BRM system administrator. Each database has a unique database number that is stored in each object in that database. This number must be used by all programs, CMs, and DMs accessing that database.<br><br>Decimal dotted notation is used for the database number: $0.0.0.x$ , where $x$ is the database number, such as 1057. See the <b>dm_pointer</b> entry in the CM <b>pin.conf</b> file for an example. |
| object type           | The class to which the object belongs, for example, <b>/event</b> and <b>/service</b> . Null <b>poid</b> has only <b>/</b> .  |
| object id             | A unique 64-bit number assigned to each object. Once assigned, the ID is never changed or re-used. The ID is a 64-bit number to accommodate the large number of objects that can exist within a single database. The ID is guaranteed to be unique within a given database, <i>not</i> across databases.<br><br>The maximum value allowed for the ID in a nonpartitioned table is $2^{64}$ and in a partitioned table is $2^{44}$ .   |
| object revision level | Revision number. This value is incremented automatically each time the object is updated. You cannot change this value directly.  |

## Decimal Data Type

The decimal data type, `PIN_FLDT_DECIMAL` is an opaque data type that you use to represent values precisely to a specified number of decimal places.

You cannot perform arithmetic operations on a void pointer and C has no operator overloading. Therefore, the API provides a set of functions to perform arithmetic operations on `pin_decimal_t`.

The BRM C API uses `pin_decimal_t`, and it is defined in `BRM_Home/include/pin.h` file, where `BRM_Home` is the directory in which you installed BRM components.

You manipulate the decimal data type, by using the decimal functions in the PIN libraries. You can perform the following arithmetic operations by using the decimal data type functions:

- Convert string to decimal and decimal to string
- Add, subtract, multiply, and divide two decimals
- Compare two decimals
- Scale or round a number
- Negate a decimal
- Output to a string
- Output to a double

For detailed descriptions of the functions, see "Decimal Data Type Manipulation Functions" in *BRM Developer's Reference*.

---

**Note:** `PIN_FLDT_DECIMAL` replaces the data type `PIN_FLDT_NUM` from earlier releases.

---

## Arrays

Use the array data type `PIN_FLDT_ARRAY` to store a defined structure of information. An array contains a recurring set of data structures called *elements*. Each element in an array can contain multiple fields, including other nested arrays. Each element in an array must contain the same *number* and *type* of fields as all the other elements in the array.

For example, the `/account` class contains an array called `PIN_FLD_NAMEINFO`. Each element in this array has fields for first name, last name, street address, and other address information. There can be any number of elements in the array to describe the different types of account addresses.

Each field in an array element has an element ID, which specifies the element of the array to which the field belongs. This element ID, in addition to the field name of the array, uniquely identifies the field in a storable object.

Arrays in BRM are sparse arrays and *not* C language style arrays. The elements in the array are not in any sequential order. Unlike C, the array element `a[24]` does not mean that there are 23 elements preceding it. You can add an element in any order with an arbitrary element ID.

The elements of a BRM array are *not* pre-allocated; they are assigned by applications as needed. Therefore, the missing elements in the sequence of element IDs do not use any memory or disk space.

You can add and delete elements from an array using the `flist` field manipulation macros. When you add an element to an array by using `PIN_FLIST_ELEM_ADD`, an array is automatically created. You do not have to create an array before adding elements to it.

For information on how to use the macros, see "Flist Field-Handling Macros" in *BRM Developer's Reference*.

## Substructure

Use the substruct data type `PIN_FLDT_SUBSTRUCT` to group several data types. You use substructs to define a field that contains several fields of different data types. Substructs can contain any of the BRM supported data types, including arrays, and they can be nested to any level.

---

---

**Note:** Use substructs to create subclasses of the default classes included with BRM.

---

---

Because there is only one element, substructs are fully identified by the field name in the object class. Unlike the arrays, they do not require element IDs.

Use the `flist` field-handling macros to create and manipulate substructs.

## Buffer Data

The buffer type `flist` field (`PIN_FLDT_BUF`) is used for large text files or binary data as an array of bytes.

`xbuf` stands for external buffer. The `buf` data is not in memory but is written directly from a file to the wire or from the wire to a file. The most common use for `xbufs` are for systems with limited or slow virtual memory. `xbufs` can only be used from an application.

A buffer (**buf**) field represented by the **pin\_buf\_t** has the following structure:

```
/*
 * data buffer.
 */
typedef struct pin_buf {
    int32    flag;        /* if XBUF, ... */
    int32    size;       /* size of data */
    int32    offset;     /* offset (for read) */
    caddr_t  data;       /* pointer to data (BUF) */
    char     *xbuf_file; /* ptr to filename for XBUF */
} pin_buf_t;
```

**xbuf** values are defined for the flag field. These can be **bit-wise-ORed** together.

```
/* users want data from/to a file...*/

#define PCM_BUF_FLAG_XBUF    0x0001

/* if XBUF, encode filename, not data*/

#define PCM_BUF_FLAG_XBUF_READ 0x0002
```

Table 5–3 describes the **pin\_buf\_t.flag** values.

**Table 5–3 Values for pin\_buf\_t.flag**

| Flag   | Description  |
|--|--|
| <b>pin_buf_t.flag = 0x0</b>  | Buffer data is assumed to be available in <b>pin_buf_t.data</b> field in memory. The <b>pin_buf_t.xbuf_file</b> field is ignored.  |
| <b>pin_buf_t.flag = 0x1 (PCM_BUF_FLAG_XBUF)</b>                          | Use this to write data to a <b>buf</b> field in an object. The buffer data is assumed to be available in the file pointed to by the <b>pin_buf_t.xbuf_file</b> field. The data is read from the file only when the flist is shipped on the wire. |
| <b>pin_buf_t.flag = 0x3 (PCM_BUF_FLAG_XBUF   PCM_BUF_FLAG_XBUF_READ)</b> | Use this to read data from a <b>buf</b> field in an object. The buffer data is written directly to the file pointed to by the <b>pin_buf_t.xbuf_file</b> field.  |

### Setting Buffer Data Fields in an Flist

The following example shows how to set a buffer field in an flist:

```
pin_buf_t buft;
buft.flag    = 0;
buft.size    = 26;
buft.offset  = 0; /* not used */
buft.data    = "abcdefghijklmnopqrstuvwxy";
buft.xbuf_file = NULL; /* not used */

PIN_FLIST_FLD_SET(flistp, PIN_FLD_BUFFER, &buft, &ebuf);
```

To avoid reallocating memory and copying the buffers in large buffers, use **PIN\_FLIST\_FLD\_PUT**.

---

**Important:** When you use **PUT** instead of **SET**, allocate memory on the heap for both the **pin\_buf\_t** data structure *and* the buffer data.

---

## Getting Buffer Fields From an Flist

When accessing buffer fields from an flist, you set a pointer to a `pin_buf_t` data structure.

If you use `TAKE()` instead of `GET()`, make sure you free up the `pin_buf_t` structure, the data pointer, and the `xbuf_file` members in it.

## Specifying Buffer Data Fields in Flist Converted to Strings

You can specify buffer fields in flist. For example, you might want to load an flist with a `buf` field into `testnap`. The following example provides the buffer data in place:

```
0 PIN_FLD_POID POID [0] $DB /xx 1
0 PIN_FLD_BUFFER BUF [0] flag/size/offset 0x2 26 0 data:
    0x000000 6162636465666768696a6b6c6d6e6f70
    0x000010 7172737475767778797a
```

You can specify `xbuf` data as in the following example, where the file `./xxx` is read and the contents sent to the wire:

```
>testnap
===> database 0.0.0.1 from pin.conf "userid"
> r xxx 1
> d 1
0 PIN_FLD_POID POID [0] $DB /xx 1
0 PIN_FLD_BUFFER BUF [0] flag/size/offset/xbuf_file 0x1 26 0 ./xxx
```

To read buffer data into a file (for example, `./yyy` from an `/account` object `PIN_FLD_INTERNAL_NOTES` field), do the following. The flist is stored in the `rd.flist` file:

```
>testnap
===> database 0.0.0.1 from pin.conf "userid"
> r rd.flist 1
> d 1
0 PIN_FLD_POID POID [0] $DB /account 1
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset/xbuf_file 0x3 26 0 ./yyy
>r flds 1
```

The contents of the `PIN_FLD_INTERNAL_NOTES` field is put into the file `./yyy`.

---

**Note:** You cannot specify file offsets when reading from or writing to files.

---

## Error Buffer

The `PIN_FLDT_ERRBUF` data type is used to record errors by the Portal Communication Module (PCM) opcodes and Portal Information Network (PIN) library macros. You call the error- or message-logging macros in the PIN library to detect the errors and to record the details of the error in a standard format.

For information on error handling in BRM, see "[Understanding API Error Handling and Logging](#)". For descriptions of all the macros available for logging messages and errors, see "Error-Handling Macros" in *BRM Developer's Reference*.

For a complete list of the errors and values discussed in this section, see `BRM_Home/include/pin.errs.h`.

`pin_errbuf_t` has the following structure:

```
typedef struct {
```

```
int32      location;
int32      pin_errclass;
int32      pin_err;
pin_fld_num_t  field;
int32      rec_id;
int32      reserved;
int32      line_no;
char       *filename;
int        facility;
int        msg_id;
int        err_time_sec;
int        err_time_usec;
int        version;
pin_flist_t  *argsp;
pin_errbuf_t *nextp;
int        reserved2
} pin_errbuf_t;
```

[Table 5–4](#) contains the definitions of each field in the `pin_errbuf` structure.





**Table 5–4** Field Definitions in *pin\_errbuf*

| Field           | Possible Values  |
|-----------------|--|
| <i>location</i> | <p>Specifies the BRM module that encountered the error. Possible values are:</p> <ul style="list-style-type: none"> <li>■ PIN_ERRLOC_APP<br/>The error occurred within an application. Use this value to specify that the problem originated in your application as opposed to a part of BRM.</li> <li>■ PIN_ERRLOC_FLIST<br/>The error occurred within an flist manipulation routine local to the application. Common causes include illegal parameters and low system memory.</li> <li>■ PIN_ERRLOC_POID<br/>The error occurred within a POID manipulation routine local to the application. Common causes include illegal parameters and low system memory.</li> <li>■ PIN_ERRLOC_PCM<br/>The error occurred within a PCM routine local to the application. Common causes include illegal parameters.</li> <li>■ PIN_ERRLOC_PCP<br/>The error occurred within the internal PCP library. This library provides communication support between the modules of the BRM. Common causes include network connection failures. This value indicates a system problem that requires immediate attention.</li> <li>■ PIN_ERRLOC_CM<br/>The error occurred within the Connection Manager. Common causes include an unknown opcode or an input flist missing the required POID field.</li> <li>■ PIN_ERRLOC_FM<br/>The error occurred within a Facilities Module. Common causes include an input flist that does not conform to the required specification.</li> <li>■ PIN_ERRLOC_DM<br/>The error occurred within a Data Manager. Common causes include an input flist that does not meet the required specifications or a problem communicating with the BRM database.</li> </ul> |

**Table 5–4 (Cont.) Field Definitions in *pin\_errbuf***

| Field               | Possible Values  |
|---------------------|--|
| <i>pin_errclass</i> | <p>Describes the class of error that occurred. Error class is used by an application to determine the appropriate type of error recovery. Possible values are:</p> <ul style="list-style-type: none"> <li>■ PIN_ERRCLASS_APPLICATION</li> <li>■ The error was caused by the application passing illegal data or a system failure within the client application. The error was detected before the requested operation was performed, so no data in the database has changed. After the error is fixed, you can retry the operation.</li> <li>■ PIN_ERRCLASS_SYSTEM_RETRYABLE</li> <li>■ The error was probably caused by a transient condition. You can try the operation again. Common causes include a possibly temporary shortage of system resources or failure of a network connection that you can route around. The error was detected before any data was committed to the database; no data has changed.</li> <li>■ PIN_ERRCLASS_SYSTEM_DETERMINATE</li> <li>■ The error was caused by a system failure during the operation. Retrying the operation is unlikely to succeed, and the system failure should be investigated immediately. The error was detected before any data was committed to the database; no data has changed. After the error is fixed, you can retry the operation.</li> <li>■ PIN_ERRCLASS_SYSTEM_INDETERMINATE</li> <li>■ The error was caused by a system failure during the commit phase of an operation. There is a small window during the commit where a network failure can leave the system unsure of whether the commit occurred or not. This means it is up to the application to determine whether system data has been changed. This class of error is extremely rare, but you must deal with it carefully to avoid corrupting the data in the database. If you determine that no changes were made, you can resolve the system failure problem and then retry the operation.</li> </ul> |
| <i>pin_err</i>      | Describes the exact error that was encountered. If an API call was successful, <i>pin_err</i> is set to PIN_ERR_NONE and all other fields in the <b>ebuf</b> are left undefined. If an API call results in an error, one or more of the fields are defined with error information.   |
| <i>field</i>        | Identifies the field number of the input parameter that caused the error.  |
| <i>rec_id</i>       | Specifies the element ID of an array element that caused the error.  |
| <i>reserved</i>     | Designates an internal system state used by Oracle Technical Support for debugging. Contains no useful information for the application developer.  |
| <i>line_no</i>      | <p>Specifies the line number within the application source file where the error was detected. The logging routines print the filename and line number from the <b>ebuf</b>, which you can use to locate the exact call to the BRM API that caused the error.</p> <p>Contains no useful information for the application developer except when working with Oracle Technical Support</p>   |
| <i>filename</i>     | <p>Specifies the name of the application source file where the error was detected. This can be used in conjunction with the <i>line_no</i> to quickly locate the source of an error.</p> <p>This information is useful for application developers only when they work with Oracle Technical Support.</p>   |
| <i>facility</i>     | <p>Specifies the code of a facility associated with BRM internationalization (I18N) features.</p> <p>Used with the <i>msg_id</i> value to create a localized error message.</p>  |
| <i>msg_id</i>       | <p>Specifies a unique ID number for each message within the facility identified by the <i>facility</i> code.</p> <p>Used with the <i>facility</i> value to create a localized error message.</p>   |

**Table 5–4 (Cont.) Field Definitions in *pin\_errbuf***

| <b>Field</b>                       | <b>Possible Values</b>                                |
|------------------------------------|---|
| <i>err_time_sec</i>                | Outputs time in seconds when the error occurred.      |
| <i>err_time_usec</i>               | Outputs time in microseconds when the error occurred. |
| <i>version</i>                     | Designates the version of the arguments.              |
| <i>pin_flist_t</i>   <i>*argsp</i> | Used as an optional arguments flist.                  |
| <i>pin_errbuf_t</i> <i>*nextp</i>  | Used an one or more optional chained errbufs.         |
| <i>reserved2</i>                   | Reserved for internal use                             |



---

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## Understanding API Error Handling and Logging

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) error logging and handling routines and how to use them in your custom applications.

For information on the log file locations, syntax of error messages, and descriptions of error codes, see "Reference Guide to BRM Error Codes" in *BRM System Administrator's Guide*.

For additional information on error handling in C++, see "[Handling Exceptions](#)".

### About the Error Handling Routines in BRM

The BRM APIs include a set of routines to handle and log errors. BRM uses these routines for internal error handling. You must use these routines in your custom applications to allow seamless detection and reporting of errors between your applications and the BRM applications.

### Error Detection

The error buffer, `pin_errbuf_t`, is the basic structure for receiving error status from calls to the BRM Application Programming Interface (API). A pointer to an error buffer, `ebufp`, is passed into each API call and is filled in by the routine with information about any error condition that occurred.

For details on the structure and fields in an `ebufp`, see "[Error Buffer](#)".

You use the `PIN_ERRBUF_IS_ERR` macro in your code to test the `ebufp` for an error condition. This macro returns zero if no error exists in the `ebufp` and nonzero if an error is recorded.

All higher-level BRM API routines use the `ebufp` for error detection. These routines check for errors in the following ways:

- Check for errors after each API call. See "[Individual-Style ebuf](#)".
- Check for errors at the end of a series of API calls. See "[Series-Style ebuf](#)".

### Individual-Style ebuf

`PCM_*` routines log error information in the `ebufp` after each API call. Since the Portal Communication Module (PCM) API routines affect data, you must detect the errors immediately and test the status of the `ebufp` after each call to a `PCM_*`

routine. If you do not detect errors after each call, any error recorded in the **ebufp** will be overwritten by another API call, and you will lose information about the errors.

For sample code on checking the **ebufp** for errors after each **PCM\_\*()** call, see **sample\_app.c** located in *BRM\_SDK\_Home/source/samples/apps/c*.

## Series-Style ebuf

**PIN\_\*()** routines *update* the error status in the **ebufp** after each API call. With the series **ebufp** style, you can perform a series of related API calls, such as creating and populating an flist, and check for errors at the end of the series. The first error is recorded in the **ebufp** and all subsequent calls are treated as no-ops so that the first error remains recorded in the **ebufp**. When you check for errors after a series of API calls, you can deal with the errors that have been detected as necessary.

Using series **ebufp** style makes manipulating flists and Portal object IDs (POIDs) much more efficient, since the entire logical operation can be completed, then tested once for any errors.

---

---

**Note:** You can check for errors any time using series-style error detection, but series-style **ebuf** has been designed to reduce the number of error checks required.

---

---

For sample code on checking the **ebufp** for errors after a series of **PIN\_\*()** routines, see **sample\_app.c**.

## Error Handling Flow

Applications that call BRM API routines must follow this general flow for error handling:

1. Declare an error buffer.
2. Call **PIN\_ERRBUF\_CLEAR** to initialize the error buffer.
3. Call PIN Library routines to create an input flist.
4. Check for errors by calling the **PIN\_ERRBUF\_IS\_ERR**.
5. Call a PCM API routine.
6. Check for errors by calling **PIN\_ERRBUF\_IS\_ERR()**.
7. Call **PIN\_ERRBUF\_RESET** to reset the **errbuf** and cleans up the memory pointed to by the **argsp** and **nextp** pointers.

---

---

**Note:** Previous versions of BRM used the **PIN\_ERR\_CLEAR\_ERR** macro to initialize the error buffer and to reset its contents to 0. This macro still appears in some BRM code to support backward compatibility. In new code that you write, use **PIN\_ERRBUF\_CLEAR** and **PIN\_ERRBUF\_RESET** to initialize and reset the error buffer.

---

---

The following example shows this flow. For a complete sample, see **sample\_app.c**.

```
...
/** Declare error buffer */
pin_errbuf_tebuf;
```

```

/** Clear the error buffer */
PIN_ERRBUF_RESET(&ebuf);

/** PIN Library routines.
 */
vp = (void *)"test";
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_BILL_MODE, vp, &ebuf);
/* Force CURRENCY to DOLLARS */
dummy = PIN_CURRENCY_DOLLARS;
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_CURRENCY, (void *)&dummy, &ebuf);
/* Set BILL_TYPE to internal (no charges). */
btype = PIN_BILL_TYPE_INTERNAL;
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_BILL_TYPE, (void*)&btype, &ebuf);
/* Add a nameaddr array element to the plan list. */
a_flistp = PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_NAMEINFO,
PIN_NAMEINFO_BILLING, &ebuf);
vp = (void *)"Doe";
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_LAST_NAME, vp, &ebuf);
vp = (void *)"John";
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_FIRST_NAME, vp, &ebuf);
vp = (void *)"1234 Main Street";
PIN_FLIST_FLD_SET(a_flistp, PIN_FLD_ADDRESS, vp, &ebuf);

/* Add more PIN library routines to gather all the information needed to register
a customer */

/* Check for errors */
if (PIN_ERRBUF_IS_ERR(&ebuf)) {
PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_ERROR,
"sample_init_input error", &ebuf);
PIN_ERRBUF_RESET(&ebuf);
return;
}
/** Clear the error buffer */
PIN_ERRBUF_RESET(&ebuf);

/* PCM operations */
/* Call the COMMIT CUSTOMER opcode */

PCM_OP(ctxp, PCM_OP_CUST_COMMIT_CUSTOMER, 0, flistp, &r_flistp, &ebuf);

/* Check for errors */
if (PIN_ERRBUF_IS_ERR(&ebuf)) {
PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_ERROR,
"create_customer error", &ebuf);
PIN_ERRBUF_RESET(&ebuf);

return;
}

```

## Logging Errors and Messages

When detecting errors using `PIN_ERRBUF_IS_ERR`, you can call the error- or message-logging macros to record the details of the error in a standard format. For example, you can use the `PIN_ERR_LOG_EBUF` macro to print the contents of an **ebufp** along with a custom message to your application's logfile.

To log any messages, including errors unrelated to ebufs and the BRM API, use the `PIN_ERR_LOG_MSG` macro at any point in your application.

Table 6–1 lists the routines you can use in your application to log status information:

**Table 6–1 Routines Used to Log Status Information**

| Action  | Routine             |
|---|---------------------|
| Specify the path and name of the log file for your application. The default log file is <b>default_pin.log</b> in the application directory.                              | PIN_ERR_SET_LOGFILE |
| Specify your application's name in the log entries to identify the program in which the error occurred.   | PIN_ERR_SET_PROGRAM |
| Specify what types of messages to log and what to discard. You can enable debugging messages during development and then turn them off by changing the log level setting. | PIN_ERR_SET_LEVEL   |
| Print the contents of an flist to the error log.  | PIN_ERR_LOG_FLIST   |
| Print the contents of a POID to the error log.  | PIN_ERR_LOG_POID    |

For a list and description of all the macros available for logging messages and errors, see "Error-Handling Macros" in *BRM Developer's Reference*.

For an explanation of the standard log entry format, see "Reference Guide to BRM Error Codes" in *BRM System Administrator's Guide*.

## Debugging Your Applications

Use the following methods to debug your applications.

### Diagnosing Application Problems

To diagnose application problems:

1. Check the information in the **ebuf** for the exact source location of the API call that generated the error. If the error is caused by an incorrect or missing field on the input flist, the **ebuf** provides the field name.

For details about the error buffer format and contents, see "Error Buffer".

2. If you can't diagnose an error with the information in the **ebuf**, use PIN\_ERR\_SET\_LEVEL to enable the application libraries to log debug messages. Errors that occur in the application libraries are printed in detail to the logfile. This helps you locate errors like illegal NULL pointers.

### Detecting CM and DM Errors

Enable the CMs and DMs to log debug messages to be printed when an operation fails because of bad input. These messages are printed to the CM and DM log files, not to the application's log file. Normally this type of error is not logged because it is not caused by a failure in the BRM system. You can enable and disable debug messages by editing the CM and DM configuration files.

For information on enabling error logging in the CM and DM configuration files, see the configuration files in the CM and DM directories.



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## Using BRM Developer Tools

This chapter includes instructions for using two Oracle Communications Billing and Revenue Management (BRM) customization tools, BRM SDK and Developer Center:

- BRM Software Development Kit (SDK) contains the application programming interfaces (APIs), libraries, and samples you need to write and customize BRM components and applications.  
See "[About BRM SDK](#)".
- Developer Center provides a suite of developer applications that you use to customize BRM.  
See "[About Developer Center](#)".

BRM also includes a set of utilities for managing and manipulating data, handling errors, and using configuration files. See "[Developer Utilities](#)".

### About BRM SDK

BRM Software Development Kit (SDK) provides the APIs, libraries, and other resources you need to:

- Write client applications in C, C++, Java, and Perl.  
See "[Adding New Client Applications](#)" for a general introduction and instructions for writing applications in C.  
For other languages, see the following:
  - [Creating Client Applications by Using PCM C++](#)
  - [Creating Client Applications by Using Java PCM](#)
  - [Creating Client Applications by Using Perl PCM](#)
- Write and customize policy Facilities Modules (FMs) in C.  
See "[Adding and Modifying Policy Facilities Modules](#)".
- Write custom standard FMs in C.  
See "[Writing a Custom Facilities Module](#)".
- Write custom Data Managers (DMs) in C.  
See "[Writing a Custom Data Manager](#)".
- Use sample applications and code as examples for your own work.  
See "Sample Applications" in *BRM Developer's Reference*.

- Use debug versions of libraries, FMs, the DM, and the Connection Manager (CM).  
See "[Debugging FMs](#)".
- Develop multithreaded applications for BRM.  
See "[Creating BRM Client Applications by Using the MTA Framework](#)".

BRM SDK includes a common core library (**libportal.so**) that combines the previously separate PCM, PCP, and PIN libraries. (The separate libraries are also included for backward compatibility.) Other libraries, including standard and policy FMs as well as support for C, C++, Java, and Perl, are located in the same directory.

To customize Customer Center, install the Customer Center SDK. See "[Using Customer Center SDK](#)".

You can install BRM SDK on HP-UX IA64, Solaris, AIX, and Linux operating systems.

Before installing BRM SDK, you must install Third-Party software, which includes the PERL libraries and JRE required for installing BRM components. See "Installing the Third-Party Software" in *BRM Installation Guide*.

For BRM SDK disk space requirements, see "BRM Software Compatibility" in *BRM Installation Guide*.

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**Note:** To install BRM SDK, see "Installing BRM SDK" in *BRM Installation Guide*.

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## BRM SDK Directory Contents

When you install BRM SDK, the following subdirectories are included. The default installation directory for BRM SDK is *BRM\_Home/PortalDevKit*, where *BRM\_Home* is the directory in which you installed BRM components. To make it easier to find files, the BRM SDK directory structure is similar to the directory structure on BRM servers as shown in [Table 7-1](#).

**Table 7-1 SDK Directory Structure**

| Directory                     | Contents   |
|-------------------------------|--|
| <b>lib</b>                    | Core and FM libraries, including <b>libportal.so</b> on HP-UX IA64, Solaris, and Linux; and <b>libportal.a</b> on AIX. |
| <b>bin</b>                    | CM and DM executables, <b>testnap</b> , <b>perl.exe</b> .  |
| <b>include</b>                | Base BRM header files, including <b>pin_os_dynload.h</b> .   |
| <b>sys</b>                    | Server system files.   |
| <b>sys/lib</b>                | CM source library files.   |
| <b>source</b>                 | Top-level directory for source code.   |
| <b>source/sys</b>             | Policy FM source code.   |
| <b>source/sys/cm</b>          | CM source file and Makefile for use in building Purify versions of the CM.   |
| <b>source/templates</b>       | FM and DM templates.   |
| <b>source/samples</b>         | Top-level directory for sample code and applications.  |
| <b>source/samples/context</b> | Context management code samples in C, C++, Java, and Perl.   |

**Table 7-1 (Cont.) SDK Directory Structure**

| Directory                         | Contents   |
|-----------------------------------|--|
| source/samples/callopcode         | Opcode-related code samples in C, C++, Java, and Perl.         |
| source/samples/flists             | Flist-related code samples in C, C++, Java, and Perl.          |
| source/samples/apps               | Sample applications in C, C++, and Java.                       |
| source/samples/apps/c/mta_samples | Sample files for creating multithreaded applications.          |
| jars                              | <b>pcm.jar</b> , <b>pcmext.jar</b> , and other Java PCM files. |

## About PCM SDK

PCM SDK contains 64-bit PCM libraries that you require to create 64-bit client applications. You must install BRM SDK, which contains the source files, samples, and debug libraries, before you install PCM SDK.

To install PCM SDK, see "Installing PCM SDK" in *BRM Installation Guide*.

## Setting Up Your Development Environment

Your programming tools must be set up to use the BRM SDK libraries. The way you do this depends on which programming languages and tools you use. This document includes environment information for specific languages and customizations.

To view a list of compilers that are supported by BRM SDK, see "BRM Software Compatibility" in *BRM Installation Guide*.

## Testing New or Customized Components

The BRM architecture makes it possible to test new or customized components without having to physically move files. For example, if you want to test a new policy FM, you can include it in a CM that you run locally on your development machine.

For testing, you need access to a test installation of BRM. For best results, the test installation should resemble very closely your production BRM environment. For example, if you use branding or multiple database schemas in your production environment, your test environment should also include these features.

The following sections provide basic instructions for common testing scenarios. Depending on the nature of your customizations and the architecture of your BRM system, these instructions might not fully describe your situation.

### Testing Custom Applications

To test an application, connect it to a BRM system via its CM, in the same way you would under production conditions. To establish a connection, the application must specify a valid user name, password, port number, and database number. Depending on how the application is designed, this information can be included in a configuration file (**pin.conf** for C/C++ applications or **Infranet.properties** for Java applications) or specified by the user.

### Testing New or Customized Policy FMs

To test a new or customized policy FM, you must add it to a CM that you then use with a BRM test installation.

1. Add the FM to the CM in BRM SDK. See ["Adding a New FM Module to the CM Configuration File"](#).
2. Use that CM in place of the default CM in a test installation of BRM. See ["Configuring Your CM to Use the Custom DM"](#).
3. Use Opcode Workbench or `testnap` to run the opcodes in the new or customized FM. See ["Testing Your Applications and Custom Modules"](#).

Keep in mind that if the opcodes in the FM require the use of new storable classes or fields, you need to add those classes or fields to the database of the test BRM installation. See ["Creating Custom Fields and Storable Classes"](#).

See ["Debugging FMs"](#) for information about debugging new or customized policy FMs.

### Testing New or Customized DMs

To test a new or customized DM, run a CM locally on your development machine. The CM should connect to the DM that you are testing as well as any other DMs included in the BRM installation. For information about including the new or customized DM in the CM, see ["Configuring Your CM to Use the Custom DM"](#).

## Deploying New and Customized Components

After you successfully test an application, FM, or DM, you can deploy it to your production BRM installation.

Because BRM SDK includes the same libraries as BRM itself, dynamic links work without modification when you deploy new or customized server components to default locations.

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**Important:** If you are replacing an existing BRM component, do not overwrite it with your new version. Save the old version under a new name or in a different location so that you can revert to it if necessary.

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See the following sections for deployment information about applications, FMs, and DMs.

### Deploying Applications

To deploy a new application, you move the executable itself plus any necessary support libraries to the desired location. The libraries you must include depend on the language you used to write the application. For example, applications written in C need the `libportal.so` file, while applications written in Java need `pcm.jar` and `pcmext.jar` files. Depending on how your application is written, you might also need to include a configuration file (`pin.conf` for C/C++ applications or `Infranet.properties` for Java applications) for storing login information.

For more information about the files required, see the sections about writing client applications in the supported languages.

In most cases, you should package your application and its support files so that the files can be installed conveniently.

### Deploying FMs

To deploy a new or customized FM:

1. Compile the FM into a shared library (**.so** for HP-UX IA64, Solaris, and Linux; and **.a** for AIX).  
See ["Compiling and Linking a Policy FM"](#).
2. For each CM server in the BRM installation:
  - a. Stop the CM. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.
  - b. Move the new shared library to *BRM\_Home/lib*.
  - c. If this is a new FM, modify the CM **pin.conf** file to include the FM.
  - d. Stop and restart the CM.

## Deploying DMs

The files you need to deploy with a DM depend on whether the destination server is already in use as a DM server.

- If you are deploying a new or customized DM to an existing DM server, all you need to move is the compiled **.so** file as well as the associated **pin.conf** file.
- If you are deploying to a server that has not previously been used for DMs, you need the compiled **.so**, **.a**, or **.so** file, the DM **pin.conf** file, all the libraries linked to the DM, and a **dm.exe** file.

In either case, you need to modify the **pin.conf** file of all CMs that will use this DM. See ["Configuring Your CM to Use the Custom DM"](#).

You should also modify the BRM start and stop scripts to include the new DM. See ["Starting and Stopping Your Custom DM"](#).

## Compiling CMs for Purify

To enable customers to build versions of the CM for use with Rational Purify, BRM SDK now includes a C++ source file along with related library and include files. To build a Purify version, you modify the source file to include your custom FMs and then compile.

[Table 7-2](#) lists the CM build files for use with Purify:

**Table 7-2 CM Build Files for Purify**

| File  | Location   |
|---|--|
| <b>cm.cpp</b><br><b>makefile</b>                      | <i>BRM_SDK_Home/source/sys/cm</i>                                  |
| <b>libcm_main.so</b> (HP-UX IA64, Linux, and Solaris) | <i>BRM_SDK_Home/sys/lib</i><br>Also in:<br><i>BRM_Home/sys/lib</i> |
| <b>pin_os_dynload.h</b>                               | <i>BRM_SDK_Home/include</i>  |

When you compile a CM, you must specify options that point to the **/include** and **/lib** directories that contain the **pin\_os\_dynload** and **libcm\_main** files. You must also specify the use of multithreaded components and dynamically loaded libraries. (The **makefile** in *BRM\_SDK\_Home/source/sys/cm* includes these options.)

To reduce thread contention on **malloc** calls, CMs include a memory pool mechanism for processing flists and POIDs. When flists and POIDs are allocated memory from a

pool, problems with memory leaks are hidden. To detect memory leaks in your CM, before you run Purify or any other diagnostic utilities to test memory usage, disable the memory pool by adding the following entry in the CM `pin.conf` file so that memory is allocated from the system heap:

```
- - disable_pcm_mempool 1
```

You can use the following commands as examples for compiling a Purify version of the CM. Depending on your operating system and the compiler you use, your syntax may be somewhat different.

**Linux:**

```
purify gcc -o cm cm.cpp -g -m32 -Bdynamic -Wl,--export-dynamic -ldl -lpthread -I  
${INFRANET_SDK_HOME} -L ${INFRANET_SDK_HOME}-lpinsys -lcm_main
```

**Solaris:**

```
purify cc -o cm cm.cpp -g -lthread -ldl -I ${INFRANET_SDK_HOME}/include  
-L ${INFRANET_SDK_HOME}/sys/lib -lpinsys
```

**HP-UX IA64:**

```
purify cc -o cm cm.cpp -g -Wl,+s -ldld -lpthread -I ${INFRANET_SDK_HOME}/include  
-L ${INFRANET_SDK_HOME}/sys/lib -l:libpinsys.a
```

**AIX:**

```
purify xlCcore_r -o cm cm.cpp -g -Drs6000 -D_aix -Dunix -D_unix -DFLIST_HEAP -I  
${INFRANET_SDK_HOME} -L ${INFRANET_SDK_HOME} -bdynamic -bexpall -brtl -q32  
-lpinsys -lcm_main -lnsl_r -lpthread -lptools_ptr -ldl
```

## About Developer Center

Developer Center is a suite of Java-based applications for BRM developers. It includes these applications:

- **Storable Class Editor**, which you use to create and modify storable classes and fields.  
See "[Creating Custom Fields and Storable Classes](#)".
- **Object Browser**, which you use to view storable objects in the database.  
See "[Reading Objects](#)".
- **Opcodes Workbench**, which you use to test applications and customized components.  
See "[Testing Your Applications and Custom Modules](#)".
- **Universal Event Mapper**, which you use to specify how batches of event data are loaded into the BRM database.  
See "[Importing and Rating Events from External Sources](#)" in *BRM Setting Up Pricing and Rating*.

This section provides basic information about Developer Center. Additional information is provided in Developer Center Help.

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**Important:** Developer Center is an optional feature that requires a separate license.

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## Installing Developer Center

You can choose to install any combination of Developer Center applications, and you can install on both Windows and UNIX systems. For details on the operating systems BRM supports, see "BRM Software Compatibility" in *BRM Installation Guide*.

To install Developer Center, see the following:

- Windows: "Installing BRM Client Applications on Windows" in *BRM Installation Guide*

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**Note:** Developer Center requires 1024 by 768 or larger screen resolution.

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## Getting Started with Developer Center

You start Developer Center as you would any other application on your platform. You need to specify a BRM database and port number as well as a login and password for that database.

1. To start Developer Center, run **DevCenter.sh**.
2. In the **Connect to** section of the Database Connection dialog box, enter a database host name and port number.
3. In the **Identification** section, enter your login and password for the specified database.
4. Click **OK**.

## Using Developer Center Applications

The toolbar at the top of the Developer Center window shows icons for the applications you have installed.

To start a Developer Center application, click its toolbar button or choose the appropriate command from the **Tools** menu.





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## Testing Your Applications and Custom Modules

This chapter describes tools for interacting with the Oracle Communications Billing and Revenue Management (BRM) server and testing custom applications and modules:

- Opcode Workbench, a GUI application that is part of Developer Center
- **testnap**, a command-line utility

### Using Opcode Workbench

Opcode Workbench, part of Developer Center, is a graphic user interface (GUI) application that you use to test a BRM implementation by executing opcodes. It includes all the functionality of **testnap**, including the following tasks:

- Creating input flists.
- Saving input and output flists.
- Executing opcodes.
- Viewing return flists.
- Creating, viewing, modifying, and deleting objects and their fields.
- Opening, committing, and aborting transactions.

In addition, Opcode Workshop includes a number of enhancements not available in **testnap**:

- Interactive editing of input flists.
- Viewing flist data in text or tree view.
- Cutting and pasting data to and from other text sources.

For more information on Opcode Workbench, see the Opcode Workbench Help system. For more information about Developer Center, see "[About Developer Center](#)".

### Starting Opcode Workbench

To start Opcode Workbench:

1. Start Developer Center and log in to the database you want to use.  
See "[About Developer Center](#)" for instructions.

2. Click the Opcode Workbench toolbar button or choose **Tools - Opcode Workbench**.

## Executing an Opcode

The most basic operation in Opcode Workbench is executing an opcode. By executing opcodes, you can accomplish many other tasks, such as creating objects, modifying objects, and searching the BRM database. For detailed instructions, see the Opcode Workbench Help.

Every opcode has specifications for the contents of its input flist. You can find these specifications in *BRM Developer's Reference*. See "[Opcode Input and Output Specifications](#)" for information about flist syntax.

To execute an opcode in Opcode Workbench:

1. Enter the opcode to execute in the **Opcode** field in one of the following ways:
  - Type or paste the opcode name directly into the **Opcode** field.
  - Choose the opcode name from the **Opcode** field's pull-down list. The pull-down list includes all default opcodes and might contain some obsolete opcodes. It might also contain custom opcodes. See "[Defining the Content of the Opcode Field](#)".
  - Enter the opcode number into the **Opcode** field. Opcode numbers are listed in the **pcm\_ops.h** file in *BRM\_Home/include* directory, where *BRM\_Home* is the directory in which you installed BRM components. Entering the opcode number is *required* for custom opcodes.
2. If necessary, enter an opcode flag in the **Flag** field.
3. Enter an input flist in one of the following ways:
  - Type it into the Input Flist area while Opcode Workbench is in Text View.
  - Create it by choosing fields and entering field data while Opcode Workbench is in Tree View.
  - Paste an flist into the Input Flist area from another source.
  - Open a saved input flist file.
4. Click the **Run Opcode** button.

## Defining the Content of the Opcode Field

The opcodes listed in the **Opcode** field are determined by the **opcode.properties** file, located in the Developer Center installation directory. This file contains a list of opcode names and corresponding opcode numbers.

You can edit the file to remove obsolete opcodes or to include custom opcodes. To include a custom opcode, enter its name and number following the pattern for the other entries in the file. For example, if you have a custom opcode called **PCM\_OP\_CUST\_CUSTOM** with an opcode number of 19999, add this entry to the file:

```
PCM_OP_CUST_CUSTOM = 19999
```

After saving the file, restart Developer Center.

## Opcodes Not Supported in Opcode Workbench

For technical reasons, the following opcodes related to transactions are not supported in this release of Opcode Workbench: PCM\_OP\_TRANS\_ABORT, PCM\_OP\_TRANS\_COMMIT, PCM\_OP\_TRANS\_OPEN, PCM\_OP\_TRANS\_POL\_ABORT, PCM\_OP\_TRANS\_POL\_COMMIT, PCM\_OP\_TRANS\_POL\_OPEN, and PCM\_OP\_TRANS\_POL\_PREP\_COMMIT.

## Using testnap

**testnap** is a command-line utility that you can use to test your application and interact with the server by establishing a PCM connection with the Connection Manager (CM) and executing PCM opcodes using that connection. With **testnap**, you can perform the following tasks:

- Create, view, modify, and delete objects and their fields.
- Create input flists.
- Save input and output flists.
- Execute opcodes.
- View return flists.
- Open, commit, and abort transactions.

See "[testnap](#)" for a complete list of commands and options.

**testnap** relies on POID logins and types to identify the specific account or storable class to modify. A POID database number is required as a placeholder only.

## Creating Objects

To create an object, you need to create an flist in a text file or as a **here** document in a **testnap** script. The following procedures show two ways to create an object using **testnap**.

For required fields of the objects, see the storable class definitions in "Storable Class Definitions" in *BRM Developer's Reference*.

### Using a Text File to Create an Object

To use a text file to create an object:

1. Create an flist using a text editor with at least the required fields of the object by using the following example:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /data 0 0
0 PIN_FLD_NAME         STR [0] "example new data object creation"
0 PIN_FLD_BUFFER       BUF [0] flag/size/offset 0x0 0 0 NULL data ptr
0 PIN_FLD_HEADER_NUM   INT [0] 1234
0 PIN_FLD_HEADER_STR   STR [0] "Some sample info in the example"
0 PIN_FLD_PARENT       POID [0] 0.0.0.0 0 0
```

2. Save the file.

In this example, the file is called **new\_data\_flist**

3. Start **testnap**.

```
pin@demo5-661> testnap
===> database 0.0.0.1 from pin.conf "userid"
```

4. Read the file into a buffer.

```
r new_data_flist 1
```

5. Create an object using that buffer.

```
create 1
poid created was: 0.0.0.1 /data 8830 0
```

The POID of the object created is returned.

## Using a Here Document to Create an Object

This procedure enables you to combine data and commands in one file:

1. Create a **testnap** script to read an object from a **here** document:

```
#
# A testnap script to create a new data object
#
# Read an flist into buffer 1 using a "here" document
# Note the space between "<<" and the "here" token.
# Note use of $DB_NO in poid database - takes current database number.
r << XXX 1
0 PIN_FLD_POID          POID [0] $DB_NO /data 0 0
0 PIN_FLD_NAME          STR [0] "example new data object creation"
0 PIN_FLD_BUFFER        BUF [0] flag/size/offset 0x0 0 0 NULL data ptr
0 PIN_FLD_HEADER_NUM    INT [0] 1234
0 PIN_FLD_HEADER_STR    STR [0] "Some sample info in the example"
0 PIN_FLD_PARENT        POID [0] 0.0.0.0 0 0      XXX
#
# Create the object
#
  create 1 poid
#
# Write the new poid id (from the "in" buffer)
# into a file "new_data_poid.<pid_of_this_process>"
#
w in new_data_poid.$$
#
```

2. Save the script.

In this example the script is saved as **new\_data\_script**.

3. Run the script.

You can either run **testnap** with the script name as the argument, as shown in this example, or use the **<** command in **testnap**.

See **testnap** for details.

```
./testnap new_data_script

poid created was: 0.0.0.1 /data 9854 0

ls new_data_poid*

new_data_poid.3881
```

4. Display the contents of the file to verify that the output file is created.

```
cat new_data_poid.3881
```

```
# number of field entries allocated 1, used 1
0 PIN_FLD_POID          POID [0] 0.0.0.1 /data 9854 0
```

## Reading an Object and Fields

You can use **testnap** to read objects or fields in an object and write its contents to a file.

### Reading Fields in an Object

To read fields from an object, each field or row in the field list must be in valid flist format, but the actual values for the last two fields need not be valid.

For example, you have to include " " for STR fields and some number for the TSTAMP field. If a field is blank, the system returns an error. Be sure to include the header line in all flists.

1. Print the flist to ensure that the format is correct and all the fields are filled.

```
# number of field entries allocated 36, used 36

cat fldlist

# number of field entries allocated 36, used 36
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_NAME          STR [0] ""
0 PIN_FLD_CREATED_T     TSTAMP [0] (8)
0 PIN_FLD_MOD_T         TSTAMP [0] (8)
0 PIN_FLD_AAC_ACCESS    STR [0] ""
```

2. Start **testnap**.

```
testnap

===> database 0.0.0.1 from pin.conf "userid"
```

3. Read the fields.

```
r fldlist 1
r flds 1
```

Results:

```
# number of field entries allocated 5, used 5
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_NAME          STR [0] "top account obj"
0 PIN_FLD_CREATED_T     TSTAMP [0] (854062698) Thu May 7 15:38:18 1999
0 PIN_FLD_MOD_T         TSTAMP [0] (854062698) Thu May 7 15:38:18 1999
0 PIN_FLD_AAC_ACCESS    STR [0] ""
```

### Reading an Object and Writing Its Contents to a File

This example reads the contents of the **/account** object and writes it in to a file called **root.account**.

1. Start **testnap**.

```
testnap

===> database 0.0.0.1 from pin.conf "userid"
```

2. Read the object you want.

This example reads the **/account** object.

```
testnap
```

```

====> database 0.0.0.1 from pin.conf "userid"

roobj - $DB /account 1

# number of field entries allocated 36, used 36
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_NAME          STR [0] "top account obj"
0 PIN_FLD_CREATED_T     TSTAMP [0] (854062698) Thu Jan 23 15:38:18 1999
0 PIN_FLD_MOD_T         TSTAMP [0] (854062698) Thu Jan 23 15:38:18 1999
0 PIN_FLD_AAC_ACCESS    STR [0] ""
0 PIN_FLD_AAC_SOURCE    STR [0] ""
0 PIN_FLD_AAC_VENDOR    STR [0] ""
0 PIN_FLD_AAC_PACKAGE   STR [0] ""
0 PIN_FLD_AAC_PROMO_CODE STR [0] ""
0 PIN_FLD_AAC_SERIAL_NUM STR [0] ""
0 PIN_FLD_STATUS        ENUM [0] 10100
0 PIN_FLD_STATUS_FLAGS  INT [0] 0
0 PIN_FLD_LAST_STATUS_T TSTAMP [0] (0) <null>
0 PIN_FLD_CLOSE_WHEN_T  TSTAMP [0] (0) <null>
0 PIN_FLD_LASTSTAT_CMNT STR [0] ""
0 PIN_FLD_ACCOUNT_NO    STR [0] ""
0 PIN_FLD_MERCHANT      STR [0] ""
0 PIN_FLD_BILL_MODE     STR [0] ""
0 PIN_FLD_BILL_TYPE     ENUM [0] 0
0 PIN_FLD_PARENT        POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_GROUP_OBJ     POID [0] 0.0.0.0 0 0
0 PIN_FLD_NEXT_BILL_T   TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_T   TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_OBJ POID [0] 0.0.0.0 0 0
0 PIN_FLD_PENDING_RECV  NUM [0] 0.000000
0 PIN_FLD_CURRENCY      INT [0] 0
0 PIN_FLD_BILL_WHEN     INT [0] 0
0 PIN_FLD_DEBIT_NUM     STR [0] ""
0 PIN_FLD_DEBIT_EXP_ABA STR [0] ""
0 PIN_FLD_INV_PO        STR [0] ""
0 PIN_FLD_INV_TERMS     ENUM [0] 0
0 PIN_FLD_INV_FORMAT    POID [0] 0.0.0.0 0 0
0 PIN_FLD_INV_INSTR     STR [0] ""
0 PIN_FLD_ACCESS_CODE1  STR [0] ""
0 PIN_FLD_ACCESS_CODE2  STR [0] ""
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset 0x0 0 0 NULL data ptr

```

### 3. Save output in buffer 1.

```
s 1
```

### 4. Write the contents on buffer 1 into a file, and quit.

This example writes the contents into a file called **root.account**.

```
w 1 root.account
```

```
q
```

### 5. Print the contents of the file (**root.account** in the example) to verify that the file contains the contents of the **/account** object.

```
cat root.account
```

```

# number of field entries allocated 36, used 36
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_NAME          STR [0] "top account obj"

```

```

0 PIN_FLD_CREATED_T          TSTAMP [0] (854062698) Thu Jan 23 15:38:18
1997
0 PIN_FLD_MOD_T             TSTAMP [0] (854062698) Thu Jan 23 15:38:18
1997
0 PIN_FLD_AAC_ACCESS        STR [0] ""
0 PIN_FLD_AAC_SOURCE        STR [0] ""
0 PIN_FLD_AAC_VENDOR        STR [0] ""
0 PIN_FLD_AAC_PACKAGE       STR [0] ""
0 PIN_FLD_AAC_PROMO_CODE    STR [0] ""
0 PIN_FLD_AAC_SERIAL_NUM    STR [0] ""
0 PIN_FLD_STATUS            ENUM [0] 10100
0 PIN_FLD_STATUS_FLAGS      INT [0] 0
0 PIN_FLD_LAST_STATUS_T     TSTAMP [0] (0) <null>
0 PIN_FLD_CLOSE_WHEN_T      TSTAMP [0] (0) <null>
0 PIN_FLD_LASTSTAT_CMNT     STR [0] ""
0 PIN_FLD_ACCOUNT_NO        STR [0] ""
0 PIN_FLD_MERCHANT          STR [0] ""
0 PIN_FLD_BILL_MODE         STR [0] ""
0 PIN_FLD_BILL_TYPE         ENUM [0] 0
0 PIN_FLD_PARENT            POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_GROUP_OBJ         POID [0] 0.0.0.0 0 0
0 PIN_FLD_NEXT_BILL_T       TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_T       TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_OBJ     POID [0] 0.0.0.0 0 0
0 PIN_FLD_PENDING_RECV      NUM [0] 0.000000
0 PIN_FLD_CURRENCY          INT [0] 0
0 PIN_FLD_BILL_WHEN         INT [0] 0
0 PIN_FLD_DEBIT_NUM         STR [0] ""
0 PIN_FLD_DEBIT_EXP_ABA     STR [0] ""
0 PIN_FLD_INV_PO            STR [0] ""
0 PIN_FLD_INV_TERMS         ENUM [0] 0
0 PIN_FLD_INV_FORMAT        POID [0] 0.0.0.0 0 0
0 PIN_FLD_INV_INSTR         STR [0] ""
0 PIN_FLD_ACCESS_CODE1      STR [0] ""
0 PIN_FLD_ACCESS_CODE2      STR [0] ""
0 PIN_FLD_INTERNAL_NOTES    BUF [0] flag/size/offset 0x0 0 0 NULL data
ptr

```

## Manipulating External Buffer Fields

You can use **testnap** to manipulate the external buffer fields, for example, to read data in a buffer to a file.

### Reading Data in a Buffer to a File

The procedure in this section shows how to set the root account object's (**/account 1**) **PIN\_FLD\_INTERNAL\_NOTES** field, which is an external buffer field in the **/account** storable class.

In the input flist in the example, the 0x1 flag indicates that the contents of the file are to be written to the object. The size parameter (37), which is required, is the number of bytes in the file. The contents of this file is to be read into the external buffer field.

The offset field, if non-zero, indicates the number of bytes to be skipped in the file before reading *size* bytes from the file and placing them in the **INTERNAL\_NOTES** field.

1. Set up an input flist that specifies that the contents of the file **xbuf.out** be placed into the **INTERNAL\_NOTES** field of the root account object when the Write Fields opcode is executed.

2. Setup an input flist that will read the INTERNAL\_NOTES field of the root account object when the Read Fields opcode is executed. The 0x3 flag indicates that the contents of the file are to be read from the object.
3. Perform the Read Fields opcode. The contents of the INTERNAL\_NOTES field are written to the newly created file **xbuf.in**.

Example:

```
file xbuf.out

this is test of xbuf to account 1
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset/xbuf_file 0x1 37 0 xbuf.out

xbuf.write

# number of field entries allocated 45, used 45
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset/xbuf_file 0x1 37 0 xbuf.out

buf.tst
# number of field entries allocated 45, used 45
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset/xbuf_file 0x3 0 0 xbuf.in

testnap
r xbuf.write 1
wflds 1
r xbuf.tst 2
rflds 2
q
```

### Using Buffers to Concatenate Flists

You can use **testnap** to concatenate flists. This example shows you how to:

1. Read the contents of two different files into two different buffers (buffer 1 and buffer 2).
2. Write the contents of buffer 1 to a file.
3. Append the contents of buffer 2 to the same file.

Example:

```
cat bill

0 PIN_FLD_POID POID [0] 0.0.0.1 /bill 1451 0

cat deal
0 PIN_FLD_POID          POID [0] 0.0.0.1 /deal 1123 0

testnap

==> database 0.0.0.1 from pin.conf "userid"

r bill 1
r deal 2
w 1 billdeal
w+ 2 billdeal
q
cat billdeal
```



```

# number of field entries allocated 20, used 1
0 PIN_FLD_POID                POID [0] 0.0.0.1 /bill 1451 0
# number of field entries allocated 20, used 1
0 PIN_FLD_POID                POID [0] 0.0.0.1 /deal 1123 0

```

## Setting up Buffers and Displaying the List of Buffers

You can use **testnap** to display a list of all the buffers on your system.

In this example, the flists in two different files (**bill** and **deal**) are read into two different buffers. Then the list of all objects in all the buffers are displayed:

```

cat bill

0 PIN_FLD_POID                POID [0] 0.0.0.1 /bill 1451 0

cat deal

0 PIN_FLD_POID                POID [0] 0.0.0.1 /deal 1123 0
pin@demo5-511> testnap
==> database 0.0.0.1 from pin.conf "userid"

r bill 1
r deal 2
l

[1] type /bill, poid 1451
[2] type /deal, poid 1123

```

## Creating and Displaying the Contents of a Buffer

To create and display the contents of a buffer:

1. Read the contents of the file called **bill** into **buffer 1**.

```
r bill 1
```

2. Display the contents of **buffer 1**.

```
d 1
```

```

# number of field entries allocated 20, used 1
0 PIN_FLD_POID                POID [0] 0.0.0.1 /bill 1451 0

```

## Executing Opcodes

To execute opcodes using **testnap**, use the **xop** command. You can execute any opcode by using the **xop** command.

The examples in this section show the following opcodes executed with a flag value of **0**:

- 107: PCM\_OP\_SUBSCRIPTION\_PURCHASE\_PRODUCT
- 113: PCM\_OP\_PYMT\_COLLECT
- 115: PCM\_OP\_PYMT\_VALIDATE

The input flist is read from a file into **buffer 1**, which is passed to **xop**, on the **xop** command line.

For more information, see "[testnap](#)".

For opcode numbers, see the opcode header files in *BRM\_Home/include/ops*.

xop

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /event/billing/charge 1926 1
1   PIN_FLD_RESULT ENUM [0] 1
1   PIN_FLD_TYPE      ENUM [0] 0
1   PIN_FLD_DESCR     STR  [0] "authorization successful"
```

xop107

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /account 1115 0
0 PIN_FLD_PROGRAM_NAME STR [0] "testnap"
0 PIN_FLD_END_T      TSTAMP [0] (863480996)
0 PIN_FLD_START_T    TSTAMP [0] (863480996)
0 PIN_FLD_PRODUCTS  ARRAY [0]
1   PIN_FLD_PRODUCT_OBJ POID [0] 0.0.0.1 /product 1015 0
1   PIN_FLD_QUANTITY    NUM [0] 1.000000
1   PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_CYCLE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_CYCLE_END_T   TSTAMP [0] (0) <null>
1   PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_USAGE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_USAGE_END_T   TSTAMP [0] (0) <null>
1   PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_DEAL_OBJ     POID [0] <null>
1   PIN_FLD_PLAN_OBJ     POID [0] <null>
```

xop 111

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /account 1129
0 PIN_FLD_START_T    TSTAMP [0] (now)
0 PIN_FLD_END_T      TSTAMP [0] (now)
0 PIN_FLD_PROGRAM_NAME STR [0] "whatever"
0 PIN_FLD_INVOICE_INFO SUBSTRUCT [0]
1 PIN_FLD_TYPE      ENUM [0] 277
1 PIN_FLD_INV_FORMAT POID [0] 0.0.0.1 /config/invoice 100
1 PIN_FLD_BILL_OBJ   POID [0] 0.0.0.1 /bill 1131
```

xop 115

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /account -1 0
0 PIN_FLD_PROGRAM_NAME STR [0] "testnap"
0 PIN_FLD_END_T      TSTAMP [0] (863481004)
0 PIN_FLD_START_T    TSTAMP [0] (863481004)
0 PIN_FLD_CHARGES    ARRAY [0]
1   PIN_FLD_ACCOUNT_OBJ POID [0] 0.0.0.1 /account 1 0
1   PIN_FLD_COMMAND     ENUM [0] 1
1   PIN_FLD_MERCHANT     STR  [0] "Portal"
1   PIN_FLD_BILL_TYPE    ENUM [0] 10003
1   PIN_FLD_CURRENCY     INT  [0] 840
1   PIN_FLD_DEBIT_NUM    STR  [0] "410100000000000000"
1   PIN_FLD_DEBIT_EXP_ABA STR  [0] "0999"
1   PIN_FLD_FIRST_CANON  STR  [0] ""
1   PIN_FLD_MIDDLE_CANON STR  [0] ""
1   PIN_FLD_LAST_CANON   STR  [0] "saver3"
1   PIN_FLD_ADDRESS     STR  [0] "I hope this works"
1   PIN_FLD_CITY        STR  [0] "x"
1   PIN_FLD_STATE       STR  [0] "CA"
1   PIN_FLD_ZIP         STR  [0] "44444"
1   PIN_FLD_COUNTRY     STR  [0] ""
```

## Retrieving Objects

You can use **testnap** to search for objects and retrieve the contents of the objects, of specific objects, or the Portal object IDs (POIDs) of the objects.

### Retrieving the Contents of the First Object Found

This example shows how to perform a search and retrieve the contents of the first object found by that search.

```
cat search
```

```
0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 201
0 PIN_FLD_ARGS                ARRAY [1]
1   PIN_FLD_POID              POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_RESULTS            ARRAY [0]
```

```
testnap
```

```
==> database 0.0.0.1 from pin.conf "userid"
```

```
r search 1
```

```
search 1
```

```
# number of field entries allocated 2, used 2
0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 201 0
0 PIN_FLD_RESULTS            ARRAY [0] allocated 36, used 36
1   PIN_FLD_POID              POID [0] 0.0.0.1 /account 1 1
1   PIN_FLD_NAME              STR [0] "top account obj"
1   PIN_FLD_CREATED_T         TSTAMP [0] (855794203) Wed Feb 12 16:36:43 1999
1   PIN_FLD_MOD_T             TSTAMP [0] (855794203) Wed Feb 12 16:36:43 1999
1   PIN_FLD_AAC_ACCESS        STR [0] ""
1   PIN_FLD_AAC_SOURCE        STR [0] ""
1   PIN_FLD_AAC_VENDOR        STR [0] ""
1   PIN_FLD_AAC_PACKAGE       STR [0] ""
1   PIN_FLD_AAC_PROMO_CODE    STR [0] ""
1   PIN_FLD_AAC_SERIAL_NUM    STR [0] ""
1   PIN_FLD_STATUS            ENUM [0] 10100
1   PIN_FLD_STATUS_FLAGS      INT [0] 0
1   PIN_FLD_LAST_STATUS_T     TSTAMP [0] (0) <null>
1   PIN_FLD_CLOSE_WHEN_T      TSTAMP [0] (0) <null>
1   PIN_FLD_LASTSTAT_CMNT     STR [0] ""
1   PIN_FLD_ACCOUNT_NO        STR [0] ""
1   PIN_FLD_MERCHANT          STR [0] ""
1   PIN_FLD_BILL_MODE          STR [0] ""
1   PIN_FLD_BILL_TYPE         ENUM [0] 0
1   PIN_FLD_PARENT            POID [0] 0.0.0.1 /account 1 0
1   PIN_FLD_GROUP_OBJ         POID [0] 0.0.0.0 0 0
1   PIN_FLD_NEXT_BILL_T       TSTAMP [0] (0) <null>
1   PIN_FLD_LAST_BILL_T       TSTAMP [0] (0) <null>
1   PIN_FLD_LAST_BILL_OBJ     POID [0] 0.0.0.0 0 0
1   PIN_FLD_PENDING_RECV      NUM [0] 0.000000
1   PIN_FLD_CURRENCY          INT [0] 0
1   PIN_FLD_BILL_WHEN         INT [0] 0
1   PIN_FLD_DEBIT_NUM         STR [0] ""
1   PIN_FLD_DEBIT_EXP_ABA     STR [0] ""
1   PIN_FLD_INV_PO            STR [0] ""
1   PIN_FLD_INV_TERMS         ENUM [0] 0
1   PIN_FLD_INV_FORMAT        POID [0] 0.0.0.0 0 0
1   PIN_FLD_INV_INSTR         STR [0] ""
1   PIN_FLD_ACCESS_CODE1     STR [0] ""
```

```

1 PIN_FLD_ACCESS_CODE2 STR [0] ""
1 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset 0x0 0 0 NULL data ptr

```

## Retrieving the POID Field of the Objects Found

This example shows how to search for objects and retrieve only the POID field of each object found.

```
cat search.all_acct
```

```

0 PIN_FLD_POID POID [0] 0.0.0.1 /search 201
0 PIN_FLD_ARGS ARRAY [1]
1 PIN_FLD_POID POID [0] 0.0.0.1 /account -1 1
0 PIN_FLD_RESULTS ARRAY [0]
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 0 0

```

```
testnap
```

```
===> database 0.0.0.1 from pin.conf "userid"
```

```
r search.all_acct 2
search 2
```

```

# number of field entries allocated 14, used 14
0 PIN_FLD_POID POID [0] 0.0.0.1 /search 201 0
0 PIN_FLD_RESULTS ARRAY [0] allocated 1, used 1
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_RESULTS ARRAY [1] allocated 1, used 1
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 1046 13
0 PIN_FLD_RESULTS ARRAY [2] allocated 1, used 1
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 1097 14
0 PIN_FLD_RESULTS ARRAY [3] allocated 1, used 1
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 1111 13
0 PIN_FLD_RESULTS ARRAY [4] allocated 1, used 1
1 PIN_FLD_POID POID [0] 0.0.0.1 /account 1127 16

```

## Creating a New Search Object

You can create a new search object, load it in the database, and use it as a template for your searches.

The following example shows you how to create a new search template. This template can be used in programs to search for search objects in the database.

1. Read an existing search object and save it as a template:

```
testnap
```

```
===> database 0.0.0.1 from pin.conf "userid"
```

```
robject - $DB /search 222
```

```

# number of field entries allocated 6, used 6
0 PIN_FLD_POID POID [0] 0.0.0.1 /search 222 1
0 PIN_FLD_NAME STR [0] "1 result: sum, 6 arg =, >=, <, =, like, >
special search in /event/usage"
0 PIN_FLD_CREATED_T TSTAMP [0] (857152638) Fri Feb 28 09:57:18 1997
0 PIN_FLD_MOD_T TSTAMP [0] (857152638) Fri Feb 28 09:57:18 1997
0 PIN_FLD_FLAGS INT [0] 1
0 PIN_FLD_TEMPLATE STR [0] "select sum( F1 ) from /event/usage where
event_total_t.rec_id = 1
and F2 = V2 and F3 >= V3 and F4 < V4

```

```

and F5 = V5 and F6 like V6 and F7 > V7"

s 1

saved input in buffer 1

w 1 search.template
q

```

2. Edit the template file to suit your needs.
3. Start **testnap**.
4. Create the new search template, that is, a new search object with the number **977**, as shown in the following example:

```

cat search.template

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 977
0 PIN_FLD_NAME          STR [0] "1 arg = search for /search/$1"
0 PIN_FLD_FLAGS         INT [0] 1
0 PIN_FLD_TEMPLATE      STR [0] "select X from /search/$1 where F1 = V1 "

testnap

==> database 0.0.0.1 from pin.conf "userid"
# Read the search template in to buffer 1

r search.template 1

# Create an object using the contents of buffer 1

create 1 poid
  poid created was: 0.0.0.1 /search 977 0

# Verify that the search object was created

roobj - $DB /search 977

# number of field entries allocated 6, used 6
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 977 0
0 PIN_FLD_NAME          STR [0] "1 arg = search for /search/$1"
0 PIN_FLD_CREATED_T     TSTAMP [0] (857521039) Tue Mar  4 16:17:19 1997
0 PIN_FLD_MOD_T         TSTAMP [0] (857521039) Tue Mar  4 16:17:19 1997
0 PIN_FLD_FLAGS         INT [0] 1
0 PIN_FLD_TEMPLATE      STR [0] "select X from /search/$1 where F1 = V1 "

```

**testnap** displays **/search** object 977 from the database.

### Retrieving Objects One at a Time

You can use **testnap** to do a step search. This example shows how to retrieve objects found in a step search one at a time:

```

t_flist2

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_ARGS          ARRAY [1]
1   PIN_FLD_PASSWD     STR [0] "md5|%"
0 PIN_FLD_RESULTS       ARRAY [1]
1   PIN_FLD_POID       POID [0] 0.0.0.0 / 0 0
1   PIN_FLD_LOGIN      STR [0] ""
1   PIN_FLD_PASSWD     STR [0] ""

```

```

testnap

==> database 0.0.0.1 from pin.conf "userid"

r t_flist2 1
ssrch 1

# number of field entries allocated 2, used 2
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 3, used 3
1   PIN_FLD_POID       POID [0] 0.0.0.1 /service/pcm_client 1 1
1   PIN_FLD_LOGIN      STR [0] "root.0.0.0.1"
1   PIN_FLD_PASSWD     STR [0] "md5|5f4dcc3b5aa765d61d8327deb882cf99"

snext

buffer: 1
# number of field entries allocated 2, used 2
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 3, used 3
1   PIN_FLD_POID       POID [0] 0.0.0.1 /service/admin_client 2 1
1   PIN_FLD_LOGIN      STR [0] "root.0.0.0.1"
1   PIN_FLD_PASSWD     STR [0] "md5|5f4dcc3b5aa765d61d8327deb882cf99"

send

buffer: 1
# number of field entries allocated 3, used 3
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_ARGS         ARRAY [1] allocated 1, used 1
1   PIN_FLD_PASSWD     STR [0] "md5|%"
0 PIN_FLD_RESULTS      ARRAY [1] allocated 3, used 3
1   PIN_FLD_POID       POID [0] 0.0.0.0 / 0 0
1   PIN_FLD_LOGIN      STR [0] ""
1   PIN_FLD_PASSWD     STR [0] ""

```

### Retrieving a Specific Number of Objects at a Time

You can change the number of elements in the PIN\_FLD\_RESULTS ARRAY specification to specify the number of objects you want to retrieve at a time.

This example shows retrieving three objects each time:

```

cat t_flist_arr

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_ARGS         ARRAY [1]
1   PIN_FLD_PASSWD     STR [0] "md5|%"
0 PIN_FLD_RESULTS      ARRAY [3]
1   PIN_FLD_POID       POID [0] 0.0.0.0 / 0 0
1   PIN_FLD_LOGIN      STR [0] ""
1   PIN_FLD_PASSWD     STR [0] ""

testnap
==> database 0.0.0.1 from pin.conf "userid"

r t_flist_arr 1
ssrch 1

# number of field entries allocated 4, used 4

```

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 236 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 3, used 3
1   PIN_FLD_POID        POID [0] 0.0.0.1 /service/pcm_client 1 1
1   PIN_FLD_LOGIN       STR [0] "root.0.0.0.1"
1   PIN_FLD_PASSWD      STR [0] "md5|5f4dcc3b5aa765d61d8327deb882cf99"
0 PIN_FLD_RESULTS      ARRAY [1] allocated 3, used 3
1   PIN_FLD_POID        POID [0] 0.0.0.1 /service/admin_client 2 1
1   PIN_FLD_LOGIN       STR [0] "root.0.0.0.1"
1   PIN_FLD_PASSWD      STR [0] "md5|5f4dcc3b5aa765d61d8327deb882cf99"
0 PIN_FLD_RESULTS      ARRAY [2] allocated 3, used 3
1   PIN_FLD_POID        POID [0] 0.0.0.1 /service/email 1061 3
1   PIN_FLD_LOGIN       STR [0] "kim@csi.com"
1   PIN_FLD_PASSWD      STR [0] "md5|ae2b1fca515949e5d54fb22b8ed95575"

```

q

## Modifying Objects

You can use **testnap** to add and replace fields in **/config** objects. See ["Using testnap to Modify /config Objects"](#).

## Sorting an Flist

On UNIX by using the **sort** option in **testnap**, you can sort the contents of a buffer.

See ["testnap"](#) for details.

This example shows how to read an flist into the buffer and sort it:

```
cat products
```

```

0 PIN_FLD_PRODUCTS      ARRAY [1] allocated 20, used 15
1   PIN_FLD_PRODUCT_OBJ  POID [0] 0.0.0.1 /product 1012 0
1   PIN_FLD_QUANTITY     NUM [0] 11.000000
1   PIN_FLD_DEAL_OBJ     POID [0] 0.0.0.1 /deal 3033 0
1   PIN_FLD_PLAN_OBJ     POID [0] 0.0.0.1 /plan 1036 0
1   PIN_FLD_SERVICE_OBJ  POID [0] 0.0.0.1 /service/ip 1048 0
1   PIN_FLD_CREATED_T    TSTAMP [0] (855613770) Fri May 7 14:29:30 1999
1   PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_CYCLE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_CYCLE_END_T   TSTAMP [0] (0) <null>
1   PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_USAGE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_USAGE_END_T   TSTAMP [0] (0) <null>
1   PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000
0 PIN_FLD_PRODUCTS      ARRAY [2] allocated 20, used 15
1   PIN_FLD_PRODUCT_OBJ  POID [0] 0.0.0.1 /product 1014 0
1   PIN_FLD_QUANTITY     NUM [0] 1.000000
1   PIN_FLD_DEAL_OBJ     POID [0] 0.0.0.1 /deal 1035 0
1   PIN_FLD_PLAN_OBJ     POID [0] 0.0.0.1 /plan 1036 0
1   PIN_FLD_SERVICE_OBJ  POID [0] 0.0.0.1 /service/ip 1048 0
1   PIN_FLD_CREATED_T    TSTAMP [0] (855613770) Fri May 7 14:29:30 1999
1   PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1   PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_CYCLE_START_T TSTAMP [0] (857341770) Fri May 7 14:29:30 1999
1   PIN_FLD_CYCLE_END_T   TSTAMP [0] (0) <null>
1   PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1   PIN_FLD_USAGE_START_T TSTAMP [0] (0) <null>

```

```

1 PIN_FLD_USAGE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000
0 PIN_FLD_PRODUCTS ARRAY [3] allocated 20, used 15
1 PIN_FLD_PRODUCT_OBJ POID [0] 0.0.0.1 /product 1009 0
1 PIN_FLD_QUANTITY NUM [0] 77.000000
1 PIN_FLD_DEAL_OBJ POID [0] 0.0.0.1 /deal 2034 0
1 PIN_FLD_PLAN_OBJ POID [0] 0.0.0.1 /plan 1036 0
1 PIN_FLD_SERVICE_OBJ POID [0] 0.0.0.1 /service/email 1053 0
1 PIN_FLD_CREATED_T TSTAMP [0] (855613777) Fri May 7 14:29:30 1999
1 PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1 PIN_FLD_CYCLE_START_T TSTAMP [0] (863389777) Fri May 7 14:29:30 1999
1 PIN_FLD_CYCLE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1 PIN_FLD_USAGE_START_T TSTAMP [0] (0) <null>
1 PIN_FLD_USAGE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000

cat products.sort

0 PIN_FLD_PRODUCTS ARRAY [0] allocated 20, used 1
1 PIN_FLD_QUANTITY NUM [0] 1.000000

testnap

==> database 0.0.0.1 from pin.conf "userid"

r products 2
r products.sort 1
sort 2 1

# number of field entries allocated 20, used 3
0 PIN_FLD_PRODUCTS ARRAY [2] allocated 20, used 15
1 PIN_FLD_PRODUCT_OBJ POID [0] 0.0.0.1 /product 1014 0
1 PIN_FLD_QUANTITY NUM [0] 1.000000
1 PIN_FLD_DEAL_OBJ POID [0] 0.0.0.1 /deal 1035 0
1 PIN_FLD_PLAN_OBJ POID [0] 0.0.0.1 /plan 1036 0
1 PIN_FLD_SERVICE_OBJ POID [0] 0.0.0.1 /service/ip 1048 0
1 PIN_FLD_CREATED_T TSTAMP [0] (855613770) Fri May 7 14:29:30 1999
1 PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1 PIN_FLD_CYCLE_START_T TSTAMP [0] (857341770) Fri May 7 14:29:30 1999
1 PIN_FLD_CYCLE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1 PIN_FLD_USAGE_START_T TSTAMP [0] (0) <null>
1 PIN_FLD_USAGE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000
0 PIN_FLD_PRODUCTS ARRAY [1] allocated 20, used 15
1 PIN_FLD_PRODUCT_OBJ POID [0] 0.0.0.1 /product 1012 0
1 PIN_FLD_QUANTITY NUM [0] 11.000000
1 PIN_FLD_DEAL_OBJ POID [0] 0.0.0.1 /deal 3033 0
1 PIN_FLD_PLAN_OBJ POID [0] 0.0.0.1 /plan 1036 0
1 PIN_FLD_SERVICE_OBJ POID [0] 0.0.0.1 /service/ip 1048 0
1 PIN_FLD_CREATED_T TSTAMP [0] (855613770) Fri May 7 14:29:30 1999
1 PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_END_T TSTAMP [0] (0) <null>
1 PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1 PIN_FLD_CYCLE_START_T TSTAMP [0] (0) <null>

```



```

1     PIN_FLD_CYCLE_END_T      TSTAMP [0] (0) <null>
1     PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1     PIN_FLD_USAGE_START_T   TSTAMP [0] (0) <null>
1     PIN_FLD_USAGE_END_T     TSTAMP [0] (0) <null>
1     PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000
0 PIN_FLD_PRODUCTS           ARRAY [3] allocated 20, used 15
1     PIN_FLD_PRODUCT_OBJ     POID [0] 0.0.0.1 /product 1009 0
1     PIN_FLD_QUANTITY        NUM [0] 77.000000
1     PIN_FLD_DEAL_OBJ        POID [0] 0.0.0.1 /deal 2034 0
1     PIN_FLD_PLAN_OBJ        POID [0] 0.0.0.1 /plan 1036 0
1     PIN_FLD_SERVICE_OBJ     POID [0] 0.0.0.1 /service/email 1053 0
1     PIN_FLD_CREATED_T       TSTAMP [0] (855613777) Fri May 7 14:29:30 1999
1     PIN_FLD_PURCHASE_START_T TSTAMP [0] (0) <null>
1     PIN_FLD_PURCHASE_END_T  TSTAMP [0] (0) <null>
1     PIN_FLD_PURCHASE_DISCOUNT NUM [0] 0.000000
1     PIN_FLD_CYCLE_START_T   TSTAMP [0] (863389777) Fri May 7 14:29:30 1999
1     PIN_FLD_CYCLE_END_T     TSTAMP [0] (0) <null>
1     PIN_FLD_CYCLE_DISCOUNT NUM [0] 0.000000
1     PIN_FLD_USAGE_START_T   TSTAMP [0] (0) <null>
1     PIN_FLD_USAGE_END_T     TSTAMP [0] (0) <null>
1     PIN_FLD_USAGE_DISCOUNT NUM [0] 0.000000

```

q

## Invoking Shell Commands

On UNIX, you can invoke shell commands from **testnap**.

This procedure shows how the results of a **grep** invocation are used to determine what exit code to use.

1. Search the database to see if **/service/ip testterm01** is already created.

```

r << XXX 1

0 PIN_FLD_POID                POID [0] $DB_NO /search 236 0
0 PIN_FLD_PARAMETERS          STR [0] "ip"
0 PIN_FLD_ARGS                ARRAY [1]
1     PIN_FLD_LOGIN            STR [0] "testterm01"
0 PIN_FLD_RESULTS             ARRAY [0]
1     PIN_FLD_POID            POID [0] 0.0.0.0 0 0
1     PIN_FLD_LOGIN            STR [0] ""
XXX

```

search 1

2. Write the results to a file.

```
w in out.setup.fm_term.$$/exist.testterm01
```

---

**Note:** **\$\$** is substituted for the current process id on UNIX, file names in the **r**, **r+**, **w**, **w+**, and **<** commands, and in the arguments to the **!** command.

---

3. Use a UNIX shell to perform an if-test on the results of a **grep** invocation, and then set the exit code accordingly.

```
! if grep "testterm01" out.setup.fm_term.$$/exist.testterm01 ; then exit 1;
else exit 0 ; fi
```

## Testing the CM to DM Connection

You can check the CM to DM connection by using **testnap** with the **noop** command. **noop** takes the database number of a POID and calls the PCM\_OP\_TEST\_LOOPBACK on that database.

1. Read the contents of the file called **foo** into **buffer 1**.
2. Display the contents of **buffer 1**.
3. Enter **noop**.

Example:

```
r foo 1
1

[1] type /bill, poid 1451

noop
buffer: 1

# number of field entries allocated 1, used 1
0 PIN_FLD_POID          POID [0] 0.0.0.1 /bill 1451 0
```

## Displaying and Setting Properties of testnap

You use the **p** command set to display properties of **testnap**.

### Displaying Property Settings

Use this example:

```
p

cwd = /BRM_Home/sys/data/pricing/example/tom
continue_on_error = off
db_no = 0
display_results = on
xop_results_on_err = off
noclobber = off
async = off
async_callback = off
op_timing = off
```

### Setting or Changing Properties

Use this example. This example displays the properties and then changes **logging** from 'off' to 'on' and sets the logfile to **default.testnaplog**.

```
p

cwd = /BRM_Home/sys/test
continue_on_error = off
db_no = 0
display_results = on
xop_results_on_err = off
noclobber = off
async = off
async_callback = off
logging = off
logfile = <nil>
echo_script = off
```

```

        op_timing = off
        exit_on_shell_status = on

p logging on
p

        cwd = /BRM_Home/sys/test
        continue_on_error = off
        db_no = 0
        display_results = on
        xop_results_on_err = off
        noclobber = off
        async = off
        async_callback = off
        logging = on
        logfile = default.testnaplog
        echo_script = off
        op_timing = off
        exit_on_shell_status = on

```

## Troubleshooting testnap

The following example shows a successful **testnap** execution:

```

testnap

==> database 0.0.0.1 from pin.conf "userid"

robj - 0.0.0.1 /account 1

# number of field entries allocated 36, used 36
0 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_NAME          STR [0] "top account obj"
0 PIN_FLD_CREATED_T     TSTAMP [0] (846729765) Fri May 7 18:42:45 1999
0 PIN_FLD_MOD_T         TSTAMP [0] (846729765) Fri May 7 18:42:45 1999
0 PIN_FLD_AAC_ACCESS    STR [0] ""
0 PIN_FLD_AAC_SOURCE    STR [0] ""
0 PIN_FLD_AAC_VENDOR    STR [0] ""
0 PIN_FLD_AAC_PACKAGE   STR [0] ""
0 PIN_FLD_AAC_PROMO_CODE STR [0] ""
0 PIN_FLD_AAC_SERIAL_NUM STR [0] ""
0 PIN_FLD_STATUS        ENUM [0] 10100
0 PIN_FLD_STATUS_FLAGS  INT [0] 0
0 PIN_FLD_LAST_STATUS_T TSTAMP [0] (0) <null>
0 PIN_FLD_CLOSE_WHEN_T  TSTAMP [0] (0) <null>
0 PIN_FLD_LASTSTAT_CMNT STR [0] ""
0 PIN_FLD_ACCOUNT_NO    STR [0] ""
0 PIN_FLD_MERCHANT      STR [0] ""
0 PIN_FLD_BILL_MODE     STR [0] ""
0 PIN_FLD_BILL_TYPE     ENUM [0] 0
0 PIN_FLD_PARENT        POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_GROUP_OBJ     POID [0] 0.0.0.0 0 0
0 PIN_FLD_NEXT_BILL_T   TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_T   TSTAMP [0] (0) <null>
0 PIN_FLD_LAST_BILL_OBJ POID [0] 0.0.0.0 0 0
0 PIN_FLD_PENDING_RECV  NUM [0] 0.000000
0 PIN_FLD_CURRENCY      INT [0] 0
0 PIN_FLD_BILL_WHEN     INT [0] 0
0 PIN_FLD_DEBIT_NUM     STR [0] ""
0 PIN_FLD_DEBIT_EXP_ABA STR [0] ""

```

```

0 PIN_FLD_INV_PO          STR [0] ""
0 PIN_FLD_INV_TERMS      ENUM [0] 0
0 PIN_FLD_INV_FORMAT     POID [0] 0.0.0.0 0 0
0 PIN_FLD_INV_INSTR      STR [0] ""
0 PIN_FLD_ACCESS_CODE1   STR [0] ""
0 PIN_FLD_ACCESS_CODE2   STR [0] ""
0 PIN_FLD_INTERNAL_NOTES BUF [0] flag/size/offset 0x0 0 0 NULL data ptr

```

When **testnap** doesn't run successfully, you see an error message or the **nap** prompt doesn't appear. Also, you see error messages in the **testnap** log file located by default in the *BRM\_Home/sys/test* directory. The error messages include an error number and the location of where the error occurred.

Check the **testnap** log file as well as the **cm.log**, **cm.pinlog**, **dm\_oracle.log**, and **dm\_oracle.pinlog** files for details.

Most problems with starting or running **testnap** involve incorrect parameters in the **testnap** configuration file.

If **testnap** doesn't start, you see the following message:

```

E Thu May B 13:16:31 1999 db2.corp :6029 pcm.c(1.40):90
    Connect open failed (4/100) in pcm context open
E Thu May B 13:22:07 1999 db2.corp :6033 pcm.c(1.40):90
    Connect open failed (4/101) in pcm context open

```

This section describes the most common problems in starting **testnap** and how to resolve them.

### Error 27: Connection Error

This error is caused by one of the following situations:

- The maximum number of connections have been exceeded. This is indicated by the following message:

```

(10567): pcp_open, bad connect: Connection refused
(10567): login failed 27
ERROR: testnap: pcm_context_open():: err 27,
       loc 0, pin_errclass 0, field 0/0, rec_id 0, resvd 5

```

You can resolve the problem by increasing the number of connections in the **CM pin.conf** file and reconfiguring the CM, or by connecting to a different CM.

- The DM processes did not start when you tried to start **testnap**, caused by the following sequence of commands:

```

pin@demo5-86> pin_ctl start dm_oracle
pin@demo5-87> pin_ctl start cm
pin@demo5-88> testnap
ERROR: testnap: pcm_connect():: err 27,
       loc 2, pin_errclass 1, field 0/0, rec_id 0, resvd 7

```

Wait a few seconds for the DM processes to start after typing **pin\_ctl start cm** before starting **testnap**.

### Error 4: Login Failure

Error 4 in the message indicates that login failed because of an incorrect port or host number or incorrect user ID.

#### Incorrect port number

A message such as the following indicates that the port number specified by the **cm\_ports** entry in the **testnap pin.conf** file is incorrect:

```
testnap
(8488): bad receive of login response, err 4
(8488): login failed 4
ERROR: testnap: pcm_context_open(): err 4,
       loc 0, pin_errclass 0, field 0/0, rec_id 0, resvd 5
```

To resolve the problem, make sure that the port number in the **cm\_ports** entry in the **testnap pin.conf** file matches the **cm\_ports** entry in the CM **pin.conf** file.

### Incorrect user ID

The following message indicates that the database number (db\_no) in the **userid** entry of the **testnap pin.conf** file is incorrect:

```
testnap
bad/no "userid" from pin.conf file
ERROR: testnap: pcm context open(): err 4,
       loc 0, pin_errclass 0, field 0/0, rec_id 0, resvd 3
```

To resolve the problem, enter the correct database number in the **pin.conf** file.

### Connection refused

The following message indicates that either the **testnap pin.conf** file has an incorrect port number or hostname in the **cm\_ports** entry or there is no CM running.

```
testnap
(1215): pcp_open, bad connect: Connection refused
ERROR: testnap: pcm context open(): err 4,
       loc 0, pin_errclass 0, field 0/0, rec_id 0, resvd 4
```

To resolve the problem, make sure that the hostname and port number are correct and that the CM is running.

### Incorrect hostname

The following message indicates that the hostname in the **testnap pin.conf** file is incorrect:

```
testnap
(6044): pcp_open(), bad gethostbyname("XXX_HOSTNAME"): Error 0
ERROR: testnap: pcm_context_open(): err 4,
       loc 0, pin_errclass 0, field 0/0, rec_id 0, resvd 3
```

To resolve the problem, enter the correct hostname.

### Incorrect Database Number

The following message indicates that **testnap** could connect to the DM through the CM, but couldn't access the database, since the database number was incorrect:

```
testnap
XXX: database 23 from pin.conf "userid"
ERROR: dd vrfy(): pcm read_flds(): 23
```

Even though the CMs and DMs successfully came up, this is the first point at which the validity of the database number is checked.

To resolve the problem, correct the database number (db\_no) in the **userid** in **testnap pin.conf** file. Also, ensure that the **testnap**, CM, and DM **pin.conf** files have the same database numbers.

### Error 26: DM Not Running

The following messages indicate that there is no DM running.

#### testnap

```
XXX: database 2 from pin.conf "userid"  
ERROR: dd vrfy(): pcm read_flds(): 26
```

#### robject - 0.0.0.2 /account 1

```
PCM_OP_READ_OBJ failed: err 26,  
    loc 3, pin_errclass I, field 0/16, rec_id 0, resvd 3
```

To resolve this, start a DM.

### Invalid Buffer Index

The following message indicates that there is a parameter missing in the **testnap** command:

#### testnap

```
XXX: database 2 from pin.conf "userid"
```

```
robject /account 1
```

```
ERROR: invalid buffer index "2"  
no object to use for robject
```

```
robject
```

To resolve the problem, be sure to include the "-" in front of the number 0.0.0.2:

```
robject - 0.0.0.2 /account 1
```

### Error 56: Failed to Connect

If some older DMs started using a different database number are still running and accepting connections from your application, which is trying to use a different database, **testnap** returns error 56.

In addition, the **testnap pinlog** file contains the following message:

```
E Fri May 7 16:14:11 1999 demo5 <no name>:2025 pcm.c(1.46):101  
    Connect open failed (56/7) in pcm_context_open  
E Fri May 7 16:14:11 1999 demo5 <no name>:2025 pcm_conn.c(1.3):158  
    pcm_connect: bad pcm_context_open, err 56
```

The CM **pinlog** file contains the following message:

```
E Fri May 7 16:35:46 1999 demo5 cm:2125 fm_utils_trans.c:114  
    fm_utils_trans_open error [location=<PIN_ERRLOC_DM:4>  
class=<PIN_ERRCLASS_APPLICATION:4> errno=<PIN_ERR_WRONG_DATABASE:31> field  
num=<PIN_FLD_POID:7,16> recid=<0> reserved=<0>]
```

To resolve the problem, stop all the DMs and restart them.

Use **ps -ef | grep dm** to find and stop all DMs.

---

---

**Note:** `testnap` also returns error 56 when you re-create the database but do not commit your changes in SQL or in `init_tables.sql.hostname`.

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# Part II

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## Customizing BRM Server Components

Part II describes how to customize Oracle Communications Billing and Revenue Management (BRM) server components. It contains the following chapters:

- [Adding and Modifying Policy Facilities Modules](#)
- [Writing a Custom Facilities Module](#)
- [Writing a Custom Data Manager](#)
- [Customizing Information Stored in the Database](#)
- [Searching for Objects in the BRM Database](#)
- [Creating Custom Fields and Storable Classes](#)
- [Adding Support for a New Service](#)
- [Integrating BRM with Enterprise Applications](#)
- [Using BRM Messaging Services](#)
- [Using Events to Trigger Operations](#)
- [Writing Custom Batch Handlers](#)
- [Creating iScripts and iRules](#)
- [Managing Devices with BRM](#)
- [Managing Orders](#)
- [Monitoring Your System with System Manager](#)



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## Adding and Modifying Policy Facilities Modules

This chapter describes how to implement a new business policy and how to change a default Oracle Communications Billing and Revenue Management (BRM) policy by using policy opcodes. It explains the difference between System Facilities Modules (FMs) and Policy FMs.

For a complete list of business policies implemented by default in BRM and how to change them, see "[Implementation Defaults](#)".

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---

**Note:** You can also change certain default implementations of business policies by using the policy configuration tools in Configuration Center or by changing entries in the Connection Manager (CM) configuration file.

---

---

### Understanding System and Policy Facilities Modules

BRM functionality, such as billing and rating, is implemented by using FMs and a set of applications that rely on them. The FMs implement opcodes, each of which performs a specific function related to the business processes of its manager. See "[FM Opcodes](#)" for more information.

BRM uses two types of opcodes:

- System opcodes
- Policy opcodes

Many system opcodes have a corresponding policy opcode that allows you to customize functionality. For example, the PCM\_OP\_AR\_REVERSE\_WRITEOFF standard opcode calls the PCM\_OP\_AR\_POL\_REVERSE\_WRITEOFF policy opcode, which you can customize.

From a technical perspective, System FMs and Policy FMs follow the same rules and are built with the same Application Programming Interfaces (APIs). However, they differ significantly in the types of functions they implement. Each System and Policy FM set has a corresponding header file, which must be included in applications that use an opcode from that FM set.

### System FM Functions

System FMs:

- Define and implement the basic functionality.

- Guarantee the integrity of all operations performed.

For example, the registration module includes an opcode in its System FM called `PCM_OP_CUST_CREATE_CUSTOMER`, which takes customer registration information and creates an account object in the database. A formal set of steps is followed, including preparing and validating all the fields, creating and initializing the account and service objects, purchasing the appropriate plans and deals, validating the credit card, and so on. These steps are carried out within a well-defined transactional model that guarantees the integrity of the resulting objects.

You cannot modify the default System FMs, but you can create new ones and configure them into BRM.

For information on creating a custom FM, see ["Writing a Custom Facilities Module"](#).

## Policy FM Functions

You use Policy FMs to implement your business policy decisions. System FMs use these policies to choose among a set of reasonable behaviors under a specific set of circumstances.

For example, the payment module includes an opcode in its Policy FM called `PCM_OP_PYMT_POL_SPEC_VALIDATE`, which determines whether a customer's payment information needs to be validated after events such as a new registration or a change to the customer's payment details. This policy opcode doesn't perform any of the actual work. It takes a description of the situation, makes the decision based on your business policy, and returns that decision to the System FM for execution.

Every policy opcode includes a default implementation already configured into BRM. If your business policies differ from the default implementation, you can implement custom policies and configure them into BRM. Because the business policies are separated into their own opcodes, you can easily customize the policies without affecting the underlying functionality of BRM.

Policy FMs consist of a number of opcodes that are implemented by using C functions, and these opcodes enable you to change the default behavior of BRM. For example, you can substitute customized opcodes for existing policy opcodes to validate Automatic Account Creation (AAC) information, create and check customer passwords, validate login names, and assign dynamic IP addresses.

## Policy Opcodes

Policy FM opcodes receive a set of situational details as input and return a business policy decision as output. In general, this decision is based on the input parameters, and the policy opcode does not call any additional opcodes or access the database. However, if the business behavior of your custom policy opcode requires executing other opcodes that access data in the database, you can implement them.

Policy FM opcodes can perform any of the actions supported by FMs while deriving the data the FMs return as input. For example, in addition to the parameters passed as input, customer information can be read from the database to drive the business decision. Or an external system, such as a credit rating bureau, can be accessed to provide additional validation of a new customer during registration.

Policy FM opcodes must conform to the standard BRM calling conventions. They receive parameters according to the input flist specification and are expected to return parameters according to the return flist specification. For detailed descriptions of the Policy FM opcodes, see the individual opcode descriptions.

Each policy opcode description explains the calling conventions and includes links to its input and output flist specifications, a detailed description of the functionality of the default implementation, and pointers to any configuration files that it uses.

Each opcode description also contains a link to the `.c` file that implements its behavior.

---



---

**Important:** When you modify policy opcodes at the source code level, observe the transactional rules around the policy call. Because the System FMs that call the Policy FMs are responsible for the transactional integrity of BRM, they impose restrictions on certain policy opcodes. See the *Transaction Handling* section of the individual opcodes for details.

---



---

## Using the Policy Opcode Source Files

You can change the default behavior of many BRM operations by using customized policy opcodes. You make your changes to the policy's `.c` file. Then, you compile and link this file with an updated Policy FM, which can be dynamically linked to any CM.

Policy opcodes are installed as executable binary files. In addition, most policy opcodes include source files that you can customize and compile. As of release 7.3, some policy opcodes do not include source files. In that case, you can create your own version of those policy opcodes.

In all cases, flist specs are provided in the documentation.

---



---

**Note:** In some cases, some opcodes in a single Policy FM include source code and some do not.

---



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To create a custom version of the opcode:

1. Create a custom version of the opcode. Use the same name as the opcode supplied by BRM. For example, to create a customer version of the `PCM_OP_ACT_POL_SCALE_MULTI_RUM_QUANTITIES` opcode, create an opcode named `PCM_OP_ACT_POL_SCALE_MULTI_RUM_QUANTITIES`.

See the opcode flist spec documentation for guidance on optional and required fields.

2. Edit the `fm_name_pol_config.c` file.

For example, `fm_gprs_aaa_pol_config.c`.

3. Comment out the opcodes that you do not want to customize as shown in the following example:

```
struct cm_fm_config fm_gprs_aaa_pol_config[] = {
    /* opcode (as an int), function name (as a string) */
    { PCM_OP_GPRS_AAA_POL_AUTHORIZE,
      "op_gprs_aaa_pol_authorize" },
    { PCM_OP_GPRS_AAA_POL_SEARCH_SESSION,
      "op_gprs_aaa_pol_search_session" },
    { PCM_OP_GPRS_AAA_POL_ACC_ON_OFF_SEARCH,
      "op_gprs_aaa_pol_acc_on_off_search" },
    { PCM_OP_GPRS_AAA_POL_AUTHORIZE_PREP_INPUT,
      "op_gprs_aaa_pol_authorize_prep_input" },
    { PCM_OP_GPRS_AAA_POL_REAUTHORIZE_PREP_INPUT,
      "op_gprs_aaa_pol_reauthorize_prep_input" },
```

```

        { PCM_OP_GPRS_AAA_POL_UPDATE_ACCOUNTING_PREP_INPUT,
"op_gprs_aaa_pol_update_accounting_prep_input" },
        { PCM_OP_GPRS_AAA_POL_STOP_ACCOUNTING_PREP_INPUT, "op_gprs_aaa_pol_stop_
accounting_prep_input" },
        { 0, (char *)0 }

```

If you comment out an opcode, the default functionality is used.

4. Run the **Makefile** provided with the opcode source. The **Makefile** creates a new policy library file called **fm\_name\_pol\_custom.so**, which contains the custom policy. The entry of the custom source code must be made in the **Makefile**.
5. Open the CM **pin.conf** file and add an entry for the custom executable file. The entry must follow the entry for the default implementation. The CM reads the entries and implements the last entry it finds.

```

- cm fm_module fm_gsm_aaa_pol.so fm_gsm_aaa_pol_config - pin
- cm fm_module fm_gsm_aaa_pol_custom.so fm_cust_gsm_aaa_custom_config -
pin

```

## Using the Default Implementation with Your Custom Implementation

To use the default implementation with your custom implementation:

1. Include multiple entries for the same opcode in the CM file.
  - a. Open CM **pin.conf** file and add the below CM **pin.conf** entry in the last line.

```

- cm fm_module ${PIN_HOME}/lib/fm_name_pol_custom${LIBRARYEXTENSION} fm_
name_pol_custom_config - pin

```

where **fm\_name\_pol\_custom\${LIBRARYEXTENSION}** denotes the custom policy library name, and **fm\_name\_pol\_custom\_config** denotes the custom policy configuration structure name.

- b. Save the CM **pin.conf** file, and restart the CM process.

The CM loads both implementations of the policy code, the default implementation and the custom implementation. However, by default, CM executes the implementation that is configured last in the CM **pin.conf** file.

2. Use the custom opcode to call the default implementation of the policy opcode by including the **CM\_FM\_OP\_PREV\_IMPL** or **CM\_FM\_OP\_PREV\_IMPL\_BY\_REF** macro in your custom opcode source code.

If you want to add some customization to the implementations and if you want to call the default implementation from the custom implementation, use one of the above functions to call the previous (default) implementation of the same policy opcode.

3. Run your custom implementation first, and then the default implementation, using the CM.

**Note:**

- In case of the `CM_FM_OP_PREV_IMPL` macro, a local copy of the input flist is created to call the opcode. The local copy is destroyed after the called opcode is returned.
- In case of the `CM_FM_OP_PREV_IMPL_BY_REF` macro, a copy of input flist is not created. The given input flist is passed to the opcode so that the called opcode uses the input flist as reference only and does not alter the data.

For information about the `CM_FM_OP_PREV_IMPL` and `CM_FM_OP_PREV_IMPL_BY_REF` macro, see the `cm_fm.h` file in the `BRM_Home/include` directory, where `BRM_Home` is the directory in which you installed BRM components.

## Adding a New Policy

A Policy FM consists of a set of opcodes and functions. The functions implement the opcodes. The functions are compiled and then linked into a shared library (the Policy FM).

For examples, see the `.c` source files for each opcode in `BRM_SDK_Home/source/sys/fm_category_pol`, where `category` is the name of the opcode category.

To create a new Policy FM:

1. Define the input and output flist specifications.

This is already done for you. Each policy opcode must conform to the input and output flist specifications referenced in the opcode reference document.

2. Write a function to implement your custom opcode.

To do this, modify a copy of the `.c` source file provided for the corresponding default policy opcode.

For example, to change the default behavior of the `PCM_OP_CUST_POL_PREP_BILLINFO` policy opcode, change the `op_cust_pol_prep_billinfo` function, which is contained in the `fm_cust_pol_prep_billinfo.c` file.

3. Create an entry in the configuration file to map the function to an opcode or if it is a new policy FM, create a configuration file to specify the opcode-to-function mapping.

For information on creating the file, see ["Creating an Opcode-to-Function Mapping File"](#).

## Handling Transactions in Custom Policy FMs

All policy operations conform to the rules for application-level transactions.

See the *Transaction Handling* section of the individual opcodes for details.

If a read-write or read-only transaction is open when a policy operation is performed, all data read as part of the operation will be consistent with the state of the database when the transaction is opened. This guarantees that the data used by this operation is consistent with related data used by other operations in the transaction.

If this operation is called when a transaction is not already open, the operation is performed without transactional control.

---

---

**Caution:** Policy operations must not modify storable object data.

---

---

## Compiling and Linking a Policy FM

After you define or modify the policy opcodes, create a shared library for the new Policy FM by using the **Makefile** included in each Policy FM source directory.

Enter **make** to create the **.so** or **.a** file.

## Configuring Your New Policy FM

The shared library (**.so** on Solaris, Linux, and HP-UX IA64; and **.a** on AIX) for the Policy FM must be included in each CM where its functionality is needed. Whenever a new CM is started or restarted, the CM reads its configuration file and loads the listed System FMs and Policy FMs dynamically. For more information, see "[Writing a Custom Facilities Module](#)".

Configure the new FM as part of the applicable CMs by adding the new Policy FMs to the CM configuration file.

For information on the format of the configuration file entries, see the CM configuration file.



---

---

## Writing a Custom Facilities Module

This chapter explains how to write an Oracle Communications Billing and Revenue Management (BRM) Facilities Module (FM) to add new features and functionality.

Creating FMs requires the following knowledge and skills:

- Programming in C or C++.
- A good understanding of the following components of BRM:
  - BRM system architecture. See "BRM System Architecture" in *BRM Concepts*.
  - Storable classes and flists. See "[Understanding Flists and Storable Classes](#)".
  - Opcodes and the PIN library routines. See "[Understanding the PCM API and the PIN Library](#)".
  - BRM error handling. See "[Understanding API Error Handling and Logging](#)".

For information on creating or modifying policy FMs, see "[Adding and Modifying Policy Facilities Modules](#)".

### About Customizing System FMs

FMs are sets of opcodes grouped into functional categories in the Connection Manager (CM). FMs implement business semantics, such as billing an account for the purchase of a product, checking credit card information, verifying passwords, and so on. FMs use the business policy decisions implemented in the policy FMs to implement the business processes. CMs pass the FM opcodes translated into base opcodes to the Data Manager (DM).

System FMs access the BRM database and manage specific types of information. You can write custom FMs that access the BRM databases or any custom data storage systems. Your custom FMs can use the existing base opcodes or implement new ones.

For a description of System FMs and policy FMs and instructions on modifying Policy FMs, see "[Adding and Modifying Policy Facilities Modules](#)".

By default, BRM includes the policies and features necessary to manage an Internet service through the System FMs.

---

---

**Important:** The System FMs are part of the base BRM system and you cannot modify them.

---

---

The System FMs perform the following functions:

- Handle registration

- Manage customer information
- Track activity
- Bill customers

The CMs execute the default functionality defined in the System FMs. To add new functionality to BRM, have the CM execute custom functionality by creating custom FMs. For example, you can create custom FMs to store electronic mail and to manage Web pages, **ftp** archives, and any other form of information.

You need to write a new FM in the following situations:

- If you implement a custom business policy by defining new opcodes, you need a new FM to process the policies.
- If you want to create customized operations on storable objects, you need a custom FM to execute the operations.

## About Implementing Custom FMs

You implement a custom FM the same way you add a custom client application in C to BRM:

- You use the same standard client libraries you use to write a custom application. These libraries are included in the BRM SDK (*BRM\_SDK\_Home\lib*).
- You use the same coding conventions in an FM and in custom applications.
- An FM can call system opcodes and use PCM Library macros just like a client application.
- You can easily implement new features at the client application level and then migrate them into an FM after debugging.

For information on creating client applications, see ["Adding New Client Applications"](#).

FMs are configured into CMs at CM execution time as dynamically loaded libraries. When a new operation is implemented with an FM and the FM becomes part of a CM, it appears to all client applications as a fully integrated BRM operation. The custom FMs can perform checks, write log records, call functions in other FMs, call the default DMs, or call custom DMs.

## Creating a New FM

Follow these procedures to create a new FM in a CM:

1. Define new opcodes. See ["Defining New Opcodes"](#).
2. Define input and output specifications for the new opcodes. See ["Defining Input and Output Flist Specifications"](#).
3. If necessary, define new storable classes and fields. See ["Defining New Storable Class and Field Definitions"](#).
4. Write a function to implement the new opcode. See ["Writing a Function to Implement a New Opcode"](#).
5. Use the **fm\_post\_init** function to call non-base opcodes at CM initialization. See ["Using the fm\\_post\\_init Function to Call Non-Base Opcodes at CM Initialization"](#).
6. Write a program to map opcodes to functions. See ["Creating an Opcode-to-Function Mapping File"](#).

7. Create a shared library for the new FM. See ["Creating a Shared Library for a New FM"](#).
8. Configure the new FM as part of the CM. See ["About Configuring a New FM into a CM"](#).

## Defining New Opcodes

You must define your custom opcodes, with their numbers, in a header file and run the `parse_custom_ops_fields` script on the file. This script creates an extension to the `pcm_tbls.c` file. Client applications use `pcm_tbls.c` to map a field or opcode to its number.

For more information on the `parse_custom_ops_fields` script, see `parse_custom_ops_fields`.

BRM opcodes and their numbers are defined in the `ops/*.h` files in the `BRM_Home/include` directory, where `BRM_Home` is the directory in which you installed BRM components.

To pass new opcodes from a client application to a new FM, you use the `PCM_OP` macro.

To define a new opcode:

1. Create a header file and define your new opcodes by using this format:

```
#define opcode_name_1          opcode_number_1
```

For example, you might create a header file named `my_opcodes.h` with these definitions:

```
#define MY_OP_SET_AGE          100001
#define MY_OP_SET_LANGUAGE    100002
```

---

**Important:** Numbers up to 10000 are reserved for use by BRM Software.

---

2. Run the `parse_custom_ops_fields` Perl script by using this syntax:

```
parse_custom_ops_fields -L language -I input -O output -P java_package
```

For information on the `parse_custom_ops_fields` parameters and their valid values, see `parse_custom_ops_fields`.

3. For applications written with PCM C, in the `pin.conf` file for each application, create an entry using this format:

```
- - ops_fields_extension_file ops_flds_ext
```

Where `ops_flds_ext` is the file name and location of the memory-mapped extension file that the `parse_custom_ops_fields` script created.

4. For applications written using Java PCM, add the location of the compiled Java classes that the script generated to the `CLASSPATH`.
5. Make sure you include your header file both in the application that is calling the opcode and in the custom FM.

## Defining Input and Output Flist Specifications

Flists are passed uninterpreted between the client application and the new FM by the PCM\_OP opcode.

Follow these rules when you define flist specifications for your custom opcode:

- Your flists must conform to the BRM flist specifications.  
See "[About Flists](#)" and "[Opcode Input and Output Specifications](#)" for details.
- Both the input and output flist specifications must contain the **PIN\_FLD\_POID** field to identify the object being manipulated.  
For an example, see the input or output flist specifications for any of the opcode descriptions.
- The client, the custom FM, and the custom Data Manager must agree on the flist format and content, especially if you are defining new fields.

## Defining New Storable Class and Field Definitions

You may have to create custom fields and storable classes for your FM. As with new opcodes and flists, the custom FM and the client application must agree on the semantics of the new fields.

If you define new classes, you must create a new opcode to manipulate the data stored in the new objects. Pass the new opcode to your custom FM with an flist containing the POID of the storable object. The FM then sends a series of basic opcodes to the DM, depending on the operation.

See "[Creating, Editing, and Deleting Fields and Storable Classes](#)" for information on defining new storable classes and fields.

You also can implement custom functionality by using **/data** storable objects, which contain generic fields and can be used for BLOB (Binary Large Object) processing.

## Writing a Function to Implement a New Opcode

To implement a new opcode, you write a new function that calls the base system opcodes to access the DM. The new function then becomes part of a new FM shared library.

The new function you write must conform to the PCM\_OP calling convention.

Use the **PCM\_OP\_\*** reference pages as checklists and templates to determine what your custom function must implement. Pay particular attention to the input and output flists.

---

---

**Important:** If you are adding a new function in the **fm\_utils** module that can be called outside the module add a prototype of that function in the **fm\_utils.h**.

---

---

## Using the **fm\_post\_init** Function to Call Non-Base Opcodes at CM Initialization

Using the **fm\_post\_init** function, custom FMs can call non-base opcodes at CM initialization. To implement this, ensure that the **fm\_post\_init** function is a part of the FM shared library.

For example:

```
void
```

```

fm_post_init(int *err)
{
* errp = 0;
.
.
.
}

```

The CM initialization takes place in two phases:

- In the first phase, the **fm\_post\_init** functions are called for all the FM modules specified in the CMs **pin.conf** file. At this time, it is not possible to call non-base opcodes from the **fm\_post\_init** functions.
- In the second phase, all the **fm\_post\_init** methods implemented by all the FM modules are called. At this time, it is possible to call non-base opcodes from the **fm\_post\_init** functions.

## Creating an Opcode-to-Function Mapping File

You create a configuration program, **fm\_\*\_config.c**, to map an opcode to the function that implements it. This configuration file is read when a dynamic library is created, and the mapping information is stored in it. When a parent CM is initialized, it configures the opcode-function pairs into itself, and each child CM inherits the same configuration as its parent.

The configuration program contains an array of **struct cm\_fm\_config** for each opcode and its corresponding function and the **config** function at the end.

For a definition of this **struct**, see the **cm\_fm.h** file in the *BRM\_SDK\_Home/Include* directory.

The following example shows an opcode-to-function configuration file.

---



---

**Important:** Include your **.h** file with your new custom opcodes.

---



---

```

/** fm_cust_config.c 1.8 99/02/11
*

#ifdef lint
static char Sccs_id[] = "@(#)fm_cust_config.c 1.8 11 Feb 1999 ";
#endif

#include /* for FILE * in pcm.h */
#include "pcm.h"
#include "ops/cust.h"
#include "pcp.h"
#include "cm_fm.h"

/*****
PIN_EXPORT void * fm_cust_config_func();

struct cm_fm_config fm_cust_config[] = {
    /* opcode as a int32, function name (as a string) */
    { PCM_OP_CUST_BILLINFO, "op_cust_billinfo" },
    { PCM_OP_CUST_CREATE_ACCT, "op_cust_create_acct" },
    { PCM_OP_CUST_CREATE_SERVICE, "op_cust_create_service" },
    { PCM_OP_CUST_DELETE_ACCT, "op_cust_delete_acct" },

```

```
        { PCM_OP_CUST_INIT_SERVICE,      "op_cust_init_service" },
        { PCM_OP_CUST_NAMEINFO,         "op_cust_nameinfo" },
        { PCM_OP_CUST_STATUS,           "op_cust_status" },
        { PCM_OP_CUST_VERIFY,           "op_cust_verify" },
        { PCM_OP_CUST_FINDSERV_VERIFY,  "op_cust_findserv" },
        { 0, (char *)0 }

void *
fm_cust_config_func()
{
return ((void *) (fm_cust_config));
}
```

For example, when the CM gets a `PCM_OP_CUST_CREATE_ACCT()` opcode through the `PCM_OP()` call from a client application, the CM looks up this table and calls the `op_cust_create_acct()` function.

---

---

**Note:** The CM gets the name of this configuration file from its own configuration file.

---

---

## Creating a Shared Library for a New FM

Each custom FM must be created as a shared library. BRM code is multi-thread (MT) safe. If you require your custom FM to be MT safe, you must make your custom FM code MT safe.

**Solaris:** See the Solaris documentation for more information on shared libraries (**LD(1)**) and making your code MT safe (**threads(3T)**).

**Linux:** See the Linux documentation for more information on shared libraries (**LD(1)**) and making your code MT safe (**threads(3T)**).

**AIX:** See the AIX documentation for more information on shared libraries (**LD(1)**) and making your code MT safe (**threads(3T)**).

## About Configuring a New FM into a CM

New FMs are implemented as shared libraries and are dynamically linked to CMs at runtime. You add new FMs to the CM configuration file. When a new CM is started or restarted, it reads its configuration file and loads the listed FMs dynamically.

Child CM processes inherit the configuration information read by their parent CM process. Child CM processes do not read the configuration file when they are forced. You can limit the number of CMs that implement the new opcode by leaving the new opcode out of the parent CM configuration file.

You must also make sure that you use the same database number in the configuration files for your client applications, custom FM, and the DMs.

## Adding a New FM Module to the CM Configuration File

The configuration file contains the names of the shared libraries that implement the base and custom opcodes. It also contains the names of the corresponding configuration files that contain the opcode-to-function mappings.

The custom shared library (**.so** on Solaris, Linux, and HP-UX IA64; and **.a** on AIX) contains the functions that implement the new opcodes and the opcode-to-function mapping table struct. No opcode-to-function mapping files need to be present when the CMs with the custom FMs are started because this information is already stored in

the shared library. However, the name of the shared library and the mapping struct still have to be in the configuration file so that the CM can find and configure them.

For the format and description of the entries for an FM, see "Syntax for Facilities Module (FM) Entries" in *BRM System Administrator's Guide*.

Use the entries for the system FMs in the default CM configuration file in *BRM\_SDK\_Home/sys/cm* as an example to add your custom FM entries:

The following example shows the configuration file entries for two custom FM config files on Solaris:

```
#
# example CM pin.conf entries for two custom FMs
#
# define new the FM module(s) for this CM
#
- cm    fm_module      ./fm_myfm.so fm_myfm_config - pin
- cm    fm_module      ./fm_anotherfm.so fm_anotherfm_config - pin
```

In this example, *./fm\_myfm.so* and *./fm\_anotherfm.so* are the dynamic libraries implementing the new opcodes that are listed in *fm\_myfm\_config* and *fm\_anotherfm\_config*, respectively. *pin* is the name chosen for the *tag*.

## Initializing Objects for Multiple Processes

In the CM configuration file, you can specify an initialization function that is called when the CM loads an FM or Policy FM. This function initializes objects that are called in multiple processes or threads.

1. Create a new file named *\*\_init.c* (for example, *fm\_term\_pol\_init.c*) in the appropriate FM or Policy FM directory (for example, *fm\_term\_pol* directory).
2. Add the new file to the **Makefile.user** file.
3. Implement an initialization function in the *\*\_init.c* file.

Example pseudo code:

```
pin_flist_t *global_flistp = NULL;
extern void
fm_term_pol_init(int32 *errp)
{
    global_flistp = read from custom objects;
    *errp = PIN_ERR_NONE;
}
```

---

**Note:** In the example above, *global\_flistp* is allocated in the master CM process or thread. When a child process is created, *global\_flistp* is duplicated and still available on the child process.

---

4. Add the initialization function to the CM configuration file file, using the following example:

```
- cm fm_term_pol ../../lib/fm_term_pol.lib fm_term_pol_config_func fm_term_
pol_init pin
```

## Handling Transactions in Custom FMs

Custom FM code is responsible for starting, aborting, and committing transactions as required depending on the semantics of the opcode. Each base opcode must be surrounded by transactions, unless a transaction is already open when the opcode is called.

All other system opcodes, except for `PCM_OP_PYMT_CHARGE` and the password opcodes, start transactions if none are open when they are called.

Custom FM transactions must conform to the transaction specifications of the PCM context management functions. See "[Context Management Opcodes](#)" for the rules to follow.

For information on system transaction handling, see the Transaction Handling sections of each opcode description.

In your custom FM, you can check for open transactions. See the `fm_generic_opcode.c` file in `BRM_SDK_Home/templates/fm_template` for sample code to use.

A custom FM can call other FMs by using the Portal Communications Module (PCM) API. Also, custom FMs use the same PCM API used to call other FMs and Data Managers.

---

---

**Note:** Calls to the Data Manager are made with base opcodes.

---

---

## Managing Memory in Custom FMs

To manage memory in your custom FMs, follow these rules:

- Always use `pin_malloc()`, `pin_free()`, `pin_realloc()`, and `pin_strdup()` for the `get()`, `set()`, `take()`, and `put()` operations on flists.
- Use the standard routines `malloc(3C)`, `free(3C)`, `realloc(3C)`, and `strdup(3C)` for other memory operations.

## Opening a New Context in an FM

To open a new context in an FM, use `(pin_flist_t)NULL` for `in_flistp` in the `PCM_CONTEXT_OPEN` call.

See the `sample_app.c` and `sample_search.c` code examples for more information.

## Compiling and Linking a Custom FM

Use the libraries in `BRM_SDK_Home/lib` for linking.

See the sample `Makefile` for `BRM_SDK_Home/source/templates/fm_temp/fm_generic_opcode.c`. The main routine for a custom opcode should look similar to the `op_generic` function in the `fm_generic_opcode.c` file. The calling parameters and their types are required.

The following example shows the list of `include` files required. Make sure you include your own header file containing your new opcodes (`custom_opcodes.h` in the following example). This example also shows skeleton code for the new opcode, the `cm_fm_config` struct, and the new function:

```
#define PCM_OP_FM_SAMPLE_LOOPBACK 999999
```



```

struct cm_fm_config fm_bill_config[] = {
    { PCM_OP_FM_SAMPLE_LOOPBACK,          "op_fm_sample_loopback" },
    { 0,          (char *)0 }
};

#include "pcm.h"
#include "cm_fm.h"
#include "pin_errs.h"
#include "pinlog.h"
#include "custom_opcodes.h"

op_fm_sample_loopback(connp, opcode, flags, i_flistp, r_flistpp, ebufp)
    cm_nap_connection_t      *connp;
    int32                    opcode;
    int32                    flags;
    pin_flist_t              *i_flistp;
    pin_flist_t              **r_flistpp;
    pin_errbuf_t             *ebufp;
{
    PIN_ERR_CLEAR_ERR(ebufp);

    /******
     * Check for errors.
     * *****/
    if (opcode != PCM_OP_FM_SAMPLE_LOOPBACK) {
        pin_set_err(ebufp, PIN_ERRLOC_FM,
            PIN_ERRCLASS_SYSTEM_DETERMINATE,
            PIN_ERR_BAD_OPCODE, 0, 0, opcode);
        PIN_ERR_LOG_EBUF (PIN_ERR_LEVEL_ERROR,
            "op_fm_sample_loopback", ebufp);
        return;
    }

    /******
     * Return a copy of our input flist.
     * *****/
    *out_flistpp = PIN_FLIST_COPY(in_flistp, ebufp);

    return;
}

```

## Debugging FMs

You can debug custom and policy FMs using BRM SDK and standard programming tools.

To debug FMs and policy opcodes, you need BRM SDK, access to a functioning BRM server, and the programming tools supported by BRM SDK on your platform. See ["About BRM SDK"](#) for installation instructions and other information about BRM SDK.

For an overview of the connections required to test an FM, see ["Testing New or Customized Policy FMs"](#).

The primary way of debugging an FM is attaching to a running CM.

Various debugging tools are available on the supported operating systems:

- On Solaris, you can use the **dbx** utility or Sun WorkShop.
- On Linux, you can use the **gdb** debugger.
- On HP-UX IA64, you can use the **WDB** debugger.

- On AIX, you can use **dbx**.

The following instructions describe debugging in Solaris using **dbx**. In HP-UX IA64, AIX, and Linux, the debugging tools perform similar tasks, but the specific steps will be different.

1. Start a CM.

Make sure the CM **pin.conf** file has a reference to the compiled FM that you are debugging. Also make sure the **pin.conf** points to a CM and EM that are valid and running.

2. Use the **ps** command to find the process ID of the CM.

3. Attach **dbx** to the process.

```
dbx cm process_id
```

4. Set **follow\_fork\_mode** to **both** or **child** depending on whether you want to debug the main CM process or a child process. For example, use this command to set **follow\_fork\_mode** to **child**:

```
dbxenv follow_fork_mode child
```

5. Scope to the FM by using either the **func** or **file** command.

6. Set breakpoints at appropriate places in the code.

---

---

## Writing a Custom Data Manager

This chapter describes how to create a new Oracle Communications Billing and Revenue Management (BRM) Data Manager (DM) to access data in a custom data storage systems or a legacy storage system.

You need to create your custom storable objects before creating a new Data Manager.

For more information, see ["Creating Custom Fields and Storable Classes"](#).

### About Adding a Custom Data Manager

DMs provide a storable object model on top of different underlying storage models. There is a standard interface, Storage Manager (SM), between the generic DM code and the various underlying storage access codes. This section describes the SM interface, which you customize to create a custom Data Manager (DM).

You can add a new DM to the BRM system for the following reasons:

- To map storable object operations to a different storage paradigm. See ["About Mapping Storable Objects to Alternate Storage Mechanisms"](#).
- To interface to legacy systems. Storable object operations can be mapped to online protocols or other methods of interfacing to the legacy systems. See ["About Adding Interfaces to Legacy Systems"](#).
- To automatically manage queues and avoid starvation for operations. This works well with legacy systems where high latency may occur.

### About Mapping Storable Objects to Alternate Storage Mechanisms

BRM is shipped with a standard SM, which provides an interface for mapping storable object operations to any storage paradigm that you require. BRM views the data at the storable object operation level, so there is no effect on the rest of the system when a data set is managed by a custom SM. This flexibility lets you use highly specialized storage paradigms, such as an indexed file system.

### About Adding Interfaces to Legacy Systems

BRM allows transparent integration with legacy systems. Operations that are routed to a legacy system for execution appear as storable object manipulations within the BRM system. The interface to the legacy system is written with the same client APIs you use to create custom applications. Only the custom SM, which is the legacy translation module, is aware that the storable object operations are being translated. The fact that the operations are not performed within the BRM system is transparent to all other modules in the system.

You can integrate any type of legacy storage system with BRM. Any type of storable object operation can be defined and sent to the custom SM for translation to the legacy system.

## Understanding the Data Manager Interface

To build a new DM, you need to understand:

- [Calling Conventions](#)
- [Data Manager Memory Model](#)
- [Function Entry Points](#)

### Calling Conventions

Your custom DMs can be called only from the Base opcodes. The FM opcodes call other underlying opcodes, which in turn call base opcodes which are executed by the DMs. The **ops/base.h** header file must be included in your application unless the application uses an FM opcode. FM opcodes already include the base opcode header file.

When you create a custom DM you need to implement the base opcodes or a subset of the base opcodes that your DM requires to provide the functionality you want. Each of the DMs included with BRM uses a different Implementation of a base opcode depending on the DM and the storage system it interacts with. For example, the base opcode PCM\_OP\_SEARCH is implemented differently for **dm\_oracle** and **dm\_ldap**.

For details, see the descriptions of the PCM\_OP\_SEARCH opcodes in "Base Opcodes" in *BRM Developer's Reference*.

### Data Manager Memory Model

The DM uses shared memory to pass data back and forth between the BRM front-end and back-end (Storage Manager) processes. The DM uses a queuing-based memory management model. For more information about queuing based memory management, see "About Queuing-Based Processes" in *BRM System Administrator's Guide*.

The DM and QM are separate processes, so external libraries do not have to be multi-thread safe.

For an example of queuing-based processes, see "Example of Queuing in a Client-to-CM Connection" in *BRM System Administrator's Guide*.

### Function Entry Points

The routines described in this section provide the entry points for your custom DM. You must name and define the entry points exactly as shown in the following list. Different underlying storage modules are dynamically linked when you use the **dm\_sm\_obj** keyword in the DM configuration file. If this dynamic linking does not work, link the DMs directly using a DM-specific **makefile**.

#### **dm\_if\_init\_process()**

This routine sets up the initial process. It is called when a child DM is started, for example, to connect to a database. It reads in the configuration information from the DM configuration file. This routine uses the following syntax:

```
void
```

```
dm_if_init_process(struct dm_sm_config *confp, int32 *errp)
```

### dm\_if\_process\_op()

This routine processes an operation that comes from the CM. This is implemented in the backend. This routine uses the following syntax:

```
void
dm_if_process_op(
    struct dm_sm_info *dsip,
    int32pcm_op,
    int32pcm_flags,
    pin_flist_t*in_flistp,
    pin_flist_t**out_flistpp,
    pin_errbuf_t*ebufp)
```

### dm\_if\_terminate\_connect()

When the CM or the DM is disconnected, this routine is called to clean up the CM connection, for example to rollback a transaction in progress. It is called only when a SIGQUIT signal is sent to the DM main process and by System Manager.

This routine uses the following syntax:

```
void
dm_if_terminate_connect(
    struct dm_sm_info *dsip,
    int32 *errp)
```

### dm\_if\_terminate\_process()

If a custom DM is stopped with a SIGQUIT signal resulting from a **kill -QUIT pid'** command in the stop script, this routine is called when the DM process is terminated. This routine uses the following syntax:

```
void
dm_if_terminate_process(int32 *errp)
```

## Argument Descriptions

Table 11–1 describes the arguments used in the DM entry-point routines:

**Table 11–1 Arguments Used in DM Entry-Point Routines**

| Argument | Description   |
|----------|---|
| confp    | <p>Pointer to the structure that contains the information about the DM to SM configuration. It is passed in to <b>dm_if_init_process()</b>.</p> <p>The structure contains the following elements:</p> <ul style="list-style-type: none"> <li>■ <b>be_id</b>: ID number of the SM starting from 0.</li> <li>■ <b>sm_shm_size</b>: Size of the shared memory allocated to this SM. A value of 0 means there is no shared memory allocated to the SM.</li> <li>■ <b>sm_shm_base</b>: Base shared memory allocated if the <b>sm_shm_size</b> is not 0.</li> </ul> <p>See <b>dm_sm.h</b> for more information.</p> |

**Table 11–1 (Cont.) Arguments Used in DM Entry-Point Routines**

| Argument           | Description   |
|--------------------|---|
| <b>dsip</b>        | <p>Pointer to the structure that contains the information about the DM to SM connection such as the connection state. The structure contains two sets of information, public and private, relevant to the underlying code.</p> <p>Public information:</p> <ul style="list-style-type: none"> <li>▪ <b>poidep</b>: Pointer to the POID of the input flist.</li> <li>▪ <b>who</b>: Pointer to the ID of the sender.</li> <li>▪ <b>trans_flag</b>: contains the transaction flags</li> </ul> <p>Private information:</p> <ul style="list-style-type: none"> <li>▪ <b>pvti</b>: An <b>int</b> for private use.</li> <li>▪ <b>pvtp</b>: Pointer to the SM private area.</li> </ul> <p>See <b>dm_sm.h</b> for more information.</p> |
| <b>pcm_op</b>      | A base PCM opcode. Only the opcodes <b>PCM_OP_CREATE_OBJ</b> through <b>PCM_OP_TRANS_COMMIT</b> defined in the <i>BRM_Home\include\ops\base.h</i> are supported in the DM. <i>BRM_Home</i> is the directory in which you installed BRM components.  |
| <b>pcm_flags</b>   | Bit-mask flags that you can set for operations. For information on different flags, see <i>BRM_Home\include\pcm.h</i> .   |
| <b>in_flistp</b>   | Input flist pointer. It can be used as it is in <b>pin_flist_xxx</b> functions.   |
| <b>out_flistpp</b> | Output flist pointer. It can be used as it is in <b>pin_flist_xxx</b> functions.  |
| <b>ebufp</b>       | <p>Pointer to an error buffer structure. For a definition of the structure, see <b>pcm.h</b>.</p> <p><b>ebufp</b> pointing to a <b>pin_err</b> will be <b>PIN_ERR_NONE</b> on entry. Use a different value to indicate an error. Also, if there is an error, specify the rest of the values or clear them.</p>  |

## About Creating a New Data Manager

Use the *BRM\_SDK\_Home\source\templates\dm\_temp\dm\_generic.c* program as a template for your new DM. The **dm\_generic.c** program just echoes any flist sent into it, but it contains all the elements needed for a new DM.

Follow these programming guidelines when writing a new DM.

## Handling Errors

You can use one or a combination of the following ways to return failure status to the application.

- You can set an error condition in the **ebuf**, which is passed back as the **ebuf** to the application that calls **pcm\_op()**.
- You can use **PIN\_ERR\_NONE** in the **ebuf** and use a field on the return flist to identify the reason for failure.

When writing a custom DM, follow the BRM conventions for error handling:

- Set errors in **ebuf**.
- Set errors in fields on the return flist so that applications or code that calls it can read the error.

## Managing Memory

To allocate storage from the shared memory segment instead of the stack, use **pin\_malloc()**, **pin\_strdup()**, **pin\_free()**, and **pin\_realloc()** routines in each custom DM. This allows the front-end and back-end processes to pass data between them, since the only common portion of their address spaces is the shared memory segment.

Use these routines to manage flists and to do **GET/SET** or **PUT/TAKE** flist operations.

For managing memory that is not related to flists, use the standard Solaris/Linux versions of the memory-management routines: **malloc(3C)**, **strdup(3C)**, **free(3C)**, and **realloc(3C)**.

To allocate memory in the shared memory area:

1. Use the Solaris/Linux **pin\_malloc()**, **pin\_strdup()**, or **pin\_realloc()** routine.
2. Use the **pin\_free()** routine.

## Creating a New Data Manager

To create a new DM, perform the following tasks:

1. [Writing, Compiling, and Linking a Custom DM](#)
2. [Configuring Your Custom DM](#)
3. [Starting and Stopping Your Custom DM](#)

### Writing, Compiling, and Linking a Custom DM

1. Write the new DM code, using *BRM\_SDK\_Home/source/templates/dm\_template/dm\_generic.c* as a template.
2. Run the make file that accompanies **dm\_generic.c** to compile the custom DM. Edit the make file to refer to the new source file.

### Configuring Your Custom DM

1. Create a directory for your custom DM and copy the compiled **.so** file to that directory.
2. Copy the configuration file (**pin.conf**) from *BRM\_SDK\_Home/sys/dm* to the new directory.
3. Edit the **pin.conf** file to refer to the new custom DM.

The file includes information about changing its entries.

### Starting and Stopping Your Custom DM

This section provides the steps for creating Start and Stop scripts. In this example, the custom DM is called **dm\_new**.

1. Go to the *BRM\_Home/bin* directory:

```
cd BRM_Home/bin
```

2. Copy the DM start and stop scripts to the *BRM\_Home/bin/* directory. For example, if BRM is using the Oracle DM:

```
cp start_dm_oracle start_dm_new
cp stop_dm_oracle stop_dm_new
```

3. Create a symbolic link from **dm** to the **dm\_new** to distinguish custom DM processes from other DM processes:

```
ln -s dm dm_new
```

4. Edit the following entries in the start script to reference your custom DM and save it:

```
start dm_new

DM=BRM_Home/bin/dm_new

DMDIR=BRM_Home/sys/dm_new

LOGDIR=BRM_Home/var/dm_new

DMLLOG=${LOGDIR}/dm_new.log

DMPID=${LOGDIR}/dm_new.pid
```

5. Edit the stop script.

- a. Change the following entries to reference your custom DM:

```
stop dm_new

DM=dm_new

LOGDIR=BRM_Home/var/dm_new

DMPID=${LOGDIR}/dm_new.pid
```

- b. Change the **kill** entry to include the QUIT signal:

```
kill -QUIT `cat ${DMPID}`
```

- c. Save the stop script.

6. Start your custom DM and verify that the scripts are working:

```
start_dm_new

ps -ef | grep new

...
cd BRM_Home/var/dm_new

more dm_new.pinlog
D Thu Mar 12 15:43:51 1999  trainsun10  dm:8241  dm_main.c(1.82):1508

DM dm_name set to "-"
```

## Configuring Your CM to Use the Custom DM

In your CM configuration file, add the following entries:

- **dm\_pointer**, which specifies where to find your DM. Each pointer has three values:
  - Database number, such as 0.0.0.4
  - IP address or host name of the computer running your custom DM
  - Port number of the DM service



```
- cm dm_pointer 0.0.0.1 test_machine 11950
```

- The database number for the custom FM to access. The entry has the name of the FM accessing the custom DM, the name of the configuration entry, and the following values for the database number, which must have the same format as the POID:
  - The database number, such as 0.0.0.2 in the example below. This value is required and must be the same as that of the **dm\_db\_no** in the configuration file of the custom DM.
  - The service type such as **/cc\_db** for the credit card processing service. This can be any meaningful text string to identify the custom database and is a placeholder for the POID format.
  - The ID of 0, which is an arbitrary value needed as a placeholder for the POID format.

An example of these entries in the configuration file is as follows:

```
- fm_bill cc_db 0.0.0.2 /_cc_db 0
```

## Editing Your Custom Opcodes to Access the Custom DM

If you have written custom opcodes, you need to edit them to access your custom DMs.

For information on editing your custom opcodes, see "[Adding and Modifying Policy Facilities Modules](#)".



## Customizing Information Stored in the Database

This chapter explains how to customize information stored in the Oracle Communications Billing and Revenue Management (BRM) database by tracking changes to specific object fields and by encrypting specific object fields.

### About Tracking Changes to Object Fields

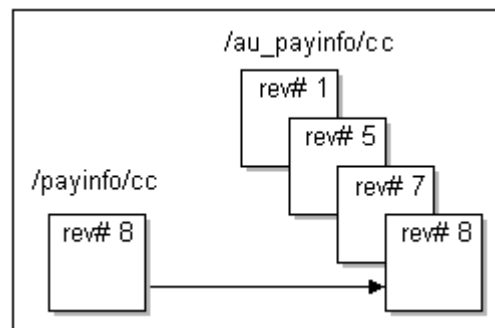
You can enable fields in objects to trigger an audit trail when they are modified. This allows you to track many changes to the BRM system. For information on why you enable an audit trail, see "About Maintaining an Audit Trail of BRM Activity" in *BRM Managing Customers*.

### Audit Trail Architecture

You enable audit trails for an individual field, but the entire object that contains the field is versioned and stored to ensure consistency with other members of the object class. When fields marked for auditing are created or modified, copies are made of the top-level object class to which the field belongs as well as that object's subclasses. The audit trail is composed of the versioned and stored object copies, which are called *shadow objects*. It is created at the end of a transaction, prior to transaction commit.

For example, if a field marked for auditing in the `/payinfo/cc` object is modified in the first, fifth, seventh, and eighth revision of the original object, the shadow objects shown in [Figure 12-1](#) are created in the audit trail:

**Figure 12-1** `/payinfo/cc` Shadow Objects



The revision number is the revision number of the object's Portal object ID (POID).

When you mark a field for auditing, the Storable Class Editor calls the PCM\_OP\_SDK\_SET\_DD opcode. This opcode creates a shadow class for the top-level class in which the auditable field is modified and for all of that class's subclasses.

The auditability of a field is specified in the PIN\_FLD\_AUDITABLE meta-level field in the data dictionary. The value **1 (AUDIT\_ENABLED)** indicates the field is marked for auditing, and the value **0 (AUDIT\_DISABLED)** indicates the field is not marked for auditing.

The following example shows the input flist of the PCM\_OP\_SDK\_SET\_DD opcode after the PIN\_FLD\_DEBIT\_NUM field is marked for auditing in the `/payinfo/cc` object class. The PIN\_FLD\_AUDITABLE meta-level field is set to **1**, which indicates that the PIN\_FLD\_DEBIT\_NUM field is marked for auditing.

```

0 PIN_FLD_OBJ_DESC      ARRAY [133] allocated 20, used 4
1   PIN_FLD_NAME        STR [0] "/payinfo/cc"
1   PIN_FLD_DESCR       STR [0] "Credit Card payment
                             information class."
1   PIN_FLD_OBJ_ELEM    ARRAY [0] allocated 20, used 14
2     PIN_FLD_FIELD_TYPE INT [0] 9
2     PIN_FLD_FIELD_NAME STR [0] "PIN_FLD_CC_INFO"
2     PIN_FLD_DESCR     STR [0] "Array to hold the
                             credit card specific
                             information. There
                             can be only one
                             array element. The
                             array element id is not
                             significant."
2     PIN_FLD_ORDER     NUM [0] 0.000000
2     PIN_FLD_OBJ_ELEM  ARRAY [0] allocated 20, used 8
3       PIN_FLD_FIELD_TYPE INT [0] 5
3       PIN_FLD_FIELD_NAME STR [0] "PIN_FLD_ADDRESS"
...
...
2     PIN_FLD_OBJ_ELEM  ARRAY [4] allocated 20, used 8
3       PIN_FLD_FIELD_TYPE INT [0] 5
3       PIN_FLD_FIELD_NAME STR [0] "PIN_FLD_DEBIT_NUM"
3       PIN_FLD_DESCR     STR [0] "Credit card
                             number."
3       PIN_FLD_ORDER     NUM [0] 0.000000
3       PIN_FLD_LENGTH   INT [0] 30
3       PIN_FLD_AUDITABLE INT [0] 1
3       PIN_FLD_CREATE_PERMISSION STR [0] "Required"
3       PIN_FLD_MOD_PERMISSION STR [0] "Writeable"
3       PIN_FLD_SM_ITEM_NAME STR [0] "debit_num"
...
...

```

After a shadow class is created, it is not deleted even if auditing is disabled later. For example, if you disable auditing for the PIN\_FLD\_DEBIT\_NUM field in the `/payinfo/cc` object, the existing audit trail for that field is retained and accessible to you if you need it.

## About Shadow Objects

Shadow objects use an **au** prefix. For example, a change to a field marked for auditing in the `/payinfo/cc` object results in the following shadow objects: `/au_payinfo`, `/au_payinfo/cc`, `/au_payinfo/inv`, `/au_payinfo/subord`, and so on. The shadow object is a replica of the original object, so it stores the POID the object had when auditing

occurred. The unique revision number of the POID is used to extract audit trail information from the database.

The shadow object contains the same fields as the original object plus the PIN\_FLD\_AU\_PARENT\_OBJ field that captures information about the audited class. The PIN\_FLD\_AU\_PARENT\_OBJ field is a pointer to the revision of the original object copied to the audit trail; its value is derived from the original object field.

## Specifying Audit Trail Tablespaces

You can specify the tablespace for the audit trail schema when you install BRM. The default tablespace for a shadow object is the same as that of its original object.

## Audit Trail Tablespace Names

The tablespace name for a shadow object is the same as that of its original object with the addition of an **au** prefix. There is a 32-character limit on tablespace names. If the addition of the **au** prefix exceeds the 32-character limit, the shadow object tablespace name is truncated, causing its tablespace name to be different than that of the original object.

## Fields Marked for Auditing by Default

Table 12-1 shows the fields that are marked for auditing by default in BRM, the top-level class associated with those fields, the event objects created when those fields are modified, and the BRM activity being audited:

**Table 12-1** Fields Marked by Default for Auditing

| Top-Level Class     | Audited Fields                          | Event Object Created                  | BRM Activity Audited   |
|---------------------|---|---------------------------------------|--|
| /deal               | All fields                              | /event/audit/price/deal               | Changes to internal BRM price lists                          |
| /payinfo            | PIN_FLD_DEBIT_NUM and PIN_FLD_DEBIT_EXP | /event/audit/customer/payinfo/cc      | Changes to customer credit card numbers and expiration dates |
| /plan               | All fields                              | /event/audit/price/plan               | Changes to internal BRM price lists                          |
| /product            | All fields                              | /event/audit/price/product            | Changes to internal BRM price lists                          |
| /rate               | All fields                              | /event/audit/price/rate               | Changes to internal BRM price lists                          |
| /rate_plan          | All fields                              | /event/audit/price/rate_plan          | Changes to internal BRM price lists                          |
| /rate_plan_selector | All fields                              | /event/audit/price/rate_plan_selector | Changes to internal BRM price lists                          |

## Enabling Auditing for a Field

You can enable new or existing object fields for auditing at any time. For information on why you would mark a field for auditing, see "About Maintaining an Audit Trail of BRM Activity" in *BRM Managing Customers*.

### Performance Tips

- Keep an audit trail only for the BRM activity that is absolutely necessary for your business. Enabling an audit trail decreases system performance significantly.
- Do not mark fields in the **/account** object for auditing. Because the **/account** object is large and is modified by many types of system activity, it is not recommended for auditing.
- Mark the **/purchased\_product** and **/purchased\_discount** objects for auditing to audit products and discounts for an account.
- If you mark an array or substruct for auditing, changes to any field in that array or substruct will trigger auditing. If you only want to track changes to one field in an array or substruct, mark *only* that field for auditing and *not* the entire array or substruct.

You mark a field for auditing by using the Storable Class Editor. For detailed instructions, see the Storable Class Editor Help.

### Disabling Auditing for a Field

You can disable auditing for a field at any time. You disable auditing for a field with the Storable Class Editor. For detailed instructions, see the Storable Class Editor Help.

### Accessing Audit Trail Information

This section summarizes the information you need and the steps necessary to access audit trail data. You can access audit trail information manually by using the **testnap** utility to retrieve specific revisions of an object given the object's POID. You can also write your own application to access audit trail changes in the database.

For a description of how audit trails work, see "[Audit Trail Architecture](#)".

#### Required Information

To access audit trail data, you must:

- Obtain the account number of the customer for whom you need audit trail data (as shown in Customer Center).
- Obtain the general time period in which the event that was audited occurred. For example, the date or month the customer changed his credit card number.
- Know the name of the event object BRM generates for each type of auditing. For example, when a customer changes the credit card number on his account, BRM generates the event object **/event/audit/customer/payinfo/cc**.

For the names of the event objects generated for default auditing, see "[Fields Marked for Auditing by Default](#)".

#### Finding the Audit Trail Data

To find audit trail data:

1. Use the customer's account number to obtain the **/account** object associated with the account number.
2. Browse the event objects for the **/account** object in the general time period to locate the event.

For example, to find a changed credit card number, browse the events to locate the `/event/audit/customer/payinfo/cc` event created at the time the customer changed his credit card number.

3. Use the event object to obtain the POID of the original object that was audited.

For example, the `/event/audit/customer/payinfo/cc` event contains the POID of the `/payinfo/cc` object that was audited when the customer's credit card number was changed. The POID provides the revision number of the object when it was audited. This number is stored in the shadow object.

4. Retrieve the shadow objects by calling the `PCM_OP_READ_OBJ` opcode with one of the following flags. (For examples of how to do this by using the `testnap` utility, see "[Using testnap to Retrieve Shadow Objects](#)".)
  - Use the `PCM_OPFLG_USE_POID_GIVEN` flag to send a request to the BRM database Data Manager (DM) to execute a search-and-read operation for the exact POID you specify (the POID of the shadow object in the audit trail).
  - Use the `PCM_OPFLG_USE_POID_PREV` flag to send a request to the BRM database DM to execute a search-and-read operation for the shadow object POID that contains a revision number preceding the revision number you specify in your POID.
  - Use the `PCM_OPFLG_USE_POID_NEXT` flag to send a request to the BRM database DM to execute a search-and-read operation for the shadow object POID that contains a revision number that is one or more numbers higher than the revision number you specify in your POID.
  - Use the `PCM_OPFLG_USE_POID_NEAREST` flag to send a request to the BRM database DM to execute a search-and-read operation for the exact audit trail revision number that you specify (the POID of the shadow object); if the exact POID is not found, to obtain the POID with a revision number that precedes the revision number you specify in your POID.

### Using testnap to Retrieve Shadow Objects

The following code samples show how to retrieve shadow objects by using `testnap`. This example accesses the audit trail of the `/payinfo/cc` object given the object's POID near the time auditing occurred.

```
# Flists and opcode for testnap to access the audit-trail
# of the /payinfo/cc object.
#
# Syntax: xop PCM_OP_READ_OBJ flags buffer
#
# where the buffer contains the following flist with the
# flags as described below:
#
#
0 PIN_FLD_POID POID [0] 0.0.0.1 /payinfo 10001 0

# NOTE: Replace the database number, the POID_ID, and
# the version as required.

#Use the following flags:

# PCM_OPFLG_USE_POID_GIVEN (0x0040): To access the exact revision.
# e.g. "xop PCM_OP_READ_OBJ 0x0040 1" on the buffer flist
# 0 PIN_FLD_POID POID [0] 0.0.0.1 /payinfo 10001 3
```

```
# This retrieves audit trail with revision 3, or NOT_FOUND.

# PCM_OPFLG_USE_POID_PREV (0x2000): To access the
# previous revision.
# e.g. "xop PCM_OP_READ_OBJ 0x2000 1" on the buffer flist
# 0 PIN_FLD_POID POID [0] 0.0.0.1 /payinfo 10001 3
# This retrieves audit trail with revision 2, assuming revision
# 2 is the previous revision to 3 in the audit-trail. Otherwise,
# the next revision lower than revision 3 is retrieved.

# PCM_OPFLG_USE_POID_NEXT (0x4000+): To access the next revision.
# e.g. "xop PCM_OP_READ_OBJ 0x4000 1" on the buffer flist
# 0 PIN_FLD_POID POID [0] 0.0.0.1 /payinfo 10001 3
# This retrieves audit trail with revision 4, assuming revision
# 4 is the next revision to 3 in the audit trail. Otherwise, the
# next revision higher than revision 3 is retrieved.

# PCM_OPFLG_USE_POID_NEAREST (0x8000): To access the nearest
# revision.
# e.g. "xop PCM_OP_READ_OBJ 0x8000 1" on the buffer flist
# 0 PIN_FLD_POID POID [0] 0.0.0.1 /payinfo 10001 3
# This retrieves audit trail with revision 3, if the revision 3
# exists; otherwise, it retrieves a revision preceding
# revision 3.
```

## Archiving Audit Data

Remove unwanted audit data from your Pipeline Manager audit tables. Purging the audit tables improves system performance, reduces memory usage, and makes the results returned by the DAT\_Account module smaller and more efficient.

---

---

**Note:** The `purge_audit_tables.pl` script does not delete objects from the database; it only purges the object rows stored in a table.

---

---

To purge objects from audit tables:

1. Open the `BRM_Home/sys/archive/oracle/purge_audit_tables.conf` file.
2. In the `storage_clause` entry, specify the tablespace for the history tables.
3. In the `time` entry, specify the column name to be used for comparing the cutoff date specified in the `purge_audit_tables.pl` script's `-d` parameter.
4. In the `cutoff_for_purge` entry, specify the percentage based on which it will invoke the `archiveindirect` mode rather than the `archivedirect` mode to archive the tables.

For example, if the `cutoff_for_purge` value is `70`, and a table contains more than 70% data that must be archived, temporary tables are used to transfer the data efficiently (`archiveindirect` mode). If the table contains less than 70% data that must be archived, the data is transferred directly to the history tables (`archivedirect` mode).

The `BRM_Home/sys/archive/oracle/purge_audit` file contains more information about the configuration entries.

5. With a text editor, open the `BRM_Home/sys/archive/oracle/purge_audit` file.
6. In the first line of the script, replace `__PERL__` with the location of the Perl executable.



7. Run the `purge_audit_tables.pl` script.

---

**Note:** To run in debug mode, set the environment variable `ARCHIVE_DEBUG` at the system prompt before you run the script. As the script runs, processing data, including the functions that are called, is printed to the screen.

---

## About Encrypting Information

You can encrypt fields that contain sensitive customer information, such as credit card numbers, to guarantee privacy and prevent unauthorized use. The fields to be encrypted must be in string format. You set up encryption with the Storable Class Editor, which will add a flag attribute in the metadata defining the field in the BRM data dictionary (`PIN_FLD_ENCRYPTABLE`).

BRM encrypts the fields marked for encryption when storing them in the database and automatically decrypts the fields when retrieving them from the database. For information on how to encrypt fields, see "[Encrypting Fields](#)".

You can also encrypt passwords, including the database password and passwords for servers and client applications that connect to the Connection Manager (CM) to access the database. For information, see "[About Encrypting Passwords](#)".

---

**Note:** You can encrypt fields by using AES (Advanced Encryption Standard) encryption or MD5 (Message-Digest algorithm 5) encryption; Oracle suggests you use the AES scheme. For more information about these encryption methods, see "[About AES Encryption](#)" and "[About MD5 Encryption](#)".

---



---

**Important:** You cannot encrypt customer account passwords with the AES or MD5 scheme. Instead, you use the customer opcodes to perform the encryption. For more information, see "[Encrypting Fields](#)".

---

## About AES Encryption

AES uses a 256-bit encrypted key to protect field data. To set up the database for AES encryption, you generate an encrypted AES key and add it to the Data Manager (DM) `pin.conf` file with other encryption configuration information. This encrypted AES key gets stored in the database. Then you define which fields should be encrypted by setting their `PIN_FLD_ENCRYPTABLE` flag. When the DM starts, the Oracle DM uses the encrypted AES key to transform the fields marked as encryptable from plaintext into ciphertext and from ciphertext into plaintext.

---

**Note:** You can have only one encrypted AES key per Oracle DM. For information on changing the encrypted AES key, see "[Replacing an Encrypted AES Key](#)".

---

In addition to encrypting data fields, you can encrypt passwords for the following features to secure your BRM system:

- BRM Data Managers

- Pipeline database
- Optional managers such as Account Synchronization Manager
- Client applications

For more information, see ["About Encrypting Passwords"](#).

### About AES Data Encryption Length

The length of AES-encrypted data is different, depending on whether the data is stored in the database. In both cases, when fields are encrypted, their lengths increase.

---

---

**Important:** If you are storing the information in an Oracle database, the maximum length of an encrypted field is 1992 bytes, which is 975 bytes in plaintext.

---

---

For information on how to encrypt fields, see ["Encrypting Fields"](#).

### Encryption Length for Fields Stored in the Database

When the AES encryption scheme is used to store database fields, the generated ciphertext is in the following format:

**&aes** | *Encrypted\_AES\_key\_index* | *Ciphertext*

where:

- **aes** identifies the encryption scheme used by the database.
- *Encrypted\_AES\_key\_index* is a unique 4-digit ID associated with the encrypted AES key.
- *Ciphertext* is the encrypted data generated from the plaintext data by using the AES key.

To calculate the length of the generated ciphertext data, the following formula is used:

$(Plaintext\_data\_length + 16) * 2 + 5 + 5$

Two hexadecimal numbers represent each byte in the ciphertext, **&aes |** is equal to 5 bytes, and *Encrypted\_AES\_key\_index* is equal to 5 bytes. For example, if *Plaintext\_data\_length* is 25, the generated ciphertext data is 92:

$(25+16)*2+5+5 = 92$

---

---

**Note:** If *Plaintext\_data\_length* is less than 17, the length of the generated ciphertext data is always 79.

---

---

### Encryption Length for Fields Not Stored in the Database

When the AES encryption scheme is used to encrypt data, rather than to store it in the database (for example, to generate encrypted passwords), the generated ciphertext is in the following format:

**&aes** | *Ciphertext*

where:

- **aes** identifies the encryption scheme used by the database.
- *Ciphertext* is the encrypted data generated from the plaintext data by using the AES key.

To calculate the length of the generated ciphertext data, the following formula is used:

$$(Plaintext\_data\_length + 16) * 2 + 5$$

A hexadecimal number represents each byte in the ciphertext, and `&aes |` is equal to 5 bytes. For example, if `Plaintext_data_length` is 25, the generated ciphertext data is 87:

$$(25+16)*2+5 = 87$$

---



---

**Note:** If `Plaintext_data_length` is less than 17, the length of the generated ciphertext data is always 74.

---



---

## About MD5 Encryption

MD5 encryption is a cryptographic hash function with a 128-bit hash value. A hash function takes a long string (or message) of any length as input and generates a fixed-length string as output.

---



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**Note:** `dm_oracle` and `dm_fusa` support data encrypted by using MD5.

---



---

BRM does not support MD5 encryption for passwords; passwords must use AES encryption.

---



---

**Important:** Because of MD5's simple encryption format and known weaknesses, you should encrypt BRM by using the AES encryption scheme. For more information on the AES scheme, see "[About AES Encryption](#)".

---



---

## About MD5 Data Encryption Length

When fields are encrypted with the MD5 scheme, their length can increase. The new length is at most 15 characters longer than the unencrypted length.

---



---

**Important:** If you are storing the information in an Oracle database, the maximum length of an encryptable field is 1992 bytes, which is 975 bytes in plaintext.

---



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To calculate the number of characters, use the following formula on the unencrypted string:

$$f(N) = (N \text{ div } 16) * 16 + ((N \text{ mod } 16) > 0 ? 16 : 0) + 5$$

which is the same as twice the next multiple of 16 greater than N plus 5. Therefore, for 16-digit credit card numbers, the encrypted length is 16 + 5. For anything larger than 16, but less than 32 characters, the encrypted length is 32 + 5, and so on.

## About Masking Data in Log Files

Currently, fields defined as encryptable are encrypted by the DM when they are stored in the database and decrypted when they are retrieved. Data passed through the CM by opcodes and data in the client applications is in plaintext. Therefore, when BRM opcodes are called and high log levels are set on list operations, the contents of the encryptable fields are saved to a log file. The fields may contain sensitive data that is

defined as encryptable but still appears in plaintext. To hide this information, you can define a field as masked. The masked data will be displayed as "XXXX" in the log files rather than as plaintext.

For information on how to mask encrypted fields during flist logging, see ["Defining Masked Fields"](#).

## Encrypting Fields

You mark fields for encryption by using the Storable Class Editor. You can enable new or existing object fields for encryption at any time.

---

---

**Note:**

- You can disable encryption for a field at any time; however, Oracle recommends that you do so only during upgrades.
  - Make sure the field is in string format. Only strings may be encrypted.
- 
- 

See the Storable Class Editor Help for detailed instructions on how to mark a field for encryption and how to disable encryption for a field.

## Defining Masked Fields

You can mask BRM fields and custom fields. For information on creating custom fields, see ["Creating Custom Fields and Storable Classes"](#).

To define masked fields:

1. Create a custom file for your masked fields, and define the fields in this file. Use the following syntax:

```
Custom_field_name masked
```

For example, you might create a file named **custom\_field\_attributes** that contains the following mask definitions:

```
CUST_FLD_CC_NUMBER masked  
CUST_FLD_EXPIRY_DATE masked
```

2. Generate the source file for your custom fields. By default, this file is called **custom\_fields.h**. See the Storable Class Editor Help for detailed instructions.
3. Copy the contents of both files (the custom masked file generated in Step 1 and the source file generated in Step 2) to a new file. For example, name the new file **custom\_masked\_fields**.
4. Run the **parse\_custom\_ops\_fields** Perl script, and use the custom masked fields file created in Step 3 as the *input*. Use the following syntax:

```
parse_custom_ops_fields -L language -I input -O output -P java_package
```

5. For applications written with PCM C, add the following entry to the **pin.conf** file for each PCM C application:

```
- - ops_fields_extension_file ops_flds_ext
```

- For applications written using Java PCM, including Developer Center, copy the contents of the `InfranetPropertiesAdditions.properties` file and paste it in the `Infranet.properties` files for each Java application.

For more information about field masking, see ["About Masking Data in Log Files"](#).

## Generating an Encrypted AES Key

An encrypted AES key is used by the DM to encrypt the database fields that are marked as encryptable.

To generate an encrypted AES key:

- Run the `pin_crypt_app` utility:

```
pin_crypt_app -genkey -key AES_key
```

- If you *do not* have an AES key, run the utility with only the `-genkey` parameter. This generates a random AES key internally, then encrypts it with a hidden key to create the encrypted AES key.
- If you *have* an AES key, run the utility with the `-genkey` and `-key` parameters, and specify the AES key value:

---



---

**Important:** The key length must be **64** and can contain only hexadecimal numbers.

---



---

The output states whether the key was generated successfully, and if so, provides the encrypted AES key. For example, if you use both the `-genkey` and `-key` parameters as shown here:

```
pin_crypt_app -genkey -key
E00D841567828BBA12C86820D018D3B6AE9BEB3B5486D2EBA1CBFC51823755C7
```

The output is:

```
Generation of Encrypted AES key is successful.
Encrypted key is:
&aes|0D5E11BFDD97D2769D9B0DBFBD1BBF7E9554B3A6D438FB19025E12540F9B122C6EB6A4A467
E15944F18447ADE052E35A
```

- Write down the encrypted AES key value or copy it to a text editor.

---



---

**Important:** Include the `&aes|` because it is part of the encrypted key.

---



---

- Add the encrypted AES key value to the `crypt` entry in the DM `pin.conf` file. See ["Configuring the Data Manager for AES Encryption"](#).

---



---

**Note:** You can have only one encrypted AES key per Oracle DM. For information on changing the encrypted AES key, see ["Replacing an Encrypted AES Key"](#).

---



---

## Replacing an Encrypted AES Key

You can replace an encrypted AES key with a new key at any time. This does not affect how data is decrypted; the DM can decrypt data encrypted with a previous key.

---

---

**Note:** This procedure assumes you have already configured the DM for AES encryption. For more information, see "[Configuring the Data Manager for AES Encryption](#)".

---

---

To replace an encrypted AES key:

1. Generate a new encrypted AES key. See "[Generating an Encrypted AES Key](#)".
2. Open the DM `pin.conf` file.
3. In the `crypt aes` entry, replace the existing encrypted AES key with the new encrypted AES key:

```
- crypt aes|BRM_Home/lib/libpin_crypt_aes4dm.so "&aes|New_encrypted_aes_key"
```

4. Save the file.
5. Stop and restart the DM.

## About Encrypting Passwords

You can encrypt passwords for the BRM database, Pipeline Manager database, optional managers such as the Account Synchronization DM, server applications, and client applications that use a password to connect to the CM.

These passwords can be encrypted manually (one at a time) by running the `pin_crypt_app` utility or automatically (all at one time) by running the `encryptpassword.pl` script.

---

---

**Important:** You must use the `pin_crypt_app` utility to encrypt the Pipeline Manager password, client application passwords, or passwords associated with customizations; for example, custom passwords in BRM-provided configuration files or passwords in non-BRM configuration files that support custom applications. For more information, see "[Encrypting Passwords Manually](#)".

---

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For more information, see:

- [Encrypting Passwords Manually](#)
- [Encrypting Passwords Automatically for BRM Base Components](#)

For information on the `encryptpassword.pl` script, see "[About the encryptpassword.pl Script](#)".

For information on configuring client applications to connect to the CM without a password, see "Using CM Proxy to Allow Unauthenticated Log On" in *BRM System Administrator's Guide*.

### Encrypting Passwords Manually

To encrypt passwords manually:

1. Log on to the system running the BRM manager.

---

---

**Note:** For Data Managers, this is generally the system running the BRM database; for client applications, it is the application host system.

---

---

2. Run the following command which transforms a plaintext password into ciphertext:

```
pin_crypt_app -enc plaintext_password
```

where *plaintext\_password* is the password to encrypt.

The output is the AES tag followed by a vertical bar and the encrypted password.

For example:

```
&aes|0D5E11BFDD97D2769D9B0DBFBD1BBF7EE03F1642861DFA57502C7FB85A654267
```

3. Write down the encrypted password or copy it to a text editor.
4. Do one of the following:
  - To set this password as the Oracle DM password or an optional manager password, add the password to the manager's **pin.conf** file. See "[Configuring the Data Manager for AES Encryption](#)".
  - To set this password as the Pipeline Manager password, add the password to the **DataPool** section of the Pipeline startup registry file.
  - To set this password as the CM password for a client application, add the password to the application's **pin.conf** file and to the **Infranet.properties** file. By default, the **Infranet.properties** file is located in **C:\Program Files\Common Files\Portal Software**.

---

**Note:** When you change a password, it is not automatically encrypted. You must encrypt the new password and update the entry in the appropriate configuration file.

---

5. Save the file.
6. Stop and restart the DM.

### About the **encryptpassword.pl** Script

You run the **encryptpassword.pl** script to encrypt the passwords for all BRM components at one time, including the Oracle DM password. BRM authenticates these passwords before connecting to the CM or to the BRM database.

---

**Important:** This script does not encrypt passwords for client applications or optional managers that are not part of base BRM, including the Pipeline Manager password. In addition, it does not encrypt passwords associated with customizations; for example, custom passwords in BRM-provided configuration files or passwords in non-BRM configuration files that support custom applications. To encrypt such passwords, run the **pin\_crypt\_app** utility. For more information, see "[Encrypting Passwords Manually](#)".

---

The **encryptpassword.pl** script has no parameters. You run it from the UNIX prompt on the system running the BRM database by running the following command:

```
perl encryptpassword.pl
```

This script performs the following tasks on the machine on which it runs:

1. Creates a backup copy of all **pin.conf** and **Infranet.properties** configuration files in which it finds a password.
2. Replaces the plaintext password in each configuration file with an encrypted password.
3. Adds all encrypted passwords to the **pin\_setup.values** file.
4. Adds the **ENABLE\_ENCRYPTION** entry with a **YES** value to the **pin\_setup.values** file. This field enables password encryption.

---

---

**Important:** The **encryptpassword.pl** script does not enable field-level encryption. If you set the encryptable value for database fields, refer to the steps in "[Configuring the Data Manager for AES Encryption](#)" after you run the script to enable field-level AES encryption for your database.

---

---

### Encrypting Passwords Automatically for BRM Base Components

To encrypt passwords for all BRM base components at one time:

1. Log on to the system running the BRM database.
2. Go to the *BRM\_Home/setup/scripts* directory.
3. Run the following command:

```
perl encryptpassword.pl
```

4. Follow the instructions at each prompt.

Passwords are encrypted in the AES format.

---

---

**Important:** If you are running optional managers or server applications on a system that does not contain the BRM database, run the **encryptpassword.pl** script on each applicable system.

---

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**Note:** If you change an encrypted password, you must update the entry in the configuration file and the **pin\_setup.values** file.

---

---

For more information on the **encryptpassword.pl** script, see "[About the encryptpassword.pl Script](#)".

### Configuring the Data Manager for MD5 decryption

The DM configuration file (**pin.conf**) specifies encryption settings for the database. You must set the DM **decrypt** entry under the following circumstances:

- When you are *not* upgrading from MD5 to AES, and AES is the encryption scheme for your database.
- When AES is the active encryption scheme. In this case, you must decrypt the existing MD5-encrypted data so it can be encrypted with the AES method.

By default, the **pin.conf** file is located in *BRM\_Home/sys/dm\_oracle* .

For more information about setting the **decrypt** entry and configuring the DM for encryption, see "[Configuring the Data Manager for AES Encryption](#)".



## Configuring the Data Manager for AES Encryption

The DM configuration file (`pin.conf`) specifies the user name and password needed to log in to the BRM database. It also contains other encryption settings you must set.

### Encrypting the Password

By default, the Oracle `pin.conf` file is in the `BRM_Home/sys/dm_oracle` directory.

To encrypt the password:

1. If necessary, generate an encrypted password and an encrypted AES key. See ["Encrypting Passwords Manually"](#) and ["Generating an Encrypted AES Key"](#).
2. Open the DM `pin.conf` file.
3. Add the encrypted password to the `sm_pw` entry:

```
- dm sm_pw Encrypted_password
```

For example:

```
- dm sm_pw
&aes|04|0D5E11BFDD97D2769D9B0DBFBD1BBF7E8762529ADB84F705B831FB1340B31687EB
```

---

**Note:** The password can use any character from the US7ASCII character set except for the hash character (#). BRM interprets the hash character as a comment and will ignore any subsequent characters in the password.

---

4. Save the file.
5. Stop and restart the DM.

Encrypted password support is now enabled for your database.

### Encrypting the Data

By default, the Oracle `pin.conf` file is in the `BRM_Home/sys/dm_oracle` directory.

To encrypt the data:

1. Generate an encrypted password and an encrypted AES key. See ["Encrypting Passwords Manually"](#) and ["Generating an Encrypted AES Key"](#).
2. Open the DM `pin.conf` file.
3. Set the `crypt` entry to enable AES encryption. Provide the encrypted AES key. Use the following syntax.

```
- crypt aes|Encryption_library "&aes|Encrypted_aes_key"
```

---

**Note:** The encryption library is different depending on the platform you are using. You must include the pathname with the file.

---

For example, the following entry sets AES as the encryption method on the Oracle Solaris platform:

```
- crypt aes|BRM_Home/lib/libpin_crypt_aes4dm.so
&aes|11336997BDDFE1AC11336997BDDFE1AC117DE391888FE4203A4D21DB3751A2679F650487B
```

```
D6BCEBB41A2D0D81C823490"
```

4. Set the **decrypt** entry to disable MD5 encryption:
  - **decrypt md5** | "Abracadabra dabracaabrA"
5. Save the file.
6. Stop and restart the DM.

## Migrating Data from MD5 to AES Encryption

Use the **pin\_crypt\_upgrade** utility to migrate MD5-encrypted data to the AES encryption scheme. This utility searches for all fields that are marked as encryptable and upgrades the data to AES encryption.

---

---

**Note:** If the **crypt** entry in the **pin.conf** file is set to AES encryption and the table has both MD5-encrypted and AES-encrypted data, the data can be read. However, if the **crypt** entry in the **pin.conf** file is set to MD5 encryption and the table has both MD5-encrypted and AES-encrypted data, the data cannot be read.

---

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---

**Important:** After you migrate data to the AES scheme, you cannot revert to the MD5 scheme.

---

---

To migrate data from MD5 to AES encryption:

1. Configure the Oracle DM **pin.conf** file for AES encryption. See "[Configuring the Data Manager for AES Encryption](#)".
2. Open the *BRM\_Home/apps/pin\_crypt/pin.conf* file in a text editor and verify the following are set correctly:
  - The **cm** pointers (for example, **cm\_ptr**, **login\_type**, **login\_name**, and **login\_pw**). For more information, see "Using Configuration Files to Connect and Configure Components" in *BRM System Administrator's Guide*.
  - The MTA application entries (for example, **per\_batch**, **per\_step**, and **fetch\_size**). For more information, see "[Error Notifications](#)".
3. Run the **pin\_crypt\_upgrade** utility from this directory.

## Configuring the Data Manager for Oracle ZT PKI Encryption

The Oracle ZT public key infrastructure (PKI) encryption algorithm uses the **pin\_crypt\_app** utility to encrypt files, plain text, passwords, and root keys.

### Encrypting the Data

The Oracle DM configuration file (**pin.conf**) specifies encryption settings for the database.

To encrypt the data:

1. Go to *BRM\_Home/bin*.
2. Run the following command, which creates a root key wallet:

```
orapki wallet create -wallet wallet_location -pwd password
```

where:

- *wallet\_location* is the directory in which the root key wallet is to be created.
- *password* is the password used to make changes to the root key wallet.

3. Run the following command to generate a root encryption key:

```
pin_crypt_app -genrootkey
```

A root encryption key is generated and is stored in the root key wallet.

4. Before enabling the Oracle ZT PKI encryption algorithm for **dm\_oracle**, set the BRM\_WALLET environment variable to *wallet\_location* value.
5. Generate an encrypted password. See "[Encrypting Passwords Manually](#)".
6. Run the following command, which generates an encrypted Oracle ZT PKI key:

```
pin_crypt_app -useZT genkey -key AES_Key
```

where *AES\_Key* is a 256-bit key in hexadecimal notation.

7. Write down the encrypted Oracle ZT PKI key value or copy it to a text editor.

---

**Important:** Include `&ozt|` because it is part of the encrypted Oracle ZT PKI key value.

---

8. Open the Oracle DM *BRM\_Home/sys/dm\_oracle/pin.conf* file in a text editor.
9. Enable the Oracle ZT PKI encryption algorithm by adding the following entry:

```
- crypt aes|Encryption_library "&ozt|Encrypted_key"
```

where:

- *Encryption\_library* is the path and filename of the encryption library. The prefix for the library is **lib** for Solaris, HP-UX, Linux, and AIX, or **null ""** for Windows. The extension for the library is **.so** for Solaris, HP-UX, and Linux; **.a** for AIX; **.dll** for Windows.
- *Encrypted\_key* is the key generated in step 6.

For example:

```
- crypt aes|BRM_Home/lib/libpin_crypt_aes4dm64.so
"&ozt|767A144C814D633DBE49E59BF5BC6E18|DC4D6836B327875B7B200BAC6CD45C50A4850DDF
3DC542FCFE57E134C4A6780A63E7445219ADC609779279B2C809C8EC"
```

---

**Note:** The encryption library is different depending on the platform you are using. You must include the pathname with the file.

---

10. Set the **decrypt** entry, which disables MD5 encryption, by adding the following entry:

```
- decrypt md5| "Abracadabra dabracaabrA"
```

By default, the MD5 key is set to **Abracadabra dabracaabrA**.

11. Save the file.

12. Stop and restart the Oracle DM.

## Generating a Root Encryption Key

The root encryption key is used for encrypting the data and password using the Oracle ZT PKI-approved encryption algorithm.

To generate a root encryption key:

1. Go to *BRM\_Home/bin*.
2. Run the following command, which creates a root key wallet:

```
orapki wallet create -wallet wallet_location -pwd password
```

where:

- *wallet\_location* is the directory in which the root key wallet is to be created.
  - *password* is the password used to make changes to the root key wallet.
3. Run the following command:

```
pin_crypt_app -genrootkey
```

A root encryption key is generated and is stored in the root key wallet.

---

---

**Note:** The root key wallet is generated at only one location. You can copy the root key wallet to the other locations.

---

---

## Modifying a Root Encryption Key

Before you modify the root encryption key, do the following:

- Back up the CRYPTKEY\_T table in the BRM database. See your database documentation for more information on performing database table backups.
- Back up the root key wallet in which the existing root encryption key is stored.

---

---

**Important:** Store the backup in a safe location. The data in the backed up CRYPTKEY\_T table and the root key wallet will become necessary if you encounter any issues in modifying the root encryption key.

---

---

---

---

**Note:** The data keys in the CRYPTKEY\_T table should be in synchronization for all the schemas while modifying the root encryption key.

---

---

### Modifying the Root Encryption Key on Single-Schema Systems

To modify the root encryption key on single-schema systems:

1. Go to the *BRM\_Home/sys/test* directory.
2. Run the following command:

```
pin_crypt_app -genrootkey
```

A new root encryption key is generated and the existing root encryption key in the root key wallet is updated with the new root encryption key. The utility

re-encrypts the data keys in the CRYPTKEY\_T table with the new root encryption key.

## Modifying the Root Encryption Key on Multischema Systems

To modify the root encryption key on multischema systems:

1. On each secondary installation machine, run the following commands, which grant permissions on the CRYPTKEY\_T table in that secondary schema to the primary schema:

```
sqlplus login/password@database_alias
SQL>GRANT ALL ON CRYPTKEY_T TO schema_name;
SQL>exit
```

where:

- *login* is the user name for the database schema you are updating.
  - *password* is the password for *login*.
  - *database\_alias* is the BRM database alias of the secondary schema you are updating.
  - *schema\_name* is the name of the primary schema.
2. On the primary installation machine, do the following:
    - a. Go to the *BRM\_Home/sys/test* directory.
    - b. Run the following command:

```
pin_crypt_app -genrootkey
```

A new root encryption key is generated and the existing root encryption key in the root key wallet is updated with the new root encryption key. The utility re-encrypts the data keys in the CRYPTKEY\_T table with the new root encryption key for all the secondary schemas.

After the root encryption key is modified, ensure that both the primary and secondary schemas can access the root key wallet in which the new root encryption key is stored.

## Enabling Password Restriction for /service Objects

In BRM, you can use password restriction to secure the creation, modification, and deletion of /service objects.

Password restriction forces passwords to adhere to the following rules:

- Contain a minimum of 8 characters
- Include at least one numeric character, one uppercase character, and one special character
- Differ from the previous four passwords (not applicable for customer registration and service creation)
- Not include any part of the user ID

By default, password restriction for /service objects is disabled in BRM.

To enable password restriction for /service objects:

1. Go to the *BRM\_Home/sys/data/config* directory.

2. Run the following command, which creates an editable XML file from the **customer** instance of the **/config/business\_params** object:

```
pin_bus_params -r BusParamsCustomer bus_params_customer.xml
```

This command creates the XML file named **bus\_params\_customer.xml.out** in your working directory. To place this file in a different directory, specify the path as part of the file name.

3. Open the **bus\_params\_customer.xml.out** file.
4. Search the XML file for the following line:  

```
<EnablePasswordRestriction>disabled</EnablePasswordRestriction>
```
5. Change **disabled** to **enabled**.
6. Save the file as **bus\_params\_customer.xml**.
7. Go to the **BRM\_Home/sys/data/config** directory, which includes support files used by the **pin\_bus\_params** utility.
8. Run the following command, which loads the change into the **/config/business\_params** object:

```
pin_bus_params PathToWorkingDirectory/bus_params_customer.xml
```

where *PathToWorkingDirectory* is the directory in which **bus\_params\_customer.xml** file resides.

---

---

**Caution:** BRM uses the XML in this file to overwrite the existing **customer** instance of the **/config/business\_params** object. If you delete or modify any other parameters in the file, these changes affect the associated aspects of the BRM customer configuration.

---

---

---

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**Note:** To run this command from a different directory, see "[pin\\_bus\\_params](#)".

---

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9. Read the object with the **testnap** utility or Object Browser to verify that all fields are correct.  
  
See "[Using testnap](#)" for general instructions on using the **testnap** utility. See "[Reading Objects by Using Object Browser](#)" for information on how to use Object Browser.
10. Stop and restart the CM.
11. (Multischema systems only) Run the **pin\_multidb** script with the **-R CONFIG** parameter. For more information, see "[pin\\_multidb](#)" in *BRM System Administrator's Guide*.

## About Storing Customer Profile Information

You can collect information about your customers and store them in the database in the **/profile** objects. In the profile object, you store marketing or other information relevant to your company, but not necessarily used for accounting. A **/profile** storable class is a top-level class in BRM, which you subclass to define **/profile** storable classes

for your specific needs. It contains the standard top-level object fields and a field which is a pointer to the POID of the **/account** object with which it is associated.

The **/account** object is not used to store this marketing information because inheriting the **/account** object to store these fields would cause object-type collisions if a variety of enhanced services were installed on the same BRM installation.

Because **/profile** objects are linked to specific **/account** objects, any number of different **/profile** objects can be linked to the same **/account** object. However, each **/profile** object can be linked to only one **/account** object.

After you define a **/profile** storable class, you use the Customer FM standard opcodes and Customer FM policy opcodes to create, delete, modify, and validate profile objects.

## Using Profile Objects to Collect Customer Profiles

This section describes how to use profile objects to collect customer profiles.

### Defining a Profile Subclass

Use the Storable Class Editor to create **/profile** storable subclasses.

See "[Creating Custom Fields and Storable Classes](#)" for details on adding storable subclasses and fields to the database.

### Creating a Profile Object

To create a profile object:

1. Create an flist with a PIN\_FLD\_INHERITED field containing your specific profile information.
2. Pass this flist into PCM\_OP\_CUST\_CREATE\_PROFILE.

### Modifying a Profile Object

To modify a profile object:

1. Modify the **/profile** object flist.
2. Pass this flist into PCM\_OP\_CUST\_MODIFY\_PROFILE.

### Deleting a Profile Object

To delete a **/profile** object, use PCM\_OP\_CUST\_DELETE\_PROFILE.

### Validating Profile Objects

To validate **/profile** objects, you customize the following customer FM policy opcodes:

- PCM\_OP\_CUST\_POL\_PREP\_PROFILE
- PCM\_OP\_CUST\_POL\_VALID\_PROFILE

For more information on customizing policy opcodes, see "[Adding and Modifying Policy Facilities Modules](#)".





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## Searching for Objects in the BRM Database

This chapter explains the Oracle Communications Billing and Revenue Management (BRM) object search strategy, including the types of searching that BRM performs by default and what you need to know about searching if you are writing custom applications to use with BRM.

### About Searching for Objects

In this context, searching means looking in your BRM database for objects that meet criteria that you specify. That is, you search for the Portal object IDs (POIDs) of all the classes that share certain characteristics.

There are two main types of searching:

- Simple searching on a single class and its inherited classes. This usually means searching for a specific account.
- Complex searching across multiple classes at the same time. For example, searching for all accounts located in a specific city that used a specific service, includes both the **/account** and **/service** classes.

These searches can be carried out on one or more database schemas, depending on your implementation.

There are two other options for the SEARCH opcodes:

- Count-only searches count and return the number of POIDS that match your search criteria. They do not return POIDS. A count-only search is performed when the `PCM_OPFLG_COUNT_ONLY` parameter is used.
- Calculate-only searches return a single calculated value such as a sum or average. A calculate-only search is performed when the `PCM_OP_CALC_ONLY_1` parameter is used.

### About Search Templates

To search for objects in the database, you use a *search template*. The template can be predefined and stored in a **/search** storable object in the BRM database or defined at runtime when a search opcode is called. When you define the template at runtime, you include the search query on the search opcode input list. The advantage of defining the template at runtime is that you do not have to create it and store it in the database first.

BRM includes a number of predefined **/search** storable objects in the `BRM_Home/sys/dd/data/init_objects.source` file that you can use as templates. (`BRM_Home` is the directory in which BRM is installed.) The predefined search templates are stored

in the `SEARCH_T` table in the database when BRM is installed. Each of these templates has a predefined ID, such as `230` or `231`.

You can also create your own search objects. When you define a search, look in the `init_objects.source` file to see whether a template for your search exists. If one does not exist, create it and load it into the database. Your `/search` storable object can then be used in a call to the search opcode.

If you create a predefined search template, add a copy of the new template to `init_objects.source`. Adding the template has the following advantages:

- You avoid assigning duplicate search template IDs.
- All search templates are in a single location, making them easy to find.
- In testing mode, you can automatically load the new search templates if you need to re-create the database.

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**Important:** When you upgrade to a new BRM release, make sure you copy your custom templates to the new `init_objects.source` file.

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## About the Search Input Flist

You specify the search criteria and the results you want returned from the search on the input flist of the search opcode.

Three fields are required on the input flist:

- **Search POID:** Specifies a `/search` storable object. See ["Search POID"](#).
- **PIN\_FLD\_ARGS array:** Specifies the arguments in the search criteria. See ["Argument List"](#).
- **PIN\_FLD\_RESULTS array:** Specifies which fields to return from the search. See ["Results Array"](#).

If you define a search template at runtime (when the search is executed), two more fields are required:

- **PIN\_FLD\_TEMPLATE:** Specifies the search query in the form of a string. See ["Search Query"](#).
- **PIN\_FLD\_FLAGS:** Specifies the type of search to perform. See ["Flags"](#).

An optional `PIN_FLD_PARAMETERS` field can be included in the flist when you use a predefined search template. This field specifies a subclass that contains the search arguments. See ["Using the PIN\\_FLD\\_PARAMETERS Field"](#).

You can specify the start row and end row of the search result to be retrieved from the search result set by using the optional `PIN_FLD_MIN_ROW` and `PIN_FLD_MAX_ROW` fields in the input flist. See ["Limiting Search Results by Using the PIN\\_FLD\\_MIN\\_ROW and PIN\\_FLD\\_MAX\\_ROW Fields"](#).

## Search POID

The search POID identifies the search template to use for the search.

- If you predefine a search template and store it in a search object, you add the POID of the `/search` object to the input flist. The POID specifies which predefined search template to use:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 301 0
```

- If you define the search template at runtime, you add the search object POID to the input flist with an object ID of 0 or -1, and you define the search query in a PIN\_FLD\_TEMPLATE field on the input flist:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /account where F1 like V1"
```

For more information, see "[About Search Templates](#)".

## Argument List

You specify the arguments for the search query in the PIN\_FLD\_ARGS array. Each array element contains one argument. You must provide at least one argument.

You should always put the POID of the storable class type you want returned in the PIN\_FLD\_ARGS array. If you do not, the search returns an error.

The maximum number of search arguments is 32. The array element ID specifies which argument is contained in the array element. For example, element ID 1 corresponds to argument 1.

The arguments in the PIN\_FLD\_ARGS array are referenced in the **where** clause of the search query. If the search criteria specified in the **where** clause exist in a class other than the one specified in the search query, an attempt is made to convert the POID type of the unspecified class to the specified class, which causes an error.

## Results Array

You specify which fields you want returned from the storable objects you are searching in the PIN\_FLD\_RESULTS array. One element is returned for each storable object that was matched.

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**Note:** You specify the storable objects themselves in the PIN\_FLD\_ARGS array.

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Results can be returned in the following ways:

- To return all the fields from a matched storable object, put the PIN\_FLD\_RESULTS element on the input flist with a value of NULL.
- To return only a count of matching objects, put the PIN\_FLD\_RESULTS element on the input flist with a value of NULL and use the PCM\_OPFLG\_COUNT\_ONLY flag. The number of matching results is returned as the element ID of the PIN\_FLD\_RESULTS array in the output flist.
- To return only those fields you specify, the PIN\_FLD\_RESULTS element on the input flist must contain a sub-flist with the specified fields.
- To return a single value that is calculated from the matched storable objects, put the PIN\_FLD\_RESULTS element that includes a single PIN\_FLD\_AMOUNT field on the input flist. Set the search flag to SRCH\_CALC\_ONLY.

To indicate the maximum number of records to return, specify that number as the element ID of the PIN\_FLD\_RESULTS element. To return all records, use zero. If you are doing a count-only or calculate-only search, only one value is returned.

If you call for a calculate-only search by using the PIN\_FLD\_CALC\_ONLY\_1 flag, the PIN\_FLD\_RESULTS array must contain only one PIN\_FLD\_AMOUNT field with an element ID of 1.

## Search Query

When you define a search template at runtime, you specify the search query in the PIN\_FLD\_TEMPLATE field. The template is in the form of an SQL-like search string. The length of the string is limited to 2048 characters. For example, "select X from <object> where <expression>". For more information, see ["Search Query Syntax"](#).

## Flags

You can specify the following searches using the PIN\_FLD\_FLAGS field on the input flist:

- **256: SRCH\_DISTINCT**

This search type returns only unique data; that is, duplicate POIDs are not returned. Using this flag is recommended to avoid duplicate data. To skip this feature, set the value to 0.

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**Note:** This flag performs distinct operations on POIDs only. If any other datatype is used in the input query, SRCH\_DISTINCT does not return distinct results. This flag cannot be used when using an **order by** clause while performing a complex search. In this case, set the flag value to 0.

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- **512: SRCH\_EXACT**

Use this flag to search arrays. This flag applies the **where** clause in the search string to arrays. If this flag is not used, the search opcode might return array elements that do not match the search criteria. For more information, see ["Performing Exact Searches"](#).

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**Tip:** To specify both SRCH\_EXACT and SRCH\_DISTINCT flags, you can add their values (512 and 256) and enter 768 in the PIN\_FLD\_FLAGS field.

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- **1024: SRCH\_WITHOUT\_POID**

This search type returns data without POIDs for each result. For more information, see ["Search without POID"](#).

There are also two flags that you can use in the call to a search opcode:

- **PCM\_OPFLG\_COUNT\_ONLY**

This search type returns only the number of POIDs that matched the search criteria. The value of the PIN\_FLD\_RESULTS element on the input flist must be NULL.

- **A calculate-only flag**

This search type returns a value, such as a sum or average. There are two forms of the calculate-only flag:

- SRCH\_CALC\_ONLY\_1  
Use this flag to return a single value.
- SRCH\_CALC\_ONLY  
Use this flag to return one or more values.

For more information, see ["Search Query Syntax for Calculate-Only Searches"](#).

## Search Query Syntax

The search query is part of the search template. You include it in either the predefined template before storing it in the database or in the PIN\_FLD\_TEMPLATE field on the input flist at runtime.

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**Important:** SQL queries must adhere to the limitations imposed by the database. For information, see your database documentation.

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Use the following syntax for search queries:

"select X from *object\_name* where *expression*"

where:

- X is a placeholder for the fields being requested, which are specified in the PIN\_FLD\_RESULTS array on the input flist.
- *object\_name* is the type name of the storable object that contains the arguments.  
The name can be fully specified; that is, it can include the specific subclass, or it can take an optional parameter (for example, /*event*/\$1). The \$1 parameter is substituted with the value of the PIN\_FLD\_PARAMETERS field on the search flist. If PIN\_FLD\_PARAMETERS is not included on the flist, the \$1 is null. See ["Using the PIN\\_FLD\\_PARAMETERS Field"](#).

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**Note:** The storable class type you specify in the search query tells BRM where to find the arguments in the **where** clause. It does not indicate the storable class type to return.

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- *expression* is an SQL expression such as "where F1 = V1 and F2 = V2".  
The column names and literal values (Fn and Vn) are replaced by the field names and field values specified in the PIN\_FLD\_ARGS array on the input flist. The column name and value indexes must be contiguous and correspond with the elements in the arguments array starting with element ID 1. That is, F1 and V1 correspond to the field name and value in PIN\_FLD\_ARGS[1], F2 and V2 to the field name and value in PIN\_FLD\_ARGS[2], and so on.

## About Searching for Objects by Their POID Subcomponent

You can search for objects by specifying any of the following POID subcomponents in the search expression:

- Database number
- Storable class type
- Object ID

- Revision number

In addition to the  $F_n = V_n$  expression, you can use any one of the following expressions in the **where** clause of the search query template:

- **$F_n.db = V_n$**  to search by the POID database number. See ["Searching for Objects by the POID Database Number"](#).
- **$F_n.type = V_n$**  to search by the POID type. See ["Searching for Objects by the POID Type"](#).
- **$F_n.id = V_n$**  to search by the POID object ID. See ["Searching for Objects by the POID Object ID"](#).
- **$F_n.rev = V_n$**  to search by the POID revision number. See ["Searching for Objects by the POID Revision Number"](#).

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**Tip:** SQL expressions for searching Oracle databases can include optimizer hints. You can use any hint supported by Oracle. See the Oracle Database documentation for complete information.

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### Searching for Objects by the POID Database Number

The following example shows the PCM\_OP\_SEARCH input flist with the POID database number specified in the search query:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search/pin 0 0
0 PIN_FLD_FLAGS        INT [0] 256
0 PIN_FLD_TEMPLATE     STR [0] "select X from /service where F1.db = V1 "
0 PIN_FLD_RESULTS     ARRAY [*] allocated 20, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/ip -1 0
0 PIN_FLD_ARGS         ARRAY [1] allocated 20, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/% 1 0
```

### Searching for Objects by the POID Type

The following example shows the PCM\_OP\_SEARCH input flist with the POID type specified in the search query:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search/pin 0 0
0 PIN_FLD_FLAGS        INT [0] 256
0 PIN_FLD_TEMPLATE     STR [0] "select X from /service where F1.type like V1 "
0 PIN_FLD_RESULTS     ARRAY [3] allocated 1, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/ip -1 0
0 PIN_FLD_ARGS         ARRAY [1] allocated 1, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/IP 1 0
```

### Searching for Objects by the POID Object ID

The following example shows the PCM\_OP\_SEARCH input flist with the POID object ID specified in the search query:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search/pin 0 0
0 PIN_FLD_FLAGS        INT [0] 256
0 PIN_FLD_TEMPLATE     STR [0] "select X from /service/ip where F1 like V1 AND
F2.id = V2"
0 PIN_FLD_RESULTS     ARRAY [0] allocated 2, used 2
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/ip -1 0
1  PIN_FLD_ACCOUNT_OBJ POID [0] 0.0.0.1 /account -1 0
0 PIN_FLD_ARGS         ARRAY [1] allocated 1, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /service/ip -1 0
0 PIN_FLD_ARGS         ARRAY [2] allocated 1, used 1
```

```
1 PIN_FLD_ACCOUNT_OBJ POID [0] 0.0.0.1 /account 24295 1 0
```

### Searching for Objects by the POID Revision Number

The following example shows the PCM\_OP\_SEARCH input flist with the POID revision number specified in the search query:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search/pin 0 0
0 PIN_FLD_FLAGS        INT [0] 256
0 PIN_FLD_TEMPLATE     STR [0] "select X from /account where F1.rev = 10 "
0 PIN_FLD_RESULTS      ARRAY [0] allocated 2, used 2
1 PIN_FLD_POID          POID [0] 0.0.0.1 /account -1 0
1 PIN_FLD_NAMEINFO     ARRAY [*] allocated 0, used 0
0 PIN_FLD_ARGS         ARRAY [1] allocated 1, used 1
1 PIN_FLD_POID          POID [0] 0.0.0.1 /account 1897978 0
```

### Search Query Syntax for Count-Only Searches

You can search using the following syntax:

```
"select result from object_name where expression"
```

where *result* is a count value returned when a search is performed using the PCM\_OPFLG\_COUNT\_ONLY flag. This flag returns only the number of matches found by the search.

The following example shows the PCM\_OP\_SEARCH input flist for counting the total journal objects:

```
...
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /journal where F1 = V1 "
0 PIN_FLD_FLAGS        INT [0] 0
0 PIN_FLD_ARGS         ARRAY [1]
1 PIN_FLD_POID          POID [0] 0.0.0.1 /journal -1 0
0 PIN_FLD_RESULTS      ARRAY [*] NULL
...
```

To run opcodes using **testnap**, use the **xop** command:

```
vxop PCM_OP_SEARCH 0x10 1
```

where **0x10** is a PCM\_OPFLG\_COUNT\_ONLY flag and **1** is the buffer.

The opcode returns the count as the index of the PIN\_FLD\_RESULTS array. For example:

```
...
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_RESULTS      ARRAY [7] NULL array ptr
...
```

where **7** is the total journal count.

### Search Query Syntax for Calculate-Only Searches

You can search using the following syntax:

```
"select result from object_name where expression"
```

where *result* is a calculated value returned when a search is performed by using the calculate-only flag. There are two forms of the calculate-only flag:

- SRCH\_CALC\_ONLY\_1

This flag returns a single value. You specify one calculation in the search query. For example:

```
"select sum( F1 ) from object_name where expression"
```

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**Important:** You must include spaces around **F1**.

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**F1** references the field value of PIN\_FLD\_ARGS array element 1 on the input flist. You must include the PIN\_FLD\_AMOUNT field with an element ID of 1 as the only field in the PIN\_FLD\_RESULTS array.

- SRCH\_CALC\_ONLY

This flag can return one or more values. You specify each calculation in the search query. For example:

```
"select sum( F1 ), avg( F2 ) from object_name where expression"
```

For multiple results, you must include a PIN\_FLD\_AMOUNT field in the PIN\_FLD\_RESULTS array for each result to return.

If you use SRCH\_CALC\_ONLY with the PCM\_OPFLG\_SRCH\_CALC\_RESULTS flag not set (which is the default), all PIN\_FLD\_AMOUNT values are returned in the PIN\_FLD\_RESULTS array. For example:

```
...
0 PIN_FLD_RESULTS      ARRAY [0]
1  PIN_FLD_AMOUNT      DECIMAL [1]
1  PIN_FLD_AMOUNT      DECIMAL [2]
...
```

If you use SRCH\_CALC\_ONLY with the PCM\_OPFLG\_SRCH\_CALC\_RESULTS flag set, each PIN\_FLD\_AMOUNT value is returned in its own PIN\_FLD\_RESULTS array. For example:

```
0 PIN_FLD_RESULTS      ARRAY [0]
1  PIN_FLD_AMOUNT      DECIMAL [0]
0 PIN_FLD_RESULTS      ARRAY [1]
1  PIN_FLD_AMOUNT      DECIMAL [0]
....
```

## Using the PIN\_FLD\_PARAMETERS Field

When you use a predefined search template, you can use an optional **\$1** object type parameter in the **from** clause of the search query. This parameter specifies a subclass and allows you to specialize the search without having to modify the stored template.

You use a PIN\_FLD\_PARAMETERS field when you use the **\$1** parameter. The **\$1** parameter in the search template is replaced by the value of the PIN\_FLD\_PARAMETERS field on the input flist.

For example, if your template search query is the following:

```
"select X from /device/$1 where F1 = V1 "
```

and your input flist contains the following:

```
...
0 PIN_FLD_ARGS          ARRAY [1] allocated 20, used 1
1  PIN_FLD_POID          POID [0] 0.0.0.1 /device/sim -1 0
```



```
0 PIN_FLD_PARAMETERS STR [0] "sim"
...
```

The string "sim" is substituted for the \$1 parameter in the search template and the search looks for the arguments in the `/device/sim` storable class.

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**Important:**

- Using this field does not restrict the search to storable objects of the type it specifies. To restrict the search, specify the class type POIDs in a `PIN_FLD_ARGS` array.
  - Be sure to format the value of `PIN_FLD_PARAMETERS` on the input flist correctly. For example, a value of `portal\user_info\` on the input flist does not work, and the search fails without returning an error message. However, when using `portal\user_info` without the trailing backslash, the search succeeds.
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## Limiting Search Results by Using the `PIN_FLD_MIN_ROW` and `PIN_FLD_MAX_ROW` Fields

You use the optional `PIN_FLD_MIN_ROW` and `PIN_FLD_MAX_ROW` fields in the input flist of the `PCM_OP_SEARCH` opcode to retrieve the records from the search result set using the start row and end row numbers. For example, if the `PCM_OP_SEARCH` opcode returns 1000 records in the search result set, if `PIN_FLD_MIN_ROW` is set to 200 and `PIN_FLD_MAX_ROW` is set to 300, the records from row number 200 to 300 are retrieved.

You can navigate through the search result set both in forward and backward directions. For example, after retrieving the records from 200 to 300, you can step backward through the search result set to retrieve the records from 100 to 200.

After the `PCM_OP_SEARCH` opcode is triggered, any modified records in the database are retrieved from the search result set only when the next time the `PCM_OP_SEARCH` opcode is triggered.

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**Important:** Opcodes that support multiple database schemas (for example, `PCM_OP_GLOBAL_SEARCH` and `PCM_OP_GLOBAL_STEP_SEARCH`) do not support retrieving the search results using row numbers.

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## Using the "in" Operator

Using the SQL *in* operator in your query is another way of simplifying your search criteria. If you use *in*, you must use the BRM syntax requirements for this operator:

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**Note:** When using the *in* operator, only POIDs and strings can be searched and POIDs must be type only.

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For example, "select X from /config where F1 in ( V1 , '/config/locales\_map' ) "

The **where** clause syntax must be entered exactly as shown and follow these requirements:

- There must be one space before *in*.

- There must be one space after *in* and also after the parenthesis following *in*.
- There must be one space between **V1** and the following comma.

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**Note:** The space between **V1** and the comma is only required when using the *in* operator.

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- All values in the query using an *in* operator must be inside parenthesis.

For example:

```
...where F1 in ( V1 , '/config/locales_map' ) and F2 in ( V2 ) "
```

A search using the following input flist will return the entire contents of **/config/notify** and **/config/locales\_map**:

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_FLAGS     INT  [0] 256
0 PIN_FLD_TEMPLATE  STR  [0] "select X from /config where F1 in (V1 ,
'/config/locales_map' )"
0 PIN_FLD_ARGS      ARRAY [1] allocated 20, used 1
1  PIN_FLD_POID     POID [0] 0.0.0.1 /config/notify -1 0
0 PIN_FLD_RESULTS  ARRAY [*] NULL array ptr
```

## Searching Subclasses

Because a subclass inherits the attributes of its parent class, a simple search includes results from all subclasses of the class specified in the arguments array, provided they match the search criteria. You only need to specify the most derived class which has a referenced argument in the **where** clause.

To constrain your search to criteria that exist only in a subclass, you must use this subclass on the query itself.

For example, the **/config/notify** object contains a **PIN\_FLD\_EVENTS** array, but its parent class, **/config**, does not. If your search argument is contained in the **PIN\_FLD\_EVENTS** array of the **/config/notify** object, but you specify the **/config** object, the search will fail.

The *faulty* flist looks like this:

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_FLAGS     INT  [0] 256
0 PIN_FLD_TEMPLATE  STR  [0] "select X from /config where F1 = V1 "
0 PIN_FLD_ARGS      ARRAY [1] allocated 20, used 1
1  PIN_FLD_EVENTS   ARRAY [0] allocated 20, used 1
2  PIN_FLD_TYPE_STR STR  [0] "/event/session"
0 PIN_FLD_RESULTS  ARRAY [*] NULL array ptr
```

The *correct* flist specifies the subclass containing the argument:

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_FLAGS     INT  [0] 256
0 PIN_FLD_TEMPLATE  STR  [0] "select X from /config/notify where F1 = V1 "
0 PIN_FLD_ARGS      ARRAY [1] allocated 20, used 1
1  PIN_FLD_EVENTS   ARRAY [0] allocated 20, used 1
2  PIN_FLD_TYPE_STR STR  [0] "/event/session"
0 PIN_FLD_RESULTS  ARRAY [*] NULL array ptr
```

## Returning Specific Classes

You must specify the storable objects you want returned in the PIN\_FLD\_ARGS array in the search input list. A search will return objects of the superclass or any other derived class. If you want to return only objects from the specified class, the POID of the class type must be **-1**.

To return only one specified class, include it in the arguments array:

```
0 PIN_FLD_TEMPLATE STR [0] "select X from /device/sim where F1 = V1 "
0 PIN_FLD_ARGS     ARRAY [1] allocated 1, used 1
1 PIN_FLD_POID    POID [0] 0.0.0.1 /device/sim -1 0
...
```

To return more than one class type, but restrict the results to only those types specified, add the class type POID for each type to return to the PIN\_FLD\_ARGS array and set each POID to **-1**:

```
0 PIN_FLD_TEMPLATE STR [0] "select X from /device/sim where F1 = V1 "
0 PIN_FLD_ARGS     ARRAY [1] allocated 1, used 1
1 PIN_FLD_POID    POID [0] 0.0.0.1 /device/sim -1 0
0 PIN_FLD_ARGS     ARRAY [2] allocated 1, used 1
1 PIN_FLD_POID    POID [0] 0.0.0.1 /device/num -1 0
...
```

To return only a specific class and all its subclasses, add the POID of the parent class type to the argument list, set the POID to **-1**, use a **like** operator in the **where** clause, and add a percent sign (%) at the end of the class type:

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**Note:** The **like** operator is used only when searching for strings.

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```
0 PIN_FLD_TEMPLATE STR [0] "select X from /device/sim where F1 like V1 "
0 PIN_FLD_ARGS     ARRAY [1] allocated 1, used 1
1 PIN_FLD_POID    POID [0] 0.0.0.1 /device/sim% -1 0
...
```

## Returning Entire Arrays

Because arrays are fields in storable classes, to return an array you must add it to the PIN\_FLD\_RESULTS array in the search opcode input list. To return the entire contents of an array, you specify the array and give it a NULL value. A NULL array is different from an empty array in which elements are allocated but not used.

For example, to retrieve the entire contents of the PIN\_FLD\_NAMEINFO array from the **/account** object, use the following input list:

```
0 PIN_FLD_POID    POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_FLAGS  INT [0] 256
0 PIN_FLD_TEMPLATE STR [0] "select X from /account where F1 = V1 "
0 PIN_FLD_ARGS     ARRAY [1] allocated 20, used 1
1 PIN_FLD_POID    POID [0] 0.0.0.1 /account 12345 0
0 PIN_FLD_RESULTS ARRAY [*] NULL array ptr
1 PIN_FLD_NAMEINFO ARRAY [*] NULL (instead of: ALLOCATED 20, USED 0 )NULL
```

When constructing this list in your application, to add a NULL array you must use PIN\_FLIST\_ELEM\_SET instead of PIN\_FLIST\_ELEM\_ADD.

For example:

```
PIN_FLIST_ELEM_SET(flistp, NULL, PIN_FLD_NAMEINFO, PCM_RECID_ALL, ebufp);
```

The following entry is *incorrect* because it adds an empty array instead of a NULL array:

```
PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_NAMEINFO, PCM_RECID_ALL, ebufp);
```

## Search Template Examples

You must provide all arguments for each search template. The following logic is used when a search is performed:

```
If the results flist is a NULL flist {
  if CM_OPFLG_COUNT_ONLY is set {
    return the count of matched objects (search count)
  } else {
    return each of the entire objects that matches
      (search robj)
  }
} else {
  If this is a calculated search {
    return the result of the calculation
  } else {
    for each object matched, return just those fields
      specified on the RESULTS flist
  }
}
```

## Using a Predefined Template

The following example is a predefined search template that you store in the database as a `/search` object. The search query placeholders are replaced by the values specified in the arguments array in the input flist, which determine the objects you search for.

```
-- 301 -- 2 arg = search in /pop
insert into search_t (
  poid_db, poid_type, poid_id0, poid_rev,
  name,
  created_t, mod_t,
  --
  flags,
  template
) values (
  DB_NO, '/search', 301, 1,
  '2 arg = search in /pop',
  DATE, DATE,
  --
  SRCH_DISTINCT,
  'select X from /pop where F1 = V1 and F2 = V2 '
);
```

The template ID is **301** and the **where** clause has two arguments. You need to enter the search template in the database with the valid date values and database number. Your search template will not work unless it is in the database. When your application performs a search, it calls ID **#301** and your flist must contain the two arguments.

To create a predefined search template:

1. Create a search flist that specifies the template. The following example shows how to create a search flist that specifies the above template:

```

/*****
    * Allocate the flist for searching.
    *****/
flistp = PIN_FLIST_CREATE(ebufp);

/*****
    * Get the database number.
    *****/
poidp = (poid_t *)PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_POID, 0, ebufp);
database = PIN_POID_GET_DB(poidp);

/*****
    * Use 301, the 2 arg search for pop objects.
    *****/
vp = PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_ANI, 1, ebufp);
id = (u_int64)301;
objp = PIN_POID_CREATE(database, "/search", id, ebufp);
PIN_FLIST_FLD_PUT(flistp, PIN_FLD_POID, (void *)objp, ebufp);

/*****
    * Return pop that matches ani and is a primary pop.
    *****/
a_flistp = PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_ARGS, 1, ebufp);
aniarray_flistp = PIN_FLIST_CREATE(ebufp);
/*
** PIN_FLD_ANI for our first arg.
*/
PIN_FLIST_FLD_SET(aniarray_flistp, PIN_FLD_ANI, vp, ebufp);
PIN_FLIST_ELEM_SET(a_flistp, aniarray_flistp, PIN_FLD_ANIS, 0, ebufp);
/*
** PIN_FLD_TYPE for our second arg.
*/
a_flistp = PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_ARGS, 2, ebufp);
aniarray_flistp = PIN_FLIST_CREATE(ebufp);
PIN_FLIST_FLD_SET(aniarray_flistp, PIN_FLD_TYPE, (void *)&type, ebufp);
PIN_FLIST_ELEM_SET(a_flistp, aniarray_flistp, PIN_FLD_ANIS, 0, ebufp);
PIN_DESTROY_FLIST(aniarray_flistp, ebufp);

/*****
    * Put on the PIN_FLD_RESULTS array for our results.
    *****/
PIN_FLIST_ELEM_SET(flistp, (void *)NULL, PIN_FLD_RESULTS, -1, ebufp);

/*****
    * Call the DM to do the search.
    *****/
PCM_OP(ctxp, PCM_OP_SEARCH, 0, flistp, &r_flistp, ebufp);

```

The search flist fields passed in might look like this:

```

0 PIN_FLD_POID      POID [0] 0.0.0.2 /search 301 0
0 PIN_FLD_ARGS     ARRAY [1] allocated 20, used 1
1  PIN_FLD_ANIS    ARRAY [0] allocated 20, used 1
2  PIN_FLD_ANI     STR [0] "408343"
0 PIN_FLD_ARGS     ARRAY [2] allocated 20, used 1
1  PIN_FLD_ANIS    ARRAY [0] allocated 20, used 1
2  PIN_FLD_TYPE    INT [0] 4
0 PIN_FLD_RESULTS  ARRAY [*] Null pointer

```

2. Load the search template into the database. You can use **testnap** to load the search template into the database. For more information, see "[Creating a New Search Object](#)".
3. Add a copy of the new search template to the **init\_objects.source** file.

When Storage Manager receives the flist, it first queries the database to find the template with **poid\_id 301**. When it has the template, it looks for the **PIN\_FLD\_ARGS** array on your input flist and substitutes field numbers with field names and values with the values passed in. It then performs the search and returns the matching storable objects from the database.

In this example, no specific fields were specified to be returned, so the entire storable object that matches the search criteria is returned.

## Defining the Search Template at Runtime

You can perform a search without using a predefined, stored template by including a template field in the search flist.

The following example shows how to create a search flist that specifies a runtime search template:

```

/*****
    * Allocate the flist for searching.
    *****/
flistp = PIN_FLIST_CREATE(ebufp);
char * template = "select X from /pop where F1 = V1 and F2 = V2 "

/*****
    * Get the database number.
    *****/
poidp = (poid_t *)PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_POID,0, ebufp);
database = PIN_POID_GET_DB(poidp);

/*****
    * Use -1, the 2 arg search for pop objects.
    *****/
vp = PIN_FLIST_FLD_GET(in_flistp, PIN_FLD_ANI, 1, ebufp);
id = -1;
objp = PIN_POID_CREATE(database, "/search", id, ebufp);
PIN_FLIST_FLD_PUT(flistp, PIN_FLD_POID, (void *)objp, ebufp);
PIN_FLIST_FLD_SET (in_flistp, PIN_FLD_TEMPLATE, template, ebufp)

/*****
    * Return pop that matches ani and is a primary pop.
    *****/
a_flistp = PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_ARGS, 1, ebufp);
aniarray_flistp = PIN_FLIST_CREATE(ebufp);
/*
** PIN_FLD_ANI for our first arg.
*/
PIN_FLIST_FLD_SET(aniarray_flistp, PIN_FLD_ANI, vp, ebufp);
PIN_FLIST_ELEM_SET(a_flistp, aniarray_flistp, PIN_FLD_ANIS, 0, ebufp );
/*
** PIN_FLD_TYPE for our second arg.
*/
a_flistp = PIN_FLIST_ELEM_ADD(flistp, PIN_FLD_ARGS, 2, ebufp);
aniarray_flistp = PIN_FLIST_CREATE(ebufp);
PIN_FLIST_FLD_SET(aniarray_flistp, PIN_FLD_TYPE, (void *)&type, ebufp);
PIN_FLIST_ELEM_SET(a_flistp, aniarray_flistp, PIN_FLD_ANIS, 0, ebufp);

```

```

PIN_DESTROY_FLIST(aniarray_flistp, ebufp);

/*****
* Put on the PIN_FLD_RESULTS array for our results.
*****/
PIN_FLIST_ELEM_SET(flistp, (void *)NULL, PIN_FLD_RESULTS, -1, ebufp);

/*****
* Call the DM to do the search.
*****/
PCM_OP(ctxp, PCM_OP_SEARCH, 0, flistp, &r_flistp, ebufp);

```

The search flist fields passed in might look like this:

```

0 PIN_FLD_POID      POID [0] 0.0.0.2 /search/pop -1 0
0 PIN_FLD_ARGS     ARRAY [1] allocated 20, used 1
1 PIN_FLD_ANIS     ARRAY[0] allocated 20, used 1
2   PIN_FLD_ANI     STR [0] "408343"
0 PIN_FLD_ARGS     ARRAY [2] allocated 20, used 1
1   PIN_FLD_ANIS   ARRAY[0] allocated 20, used 1
2   PIN_FLD_TYPE   INT [0] 4
0 PIN_FLD_RESULTS  ARRAY [*] Null pointer
0 PIN_FLD_TEMPLATE STR [0] select X from /pop where F1 = V1 and F2 = V2

```

With the template field in the flist, Storage Manager looks for the PIN\_FLD\_ARGS array on your input flist and substitutes field numbers with field names and values with the values passed in. It then performs the search and returns the matching storable objects from the database. Note that the arguments in the PIN\_FLD\_ARGS array must be the specified classes and not the superclass.

In this example, no specific fields were specified to be returned, so the entire storable object that matches the search criteria is returned.

## About Single-Schema Searches

There are two basic ways to search for information in a single database schema:

- Search the schema and return all of the results at one time by calling PCM\_OP\_SEARCH.
- Search the schema with PCM\_OP\_STEP\_SEARCH, which uses PCM\_OP\_STEP\_NEXT and PCM\_OP\_STEP\_END to display the results as smaller sets of accounts.

The searches performed by PCM\_OP\_SEARCH and PCM\_OP\_STEP\_SEARCH are identical; they take the same input flist and return the same results. The results of PCM\_OP\_SEARCH, however, can be very large—large enough to use all the Data Manager (DM) shared memory. If you expect the size of your search results to be very large, use the PCM\_OP\_STEP\_SEARCH opcode for the search. Step searching has the following advantages:

- **Speed:** The search results come back much faster in smaller pieces. PCM\_OP\_STEP\_SEARCH returns the first set of results immediately; it does not wait for the entire result set to be built.
- **System Resources:** PCM\_OP\_STEP\_SEARCH allocates just enough shared memory in the DM for a single set of results at a time. PCM\_OP\_SEARCH results use enough shared memory for the entire result set all at one time.

The disadvantage to step searching is that you must call all three step search opcodes for each search: PCM\_OP\_STEP\_SEARCH, PCM\_OP\_STEP\_NEXT, and PCM\_OP\_STEP\_END.

## Performing a Search on a Single Schema

To perform a search on a single database schema, use the `PCM_OP_SEARCH` opcode. This opcode enables a client application to search for storable objects that meet a set of criteria defined by the client application.

---

---

**Important:** Use this opcode only to search a single, known schema. If your BRM implementation uses multiple schemas and you need to search more than one, use the `PCM_OP_GLOBAL_SEARCH` opcode.

---

---

For information about required fields in the input flist, see "[About the Search Input Flist](#)".

This opcode performs a search by creating a search template at runtime. To use a stored template instead, the POID must specify a template `/search` object. If it is specified, this opcode searches for a stored template in the database schema and uses that template for the search. For information on how to set up and use stored templates for search criteria, see "[About Search Templates](#)".

---

---

**Note:** Performing a search using a `/search` object template stored in the database is supported but not recommended.

---

---

Search results can be manipulated by using the flist field handling macros. For a list of opcodes, see "Flist Field-Handling Macros" in *BRM Developer's Reference*.

### Flags

The following flags are used in the call to the `PCM_OP_SEARCH` opcode:

- To return only the number of matching results, use `PCM_OPFLG_COUNT_ONLY`. See "[Flags](#)".
- To increase performance, use `PCM_OPFLG_CACHEABLE`. See "[Improving Performance when Working with Objects](#)".

### Memory Management

If your search returns a large amount of data, you need to make sure there is sufficient memory available to hold that data. To control the size of the data returned, use the `PCM_OP_STEP_SEARCH` opcode.

For a discussion of when to use searching and step searching, see "[About Single-Schema Searches](#)".

For a discussion of the memory implications of searching, see "[The Impact of Searches on Shared Memory Allocation](#)".

### Examples

For an example of a simple search, see "[Simple Search Example](#)".

For examples of input flists for complex searches, see "[Complex Searches](#)".

For a sample search program that searches for a single and multiple results, see `BRM_Home/apps/sample/sample_search.c`.



## Performing a Step Search on a Single Schema

To perform a step search on a single database schema, use the PCM\_OP\_STEP\_SEARCH opcode.

---



---

**Important:** Use this opcode only to search a single, known schema. If your BRM implementation uses multiple schemas and you need to search more than one, use the PCM\_OP\_GLOBAL\_SEARCH opcode.

---



---

This opcode enables a client application to define search criteria, search for storable objects using those criteria, and receive a specified number of result sets. The advantage of using this opcode instead of PCM\_OP\_SEARCH is that the results are returned in discrete chunks, which enables you to control resource usage in both the DM and the application.

For information on when to use PCM\_OP\_SEARCH and PCM\_OP\_STEP\_SEARCH, see "[About Single-Schema Searches](#)".

This opcode must be used in combination with the PCM\_OP\_STEP\_NEXT and PCM\_OP\_STEP\_END opcodes to complete a step search cycle. The cycle must start with PCM\_OP\_STEP\_SEARCH, which initiates a step search and gets the first set of PIN\_FLD\_RESULT elements. One or more PCM\_OP\_STEP\_NEXT opcodes follow, each retrieving the next specified number of result sets. PCM\_OP\_STEP\_END must come last to end the step search.

---



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**Note:** Stepping backward through the result set is not supported.

---



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When a step search is initiated, no other functions can be performed, including another step search, until the search cycle is completed. If a second PCM\_OP\_STEP\_SEARCH opcode is sent to the database before a first has finished its search cycle, an error is returned to the client.

The search criteria are passed in by the client application on the input flist. The input flist must contain a POID, and its type must be `/search`. The POID is ignored. You must also include a PIN\_FLD\_RESULTS array that indicates which fields and how many matching results to return for this opcode.

In the PIN\_FLD\_RESULTS\_LIMIT field, specify the maximum number of results to be returned from all steps of the search. The information from this field is conveyed to the database so that the search is executed more efficiently. If this field is not specified, all matching results are cached, even if they are not returned.

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**Important:** If the search uses an **order by** clause, the PIN\_FLD\_RESULTS\_LIMIT field causes incorrect sorting. Do not use the PIN\_FLD\_RESULTS\_LIMIT field if the search includes an **order by** clause.

---



---

Specify search arguments in the PIN\_FLD\_ARGS array on the input flist. Each element of the array contains one argument for the search. You must provide at least one argument. The maximum number of search arguments is 32. Indicate which argument is contained in an array element sub-flist by specifying the element ID. For example, element ID 1 corresponds to argument 1.

Search results can be manipulated by using the flist field handling macros. For a list of opcodes, see "Flist Field-Handling Macros" in *BRM Developer's Reference*.

To increase performance, use `PCM_OPFLG_CACHEABLE`. See ["Improving Performance when Working with Objects"](#).

### Examples

For an example of input and return flists for step searching, see ["Step Search Example"](#).

For examples of input flists for complex searches, see ["Complex Searches"](#).

For a sample search program that searches for a single and multiple results, see `BRM_Home/apps/sample/sample_search.c`.

## Getting the Next Set of Search Results from a Step Search

The `PCM_OP_STEP_NEXT` opcode enables a client application to receive the next set of results from a search initiated by `PCM_OP_STEP_SEARCH`. Results of the search are returned in discrete chunks.

This opcode must be used in combination with the `PCM_OP_STEP_SEARCH` and `PCM_OP_STEP_END` opcodes to complete the step search cycle. `PCM_OP_STEP_SEARCH` initiates step searching and gets the first set of `PIN_FLD_RESULT` elements. `PCM_OP_STEP_NEXT` goes to the DM and gets the next set of `PIN_FLD_RESULT` elements. `PCM_OP_STEP_END` ends the step search.

Use this opcode for each set of results to be returned. Specify the maximum number of records to return as the element ID of the `PIN_FLD_RESULTS` element. To return no records, use zero. `PCM_OP_STEP_END` can be called at any time to end the search.

This opcode uses the same input flist as `PCM_OP_STEP_SEARCH`.

To increase performance, use the `PCM_OPFLG_CACHEABLE` flag. See ["Improving Performance when Working with Objects"](#).

## Ending a Step Search

To end a search result that has been initiated by `PCM_OP_STEP_SEARCH`, use the `PCM_OP_STEP_END` opcode.

This opcode must be used in combination with the `PCM_OP_STEP_SEARCH` and `PCM_OP_STEP_NEXT` opcodes to complete the step search cycle. `PCM_OP_STEP_SEARCH` initiates step searching and gets the first set of `PIN_FLD_RESULT` elements. `PCM_OP_STEP_NEXT` retrieves the next specified number of results. `PCM_OP_STEP_END` ends the step search.

## Simple Search Example

The following example of a simple `PCM_OP_SEARCH` searches for each account whose status is active and retrieves all corresponding events created in the last week:

```
elem_id = 0;
cookie = (pin_cookie_t)NULL;
while ((acct_flistp = PIN_FLIST_ELEM_GET_NEXT(flistp,
                                             PIN_FLD_RESULTS, &elem_id, 1, &cookie, ebufp))
      != (pin_flist_t *)NULL) {

    /* get the status of the current account */
    status = PIN_FLIST_FLD_GET(acct_flist, PIN_FLD_STATUS, 0, ebufp);

    /* process accordingly, based on status */
    switch (status) {
    case PIN_STATUS_ACTIVE:
```

```

/* fetch events created in the last week */
fetch_last_weeks_events(cur_flist, ebufp);
break;
case PIN_STATUS_INACTIVE:
/* do something */
break;
default:
/* log an error */
break;
}
}

fetch_last_weeks_events(acct_flist, ebufp)
{
/*
    * Create the search flist.
    */
s_flistp = PIN_FLIST_CREATE(ebufp);

/*
    * Create and add the search poid.
    */
search_poidp = PIN_POID_CREATE((int64)0, "/search", (int64)-1, ebufp);
PIN_FLIST_FLD_PUT(s_flistp, PIN_FLD_POID, (void *)search_poidp, ebufp);

/*
    * Add the search template.
    */
PIN_FLIST_FLD_PUT(s_flistp, PIN_FLD_TEMPLATE,
    (void *)"select X from /event where F1 = V1 and F2 > V2 ", ebufp);

/*
    * Add the search arguments.
    */
arg_flistp = PIN_FLIST_ELEM_ADD(s_flistp, PIN_FLD_ARGS, 1, ebufp);
acct_poidp = PIN_FLIST_FLD_TAKE(acct_flist, PIN_FLD_POID, 0, ebufp);
PIN_FLIST_FLD_PUT(arg_flistp, PIN_FLD_ACCOUNT_OBJ, acct_poidp, ebufp);

arg_flistp = PIN_FLIST_ELEM_ADD(s_flistp, PIN_FLD_ARGS, 2, ebufp);
one_week_ago = <timestamp corresponding to 1 week ago>;
PIN_FLIST_FLD_PUT(arg_flistp, PIN_FLD_CREATED_T, &one_week_ago, ebufp);

/*
    * Fetch everything.
    */
PIN_FLIST_FLD_PUT(s_flistp, PIN_FLD_RESULT, (void *)NULL, ebufp);

/*
    * Do the search.
    */
PCM_OP(pcm_ctxp, PCM_OP_SEARCH, PCM_OPFLG_READ_UNCOMMITTED,
    s_flistp, &r_flistp, ebufp);

/*
    * do something with the events we just fetched
    */
}

```

## Step Search Example

The following example shows the results of a call to `PCM_OP_STEP_SEARCH`. This step search has four steps.

---

**Note:** At the end of a step search, you do *not* receive a results array. You receive only your search POID, as shown at the end of this example.

---

### Input flist:

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /account where F1 like V1 "
0 PIN_FLD_FLAGS        INT [0] 0
0 PIN_FLD_ARGS         ARRAY [1]
1  PIN_FLD_NAMEINFO    ARRAY [*]
2    PIN_FLD_FIRST_CANON STR [0] "%"
0 PIN_FLD_RESULTS      ARRAY [4]
1  PIN_FLD_ACCOUNT_NO  STR [0] ""

```

### Search results:

```

# number of field entries allocated 5, used 5
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "ROOT.0.0.1"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 1 1
0 PIN_FLD_RESULTS      ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-8759"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 8759 133
0 PIN_FLD_RESULTS      ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-9267"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 9267 122
0 PIN_FLD_RESULTS      ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-9961"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 9961 128

```

### Results of the calls to `PCM_OP_STEP_NEXT`:

```

# number of field entries allocated 5, used 5
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-10709"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 10709 53
0 PIN_FLD_RESULTS      ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-10721"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 10721 98
0 PIN_FLD_RESULTS      ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-10881"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 10881 134
0 PIN_FLD_RESULTS      ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-11057"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 11057 122

# number of field entries allocated 5, used 5
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO  STR [0] "0.0.0.1-12047"
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 12047 75
0 PIN_FLD_RESULTS      ARRAY [1] allocated 2, used 2

```

```

1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12213"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12213 123
0  PIN_FLD_RESULTS       ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12241"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12241 122
0  PIN_FLD_RESULTS       ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12356"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12356 39

# number of field entries allocated 5, used 5
0  PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0  PIN_FLD_RESULTS       ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12484"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12484 45
0  PIN_FLD_RESULTS       ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12569"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12569 8
0  PIN_FLD_RESULTS       ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12590"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12590 19
0  PIN_FLD_RESULTS       ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12612"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12612 12

# number of field entries allocated 5, used 5
0  PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0  PIN_FLD_RESULTS       ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12697"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12697 8
0  PIN_FLD_RESULTS       ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12705"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12705 14
0  PIN_FLD_RESULTS       ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-12740"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 12740 54
0  PIN_FLD_RESULTS       ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-13090"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 13090 38

# number of field entries allocated 5, used 5
0  PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0  PIN_FLD_RESULTS       ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-13346"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 13346 45
0  PIN_FLD_RESULTS       ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-13476"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 13476 48
0  PIN_FLD_RESULTS       ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-13732"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 13732 66
0  PIN_FLD_RESULTS       ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-13956"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 13956 84

# number of field entries allocated 5, used 5
0  PIN_FLD_POID          POID [0] 0.0.0.1 /search 0 0
0  PIN_FLD_RESULTS       ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO    STR [0] "0.0.0.1-14313"
1  PIN_FLD_POID          POID [0] 0.0.0.1 /account 14313 8
0  PIN_FLD_RESULTS       ARRAY [1] allocated 2, used 2

```

```

1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-14825"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 14825 8
0 PIN_FLD_RESULTS          ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-14896"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 14896 70
0 PIN_FLD_RESULTS          ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-15069"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 15069 12

# number of field entries allocated 5, used 5
0 PIN_FLD_POID            POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_RESULTS          ARRAY [0] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-15129"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 15129 8
0 PIN_FLD_RESULTS          ARRAY [1] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-15257"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 15257 8
0 PIN_FLD_RESULTS          ARRAY [2] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-15385"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 15385 8
0 PIN_FLD_RESULTS          ARRAY [3] allocated 2, used 2
1  PIN_FLD_ACCOUNT_NO      STR [0] "0.0.0.1-15824"
1  PIN_FLD_POID            POID [0] 0.0.0.1 /account 15824 68

```

Final set of search results:

```

# number of field entries allocated 1, used 1
0 PIN_FLD_POID            POID [0] 0.0.0.1 /search 0 0

```

---



---

**Note:** You do not receive a results array with the last call to `PCM_OP_STEP_NEXT` because there are no more search results. You call `PCM_OP_STEP_END` to finish the search.

---



---

Results of the call to `PCM_OP_STEP_END`:

```

# number of field entries allocated 3, used 3
0 PIN_FLD_POID            POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_ARGS            ARRAY [1] allocated 1, used 1
1  PIN_FLD_NAMEINFO        ARRAY [0] allocated 1, used 1
2  PIN_FLD_FIRST_CANON     STR [0] "%"
0 PIN_FLD_RESULTS          ARRAY [4] allocated 1, used 1
1  PIN_FLD_ACCOUNT_NO      STR [0] ""

```

## Performing Exact Searches

To search and return array elements, you use an exact search. Exact searches enable you to limit results to only the array elements that match the search criteria.

If your search includes a **where** clause and you want that clause to be applied to array elements, use the `SRCH_EXACT (512)` flag with the `PCM_OP_SEARCH` and `PCM_OP_STEP_SEARCH` opcodes. If you do not use the `SRCH_EXACT` flag, the **where** clause is applied to the object and not limited to array elements that match the search criteria within that object. The results, therefore, include all items in the object instead of only those items in the array that match your search criteria.

For example, suppose you want to search for all */rate* objects with general ledger IDs greater than 0 and element IDs less than 1001. *Without* the `SRCH_EXACT` flag, the input flist looks like this:

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 0 0
0 PIN_FLD_TEMPLATE            STR [0] "select X from /rate where F1 > V1 and
F2 < V2 "
0 PIN_FLD_FLAGS                INT [0] 256

0 PIN_FLD_ARGS                ARRAY [1] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 20, used 1
3   PIN_FLD_GL_ID            INT [0] 0

0 PIN_FLD_ARGS                ARRAY [2] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 20, used 1
3   PIN_FLD_ELEMENT_ID       INT [0] 1001

0 PIN_FLD_RESULTS            ARRAY [0] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 20, used 2
3   PIN_FLD_ELEMENT_ID       INT [0] 0
3   PIN_FLD_GL_ID            INT [0] 0

```

The output flist might look like this:

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 0 0

0 PIN_FLD_RESULTS            ARRAY [0] allocated 2, used 2
1   PIN_FLD_POID                POID [0] 0.0.0.1 /rate 8257 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 2, used 2
3   PIN_FLD_ELEMENT_ID       INT [0] 978
3   PIN_FLD_GL_ID            INT [0] 13000001

0 PIN_FLD_RESULTS            ARRAY [1] allocated 2, used 2
1   PIN_FLD_POID                POID [0] 0.0.0.1 /rate 8321 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 2, used 2
3   PIN_FLD_ELEMENT_ID       INT [0] 978
3   PIN_FLD_GL_ID            INT [0] 12000065

0 PIN_FLD_RESULTS            ARRAY [3] allocated 2, used 2
1   PIN_FLD_POID                POID [0] 0.0.0.1 /rate 8702 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 2, used 2
3   PIN_FLD_ELEMENT_ID       INT [0] 978
3   PIN_FLD_GL_ID            INT [0] 1000001

0 PIN_FLD_RESULTS            ARRAY [2] allocated 2, used 2
1   PIN_FLD_POID                POID [0] 0.0.0.1 /rate8446 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2   PIN_FLD_BAL_IMPACTS      ARRAY [0] allocated 2, used 2
3   PIN_FLD_ELEMENT_ID       INT [0] 1000006
3   PIN_FLD_GL_ID            INT [0] 51000001

```

---

**Note:** The last result is incorrect; the element ID is greater than 1001. Incorrect results such as this occur because the search finds all the objects that match the condition in the **where** clause but does not apply that clause to the array elements.

---

If you use `SRCH_EXACT` by entering a flag value of **512**, the input flist looks like this:

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 0 0

0 PIN_FLD_TEMPLATE            STR [0] "select X from /rate where F1 > V1
and F2 < V2 "

0 PIN_FLD_FLAGS               INT [0] 512

0 PIN_FLD_ARGS                ARRAY [1] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 20, used 1
3       PIN_FLD_GL_ID         INT [0] 0

0 PIN_FLD_ARGS                ARRAY [2] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 20, used 1
3       PIN_FLD_ELEMENT_ID    INT [0] 1001

0 PIN_FLD_RESULTS            ARRAY [0] allocated 20, used 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 20, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 20, used 2
3       PIN_FLD_ELEMENT_ID    INT [0] 0
3       PIN_FLD_GL_ID         INT [0] 0
    
```

The output flist might look like this:

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /search 0 0

0 PIN_FLD_RESULTS            ARRAY [0] allocated 2, used 2
1   PIN_FLD_POID              POID [0] 0.0.0.1 /rate 8257 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 2, used 2
3       PIN_FLD_ELEMENT_ID    INT [0] 978
3       PIN_FLD_GL_ID         INT [0] 13000001

0 PIN_FLD_RESULTS            ARRAY [1] allocated 2, used 2
1   PIN_FLD_POID              POID [0] 0.0.0.1 /rate 8321 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 2, used 2
3       PIN_FLD_ELEMENT_ID    INT [0] 978
3       PIN_FLD_GL_ID         INT [0] 12000065

0 PIN_FLD_RESULTS            ARRAY [2] allocated 2, used 2
1   PIN_FLD_POID              POID [0] 0.0.0.1 /rate 8702 1
1   PIN_FLD_QUANTITY_TIERS    ARRAY [0] allocated 1, used 1
2     PIN_FLD_BAL_IMPACTS     ARRAY [0] allocated 2, used 2
3       PIN_FLD_ELEMENT_ID    INT [0] 978
3       PIN_FLD_GL_ID         INT [0] 1000001
    
```

---

**Note:** This search returns only objects that satisfy both parts of the **where** clause. Spurious results are eliminated.

---

## Using "like" with Exact Searches

You use a **like** operator with an exact search to return all elements of an array that match the search criteria.



The following example returns all arrays from **/account** that contain any string in the **PIN\_FLD\_FIRST\_CANNON** field:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /account where F1 like V1 "
0 PIN_FLD_ARGS         ARRAY [1]
1  PIN_FLD_NAMEINFO    ARRAY [*]
2    PIN_FLD_FIRST_CANNON STR [0] "%"
0 PIN_FLD_RESULTS      ARRAY [*] NULL array ptr
```

## Exact Search Limitations

When performing a complex search (searching across multiple objects), using an array element as a join column is not supported with exact searches. In the **where** clause, trying to match a value in one table with a value in another table can return results that do not match your search criteria.

For example, to find all products in an account with a product name that begins with the string **"Pr"**, you might use the following query:

```
"select X from /account 1, /product 2 where 1.F1 = V1 and 1.F2 = 2.F3 and 2.F4
like V4 "
```

Where the arguments array is:

```
0 PIN_FLD_ARGS         ARRAY [1] allocated 20, used 1
1  PIN_FLD_POID        POID [0] 0.0.0.1 /account 12345
0 PIN_FLD_ARGS         ARRAY [2] allocated 20, used 1
1  PIN_FLD_PRODUCTS   ARRAY [0]
2    PIN_FLD_PRODUCT_OBJ POID [0] NULL
0 PIN_FLD_ARGS         ARRAY [3] allocated 20, used 1
1  PIN_FLD_POID        POID [0] NULL
0 PIN_FLD_ARGS         ARRAY [4] allocated 20, used 1
1  PIN_FLD_NAME        STR [0] "Pr%"
```

However, with an exact search, **"1.F2 = 2.F3"** in the **where** clause causes the search to return *all* products in the account if at least one product name starts with the string **"Pr"**.

An alternative to using an array element as a join column with exact searches is to perform two separate searches and then compare the search results for matching data. In the above example, you search **/product** for products that begin with **"Pr"** and then perform the preceding search as shown to return all products for the **/account**. Then, for each POID in the **/product** list, iterate through the **/account** products list to find the matching products.

## Complex Searches

You can perform a complex search across multiple objects by including each object in the *object\_name* section of the **PIN\_FLD\_TEMPLATE** string.

In a simple search, when a client wants a list of all events pertaining to deal purchases, the client must perform two searches:

- Get all deal POIDs (with the deal names).
- Search on the event class (and subclasses) with each of the deal POIDs obtained from the previous search for the required event fields.

A complex search eliminates the need for cascading searches and enables the client to issue one complex search instead of multiple simple searches.

---



---

**Note:** The search results include only the fields from the first class in the query.

---



---

Use the following rules when creating a complex search template:

- When connecting separate objects types (**1.F3 = 2.F4**), explicitly specify the join clause as part of the template by using the form **X.Fm = Y.Fn**.
- **Fm** and **Fn** must have a value specified as a NULL pointer in the PIN\_FLD\_ARGS array.
- When you use an **order by** clause (which can be included when you have a **where** clause), set the SRCH\_DISTINCT flag to 0.
- A maximum of six separate objects is allowed in a complex search template.

The following example shows the template syntax to retrieve all deal-purchase events:

```
"select X from /event/billing/deal 1, /deal 2 where (2.F1 Like V1 and 2.F2 != V2 and 1.F3 = 2.F4 ) order by 3.F5 "
```

---



---

**Note:** There are no stored templates available for complex searches.

---



---

## Complex Search Example

The following example searches for all deal purchase events.

Input list:

```
# number of field entries allocated 5, used 5
0 PIN_FLD_RESULTS      ARRAY [10]
1  PIN_FLD_SYS_DESCR   STR [0] NULL str ptr
1  PIN_FLD_ACCOUNT_OBJ POID [0] NULL poid pointer
1  PIN_FLD_POID        POID [0] NULL poid pointer
1  PIN_FLD_END_T       TSTAMP [0] (0) <null>
0 PIN_FLD_ARGS         ARRAY [1]
1  PIN_FLD_NAME        STR [0] "%"
0 PIN_FLD_ARGS         ARRAY [2]
1  PIN_FLD_POID        POID [0] 0.0.0.1 /deal 0 0
0 PIN_FLD_ARGS         ARRAY [3]
1  PIN_FLD_DEAL_INFO   SUBSTRUCT [0]
2  PIN_FLD_DEAL_OBJ    POID [0] NULL poid pointer
0 PIN_FLD_ARGS         ARRAY [4]
1  PIN_FLD_POID        POID [0] NULL poid pointer
0 PIN_FLD_TEMPLATE     STR [0] "select X from /event/billing/deal 1, /deal
2  where ( 2.F1 Like V1 and 2.F2 != V2 and 1.F3 = 2.F4 ) "
0 PIN_FLD_FLAGS        INT [0] 256
0 PIN_FLD_POID        POID [0] 0.0.0.1 /search -1 0
```

## Search without POID

Use the SEARCH\_WITHOUT\_POID (**1024**) flag to return data without the POID for each result. To do this, set the value to **1024**.

Without the SRCH\_WITHOUT\_POID flag set, the input list looks like this:

```
0 PIN_FLD_POID        POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /event where F1 like V1 "
```

```

0 PIN_FLD0 PIN_FLD_ARGS  ARRAY [1] allocated 20, used 1D_FLAGS INT [0] 0
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session -1 0
0 PIN_FLD_RESULTS      ARRAY [4] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0

```

The output flist might look like this:

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 20, used 2
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session 252887674388488909 1
0 PIN_FLD_RESULTS      ARRAY [1] allocated 20, used 2
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session 252887674388490957 1
0 PIN_FLD_RESULTS      ARRAY [2] allocated 20, used 2
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session 252887674388489103 1
0 PIN_FLD_RESULTS      ARRAY [3] allocated 20, used 2
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session 252887674388491981 1

```

With the SRCH\_WITHOUT\_POID flag set, the input flist looks like this:

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /event where F1 like V1 "
0 PIN_FLD_FLAGS        INT [0] 1024
0 PIN_FLD_ARGS         ARRAY [1] allocated 20, used 1
1 PIN_FLD_POID          POID [0] 0.0.0.1 /event/session -1 0
0 PIN_FLD_RESULTS      ARRAY [4] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0

```

The output flist might look like this:

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_RESULTS      ARRAY [0] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_RESULTS      ARRAY [1] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_RESULTS      ARRAY [2] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_RESULTS      ARRAY [3] allocated 20, used 1
1 PIN_FLD_ACCOUNT_OBJ  POID [0] 0.0.0.1 /account 1 0

```

## About Multischema (Global) Searches

BRM includes an alternative set of opcodes designed for use with multiple database schemas. Global searches on multiple schemas are similar to searches on a single schema with two main differences:

- No database number is specified in the search POID.
- The PCM\_OP\_GLOBAL\_SEARCH opcode is called instead of the PCM\_OP\_SEARCH opcode.

Use PCM\_OP\_SEARCH and the other single-schema search opcodes whenever you can because single-schema searches are the most efficient. A global search is expensive because it is performed synchronously. It opens a context to each schema and waits for all results to be returned before merging the results.

---

**Important:**

- BRM does not support using global searches when transactions are open.
  - Single-schema searches are useful only when you know the database number of the schema. If you do not know the specific schema to search, you must use a global search.
- 

For more information, see the following opcodes:

- To perform a global search, use the PCM\_OP\_GLOBAL\_SEARCH opcode. See "[Performing a Global Search](#)".
- To perform a global step search, use the following opcodes:
  - PCM\_OP\_GLOBAL\_STEP\_SEARCH
  - PCM\_OP\_GLOBAL\_STEP\_NEXT
  - PCM\_OP\_GLOBAL\_STEP\_ENDSee "[Performing a Global Step Search](#)".

## Performing a Global Search

To perform a global search, use the PCM\_OP\_GLOBAL\_SEARCH opcode. This opcode searches for storable objects across multiple database schemas.

This opcode enables a client application to search for storable objects that meet a set of criteria defined by the client application. Use this opcode when you do not know enough about the target object to specify its database schema. If you do know the specific schema to search, use PCM\_OP\_SEARCH instead.

The input flist contains a search template for a storable object in the database. The element ID of the PIN\_FLD\_ARGS element on the input flist specifies which argument is contained on its sub-flist. The maximum number of search arguments is 32.

The output flist is a list of storable objects that meet the search criteria. An array of PIN\_FLD\_RESULTS elements is returned, one for each storable object that was matched.

If one or more schemas are returning errors, those schemas are excluded from the search, and this opcode continues the search across the rest of the schemas. Errors that cause this exclusion include the following:

- A PCP context cannot be opened.
- A socket cannot be opened to a DM.
- A DM connection cannot be set to asynchronous mode.
- A send operation to the DM fails.
- A receive operation from the DM fails.

If the value of the PIN\_FLD\_RESULTS element on the input flist is **NULL**, each element of the returned array contains all the fields from the matched storable object.

If the PIN\_FLD\_RESULTS element on the input flist contains a sub-flist with fields, only those fields specified are returned for each of the matched storable objects.

You can manipulate the search results using the Flist Field Handling Macros. See the "[Flist Field-Handling Macros](#)" in *BRM Developer's Reference*.

## Limitations

The PCM\_OP\_GLOBAL\_SEARCH opcodes cannot do the following:

- Perform ORDER-BY searches
- Use the PCM\_OPFLG\_CALC\_ONLY parameter

## Transaction Cache

To improve performance, set the PCM\_OPFLG\_CACHEABLE flag.

Before the start of any search opcode, the Connection Manager (CM) writes into the database all objects that are in writable cache, have changed during the transaction, and are the same object type as the expected results of the search.

See "[Improving Performance when Working with Objects](#)".

## Examples

See the sample test program `sample_search.c` in `BRM_Home/apps/sample`. This program includes examples of the following:

- A read storable object search with a single result expected
- A read fields search with multiple results expected

## Performing a Global Step Search

To perform a global step search, use the PCM\_OP\_GLOBAL\_STEP\_SEARCH opcode. This opcode step searches for storable objects across multiple BRM database schemas. This opcode enables a client application to define search criteria, search for storable objects using that criteria, and receive a specified number of result sets.

---



---

**Note:** If you are searching for an object in a known database schema, use PCM\_OP\_STEP\_SEARCH instead.

---



---



---



---

**Important:** When you perform a global step search, follow best practices and call PCM\_OP\_GLOBAL\_STEP\_SEARCH before you call PCM\_OP\_GLOBAL\_STEP\_END. Calling PCM\_OP\_GLOBAL\_STEP\_END in the incorrect sequence might cause the CM to crash.

---



---

The search criteria are passed in by the client application in the form of a PCM\_OP\_GLOBAL\_SEARCH input flist. The input flist contains a search template for a storable object in the database. The element ID of the PIN\_FLD\_ARGS element on the input flist specifies which argument is contained on its sub-flist. The maximum number of search arguments is 32.

Be careful when you pass in the search criteria.

- If you have  $n$  schemas and ask for  $m$  results,  $(n \times m)$  results are fetched. Any extra results are cached in memory in the CM.
- A global search on  $n$  schemas opens  $n$  sockets, which could adversely affect performance.

PCM\_OP\_GLOBAL\_STEP\_SEARCH only initiates step searching and gets the first set of PIN\_FLD\_RESULT elements. PCM\_OP\_GLOBAL\_STEP\_NEXT retrieves the next specified number of results, and PCM\_OP\_GLOBAL\_STEP\_END ends the step search.

---

---

**Note:** Stepping backward through the result set is not supported.

---

---

No shared memory is allocated in the DM for the results until PCM\_OP\_GLOBAL\_STEP\_NEXT gets a part of the result set. When PCM\_OP\_GLOBAL\_STEP\_END ends the search, the shared memory is freed. An array of PIN\_FLD\_RESULTS elements is returned, one for each storable object that was matched.

If the value of the PIN\_FLD\_RESULTS element on the input flist is **NULL**, each element of the returned array contains all the fields from the matched storable object.

If the PIN\_FLD\_RESULTS element on the input flist contains a sub-flist with fields, only the specified fields are returned for each of the matched storable objects.

The array size of PIN\_FLD\_RESULTS determines the number of PIN\_FLD\_RESULT elements to return to the client.

An error is returned to the client if two PCM\_OP\_GLOBAL\_STEP\_SEARCH opcodes are sent to the server. If the client is in the middle of a step search, the first search must be ended before another is initiated.

This opcode uses the same input and output flists as PCM\_OP\_GLOBAL\_SEARCH.

### Transaction Cache

To improve performance, set the PCM\_OPFLG\_CACHEABLE flag.

Before the start of any search opcode, the CM writes into the database all objects that are in writable cache, have changed during the transaction, and are the same object type as the expected results of the search.

See "[Improving Performance when Working with Objects](#)".

### Examples

The *BRM\_Home/apps/sample/sample\_search.c* file contains example step searching code.

## Getting the Next Set of Search Results from a Global Step Search

To get the next set of search results, use the PCM\_OP\_GLOBAL\_STEP\_NEXT opcode.

This opcode enables a client application to receive the next set of results from a search initiated by PCM\_OP\_GLOBAL\_STEP\_SEARCH.

The PCM\_OP\_GLOBAL\_STEP\_SEARCH opcode determines the criteria for the search, sets the size of the results, and initiates the search. See that opcode for details. This opcode only receives results; it does not perform the search. PCM\_OP\_GLOBAL\_STEP\_END ends the step search, freeing the database cursor and returning any shared memory allocated for the results by the DM.

This opcode returns the results of the search in discrete chunks. That is, it goes to the DM and gets the next set of PIN\_FLD\_RESULT elements. You determine the size of this result set by using the PIN\_FLD\_RESULTS field on the input flist.

You can manipulate the search results by using the flist field handling macros. See "Flist Field-Handling Macros" in *BRM Developer's Reference*.

This opcode uses the same input and output flists as PCM\_OP\_GLOBAL\_SEARCH.

## Transaction Cache

To improve performance, set the PCM\_OPFLG\_CACHEABLE flag.

Before the start of any search opcode, the CM writes into the database all objects that are in writable cache, have changed during the transaction, and are the same object type as the expected results of the search.

See "[Improving Performance when Working with Objects](#)".

## Example

The *BRM\_Home/apps/sample/sample\_search.c* file contains example step searching code.

## Ending a Global Step Search

To end a global step search, use the PCM\_OP\_GLOBAL\_STEP\_END opcode. This opcode ends global step searching that has been initiated by PCM\_OP\_GLOBAL\_STEP\_SEARCH.

PCM\_OP\_GLOBAL\_STEP\_SEARCH sets the criteria for a step search, sets the size of the results, and initiates the search. See that opcode for details. PCM\_OP\_GLOBAL\_STEP\_NEXT only receives results; it does not do a search. This opcode ends the step search, freeing the database cursor and returning any shared memory allocated for the results by the DM.

This opcode uses the same input and output flists as PCM\_OP\_GLOBAL\_SEARCH.

The *BRM\_Home/apps/sample/sample\_search.c* file contains example step-searching code.

## Global Search Example

This example searches for all accounts with a billing cycle of 6 months:

```
/*
 * Create the search flist.
 */
s_flistp = PIN_FLIST_CREATE(ebufp);

/*
 * Create and add the search poid.
 */
search_poidp = PIN_POID_CREATE((int64)0, "/search", (int64)-1, ebufp);
PIN_FLIST_FLD_PUT(s_flistp, PIN_FLD_POID, (void *)search_poidp, ebufp);

/*
 * Add the search template.
 */
PIN_FLIST_FLD_PUT(s_flistp, PIN_FLD_TEMPLATE,
    (void *)"select X from /account where F1 = V1 ", ebufp);

/*
 * Add the search argument.
 */
arg_flistp = PIN_FLIST_ELEM_ADD(s_flistp, PIN_FLD_ARGS, 1, ebufp);
num_monthly_cycles = 6;
PIN_FLIST_FLD_PUT(arg_flistp, PIN_FLD_BILL_WHEN,
    (void *)&num_monthly_cycles, ebufp);

/*
```

```
* Add the results we want to fetch.
*/
rslt_flistp = PIN_FLIST_ELEM_ADD(s_flistp, PIN_FLD_RESULTS, 0, ebufp);
PIN_FLIST_FLD_PUT(rslt_flistp, PIN_FLD_POID, (void *)NULL, ebufp);
PIN_FLIST_FLD_PUT(rslt_flistp, PIN_FLD_ACCOUNT_NO, (void *)NULL, ebufp);
PIN_FLIST_FLD_PUT(rslt_flistp, PIN_FLD_STATUS, (void *)NULL, ebufp);

/*
* Do the search.
*/
PCM_OP(ctxp->pcm_ctxp, PCM_OP_GLOBAL_SEARCH, PCM_OPFLG_READ_UNCOMMITTED,
      s_flistp, &r_flistp, ebufp);
```

## Building the POID for the Input Flist

With multiple database schemas, all billing information, such as bill items and events for an account, must be in the same schema where the account is located. A common algorithm includes finding the POID for a BRM account object and then searching for additional data that is directly related to that account, such as bill items and events.

When building the PIN\_FLD\_POID (**FldPoid.getInst()** in Java) for the opcode input flist, it is common to use the database number of the login context. This *does not work* for multiple schemas. Instead, build the PIN\_FLD\_POID for the search input flist by using the database number from the account POID.

### Building POID for the Input Flist in C

```
void FindBillItemsForAnAccount(pcm_context_t* pContext, poid_t* pAcctPoid)
{
// Start building the search input FList.

// Obsolete way:
int64 ContextDB = pin_poid_get_db(pcm_get_userid(pContext));
poid_t* pSearchPoid = PINApp::PoidCreate( ContextDB, _T("/search"), 0, &ebufp );

// Right way:
poid_t* pSearchPoid = PINApp::PoidCreate( pin_poid_get_db(pAcctPoid), _
T("/search"), 0, &ebufp );
.
.
}
```

### Building POID for the Input Flist in Java

```
void FindBillItemsForAnAccount(PortalContext connection, Poid acctPoid)
{
// Start building the search input FList.

// Obsolete way:
Poid searchPoid = new Poid( connection.getCurrentDB(), 0, "/search" );

// Right way:
Poid searchPoid = new Poid( acctPoid.getDb(), 0, "/search" );
.
.
}
```



## The Impact of Searches on Shared Memory Allocation

For information about the shared memory implications of searching using PCM\_OP\_SEARCH or PCM\_OP\_GLOBAL\_SEARCH, see "How BRM Allocates Shared Memory for Searches" in *BRM System Administrator's Guide*.

## Improving Search Performance

Search operations often constitute most of the activity in the BRM database. When appropriate, it is a good idea to use the following techniques to improve search performance.

### Step Search Limits

You can improve search performance by limiting the size of search results.

You can specify the maximum number of objects to be returned for the entire step search (that is, for all steps of the search) by specifying the optional PIN\_FLD\_RESULTS\_LIMIT field in the input list of the following opcodes:

- PCM\_OP\_SEARCH
- PCM\_OP\_GLOBAL\_SEARCH
- PCM\_OP\_STEP\_SEARCH
- PCM\_OP\_GLOBAL\_STEP\_SEARCH

In the PCM\_OP\_SEARCH and PCM\_OP\_GLOBAL\_SEARCH opcodes, PIN\_FLD\_RESULTS\_LIMIT 100 has the same effect as PIN\_FLD\_RESULTS [100].

This information helps the RDBMS execute the search more efficiently.

---

---

**Note:** This limit does not apply to any search that uses an **order by** clause. It also does not apply to the PCM\_OP\_STEP\_NEXT or PCM\_OP\_GLOBAL\_STEP\_NEXT opcodes.

---

---

Limiting the size of search results helps the database to process the query more efficiently because it can stop processing as soon as it has fetched the required number of results. For example, if a search yields 4,000,000 qualifying results, PIN\_FLD\_RESULTS\_LIMIT 100 stops the processing after 100 matching results are found, so only a small subset of the data is scanned.

### Transaction Caching

You can improve performance by caching transactions. Without caching, search operations can search the same data object repeatedly within one transaction. By letting the CM cache transactions, you eliminate this redundancy and speed transaction processing. See "[Improving Performance when Working with Objects](#)".



---

---

## Creating Custom Fields and Storable Classes

This chapter provides instructions for creating custom fields and storable classes using the Oracle Communications Billing and Revenue Management (BRM) Software Development Kit (SDK) opcodes and Storable Class Editor, part of Developer Center. It also provides information about some utilities you might need to use with Storable Class Editor.

This chapter provides instructions for:

- Creating and deploying custom storable classes and fields.
- Exporting storable classes to and from the BRM database.

### About Fields and Storable Classes

BRM includes a large number of default fields and classes. You can create custom fields and storable classes to add new features and functionality. You can create subclasses of existing base classes as well as new base classes.

You create, modify, and delete storable classes by using the following:

- Storable Class Editor, a part of Developer Center. See ["About Storable Class Editor"](#).
- BRM SDK opcodes. See ["About BRM SDK Opcodes"](#).

For a description of the storable class structure and a list of predefined classes, see ["Understanding Flists and Storable Classes"](#).

### About Storable Class Editor

You can create subclasses and fields by using Storable Class Editor. Storable Class Editor is part of Developer Center, a suite of applications for BRM developers. For Developer Center system requirements and installation instructions, see ["About Developer Center"](#).

Use Storable Class Editor to:

- Define new base classes and add fields to them.
- Create new subclasses and add fields to them.
- Modify custom classes.
- Add fields to custom classes.

---

---

**Caution:** Do not modify or add fields to default classes, because it makes BRM behavior unpredictable. Instead, create a new subclass of a system-defined class. The new subclass inherits all the fields of its parent and can be modified to meet your needs.

---

---

Storable Class Editor compiles field and class definitions as you define them, helping to prevent syntax errors in your data. In addition, Storable Class Editor updates your database table definitions and modifies SQL mapping information for the classes you create.

## Starting Storable Class Editor

To start Storable Class Editor:

1. Start Developer Center and log in to the database you want to use.  
See "[About Developer Center](#)" for instructions.
2. Click the Storable Class Editor toolbar button or choose **Tools - Storable Class Editor**.

## Creating, Editing, and Deleting Fields and Storable Classes

To create, edit, and delete fields and custom storable classes, first determine the data that you want them to contain. You then enter the information into Storable Class Editor, using BRM conventions for naming and formatting.

To manage field and storable class specifications in Storable Class Editor:

1. Enable changes to the data dictionary. See "[Modifying the pin.conf File to Enable Changes](#)".
2. Create your custom fields. See "[Creating Custom Fields](#)".
3. Create your custom storable classes. See "[Creating Custom Storable Classes](#)".
4. Make your custom fields and storable classes available to BRM by generating source and header files. See "[Making Custom Fields Available to Your Applications](#)".

For more information, see "[About Defining Storable Classes](#)" and "[Class Naming and Formatting Conventions](#)".

## Modifying the pin.conf File to Enable Changes

Before you can add or change fields and storable classes, you must make the data dictionary writable by editing the Data Manager (DM) configuration (**pin.conf**) file.

To make the data dictionary writable, perform the following for each database in your system:

1. Open the Oracle DM configuration file (*BRM\_Home/sys/dm\_oracle/pin.conf*) in a text editor. (*BRM\_Home* is the directory in which you installed BRM components.)
2. To enable field creation in the data dictionary, set the following entry to **1**:  

```
- dm_dd_write_enable_fields 1
```
3. To enable the creation, editing, or deletion of custom storable classes in the data dictionary, set the following entry to **1**:

```
- dm dd_write_enable_objects 1
```

### Increasing the Size of the CM Cache for the Data Dictionary

If your data dictionary contains a lot of data, you might need to increase the space allocated to it in the CM cache.

To increase the size of the CM cache for the data dictionary:

1. Open the Connection Manager (CM) configuration file (*BRM\_Home/sys/cm/pin.conf*).
2. Increase the *cache\_size* in the following entries:
  - `cm_cache cm_data_dictionary_cache number_of_entries, cache_size, hash_size`
  - `cm_cache fm_utils_data_dictionary_cache number_of_entries, cache_size, hash_size`
3. Save the file.
4. Stop and restart the CM. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

### Using DDL when Updating the Data Dictionary Tables

You can configure the DM to execute Data Definition Language (DDL) when updating object types in the data dictionary tables. This ensures that database objects are mapped to the correct tables.

To specify whether DDL is used when updating the data dictionary tables:

1. Open the Oracle DM configuration file (*BRM\_Home/sys/dm\_oracle/pin.conf*) in a text editor.
2. Set the `sm_oracle_ddl` entry to one of the following:
  - 0 to not execute DDLs when updating object types in the data dictionary.
  - 1 to execute DDLs when updating object types in the data dictionary.

```
- dm sm_oracle_ddl 1
```
3. Save and close the file.

## Creating Custom Fields

When you create a new field in Storable Class Editor, it is committed to the data dictionary when you click **OK** in the New Field dialog box. You can't delete a field after it has been committed. For more information, see Storable Class Editor Help.

1. In Storable Class Editor, choose **File - New - Field**.
2. In the **Field Name** box, enter a unique name for the new field.
3. In the **Type** list, choose a field type in the list.
4. (Optional) In the **Description** box, enter text to define the purpose of the field.
5. (Optional) In the **Field ID** field, change the automatically assigned ID number.

The following table lists the field ID ranges for Oracle-only use and for customer use:

**Table 14–1 BRM Field ID Restrictions**

| Field ID Range              | Reserved For    |
|-----------------------------|-----------------|
| 0 through 9999              | Oracle use only |
| 10,000 through 999,999      | Customer use    |
| 1,000,000 through 9,999,999 | Oracle use only |
| Over 10,000,000             | Customer use    |

6. Click **OK** to add the field to the data dictionary.

## Creating Custom Storable Classes

You can create custom base classes and subclasses. Classes are not saved to the data dictionary until you commit them. For more information, see *Storable Class Editor Help*.

---

**Caution:** When you create a subclass, the total number of tables for the parent class and its subclasses cannot be greater than 64. For example, if you create tables for storable class */a* and its subclasses */a/b* and */a/b/c*, the total number of tables for all three storable classes must be less than or equal to 64:

$$/a \text{ tables} + /a/b \text{ tables} + /a/b/c \text{ tables} \leq 64 \text{ tables}$$


---

1. In Storable Class Editor, choose **File - New - Class**.
2. In the **Class Name** field, enter the class name in the format */classname* for base classes and */classname/subclass* for subclasses.
3. (Optional) In the **Label** field, enter a name for the storable class.
4. (Optional) In the **Description** field, enter text to define the purpose of the storable class.
5. (Optional; base classes only) In the **Sequence Start** field, enter a number to designate how objects in this class should be numbered.
6. (Optional; base classes only) In the **Table Name** field, optionally change the default SQL table name suggested by Storable Class Editor. You should accept the default table name unless your business logic requires you to change it.
7. (Optional; base classes only) In the **Storage Specifications** field, enter storage specifications for the database you are using.

For Oracle databases, parameters include *tablespace*, and initial extent size. See "Database Configuration and Tuning" in *BRM Installation Guide*.

8. Click **OK**.  
The storable class opens in a Class Definition window. The class name appears in the title bar.
9. Select the root icon of the new class.
10. In the Properties window, choose values for the **Read Access** and **Write Access** properties.

11. Add fields to the class by dragging field icons from the Class Browser or Field Browser.

---

**Note:** Each storable class must have the PIN\_FLD\_ACCOUNT\_OBJ field. If you do not include this field, it is automatically inserted when the storable class is created.

---

12. Choose **File - Commit New Class** to commit the class to the data dictionary.
13. If you created a new subclass *and* if the base class is partitioned, you must run the **partition\_utils** script with the **-n** parameter to ensure that the new subclass uses the same partitioning layout as its base class.

See "Partitioning Tables" in *BRM System Administrator's Guide*.

## Making Custom Fields Available to Your Applications

After you create custom fields and classes, you must make them available to applications. The first step is to use Storable Class Editor to create Java source files and a C header file. The steps that follow depend on whether your applications are written in C or Java. For more information about using custom fields in Java applications, see "[Using Custom Fields in Java Applications](#)".

---

**Note:** Developer Center is a Java application. To ensure that custom fields are displayed properly in lists in Object Browser and Opcode Workbench, you must follow the procedures for making fields available to Java applications.

---

1. In Storable Class Editor, choose **File - Generate Custom Fields Source** to create source files for your custom fields. See the Storable Class Editor Help system for detailed instructions.

Storable Class Editor creates a C header file called **cust\_flds.h**, a Java properties file called **InfranetPropertiesAdditions.properties**, and a Java source file for each custom field.

2. For applications written in PCM C or PCM C++, perform these steps:
  - a. Run the **parse\_custom\_ops\_fields.pl** Perl script on the **cust\_flds.h** file created by Storable Class Editor. Use this syntax:

```
parse_custom_ops_fields -L language -I input -O output
```

For information on the parameters of **parse\_custom\_ops\_fields** and their valid values, see "[parse\\_custom\\_ops\\_fields](#)".

- b. In the **pin.conf** file for applications that need to access these fields, including **testnap** and other utilities, create an entry using the format shown below. Replace *cust\_flds* with the file name and location of the memory-mapped extension file that the **parse\_custom\_ops\_fields** script created.

```
- - ops_fields_extension_file cust_flds
```

---



---

**Note:** Do not add more than one `ops_fields_extension_file` entry. The custom fields source file and the extension file that results from it contain information about all the custom fields in the data dictionary, so a single reference to that file is sufficient.

---



---

- c. Include the `cust_flds.h` header file in the applications and in the FMs that use the fields.

---



---

**Note:** Default BRM fields are defined with their numbers in the `pin_flds.h` file in the `BRM_Home/include` directory. While it is possible to add custom fields directly to `pin_flds.h`, you should not do so. Placing custom field definitions in the separate `cust_flds.h` file allows you to upgrade to new releases without having to edit `pin_flds.h`.

---



---

- 3. For applications written using Java PCM, including Developer Center, perform these steps:
  - a. Copy the contents of the `InfranetPropertiesAdditions.properties` file and paste it in the `Infranet.properties` file for your application.
  - b. Compile the source files you created in step 1.
  - c. (Optional) Jar the compiled classes.
  - d. In the CLASSPATH, add the location of the `JAR` files or compiled Java classes.

## About BRM SDK Opcodes

The BRM SDK opcodes allows you to create, modify, delete, or retrieve storable class and field specifications without the use of BRM Storable Class Editor.

For information about BRM SDK, see "[About BRM SDK](#)".

To manage field and storable class specifications with BRM SDK opcodes:

1. Enable changes to the data dictionary. See "[Modifying the pin.conf File to Enable Changes](#)".
2. Create, edit, or delete your custom fields. See "[Using BRM SDK Opcodes to Manage Storable Classes](#)".
3. Create, edit, or delete your custom storable classes. See "[Using BRM SDK Opcodes to Manage Field Specifications](#)".
4. Make your custom fields and storable classes available to BRM by generating source and header files. See "[Making Custom Fields Available to Your Applications](#)".

## Using BRM SDK Opcodes to Manage Storable Classes

Use the following BRM SDK opcodes to manage storable class specifications:

- To create or modify a storable class specification, use `PCM_OP_SDK_SET_OBJ_SPECS`. See "[Creating and Modifying Storable Classes](#)".
- To retrieve a storable class specification, use `PCM_OP_SDK_GET_OBJ_SPECS`. See "[Retrieving Storable Class Specifications](#)".



- To delete a storable class specification, use PCM\_OP\_SDK\_DEL\_OBJ\_SPECS. See ["Deleting Storable Class Specifications"](#).

### Creating and Modifying Storable Classes

Use the PCM\_OP\_SDK\_SET\_OBJ\_SPECS opcode to create or modify a storable class. This opcode creates or modifies storable classes in the data dictionary of all databases in your BRM system.

---



---

**Caution:** If you change a storable class after it has been instantiated and populated with data, you will corrupt your database.

---



---



---



---

**Important:** Instead of using this opcode, it's safer and more reliable to create or modify storable class specifications by using the Storable Class Editor in Developer Center.

---



---

PCM\_OP\_SDK\_SET\_OBJ\_SPECS takes the following as input:

- POID
- Class name
- Class type

---



---

**Note:** The Portal object ID (POID) is the only mandatory field on the input flist. However, to create a class specification, you must at least specify the class name and type. To specify fields for the storable class, add a PIN\_FLD\_OBJ\_ELEM array for each field.

---



---

If the transaction is successful, PCM\_OP\_SDK\_SET\_OBJ\_SPECS returns these values:

- The POID of the newly created or modified storable class.
- A results array containing an SQL description of any table changes, with one array for each change.

### Retrieving Storable Class Specifications

Use the PCM\_OP\_SDK\_GET\_OBJ\_SPECS opcode to retrieve one or more storable class specifications. This opcode retrieves all class specifications specified on the input flist. When no classes are specified, this opcode returns all class specifications in the BRM database.

---



---

**Note:** You can retrieve specific levels or types of objects by using the \* wildcard character.

---



---

PCM\_OP\_SDK\_GET\_OBJ\_SPECS returns the following, depending on the success of the transaction:

- When successful, this opcode returns specifications for the specified storable classes, or all class specifications if the input flist doesn't specify a class.
- When the opcode doesn't exist in the database, the opcode returns PIN\_ERR\_BAD\_ARG.

## Deleting Storable Class Specifications

Use the PCM\_OP\_SDK\_DEL\_OBJ\_SPECS opcode to delete storable class specifications from the data dictionary of all databases in your BRM system.

---

---

**Note:** The opcode deletes data from the data dictionary only. To drop the actual table that was created by PCM\_OP\_SDK\_SET\_OBJ\_SPECS, you must drop it manually.

---

---

---

---

**Caution:** If you delete a storable class that has already been instantiated, you will corrupt your database. For example, never delete the /account object. Because of this danger, we recommend that you *do not* use this opcode on a production system.

---

---

PCM\_OP\_SDK\_DEL\_OBJ\_SPECS returns the following, depending on the success of the transaction:

- When the storable class doesn't exist, the opcode returns PIN\_ERR\_BAD\_ARG\_EBUF.
- When successful, the opcode returns these values:
  - The POID of the deleted object.
  - A results array containing an SQL description of any table changes; one array for each change.

## Using BRM SDK Opcodes to Manage Field Specifications

Use the following BRM SDK opcodes to manage field specifications:

- To create or modify a field specification, use PCM\_OP\_SDK\_SET\_FLD\_SPECS. See "[Creating and Modifying Field Specifications](#)".
- To retrieve a field specification, use PCM\_OP\_SDK\_GET\_FLD\_SPECS. See "[Retrieving Field Specifications](#)".
- To delete a field specification, use PCM\_OP\_SDK\_DEL\_FLD\_SPECS. See "[Deleting Field Specifications](#)".

### Creating and Modifying Field Specifications

Use the PCM\_OP\_SDK\_SET\_FLD\_SPECS opcode to create or modify field specifications. This opcode creates or modifies the specified field specifications in the data dictionary of all databases in your BRM system.

---

---

**Caution:** If you change specifications for fields that have already been instantiated, you will corrupt your database.

---

---

PCM\_OP\_SDK\_SET\_FLD\_SPECS takes the following as input:

- Partial POID (database number plus /**dd/fields**)
- Field name
- Field type

---



---

**Note:** The POID is the only mandatory field on the input flist. However, to implement the field, you must at least specify the field name and type.

---



---

PCM\_OP\_SDK\_SET\_FLD\_SPECS returns the following, depending on the success of the transaction:

- If successful, the opcode returns the POID of the created or modified data dictionary field.
- If the opcode cannot create or modify the field, the opcode returns the field's POID, along with the PIN\_FLD\_ACTION field set to **NOOP**.

### Retrieving Field Specifications

Use the PCM\_OP\_SDK\_GET\_FLD\_SPECS opcode to retrieve one or more field specifications. This opcode retrieves all field specifications specified on the input flist. When no fields are specified, this opcode returns all field specifications in the BRM database.

---



---

**Important:** Returning all field specifications can take a long time.

---



---

### Deleting Field Specifications

Use the PCM\_OP\_SDK\_DEL\_FLD\_SPECS opcode to delete field specifications. This opcode deletes the specified field specification from the data dictionary of all databases in your BRM system.

---



---

**Caution:** If you delete specifications for fields that have already been instantiated, you will corrupt your database. For example, never delete PIN\_FLD\_POID from a base BRM system. Because of this danger, we recommend that you *do not* use this opcode on a production system.

---



---

PCM\_OP\_SDK\_DEL\_FLD\_SPECS takes the following as input:

- Partial POID (database number plus **/dd/fields**)
- Name of the field to delete

If successful, this opcode returns the POID of the deleted field specification.

## Converting Storable Class Files from Previous Versions

If you used Developer Workshop in the past to create storable classes, you may have saved storable class definitions as files in **.PSC** format. If you want to use these files in Storable Class Editor, you must convert them to **.SCE** format before you can open them. (See Storable Class Editor Help for instructions about opening storable class files.)

You use the PSC Converter application to convert files. This application is installed along with the rest of Developer Center. See "[Installing Developer Center](#)".

1. From the start options, choose **PSC to SCE Converter**, which is under **Portal**.
2. Click the **Select File** button and navigate to the **.PSC** file you want to convert.

The Save As field automatically fills in the with the same path. The filename is changed to include the **.SCE** extension. (If a **.SCE** file of that name already exists, the Save As field is left blank. Enter a different path and filename or click New File to choose an existing file to overwrite.)

3. Click **Convert**.

A dialog box confirms the creation of the new **.SCE** file.

## Deploying Custom Fields and Storable Class Definitions

You deploy your custom fields and storable classes by using the **pin\_deploy** command-line utility. The **pin\_deploy** utility exports and imports field and storable class definitions from one BRM database to another, such as from your development environment to your production environment.

The **pin\_deploy** utility is available on all BRM platforms, can be scripted, and can use **stdin** and **stdout**. It has several modes of operation to ensure atomic operations and consistency. **pin\_deploy** provides the following advantages:

- Streamlines the process of putting all storable class and field definitions into source code management
- Enables you to print out a storable class or field definition for review
- Reduces the possibility of damaging the BRM production database data dictionary

The **pin\_deploy** utility uses PODL (Portal Object Definition Language) to export and import field and storable class definitions. PODL is a text-based definition language that represents fields and storable classes. Using this language, **pin\_deploy** can:

- Extract storable class and field definitions from any BRM database on any platform and produce a human-readable PODL file.
- Read PODL files and use the files to load storable class and field definitions into any BRM server on any platform.

You can use the following command-line options in **pin\_deploy**:

- **field** extracts field definitions.
- **class** extracts storable class definitions.
- **verify** connects to BRM database, accepts PODL commands, determines what changes would be made, and reports back any conflicts.
- **create** connects to a BRM database, attempts to create storable classes and fields according to PODL, succeeds if there are no conflicts, or reports conflicts.
- **replace** connects to a BRM server; attempts to create storable classes and fields according to PODL, and succeeds even if there are conflicts. It overwrites and replaces any classes that are already present.

In all cases, the entire PODL file is imported. If the entire file cannot be loaded correctly, nothing from the file is loaded. For example, if a storable class is loaded that includes custom fields, those custom fields must exist in the data dictionary or in the PODL file for the class to load.

---

---

**Important:** Before you deploy your custom classes and fields, verify that you have enough space in the BRM database for the new storable classes. If you run out of space during deployment, the new storable classes might be in an inconsistent state.

---

---

See the `pin_deploy` description for more information and a complete list of options.

## Extracting Field and Class Definitions with `pin_deploy`

To extract field definitions, enter a command with the following syntax:

```
% pin_deploy field [-cp] [field_name1] [field_name2]
```

To extract storable class definitions, use the following syntax:

```
% pin_deploy class [-smncp] [class_name1] [class_name2]
```

## Importing Class Definitions with `pin_deploy`

To import storable class definitions into a BRM database, you must use PODL files that include the interface and corresponding implementation definitions.

---

**Important:** The `pin_deploy` utility cannot determine the space requirement in the BRM database. If you run out of disk space before the deployment is complete, you need to manually drop the tables that were created, make more space, and try again.

---

1. Add up the implementation definitions (for example, **initial clause**) of the PODL files you want to import to verify that you have enough disk space.

These lines start with this text:

```
SQL_STORAGE =
```

2. Run `pin_deploy` in the **verify** mode to determine the changes that will be caused by importing new field and storable class definitions and to verify that there are no conflicts.

```
% pin_deploy verify [file_name1] [file_name2]
```

3. To commit new definitions to BRM, run `pin_deploy` in one of the following modes.

- **create** – preserves old storable class and field definitions that conflict with new ones
- **replace** – copies all storable class and field definitions, including those that conflict with old definitions

```
% pin_deploy replace [file_name1] [file_name2]
```

## Adding Fields to /config Objects

Many BRM features use `/config` objects to store business configuration information in the database. For example, `/config/paymenttool` defines the batch types and optional fields displayed in the Payment Tool while `/config/device_permit_map` maps relationships between device types and services.

In some cases, you may need to add or replace fields in `/config` objects. For example, you may need to add or replace events in the `/config/adjustment/event` object to add to the list of events you can adjust in the Event Browser.

You can use either Developer Center or **testnap** to make changes to /config objects. The general procedure is to display the current contents of the object, write an flist that contains the fields you want to add, and then write the flist to the object.

The following two sections provide examples for both Developer Center and **testnap**. Depending on the nature of the /config object, the exact procedure you use may be different from the examples.

## Using Developer Center to Modify /config Objects

This example demonstrates adding a new event field to /config/adjustment/event using Developer Center. See "[About Developer Center](#)" for general instructions and information.

1. Start Developer Center.
2. Open the Object Browser.
3. Enter or choose /config/adjustment/event in the **Objects** field, then click **Browse**.

The /config/adjustment/event object is displayed in the **Objects** area and the contents of the object are displayed in the Output Flist area.

4. Select and copy the last element in the PIN\_FLD\_EVENTS array, located at the end of the output flist. It should be similar to the following:

```
0 PIN_FLD_EVENTS      ARRAY [9] allocated 20, used 1
1 PIN_FLD_TYPE_STR   STR [0] "/event/session"
```

5. Switch to Opcode Workbench.
6. Enter or choose PCM\_OP\_WRITE\_FIELDS in the **Opcode** field.
7. Enter **32** in the **Flags** field to specify the PCM\_OPFLG\_ADD\_ENTRY flag. This flag makes it possible to add a new element to the array.
8. In the **Input Flist** area, enter the first line of the input flist as shown below. If necessary, modify the database number.

```
0 PIN_FLD_POID        POID [0] 0.0.0.1 /config/adjustment/event 301
```

9. Paste the text you copied in Object Browser onto the next line. The result should be similar to the following:

```
0 PIN_FLD_POID        POID [0] 0.0.0.1 /config/adjustment/event 301
0 PIN_FLD_EVENTS      ARRAY [9] allocated 20, used 1
1 PIN_FLD_TYPE_STR   STR [0] "/event/session"
```

10. Increment the element number by one. For example, if the element number you pasted is [9], change it to [10].
11. Change the event class name in the PIN\_FLD\_TYPE\_STR field to that of the event type you are adding. For example, if the event type you pasted was /event/session, you could change it to /event/session/call/telephony.
12. Click **Run**.

The **Output Flist** area displays the object POID to confirm that the opcode ran successfully.

13. Switch to Object Browser, then repeat step 3 to confirm that the new event type has been added.
14. Stop and restart the CM.

## Using testnap to Modify /config Objects

This example demonstrates replacing an event field in `/config/adjust/event` using `testnap`. See "Using testnap" for general instructions and examples for `testnap`.

1. Start `testnap`.

```
% testnap
```

2. Use the `robj` command to view the contents of the `/config` object you want to modify.

This `robj` command reads the contents of the `/config/adjust/event` object.

```
robj - 0.0.0.1 /config/adjustment/event 301
```

3. When the object is displayed, note the element ID of the field that you want to replace in the `PIN_FLD_EVENTS` array.
4. Create a text file that contains a flist with the field that you want to add. The field must contain the complete POID of the `/config` object as well as the element you are adding. Set the element ID to the number of the element you are replacing.

For example, this flist replaces element [5] in the `PIN_FLD_EVENTS` array in `/config/adjustment/event`.

```
0 PIN_FLD_POID      POID [0] 0.0.0.1 /config/adjustment/event 301 0
0 PIN_FLD_EVENTS   ARRAY [5] allocated 20, used 1
1   PIN_FLD_TYPE_STR      STR [0] "/event/session"
```

5. Save this file.
6. Read the file into buffer 1. In this example, the file is called `config`.

```
r config1 1
```

7. Display the contents of the buffer to verify that it is correct.

```
d 1
```

8. Write the contents of the buffer to the `/config` object.

```
wflds 1
```

9. Read the object again to verify that your change was made.

```
robj - 0.0.0.1 /config/adjustment/event 301
```

10. Stop and restart the CM.





---

---

## Adding Support for a New Service

This chapter provides an overview of adding a custom service to your Oracle Communications Billing and Revenue Management (BRM) system. It provides an end-to-end survey of the tasks you need to perform from creating service and event storable classes to setting up rating and billing for a new service. Each task in this chapter provides a cross-reference to the document that contains more detailed information.

You may need to perform additional tasks not described in this chapter, depending on your business needs and the type of service you add.

Creating BRM services requires the following:

- Knowledge of programming in C or C++.
- A good understanding of the following BRM components:
  - BRM system architecture. See "BRM System Architecture" in *BRM Concepts* and "[About Customizing BRM](#)".
  - Storable classes and flists (field lists). See "[Understanding Flists and Storable Classes](#)".
  - Opcodes and the Portal Information Network (PIN) library routines. See "[Understanding the PCM API and the PIN Library](#)".
  - BRM error handling. See "[Understanding API Error Handling and Logging](#)".

### About BRM Services

A service is a capability that you provide to customers, such as telephony, internet access, and email. BRM comes ready to use with a set of preconfigured services, and you can create your own custom services.

### About Supporting a New Service

Before adding a new BRM service, you must understand the details of the service and how it will be implemented. For example, if you offer a wireless telephony service, you might want to track customer logins and provide optional support for add-on services such as text messaging.

To offer a service that is not supported by default in BRM, you may need to perform some of the following tasks to implement the new service:

- Create the storable classes and any custom fields the service requires. See "[Creating Storable Classes for Services and Events](#)".

- Set up price list data for the new service and configure Pipeline Manager to rate the service usage. See ["Setting Up Rating for a New Service"](#).
- Set up bill items to bill for usage of a new service. See ["Setting Up Billing for a New Service"](#).
- Enable accounts to use the new service. See ["Setting Up Account Creation for a New Service"](#).
- Integrate the new service with BRM optional managers. For example, you can associate a new wireless service with a device, display information for a new service on the Web or in Customer Center, and collect revenue assurance data for a new service. See ["Optional Support for a New Service"](#).

## Creating Storable Classes for Services and Events

To add a new service, first define your service by determining which information you need to track and rate. Then use Storable Class Editor in Developer Center to create new classes and any custom fields required to store custom service attributes.

For information about BRM storable classes, see "Storable Class Definitions" in *BRM Developer's Reference*.

You can add a new service to BRM by creating a subclass of an existing BRM `/service` class (for example, `/service/telco/gsm/service_subclass`) or by creating a new base class (`/service/service_type`).

You may also need to create other storable classes and custom fields to store information about the new service. For example:

- To capture rating information for the service, you might need to create a new `/event` subclass (for example, `/event/session/telco/service`).
- To use Pipeline Manager to rate the service usage, you need to create a corresponding delayed event class for any new `/event` class you added (for example, `/event/delayed/session/telco/service`).
- To store custom configurations for a new service, you might need to add fields to or create a subclass of a `/config` class. For example:
  - To set up provisioning tags for a new Global System for Mobile Communications (GSM) service, create a new `/config/telco/gsm/service` storable class.
  - To store service-order state changes for devices associated with a new service, create a `/config/telco/service_order_state/service` storable class.
  - To specify a default reservation amount for a new prepaid service, create a `/config/reserve/service` storable class.
  - To allow CSRs to adjust events for a new service, add the event type to the `/config/adjustment/event` object.
- To collect custom profile information for a new service, create a new `/profile` subclass. For information about using profiles, see ["Using Profile Objects to Collect Customer Profiles"](#).
- To enable BRM to determine whether a new service meets the requirements of a business profile, create a subclass of the `/config/template/service` object. See "About Validation Templates" in *BRM Managing Customers*.
- To store failed call records for a new service whose events are rated in a pipeline and suspended by Suspense Manager, you might need to create a `/suspended_`

**usage/service** storable class. You need to create this new subclass only when the fields unique to the new service type are among the queryable or editable fields in suspense. See "Adding /suspended\_usage Subclasses With Queryable Fields" in *BRM Configuring Pipeline Rating and Discounting*.

- To implement a new service in a branded environment, avoid duplicate service logins by doing one of the following:
  - Create a subclass of the new service storable class to create a unique **/service** class for each brand.
  - Modify the **fm\_cust\_pol\_prep\_login.c** source file to append the brand domain to the login for the new service.

See "About Duplicate Service Logins Across Brands" in *BRM Managing Customers*.

To create storable classes and custom fields for a new service, perform the tasks in "[Creating Custom Fields and Storable Classes](#)".

Use Opcode Workbench to create test instances of your new classes. See "[Using Opcode Workbench](#)".

## Setting Up Rating for a New Service

To enable BRM to rate a new service, you need to set up price list data for the new service, configure Pipeline Manager to rate the new service, and load rated event data into the database.

### Setting Up Price List Data for Real-Time Rating

You set up service-specific price list data for real-time rating by using configuration files. You then add the service to a price list by creating products for the new service and adding those products to deals.

For general information about setting up price list data, see "Setting up Price List Data" in *BRM Setting Up Pricing and Rating*.

#### Mapping Event Types to a New Service Storable Class

You map a new service to the events that are used to rate the service, including any new events you add for the service.

To map events to a new service type, modify the *BRM\_Home/sys/data/pricing/example/pin\_event\_map* file, where *BRM\_Home* is the directory in which you installed BRM components. Load the contents of the file into the **/config/event\_map** object by running the **load\_event\_map** utility. See "Mapping Event Types to Services" in *BRM Setting Up Pricing and Rating*.

#### Defining RUMs for New Service Usage Events

You define ratable usage metrics (RUMs) to charge for events. If a new service requires RUMs that are not already defined, you can define new RUMs.

To define RUMs, modify the **pin\_rum** configuration file and load the contents of the file into the **/config/rum** object by running the **load\_pin\_rum** utility. See "About Setting up RUMs for Real-Time Rating" in *BRM Setting Up Pricing and Rating*.

#### Setting Up Provisioning Tags for a New Service

You use product-level provisioning to rate a service differently based on product attributes. You implement product-level provisioning by defining provisioning tags.

You can use provisioning tags to define any kind of attribute. For example, provisioning tags for prepaid services define the following service attributes:

- Extended rating attributes (ERAs)
- Supplementary services for a GSM service
- Bearer services or other service extensions for a telco service

How you define provisioning tags depends on various factors, such as the type of service, whether you need to create new ERAs, and whether you need to use the provisioning tag with discounts. See "Working with Provisioning Tags" in *BRM Setting Up Pricing and Rating*.

For information about ERAs, see "Working with Extended Rating Attributes" in *BRM Setting Up Pricing and Rating*.

### **Defining Impact Categories for a New Service**

You use impact categories to apply different balance impacts for the same rate plan based on event attributes, such as call origin and destination.

If you added new service events and require additional impact categories that are not already defined in order to rate those events, define new impact categories by editing the `pin_impact_category` file and loading the contents of the file into the `/config/impact_category` object by running the `load_pin_impact_category` utility. See "Creating Impact Categories" in *BRM Setting Up Pricing and Rating*.

You assign rates to impact categories when you create your price plans in Pricing Center.

For information about impact categories, see "Using Event Attributes to Define Impact Categories" in *BRM Setting Up Pricing and Rating*.

### **Charging for a New Service Based on Custom Event Attributes**

If you added a new service event and you want to rate custom attributes of that event or non-event attributes for the new service, modify the `PCM_OP_ACT_POL_SPEC_RATES` policy opcode and associate the opcode with the event type that it rates. See "About Charging for Custom Events and Attributes" in *BRM Setting Up Pricing and Rating*.

### **Defining Custom Resources for a New Service**

If a new service requires a resource (such as an aggregation counter resource) that is not already defined, define the resource so that BRM can create a balance for it.

You define resources for both real-time rating and pipeline rating by using Pricing Center. See "Setting up Resources" in *BRM Setting Up Pricing and Rating*.

### **Specifying How to Round Resources for New Service Usage Events**

You can configure resource rounding for specific types of events. For example, you can round session events differently than you round purchase events. If you do not specify a rounding rule for an event type, BRM uses the default rounding rule.

To specify a rounding rule for an event type you added for a new service, edit the `pin_beid` file and load the contents of the file into the `/config/beid` object by running the `load_pin_beid` utility. See "About Resource Rounding" in *BRM Setting Up Pricing and Rating*.

## Adding a New Service to a Price List

After setting up price list data for a new service, you can create products and add those products to price lists.

You specify the new service type and event types for the new service when defining various price list components, such as the following components:

- Products:
  - When creating a product.
  - When defining product rates, event maps and multiple RUMs.
  - When defining rollover properties if you added a custom non-currency resource and you want to enable rollover for that resource.
- Discounts:
  - When creating a discount.
  - When defining discount exclusion rules.
  - When mapping events to a discount model.
- Deals:
  - When creating a deal.
  - When making deals mutually exclusive.
- Plans:
  - When creating a plan.
  - When adding deals to a plan.
  - When defining how a plan is upgraded or downgraded to another plan.
  - When creating a subscription group.
  - When setting credit limits and thresholds for a subscription service.
  - When setting resource consumption rules for a subscription service.
  - When creating service-level balance groups.
- Rate plans:
  - When defining a rate plan.
- Rate plan selectors:
  - When specifying the service or event fields that determine the rate plan selected.

Use Pricing Center to create price plans that define pricing information for the new service. See "About Creating a Price List" in *BRM Setting Up Pricing and Rating*.

## Configuring Sub-Balances to Track Specific Types Of Usage for a New Service

You can configure BRM keep separate balances for specific types of service usage, such as frequent flyer miles per service instance or free minutes per call session.

To keep separate sub-balances for a new service, configure sub-balances for the service's events in the `pin_sub_bal_contributor` file and load the contents of the file into the `/config/sub_bal_contributor` object by running the `load_pin_sub_bal_contributor` utility. See "About Configuring Sub-Balances" in *BRM Setting Up Pricing and Rating*.

## Setting Up Price List Data for Pipeline Rating

To use Pipeline Manager to rate usage for a new service, you set up service-specific price list data by using the Pipeline Setup Toolbox in Pricing Center.

For general information about setting up pipeline price list data, see "Setting up Pipeline Price List Data" in *BRM Setting Up Pricing and Rating*.

### Defining a New Service

To define a new service for pipeline rating, do the following:

1. Define the new service by mapping the service attributes to an internal service code.
2. (Optional) Define service storable classes to define new subsets for a new service, such as quality-of-service (QoS) levels or bandwidth.
3. Define reference mapping to associate the service with a BRM service type and a usage event type.

### Defining Usage Classes and Usage Types

You can define usage classes and usage types to rate usage for a new service based on more specific attributes.

1. (Optional) Define usage classes to define new network-specific usage scenarios for a new service.
2. (Optional) Define usage types to define new customer-specific usage scenarios for a new service. You also define usage types for any new ERAs you added for a new service. To implement usage types, you configure the IRL\_UsageType iRule.

### Mapping Internal Codes to External Data

You map the service code, usage classes, and usage types you defined to the external EDR data.

1. (Optional) If you'll use a separate pipeline to rate usage for a new service, you might want to create a new map group. You can also add any new usage class maps and service code maps you create to an existing map group. The map group you use must be defined before you can define a usage class map and a service class map.
2. If you defined a new usage class, define a usage class map to map external EDR data to the new internal usage class.
3. Define a service code map to map external event data record (EDR) data to the internal service code for a new service and associate the service with usage classes and service classes.

When you configure pipeline modules, you specify the name of the service code map and the usage class map in pipeline module registries.

### Defining a Pipeline Rate Plan

After setting up pipeline price list data for a new service, you define a rate plan to specify the usage rates. Set up a pipeline rate plan that corresponds to the real-time rate plan you set up for the new service usage events.

You specify a service code and service class when defining various rate plan components, such as the following:

- Rate plan configurations.
- Rate service class (RSC) mapping.
- APN mapping.
- Standard and geographical zones.
- Usage scenario mapping. See "About Usage Scenario Mapping" in *BRM Setting Up Pricing and Rating*.
- Interconnect products for roaming.
- Splitting types for pipeline output streams.

When you create products, you map the pipeline rate plan to a delayed event type (for example, `/event/delayed/session/telco/gsm`).

## Configuring Pipeline Manager to Process Events for a New Service

You configure Pipeline Manager to rate usage for a new service by configuring pipeline input and output processing.

### Configuring Pipeline Manager Input Processing for New Service Usage Events

Perform this task if you'll use Pipeline Manager to rate new or customized events for a new service.

If the CDRs or authentication, authorization, and accounting (AAA) requests you process for a new service include information that has no corresponding fields in the appropriate default EDR container description, you must modify the description to accommodate the custom data. See "Modifying and Loading the EDR Container Description" in *BRM Setting Up Pricing and Rating*.

If you modify the EDR container description, you must also modify the appropriate input grammar and mapping files in order to process the new fields. For more information, see "Setting up an Input Mapping File" and "Setting up an Input Grammar File" in *BRM Configuring Pipeline Rating and Discounting*.

For information about Pipeline Manager input processing, see "Configuring EDR Input Processing" in *BRM Configuring Pipeline Rating and Discounting*.

### Configuring Pipeline Manager Service-Mapping Modules

If you used Pricing Center to create a new service code map or usage class map for a new service type, do the following:

- Specify the name of the service code map in the `FCT_ServiceCodeMap` registry.
- Specify the name of the usage class map in the `FCT_UsageClassMap` registry.

If you defined new usage types, configure the `IRL_UsageType` iRule to set usage types in EDRs based on mapping files that you configure.

See "Setting up Pipeline Price List Data" in *BRM Setting Up Pricing and Rating*.

### Configuring a Pipeline Manager Output Stream for New Service Usage Events

You configure a rated-event output stream for each service type; for example, one output stream for `/event/delayed/session/gsm` events and another for `/event/delayed/session/gprs` events. If you create a subclass of an existing event type (such as `/event/session/gsm/subclass`), you can use the output stream for the parent class, or you can create a new output stream.

To configure an output stream for a new service type:

- Configure the `IRL_EventTypeSplitting` iScript to split EDRs by service code. See "Sending EDRs to an Output Stream Based on Service Code" in *BRM Configuring Pipeline Rating and Discounting*.
- Configure an instance of the `OUT_GenericStream` module to write rated EDRs for a new service to an output file. See "OUT\_GenericStream" in *BRM Configuring Pipeline Rating and Discounting*.

This output file containing rated events is loaded into the BRM database by RE Loader. See "[Loading Pipeline-Rated Usage Events into the BRM Database](#)".

### Configuring Prepaid-Postpaid Convergence

If you optimized BRM for prepaid and postpaid convergence and you added a new usage event for a new service, specify the new event type in the registry file of the convergent output stream module (`CONV_TelOutput`). This module is an instance of the `OUT_GenericStream` module.

### Enabling Object Auditing for New Service Objects

You must perform this task when you add a new GSM service. You can also perform this task for other types of new services if you wish to audit changes to fields unique to the new service.

You enable object auditing so that BRM can audit changes to BRM objects.

If you use BRM wireless managers, such as Account Synchronization Data Manager (DM) and GSM Manager, make sure you have installed all wireless managers, and then run the `pin_history_on` utility to enable object auditing for the new service objects. See "Manually Configuring Object Auditing" in *BRM Installation Guide*.

### Configuring Suspension and Recycling Of New Service Usage Events

Perform this task if you use BRM suspense and recycling features.

- If you set up a service-specific pipeline to rate new service usage events, configure the pre-recycling pipeline module that routes EDRs to the pipeline that rated them:
  - If you use the `IRL_PipelineSplitting` module, edit the `IRL_PipelineSplitting.data` file to associate the name of the pipeline that rated the new service with an output stream.
  - If you use the `FCT_AccountRouter` module for multiple database schemas, associate the name of the pipeline that rated the new service and its output stream in the module registry.

See "Configuring a Pre-Recycling Pipeline" in *BRM Configuring Pipeline Rating and Discounting*.

- If you use BRM Suspense Manager, you can use Suspense Management Center to edit and correct event fields for failed EDRs that have been suspended. If you added unique fields to a new `/service` storable class and you want to be able to query and edit those fields, you create a `/suspended_usage/service` object (see "[Creating Storable Classes for Services and Events](#)") and determine the fields that are editable based on that subclass. Add the editable fields to the `pin_suspense_editable_flds` file and load the contents of the file into the `/config/suspense_editable_flds` object by running the `load_pin_suspense_editable_flds` utility. See "Planning and Setting Up Your Database for Suspense Manager" in *BRM Configuring Pipeline Rating and Discounting*.



### Configuring the Real-Time Rerating Pipeline for Rerating Custom Events

Perform these tasks if you will use the real-time rerating pipeline for rerating custom events:

- If you have custom event fields, add the custom fields to the *Pipeline\_Home/pin.conf* file to make the custom fields available to the pipeline. See ["Making Custom Fields Available to Your Applications"](#).
- Map the custom events and its fields to corresponding fields in the EDR container description. See "About Customizing Mapping of Flist Fields to Rating EDR Container Fields" in *BRM Configuring Pipeline Rating and Discounting*.
- To route the custom events to the real-time rerating pipeline, map the event field value in the Pipeline registry file. See "Configuring NET\_EM to Route Rerate Requests Based on the Event Field Value" in *BRM Setting Up Pricing and Rating*.

### Adding Database Partitions for New Service Usage Events

If you use a partitioned database and you created a new service usage event, add database partitions for the event.

If you use Pipeline Manager to rate events for the new service, be sure to add partitions for delayed events also. See "Partitioning Tables" in *BRM System Administrator's Guide*.

### Loading Rated Events for a New Service into the Database

If you rate usage for a new service, you need to load rated usage events into the database.

#### Loading Real-Time Rated Usage Events into the BRM Database

Perform this task if you rate new service usage events in real time and you use Universal Event (UE) Loader to load the events in batches.

To collect usage data from batch files for a new service, use Universal Event Mapper to create a template that translates data in the event log file into the data captured by billable events. See "Creating an Event Import Template" in *BRM Setting Up Pricing and Rating*.

For information about UE Mapper and UE Loader, see "About Rating Events Created by External Sources" in *BRM Setting Up Pricing and Rating*.

#### Loading Pipeline-Rated Usage Events into the BRM Database

Perform this task if you use Pipeline Manager to rate usage for a new service.

Use Rated Event (RE) Loader to load events for a new service that are rated in a pipeline into the BRM database. Set up a processing directory for the new events and configure RE Loader and the RE Loader batch handler to load the events from that directory.

If a new service object includes new fields, you might also need to modify the RE Loader pre-processing script and create new control files.

See "Adding New Event Types for RE Loader to Load" in *BRM Configuring Pipeline Rating and Discounting*.

## Setting Up Billing for a New Service

You can collect revenue assurance data for a new service and bill customers for using the service.

### Setting Up Bill Items for a New Service

Perform this task if you'll use Pipeline Manager to rate an event type that you added for a new service.

To bill for service usage rated by Pipeline Manager, configure BRM to pre-create service-level bill items. (See "How Pipeline Manager Assigns Delayed Events to Items" in *BRM Configuring Pipeline Rating and Discounting*.)

To set up service-level bill items, associate the new service type and its usage events with an `/item/misc` object by modifying the `config_item_tags` and `config_item_types` files. Load the contents of these files into the `/config/item_tags` and `/config/item_types` objects by running the `load_config_item_tags` and `load_config_item_types` utilities. See "About Assigning Custom Bill Items to Events" in *BRM Configuring and Running Billing*.

### Collecting Revenue Assurance Data for New Service Usage

To collect revenue assurance data for a new service, modify the `racustom.properties` file to include the new service type. This makes the service searchable from Revenue Assurance Center. See "Customizing Revenue Assurance Center" in *BRM Collecting Revenue Assurance Data*.

## Setting Up Account Creation for a New Service

To successfully create accounts for your new service, you may need to first customize the `PCM_OP_CUST_POL_PREP_INHERITED` policy opcode to prepare the inherited information for an extended subclass.

You can also write a new policy to implement custom functionality. See "[Adding and Modifying Policy Facilities Modules](#)".

### Setting Up Business Profiles for a New Service

If you use business profiles and you want to specify rules that determine whether a new service meets the requirements of a business profile, modify the `pin_business_profile.xml` file to configure a validation template for the new service type. Load the contents of the file into the `/config/business_profile` object by running the `load_pin_business_profile` utility. See "Managing Business Profiles" in *BRM Managing Customers*.

## Optional Support for a New Service

This section describes some optional ways you can configure BRM to support a new service.

### Synchronizing Data for a New Service with External Applications

Business events capture information needed by external applications or internal BRM components. Business events are used by BRM EAI Manager to ensure data synchronization across applications.

You can add events for a new service to a business event to synchronize any data that the service's event might change. To add an event to a business event, modify the Payload Generator EM configuration file (`payloadconfig.xml`). See ["About Publishing Additional Business Events"](#).

For information about EAI Manager, see ["Integrating BRM with Enterprise Applications"](#).

## Mapping Devices to a New Service

Perform this task if the new service requires a device such as a SIM card, phone number, or voucher.

To associate a new service with a device, add the service type to your device permit map file (such as `pin_device_permit_map_num`) and load the file into the `/config/device_permit_map` object by running the `load_pin_device_permit_map` utility. See ["Defining Device-to-Service Associations"](#).

You can associate services to the following types of devices or to custom device types that you create:

- APNs (access point names)
- IP addresses
- Telephone numbers
- SIM cards
- Vouchers

For information about managing devices and creating new device types, see ["Managing Devices with BRM"](#).

## Extending Customer Center to Display a New Service

You can add elements for a new service to the Customer Center interface. For example:

- Add custom fields to existing panels.
- Create a new service panel.
- Add Help topics and information for new fields and panels.
- Add a new service to the list of services available in the Search panel.

See ["Customizing the Customer Center Interface"](#).

If you add a new service and you use the Services Framework Manager client, you also use BRM Configurator and JBuilder to customize Customer Center telco components. See ["About Customizing the Services Framework Manager Client"](#) in *BRM Telco Integration*.

## Providing Access to a New Service on the Web

Perform this task if you use Self-Care Manager to provide customers with self-care access to services on the Web.

To provide access to information about a new service on the Self-Care Manager home page, customize the Self-Care Manager interface by using the Customer Center SDK. See ["Customizing the Self-Care Manager Interface"](#).

## Generating Usage Reports for a New Service

If you create a subclass of an existing BRM */service* storable class, you can run and analyze usage reports for the new service. See "Running BRM Reports" in *BRM Reports*.

For information about BRM reports, see "[About BRM Reports](#)".

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## Using BRM Messaging Services

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) Universal Message Store (UMS) framework and explains how to use its components to provide messages on invoices or other documents.

Before you read this chapter, you should have a good understanding of BRM opcodes and storable classes. See ["Understanding the PCM API and the PIN Library"](#) and ["Understanding Flists and Storable Classes"](#).

If you plan to develop custom applications that produce or consume BRM messages, you should also read ["Adding New Client Applications"](#) as well as the client applications chapter that covers the programming language you will use.

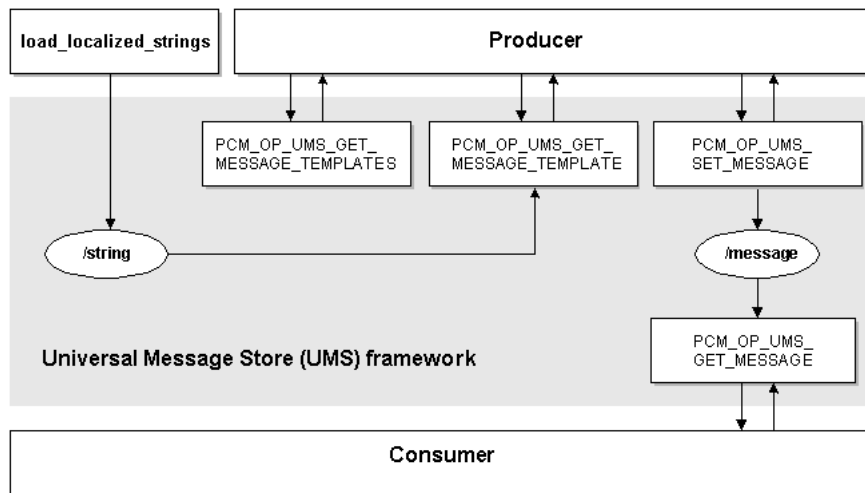
### About the UMS Framework

The UMS framework enables you to include system-generated messages in customer documents such as invoices. You can use these messages to market new services or deliver reminders of overdue balances, for example.

UMS works by providing a middle layer between *producers* of messages, such as Collections Manager and third-party customer relationship management (CRM) applications, that generate invoice reminders, and *consumers* of message, such as the invoicing system. This middle layer includes storable classes to store messages and message templates as well as opcodes that process the messages.

[Figure 16-1](#) illustrates the relationships among the components of UMS. These components are discussed in subsequent sections.

Figure 16–1 UMS Framework Components



## Setting Up Messaging by Using the UMS Framework

To set up messaging, perform these tasks:

- [Enabling Messaging](#)
- [Loading the Message Style Sheet](#)
- [Generating Messages in the Producer Application](#)
- [Retrieving Message Objects in the Consumer Application](#)

### Enabling Messaging

To enable messaging, you must modify the PCM\_OP\_INV\_POL\_PREP\_INVOICE policy opcode. See "[Adding and Modifying Policy Facilities Modules](#)" for general information about modifying policy opcodes.

To enable messaging:

1. Open `fm_inv_pol_prep_invoice.c`, the source file for PCM\_OP\_POL\_PREP\_INVOICE. This file is located in `BRM_SDK_Home/source/sys/fm_inv_pol`.
2. Delete or comment out the following line:
 

```
#ifdef UMS_MESSAGE_FEATURE
```
3. Delete or comment out the `#endif` line following the block of code after the `#ifdef` line.
4. Compile and link `fm_inv_pol_prep_invoice.c` to create a new shared library. See "[Compiling and Linking a Policy FM](#)".
5. Replace the existing shared library on your production system with the new one.
6. Add the following entry as a single line in your CM `pin.conf` to load the required messaging library:
 

```
- cm fm_module ${PIN_HOME}/lib/fm_ums/${LIBRARYEXTENSION} fm_ums_config
- pin
```
7. Stop and restart the CM. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

## Loading the Message Style Sheet

If you are planning to use Universal Message Store (UMS) to deliver invoice reminders, you must load a new invoice style sheet that allows messages to be displayed.

The new style sheet is called **message.xsl** and is located in the *BRM\_Home/sys/data/config/stylesheets* directory, where *BRM\_Home* is the directory in which you installed BRM components. It is similar to the default invoice style sheet (**sample1.xsl**), except that it retrieves and displays messages.

You load the new style sheet by using the **pin\_load\_invoice\_template** application. See "pin\_load\_invoice\_template" in *BRM Designing and Generating Invoices*.

## Creating and Loading Message Templates

Message templates are localizable **/strings** objects in the BRM database. They contain the basic text of a message along with placeholders for specific data such as names, balances, and dates.

You create message templates by writing a localized string file. Each file contains messages for one combination of locale (U.S. English, for example) and domain (invoice reminder messages, for example). The file also contains the text, optionally including placeholders, for one or more message strings. Each string requires a version and ID number.

The name of the template is entered in the HELPSTR field. This name can be displayed in client applications such as Collections Configuration.

The combination of locale, domain, ID, and version must uniquely define each string within the **/strings** class.

When you create a message string file, you can include placeholders that are filled with data when the complete **/message** object is created. The placeholder character is a percent sign (%) followed by a number that is incremented for each placeholder. In this example, there are two placeholders:

```
LOCALE = "en_US" ;

DOMAIN = "Messages - invoice reminder" ;
STR
  ID = 0 ;
  VERSION = 1 ;
  STRING = "Your account is now past due in the amount of %1
           which was due on %2. Please send in your payment
           promptly." ;
  HELPSTR = "First Reminder";
END
```

The placeholders are replaced with data supplied as elements in the PIN\_FLD\_ARGS array in the input list of PCM\_OP\_UMS\_SET\_MESSAGE. Element numbers must correspond to placeholder numbers; element 1 replaces %1, element 2 replaces %2, and so on.

You can include HTML tags in the message string. This is useful when the string will be displayed in an HTML document such as an email or Web page.

You load message templates into the BRM database by running the **load\_localized\_strings** utility. To overwrite strings with the same version and ID, specify the **-f** option when you run the utility.

## Generating Messages in the Producer Application

As their name implies, producer applications supply the messages to the UMS framework. In most cases, a complete message is assembled from a message template that is filled in with data supplied by the producer application.

### Retrieving Message Templates

To create a complete **/message** object, the producer application requires the POID of the template on which the message will be based. The first step is gathering a list of available templates. From this list you can extract the POID of the template you want to use.

The producer application calls `PCM_OP_UMS_GET_MESSAGE_TEMPLATES` to return a list of the POIDs of all message templates for a domain and locale that you specify. For example, if you have stored a number of different marketing message templates for the same locale and domain, the opcode returns a list of the POIDs and template names.

If the producer application includes a graphic user interface (GUI), you can display the available template names for selection by the user. Otherwise, you can select the template Portal object ID (POID) programmatically.

You can also search for the **/strings** object that contains the message you want. This option is particularly useful if you aren't using a GUI and therefore do not need to display the list of available templates. See ["Searching for Objects in the BRM Database"](#) for information about searching.

If successful, `PCM_OP_UMS_GET_MESSAGE_TEMPLATES` returns an array containing the POID, brand, and name of each template in the current brand that matches the locale and domain specified in the input flist.

`PCM_OP_UMS_GET_MESSAGE_TEMPLATES` stops processing if no templates are available for the specified combination of brand, locale, and domain.

### Retrieving Message Templates from /strings Objects

To display a full message template in an application, call `PCM_OP_UMS_GET_MESSAGE_TEMPLATE`. This opcode retrieves the full contents of the template.

If successful, `PCM_OP_UMS_GET_MESSAGE_TEMPLATE` returns the contents of the specified message template **/strings** object, including the POID, domain, locale, template name, and template string.

`PCM_OP_UMS_GET_MESSAGE_TEMPLATE` stops processing if the POID of the requested template is incorrect or missing.

You can skip this step if you do not need to display the template contents. The opcode that creates **/message** objects automatically calls `PCM_OP_UMS_GET_MESSAGE_TEMPLATE` to retrieve the template it needs.

### Creating Message Objects

The producer application creates the **/message** object by calling `PCM_OP_UMS_SET_MESSAGE_TEMPLATE`. The input flist must include the POID of the message template that will be used for this message.

If the template contains placeholders, the input flist must also contain an array whose elements supply data for the placeholder. The data in element 1 replaces placeholder **%1**, the data in element 2 replaces **%2**, and so on.



You also set the scope of the message; whether it applies to a particular bill, an account, or to an entire brand when you create the **/message** object. You define the scope by supplying the POID of the brand, account, or bill to which the message applies.

If the message scope is the account or brand, you can also supply an effective date in the input flist.

PCM\_OP\_UMS\_SET\_MESSAGE stops processing under these circumstances:

- The POID of the template is missing or incorrect.
- No locale is specified.
- No scoping information (brand, account, or bill) is specified.
- No effective date is included for brand or account-scoped messages.

## Retrieving Message Objects in the Consumer Application

The consumer application retrieves **/message** objects by calling PCM\_OP\_UMS\_GET\_MESSAGE.

The opcode retrieves **/message** objects based on scoping information that you provide. You specify the scope by including the brand, account, or bill object POID associated with the messages you want.

By default, PCM\_OP\_UMS\_GET\_MESSAGE retrieves all messages that apply at the scoping level you specify. For example, if you specify a **/bill** object, the opcode retrieves all messages that are scoped to that bill, the bill's account, and the brand with which it is associated. Similarly, if you specify an **/account** object, the opcode retrieves messages scoped to the account and its brand.

You can modify the default scoping behavior by including the PIN\_FLD\_SCOPE field in the input flist with a value of **1**. With this option, PCM\_OP\_UMS\_GET\_MESSAGE finds only messages scoped narrowly to the bill, account, or brand you specify. For example, including a **/bill** object in the input flist returns only messages specifically scoped to that bill.

You can also include a locale and effective date in the input flist to further narrow the list of messages that is returned.

For each message that matches the scope, PCM\_OP\_UMS\_GET\_MESSAGE returns an array that contains the text of the message, the message template name, and the message domain. The consumer application can then select the individual message programmatically or via a GUI.

PCM\_OP\_UMS\_GET\_MESSAGE stops processing under these circumstances:

- No scoping information is included in the input flist.
- No **/message** objects exist that meet the scope defined in the input flist.



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## Integrating BRM with Enterprise Applications

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) Enterprise Application Integration (EAI) Manager framework and explains how to build a connector application to integrate BRM with other enterprise applications.

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**Important:** The EAI Manager is an optional feature that requires a separate license.

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To build a connector application using EAI Manager and to publish additional events, you must be familiar with:

- BRM flists and storable classes. See "[Understanding Flists and Storable Classes](#)".
- BRM event notification. See "[Using Events to Trigger Operations](#)".
- XML.

### About Integrating BRM with Enterprise Applications

You can integrate BRM with other applications in your enterprise by using EAI Manager. Integrating BRM with enterprise applications ensures data synchronization across applications in your enterprise and avoids data duplication among applications.

EAI Manager integrates BRM with enterprise applications by publishing business events. EAI Manager includes a default set of business events to be published. You can add additional events or remove unnecessary events by modifying a configuration file. A connector application built by you or a middleware vendor provides access to these events. The EAI Manager framework includes a set of functions that you implement in the connector application.

By default, EAI Manager publishes events in XML format. You can publish events in BRM flist format by specifying that format in the configuration file.

To integrate BRM with enterprise applications, you need to perform the following tasks:

1. Install EAI Manager. See "[About Installing EAI Manager](#)".
2. (Optional) Edit the configuration file to publish additional business events or change the data for default events. See "[About Publishing Additional Business Events](#)".
3. Build your connector application. See "[About Building a Connector Application](#)".

4. Configure BRM to connect to EAI Manager and your connector application. See ["Configuring EAI Manager"](#).

## How EAI Manager Publishes Events

To collect and publish BRM events, EAI Manager performs these tasks:

1. EAI Manager uses event notification to cache events in the Payload Generator.
2. When the cached events form a complete business event as defined in the **payloadconfig.xml** configuration file, the Payload Generator generates the data (payload) to be published.

The payload is generated in one of two ways, depending on the option you choose in the configuration file:

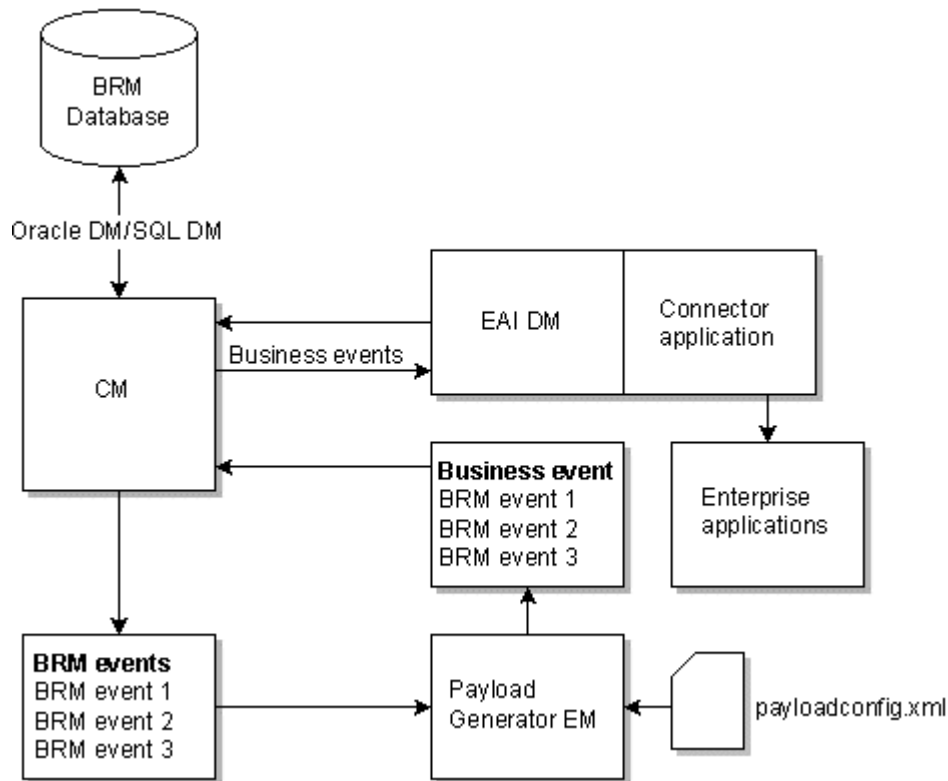
- By reading the fields in the incoming flists for the event
- By accessing the BRM database

The Payload Generator generates the payload in XML or flist format as specified in the configuration file and sends it to the EAI Data Managers (DMs) through the Connection Manager (CM).

3. The EAI DM publishes the payload as a business event to external systems.

Figure 17-1 shows the EAI Manager architecture and data flow:

**Figure 17-1 EAI Manager Architecture and Data Flow**



## About Installing EAI Manager

You can install EAI Manager on the HP-UX IA64, Solaris, Linux, and AIX operating systems.

To ensure proper load balancing on your BRM system, you can install these three EAI features on different computers:

- **EAI Connection Manager (CM) module**  
You must install this module on the same machine where the CM is running. The EAI CM module includes the opcodes required by EAI.
- **EAI Data Manager**  
You can install the EAI Data Manager (DM) on any system accessible to the BRM server.
- **Payload Generator External Module (EM)**  
You can install the Payload Generator EM (also called the EAI Java Server or `eai_js`) on any system accessible to the BRM server.

## Software Requirements

Before installing EAI Manager, you must install:

- Third-Party software, which includes the Perl libraries and JRE required for installing BRM components. See "Installing the Third-Party Software" in *BRM Installation Guide*.
- BRM. See "Putting Together Your BRM System" in *BRM Installation Guide*.

## Installing EAI Manager

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**Note:** If you have already installed the product, features that are already installed cannot be reinstalled without uninstalling them first. To reinstall a feature, uninstall it and then install it again.

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The EAI Manager downloadable package includes the installer for both EAI Manager and Synchronization Queue Data Manager. You must download the EAI Manager package and extract these two components before you can install EAI Manager. For more information about Synchronization Queue Data Manager, see "Understanding the Synchronization Queue Data Manager" in *BRM Synchronization Queue Manager*.

When you install EAI Manager, the installation program assigns default values in the Connection Manager (CM) and EAI DM configuration (`pin.conf`) files as well as the Payload Generator properties (`Infranet.properties`) file.

For information on changing the entries in the `pin.conf` and properties files, see "[Configuring EAI Manager](#)".

Follow the instructions in the appropriate section to install all EAI Manager features on the same system or to install them on separate computers. See "[Installing EAI Features on the Same Computer](#)" and "[Installing EAI Features on Separate Computers](#)".

### Installing EAI Features on the Same Computer

To install EAI Manager:

1. Download the EAI Manager package (**7.5.0\_EAI\_FrameworkMgr\_platform\_opt.tar.Z**) where *platform* is the operating system name. Download this file to a temporary directory (*temp\_dir*). For information on downloading the software, see "Downloading the BRM Applications Software" in *BRM Installation Guide*.

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**Important:**

- If you download to a Windows workstation, use **FTP** to copy the package to a temporary directory on your server.
  - You must increase the heap size used by the Java Virtual Machine (JVM) before running the installation program to avoid "Out of Memory" error messages in the log file. For information, see "Increasing Heap Size to Avoid "Out of Memory" Error Messages" in *BRM Installation Guide*.
- 
- 

2. Go to *temp\_dir* and uncompress and extract the **.tar.Z** file. The following files are extracted:
  - **7.5.0\_EAI\_FrameworkMgr\_platform\_opt.bin** - EAI Manager
  - **7.5.0\_DM\_AQ\_platform\_opt.bin** - Synchronization Queue Data Managerwhere *platform* is the operating system name.
3. Go to the directory where you installed the Third-Party package and source the **source.me** file.

---

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**Caution:** You must source the **source.me** file to proceed with installation, otherwise "suitable JVM not found" and other error messages appear.

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---

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

4. Go to the *temp\_dir* and enter this command:

```
7.5.0_EAI_FrameworkMgr_platform_opt.bin
```

where *platform* is the operating system name.

---

---

**Note:** You can use the **-console** parameter to run the installation in command-line mode. To enable a graphical user interface (GUI) installation, install a GUI application such as X Windows and set the **DISPLAY** environment variable before you install the software.

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---

5. Follow the instructions displayed during installation.

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**Note:** The installation program does not prompt you for the installation directory if BRM or EAI Manager is already installed on the machine and automatically installs the package at the *BRM\_Home* location, where *BRM\_Home* is the directory in which you installed BRM components.

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---

6. Go to the directory where you installed the EAI Manager package and source the **source.me** file:

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

7. Go to the *BRM\_Home/setup* directory and run the **pin\_setup** script.
8. Open the *BRM\_Home/sys/cm/pin.conf* file in a text editor, change the value of the **enable\_publish** entry to **1**, and then save and close the file.
9. Load information for EAI Manager into your system's event notification list.  
See "[Configuring Event Notification for EAI Manager](#)".
10. **(Solaris and Linux)** Stop and restart all BRM processes.

See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide* for more information.

### Installing EAI Features on Separate Computers

To install EAI features on separate computers, you must download the EAI Manager software package and then complete a separate installation procedure for each component.

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**Note:** The EAI Connection Manager (CM) module must be installed on the same system as the CM.

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#### Installing the EAI CM module

1. Download the software to a temporary directory (*temp\_dir*).
2. Log in as user **pin**.
3. Go to the *temp\_dir* where you downloaded the BRM software and enter this command:

```
7.5.0_EAI_FrameworkMgr_platform_opt.bin
```

where *platform* is the operating system name.

---



---

**Note:** You can use the **-console** parameter to run the installation in command-line mode. To enable a graphical user interface (GUI) installation, install a GUI application such as X Windows and set the **DISPLAY** environment variable before you install the software.

---



---

This starts the installation program.

4. Enter **Custom** when asked to specify the setup type. Select **EAI\_CM** by typing its respective number. Click **Next**.
5. Follow the instructions displayed during installation. Your responses are written to the *BRM\_Home/setup/pin\_setup.values* file.
6. Go to the directory where you installed the EAI Manager software and source the **source.me** file:

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

7. Open the *BRM\_Home/setup/pin\_setup.values* file in a text editor.
8. Set the value of the EAI **hostname** parameter to the name of the system where you will install the EAI DM:

```
$EAI{'hostname'} = "hostname";
```

9. On the system where the Oracle DM is running, perform these steps:
  - a. Open the Oracle DM configuration file (*BRM\_Home/sys/dm\_oracle/pin.conf*) in a text editor.
  - b. Set the three **dd\_write\_enable** parameters to **1**:

```
- dm dd_write_enable_fields 1
- dm dd_write_enable_objects 1
- dm dd_write_enable_portal_objects 1
```

- c. Save and close the file.
  - d. Stop and restart the Oracle DM.
10. Log in as user **pin**.
11. Go to the *BRM\_Home/setup* directory and run the **pin\_setup** script.
12. Open the *BRM\_Home/sys/cm/pin.conf* file, change the value of **fm\_publish** entry to **1**, and then save and close the file.

13. On the system where the Oracle DM is running, perform these steps:
  - a. Open the Oracle DM configuration file (*BRM\_Home/sys/dm\_oracle/pin.conf*) file in a text editor.

- b. Reset the three **dd\_write\_enable** parameters to their original values, probably **0**:

```
- dm dd_write_enable_fields 0
- dm dd_write_enable_objects 0
- dm dd_write_enable_portal_objects 0
```

- c. Save and close the file.
  - d. Stop and restart the Oracle DM.
14. Load information for EAI Manager into your system's event notification list.  
See ["Configuring Event Notification for EAI Manager"](#).



## Installing the EAI DM

1. Log in as user **pin**.
2. Go to the *temp\_dir* where you downloaded the BRM software and enter this command:

```
7.5.0_EAI_FrameworkMgr_platform_opt.bin
```

where *platform* is the operating system name.

---

**Note:** You can use the **-console** parameter to run the installation in command-line mode. To enable a graphical user interface (GUI) installation, install a GUI application such as X Windows and set the **DISPLAY** environment variable before you install the software.

---

This starts the installation program.

3. Enter **Custom** when asked to specify the setup type. Select **EAI\_DM** by typing its respective number. Click **Next**.
4. Follow the instructions displayed during installation. Your responses are written to the *BRM\_Home/setup/pin\_setup.values* file.
5. Go to the directory where you installed the EAI Manager software and source the **source.me** file:

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

6. Log in as user **pin**.
7. Go to the *BRM\_Home/setup* directory and run the **pin\_setup** script.
8. On the computer where the Connection Manager (CM) is installed, perform these steps:

- a. Open the *BRM\_Home/sys/cm/pin.conf* file in a text editor.
- b. Edit the **dm\_eai\_pointer** entry to point to the computer where you installed the EAI DM:

```
- cm dm_pointer db_no ip host_name port_number # dm_eai
```

where:

*db\_no* specifies the database number for the EAI DM

*host\_name* specifies the host name where the EAI DM is installed

*port\_number* specifies the port used by the EAI DM

- c. Stop and restart all BRM processes.

See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

## Installing the EAI Payload Generator

1. Log in as user **pin**.

2. Go to the *temp\_dir* where you downloaded the BRM software and enter this command:

```
7.5.0_EAI_FrameworkMgr_platform_opt.bin
```

where *platform* is the operating system name.

---

---

**Note:** You can use the **-console** parameter to run the installation in command-line mode. To enable a graphical user interface (GUI) installation, install a GUI application such as X Windows and set the **DISPLAY** environment variable before you install the software.

---

---

This starts the installation program.

3. Enter **Custom** when asked to specify the setup type. Select **EAI\_JS** by typing its respective number. Click **Next**.
4. Follow the instructions displayed during installation. Your responses are written to the *BRM\_Home/setup/pin\_setup.values* file.
5. Go to the directory where you installed the EAI Manager software and source the **source.me** file:

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

6. Go to the *BRM\_Home/setup* directory and run the **pin\_setup** script.

## Configuring Event Notification for EAI Manager

When a BRM event that is included in a business event occurs, EAI Manager uses event notification to call the opcode that caches the BRM event in the Payload Generator.

Before you can use EAI Manager, you must configure the event notification feature as follows:

1. If your system has multiple configuration files for event notification, merge them. See "[Merging Event Notification Lists](#)".
2. Ensure that the merged file includes the entire event notification list in the *BRM\_Home/sys/data/config/pin\_notify\_eai* file.

---

---

**Note:** The BRM events listed in the **pin\_notify\_eai** file are not business events. A business event comprises one or more BRM events. You define business events in the **payloadconfig.xml** file. See "[About BRM Business Events](#)".

---

---

3. If you configured EAI Manager to publish to an HTTP port, ensure that the merged file also includes the entire event notification list in the *BRM\_Home/sys/data/config/pin\_notify\_plugin\_http* file.

See "[Configuring EAI Manager to Publish to an HTTP Port](#)".

4. (Optional) If necessary, add, modify, or delete entries in your final event notification list. See ["Editing the Event Notification List"](#).

---

**Important:** If you changed the default set of BRM events to be published by adding business events or by modifying the existing business events, you must edit your final event notification list to include all the BRM events in the new or modified business events.

---

5. Load your final event notification list into the BRM database. See ["Loading the Event Notification List"](#).

For more information, see ["Using Events to Trigger Operations"](#).

## About BRM Business Events

A business event is a BRM operation that you define in the Payload Generator EM configuration file (**payloadconfig.xml**). A number of business events are defined by default; for example, one of the default business events is ProductPurchase, which is created when a customer buys a product.

A business event is created only after EAI Manager has been notified that a qualifying BRM event has occurred. For example, several BRM events, including **/event/customer/billinfo**, **/event/billing/product/action/purchase**, and **/event/customer/nameinfo**, must occur before the CustCreate business event is created.

BRM uses event notification to cache the events that make up a business event in the Payload Generator. See ["Configuring Event Notification for EAI Manager"](#).

Business event definitions include data or pointers to data from the flists of events included in the definition. For an example of the relationship between the event flist and the definition of the business event to publish, see ["Event Flist, Event Definition, and XML Output Example"](#).

The default set of business events that BRM publishes is defined in the Payload Generator EM configuration file, **payloadconfig.xml**. You can edit the configuration file to:

- Add events that you want to publish.
- Remove events that you do not want to publish.
- Specify whether you want the events to be published in XML or flist format.

For the definitions of the default set of business events, see the payload configuration file (*BRM\_Home/sys/eai\_js/payloadconfig.xml*).

## About Publishing Additional Business Events

To publish additional business events, you include definitions of the events in the **payloadconfig.xml** configuration file. For information on the syntax of the entries, see ["About the Payload Configuration File Syntax"](#).

You use the fields in the event flist or storable class to define the business event. You need to specify the BRM events to publish, the data to publish, where to get the values for the fields, and how to present the data in the XML output.

For information on how to define events, see ["Defining Business Events"](#).

For an example of the relationship between the flist, event definition, and XML output, see "[Event Flist, Event Definition, and XML Output Example](#)".

If you need to publish valid XML documents for events, you must create data type definitions (DTDs) for the events. For a sample, see the DTDs for the default events in the *BRM\_Home/sys/eai-js/dtds* directory.

## Setting Up Multiple Publishers and Events

You can define multiple publishers in EAI Manager to publish separate sets of business events. You define a publisher by including a **<PublisherDefs>** tag for it in the *payloadconfig.xml* file. See "[Publisher Definitions](#)" for more information.

Using multiple publishers, you can ensure that applications receive only the events they need. For example, one publisher could publish the customer creation event to one application, while another publisher publishes the service creation event to another application.

Events can be published separately even if one event is part of another. For example, service creation can take place during customer creation, but the subscriber interested in service creation receives only that event, not the larger customer creation event.

## Defining Business Events

1. In a text editor, open the payload configuration file (*BRM\_Home/sys/eai\_js/payloadconfig.xml*).
2. In the **<Publisher>** section, specify the business events you want to publish.  
For information on the syntax, see "[Publisher Definitions](#)".
3. (Optional) In the **<Publisher>** section, specify attributes for business events that will cause identifiers to be returned.  
See "[Returning Identifiers from Enterprise Applications](#)".
4. For each business event you specified, define the following attributes in the **<EventDefs>** section:
  - [Source](#)
  - [Tag](#)
  - [StartEvent](#)
  - (Optional) [EndEvent](#)
  - (Optional) [DataFrom](#)
  - (Optional) [UseOnlyElement](#)
5. (Optional) Include the following elements in the **<EventDefs>** section:
  - [DTD](#)
  - [Attribute](#)
  - [Field](#)
  - [Search](#)
  - [SubElement](#)
6. For each **SubElement** in the **<ElementDefs>** section, include the following attributes to define the sub-element:

- [Source](#)
  - (Optional) [DataFrom](#)
  - [Tag](#)
7. (Optional) Include the following attributes:
- [UseOnlyElement](#)
  - [UseElementId](#)
  - [PinFld](#)

---

**Important:** If you are using the flist (field list) output format, you *must* specify **PinFld**.

---

8. Include the following elements in the element definition:
- [Field](#)
  - [ExtendedInfo](#)
9. (Optional) To check the configuration file for errors, run the **ValidateConfig** program.
- For more information, see "[Validating Your Changes to the Payload Configuration File](#)".
10. Save and close the file.
11. Ensure that the BRM events included in each newly defined business event are in your system's event notification list.
- See "[Configuring Event Notification for EAI Manager](#)".
12. Stop and restart the Payload Generator External Module (EM):

```
cd BRM_Home/bin
pin_ctl bounce eai_js
```

---

**Important:** If you rename the file, make sure you also change the file name in the Payload Generator EM **Infranet.properties** file. For more information, see "[Configuring the Payload Generator EM](#)".

---

13. If your custom event is used by Pipeline Manager, configure the DAT\_BalanceBatch **CustomEvents** registry entry. See "[Configuring Custom Business Events for Pipeline Discounting](#)" and "DAT\_BalanceBatch" in *BRM Configuring Pipeline Rating and Discounting*.

## Configuring Custom Business Events for Pipeline Discounting

To enable custom business events in Pipeline Manager, you need to list them in the DAT\_BalanceBatch **CustomEvents** registry entry. For example, this entry enables an event named CycleRollover20days:

```
CustomEvents
{
  CycleRollover20days
}
```

## Removing Events that You Do Not Want to Publish

1. In a text editor, open the payload configuration file (*BRM\_Home/sys/eai\_js/payloadconfig.xml*).
  2. Remove the events that you do not want to publish from the event list in the **<Publisher>** section.
  3. (Optional) To check the configuration file for errors, run the **ValidateConfig** program.
- For more information, see ["Validating Your Changes to the Payload Configuration File"](#).
4. Save and close the file.
  5. Stop and restart the Payload Generator EM:

```
cd BRM_Home/bin
pin_ctl bounce eai_js
```

## Returning Identifiers from Enterprise Applications

You can configure EAI Manager to receive identifiers returned from enterprise applications. For example, if data is published to a contact management application, that application may return user IDs. You can store those IDs in the BRM database.

You specify additional attributes in the **payloadconfig.xml** file when you define a business event that returns an identifier. These attributes are necessary only for business events that return an identifier.

See ["Publisher Definitions"](#) for more detailed information about the syntax.

In addition to including information about identifiers in the **<Publisher>** section of the **payloadconfig.xml** file, you must implement the **SetIdentifier** function in your connector application. See ["SetIdentifier"](#) for more information.

## Changing the Format of Published Events

By default, EAI Manager publishes business events in XML format. You can publish events in flist format by editing the configuration file.

1. In a text editor, open the payload configuration file (*BRM\_Home/sys/eai\_js/payloadconfig.xml*).
2. In the **<PublisherDefs>** section, change the value of **Format** from **XML** to **FLIST**:

```
<PublisherDefs>
  <Publisher DB="0.0.9.1" Format="FLIST">
```

3. (Optional) To check the configuration file for errors, run the **ValidateConfig** program.

For more information, see ["Validating Your Changes to the Payload Configuration File"](#).

4. Save and close the file.
5. Stop and restart the Payload Generator EM:

```
cd BRM_Home/bin
pin_ctl bounce eai_js
```

## Validating Your Changes to the Payload Configuration File

After you edit the `payloadconfig.xml` configuration file, you can check the validity of the file by using the `ValidateConfig` program. This program checks the configuration file for errors and displays the list of events to be published along with a message that the file is valid. If there are errors, the `ValidateConfig` program specifies them.

To validate your changes to the configuration file, run the `ValidateConfig` program using the following syntax:

```
java com.portal.eai.ValidateConfig [config_file_name]
```

For example:

```
java com.portal.eai.ValidateConfig BRM_Home/sys/eai_js/payloadconfig.xml
```

---

---

**Note:** If the configuration file name is not specified, the `ValidateConfig` program uses the configuration file specified in the `Infranet.properties` file.

---

---

## About the Payload Configuration File Syntax

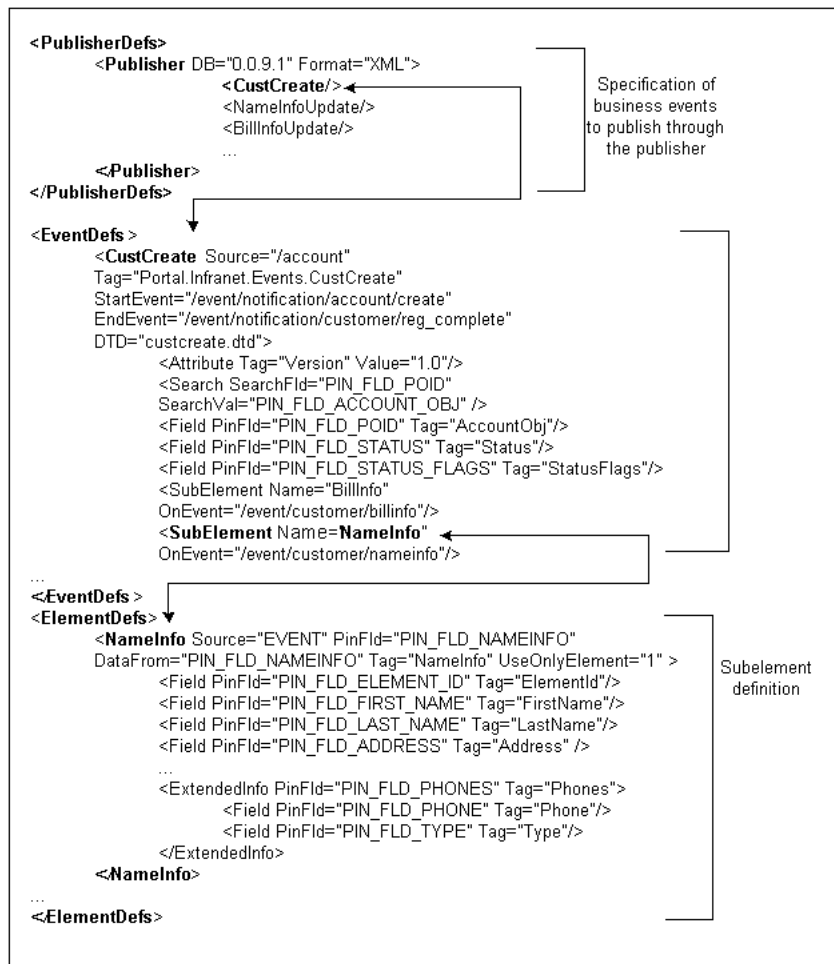
This section describes the syntax of the configuration file used to define the business events.

The configuration file has three sections:

- **"Publisher Definitions"** (<`PublisherDefs`>) lists the publisher and the events to publish. Each event in the list is defined in the event definition section.
- **"Event Definitions"** (<`EventDefs`>) defines the contents, source, and format of the events to publish. Each sub-element in the event definition is defined in the element definition section.
- **"Element Definitions"** (<`ElementDefs`>) defines the sub-elements specified in the event definitions.

Figure 17-2 shows the relationship between the elements in the different sections of the configuration file:

Figure 17–2 Sample Payload Configuration File



## Publisher Definitions

You specify each business event that needs to be published, such as customer account creation, in the **<PublisherDefs>** section between the **<Publisher>** tags. The publisher definition is a list of all the business events to publish.

The **<PublisherDefs>** section defines the publisher to which the events are sent. You can include multiple publishers. You define each publisher as an element with the tag **<Publisher>**.

The publisher definition includes the following elements:

- The mandatory attribute, **DB**, which specifies the database number of the EAI DM.

---

**Important:** The database number must match the database number in the **dm\_pointer** entry of the CM **pin.conf** file and the **dm\_db\_no** entry of the EAI DM **pin.conf** file.

---

- An optional attribute, **Format**, which specifies the format for the published output. Possible values are **XML**, which is the default, and **FLIST**.
- A list of events to publish. Each event is listed in a separate tag. If an event triggers an identifier to be returned from a third-party application, the tag must include



attributes specifying where the identifier will be stored in BRM. These attributes are required only for events that trigger identifiers.

This example includes one event (CustCreate) that triggers an identifier:

```
<PublisherDefs>
<Publisher DB="0.0.9.1" Format="XML">
<CustCreate ObjectPoid="PIN_FLD_POID" IdentifierFld="PIN_FLD_ACCOUNT_NO"/>
<NameInfoUpdate/>
<BillInfoUpdate/>
...
</Publisher>
</PublisherDefs>
```

---



---

**Note:** In previous versions of EAI Manager, a different syntax was used for event definitions. The events were defined in a comma-separated list, not as tags. This syntax is still supported when *no* events trigger an identifier. If any of the defined events returns an identifier, all of the events must be defined with tags.

---



---

## Event Definitions

Each event listed in the publisher definition is defined in the event definition between the `<EventDefs>` and `</EventDefs>` tags. The event definition contains a list of events to publish, each of which contains elements and attributes that specify the following information:

- Where to get the fields and the data for the event
- The sub-elements that make up the event
- The start and end event for the business event if multiple events are generated for the business event
- How the elements should be presented in the final XML output

---



---

**Note:** If only one BRM event is generated during a business event, you need to specify only the start event.

---



---

The `<EventDefs>` tag defines a business event. Event definitions must have the following attributes:

- [Source](#)
- [Tag](#)
- [StartEvent](#)

Optionally, the event definition can include the following elements and attributes:

- [EndEvent](#)
- [DTD](#)
- [Attribute](#)
- [PinFld](#)
- [Search](#)
- [SubElement](#)

This example shows the definition of the customer creation business event in the default configuration file:

```
<EventDefs>
  <CustCreate Source="/account"
    Tag="Portal.Infranet.Events.CustCreate"
    StartEvent="/event/notification/account/create"
    EndEvent="/event/notification/customer/reg_complete"
    DTD="custcreate.dtd">
    <Attribute Tag="Version" Value="1.0"/>
    <Search SearchFld="PIN_FLD_POID"
      SearchVal="PIN_FLD_ACCOUNT_OBJ"/>
    <Field PinFld="PIN_FLD_POID" Tag="AccountObj"/>
    <Field PinFld="PIN_FLD_STATUS" Tag="Status"/>
    <Field PinFld="PIN_FLD_STATUS_FLAGS" Tag="StatusFlags"/>
    <SubElement Name="BillInfo"
      OnEvent="/event/customer/billinfo"/>
    <SubElement Name="PayInfo"
      OnEvent="/event/notification/customer/reg_complete"/>
    <SubElement Name="NameInfo"
      OnEvent="/event/customer/nameinfo"/>
    <SubElement Name="DealInfo"
      OnEvent="/event/billing/deal/purchase"/>
    <SubElement Name="ProductInfo"
      OnEvent="/event/billing/product/action/purchase"/>
    <SubElement Name="ProductDetail"
      OnEvent="/event/billing/product/action/purchase"/>
    <SubElement Name="Service"
      OnEvent="/event/notification/customer/reg_complete"/>
    <SubElement Name="Profile"/>
  </CustCreate>
</EventDefs>
```

## Element Definitions

Each sub-element in the event definition must be defined as an element in the element definition (<**ElementDefs**>). An array or substructure (at element level 0) in the BRM event flist or the storable object flist is defined in the element definition.

Each element definition specifies the following information:

- Where to get the data for the element
- The BRM field name for the data
- How to present the data in the final XML output

The <**ElementDefs**> tag is used to define elements. The element definition includes the following elements and attributes:

- The mandatory attributes, "**Source**" and "**Tag**"
- The optional attributes, "**PinFld**" and "**UseOnlyElement**"

---

---

**Important:** If the output format for the payload is **FLIST**, **PinField** is mandatory.

---

---

- The elements "**Field**" and "**ExtendedInfo**"

This example shows the definition of the sub-element **NameInfo** in the default configuration file:

```

<ElementDefs>
  <NameInfo Source="EVENT" PinFld="PIN_FLD_NAMEINFO"
    DataFrom="PIN_FLD_NAMEINFO" Tag="NameInfo" UseOnlyElement="1" >
    <Field PinFld="PIN_FLD_ELEMENT_ID" Tag="ElementId" />
    <Field PinFld="PIN_FLD_FIRST_NAME" Tag="FirstName" />
    <Field PinFld="PIN_FLD_MIDDLE_NAME" Tag="MiddleName" />
    <Field PinFld="PIN_FLD_LAST_NAME" Tag="LastName" />
    <Field PinFld="PIN_FLD_ADDRESS" Tag="Address" />
    <Field PinFld="PIN_FLD_CITY" Tag="City" />
    <Field PinFld="PIN_FLD_STATE" Tag="State" />
    <Field PinFld="PIN_FLD_ZIP" Tag="Zip" />
    <ExtendedInfo PinFld="PIN_FLD_PHONES" Tag="Phones">
      <Field PinFld="PIN_FLD_PHONE" Tag="Phone" />
      <Field PinFld="PIN_FLD_TYPE" Tag="Type" />
    </ExtendedInfo>
  </NameInfo>
</ElementDefs>

```

## Syntax of Elements and Attributes

This section describes the attributes and elements you use to define events and elements.

For an example of the relationship between the events, elements, and the flist data, see ["Event Flist, Event Definition, and XML Output Example"](#).

### Source

Specifies where to get the data for fields specified in the event or element definitions.

**Source** can be a BRM storable class name or **EVENT**. If you set the **Source** attribute to **EVENT**, the Payload Generator EM reads the fields for the element from the incoming flist of the event. If you specify a class name, the Payload Generator EM reads the fields from the BRM database.

If all the data for the fields you need to publish is present in the event flist, specify **EVENT** for the source. If the event flist has a pointer to data through a POID (Portal object ID), specify **Source** to be a storable class.

For example:

```

<!-- Source is a Portal class name-->
PayInfo Source="/payinfo"

<!-- Source is the Event flist -->
NameInfo Source="EVENT"

```

### Tag

Specifies the XML tag to be associated with the event, element, or field in the final XML output file.

For example, this entry in the configuration file appears as

```

<FirstName>Name</FirstName> in the XML output:

<Field PinFld="PIN_FLD_FIRST_NAME" Tag="FirstName" />

```

### StartEvent

Specifies the BRM event that triggers the beginning of the business event. The Payload Generator EM starts caching event data when the event specified in the **StartEvent** attribute occurs. This element is mandatory in event definitions. If there is only one

BRM event generated for the business event, the Payload Generator generates and publishes the business event as soon as it receives the event specified in **StartEvent**. If more than one BRM event is generated for a business event, the Payload Generator caches all the events starting with this event up to the event specified in **EndEvent**, and then generates and publishes the business event.

For example:

```
<-- StartEvent for customer creation business event -->
StartEvent="/event/notification/account/create"
```

### EndEvent

Specifies the BRM event that marks the end of the business event. When the Payload Generator has cached all the events from the event specified in the **StartEvent** attribute to the event specified in the **EndEvent** attribute, the Payload Generator generates and sends the payload to the EAI DM.

When this attribute isn't present, the business event begins and ends with the BRM event specified in **StartEvent**.

For example:

```
<!-- EndEvent for customer creation business event -->
EndEvent="/event/notification/customer/reg_complete"
```

### DataFrom

Specifies the array or substructure field in an flist from which to retrieve data for the event or the element.

If the source for the element data is specified as **EVENT**, the array or substructure is read from the incoming flist for the event. If the source for the element data is specified as a storable class, the array or substructure is read from the storable class in the BRM database.

For example:

```
<!-- Data to be read from PIN_FLD_NAMEINFO array for the NameInfo element -->

DataFrom="PIN_FLD_NAMEINFO"
```

### UseOnlyElement

Specifies an element of an array to publish. Use this tag when you want to publish only one of the elements of the array in the flist.

For example, suppose the **BillInfo** element of a business event is constructed when an **/event/customer/billinfo** event occurs. To publish only element 1, specify **UseOnlyElement="1"**.

### UseElementId

Determines whether element IDs are retained with array fields. If you set **UseElementId** to **1**, element IDs are retained with array elements. If you set **UseElementId** to **0**, array elements are published in sequential order without their original element IDs.

---



---

**Note:** If the data is published in flist format with **UseElementID** set to 0, elements are numbered sequentially starting from 0. These numbers do not correspond to the original element IDs. They are included only to ensure that the flist is in a valid format.

---



---

For example:

```
<!-- This tag will cause element IDs to be retained for elements in this array -->

<NameInfo Source="EVENT" PinFld="PIN_FLD_NAMEINFO"
DataFrom="PIN_FLD_NAMEINFO" Tag="NameInfo" UseElementId="1" >
```

### Attribute

Adds an attribute to the XML output of the events.

---



---

**Note:** **Attribute** is used only in event definitions.

---



---

You must specify two entries for the **Attribute** field:

- **Tag** to specify the name of the attribute you want to add.
- **Value** to specify the value of the attribute.

For example:

```
<!-- This Attribute adds the version number to a customer creation business event
definition -->
<CustCreate ... Tag="Portal.Infranet.Events.CustCreate"
<Attribute Tag="Version" Value="1.0"/>
```

The XML output for this business event includes a **Version** attribute:

```
<Portal.Infranet.Events.CustCreate Version="1.0">
```

### DTD

Specifies the data type definition (DTD) used for the XML output for this business event.

---



---

**Note:** You need to specify a DTD only if you publish valid XML documents.

---



---

You must use the **Name** attribute to specify the name of the DTD file.

This example specifies that the **custcreate.dtd** file be used for the output:

```
<!-- Specifies the custcreate.dtd as the file to use for the XML output -->

<DTD Name="custcreate.dtd">
```

The XML output for that example includes the DTD file in its DOCTYPE tag:

```
<!DOCTYPE Portal.Infranet.Events.CustCreate SYSTEM "custcreate.dtd">
```

### PinFld

Specifies the BRM field name.

For element and **ExtendedInfo** definitions, the data type of the BRM field must be an array or substructure.

---

---

**Important:** This field is mandatory if you specify **FLIST** as the output format for the published event.

---

---

```
<--! Specifies that the data for the NameInfo element is from the PIN_FLD_NAMEINFO field of the event flist-->
```

```
<NameInfo Source="EVENT" PinFld="PIN_FLD_NAMEINFO"
```

### Field

Specifies the BRM field to include in the definition of an event, element, or **ExtendedInfo**.

You must specify two attributes:

- **PinFld** to specify the name of the field in BRM.
- **Tag** to specify the XML tag to use for the value in the XML file generated for this business event.

This example specifies that the data is retrieved from the PIN\_FLD\_FIRST\_NAME field and assigned to the **<FirstName>** tag in the XML output:

```
<Field PinFld="PIN_FLD_FIRST_NAME" Tag="FirstName" />
```

The XML output:

```
<FirstName> Name </FirstName>
```

### ExtendedInfo

Specifies an array or substruct field within an element definition.

For example, if the array that defines the element contains a nested array that you want to include in your element definition, use **ExtendedInfo**.

You must use the following attributes:

- **PinFld** to specify the BRM field name. The data type must be an array or substruct.
- **Tag** to specify the XML tag used for the value in the XML file generated for this business event.

You can optionally specify the **"UseOnlyElement"** attribute to read only the element specified from the array.

### Search

Specifies the search criteria to read data from a storable class when **Source** is specified as a storable class.

---

---

**Note:** You can specify **Search** only in event and element definitions.

---

---

EAI Manager searches the database by creating an SQL query using the attributes specified:

- **SearchFld** specifies the field to search in the database.

- **SearchVal** specifies the value in the input flist to be used in the search arguments.
- **SearchValFrom** specifies that the value for the search needs to be read from an array or substruct element in the input flist.

For example, when this **Search** field is specified:

```
<PayInfo Source="/payinfo" PinFld="PIN_FLD_PAYINFO"
  Tag="PayInfo" >
  <Search SearchFld="PIN_FLD_ACCOUNT_OBJ"
    SearchVal="PIN_FLD_ACCOUNT_OBJ" />
  ...
```

EAI Manager creates this query:

Select from **/payinfo** where PIN\_FLD\_ACCOUNT\_OBJ equals the value of the field PIN\_FLD\_ACCOUNT\_OBJ in the event flist.

When this **Search** field is specified:

```
<ProductDetail Source="/product" PinFld="PIN_FLD_PRODUCT"
  Tag="ProductDetail">
  <Search SearchFld="PIN_FLD_POID"
    SearchVal="PIN_FLD_PRODUCT_OBJ"
    SearchValFrom="PIN_FLD_PRODUCT" />
  ....
```

EAI Manager creates this query:

Select from **/product** where PIN\_FLD\_POID equals the value of the field PIN\_FLD\_PRODUCT\_OBJ in the PIN\_FLD\_PRODUCT array of the event flist.

## SubElement

Specifies the element to add to an event in the event definition.

You must specify the **Name** attribute, which must match the tag of the element in the **<ElementDefs>** section. If you have an element called **NameInfo** in the **<ElementDefs>** tag:

```
<ElementDefs>
<NameInfo Source="EVENT" ...>
```

the **Name** attribute in the **SubElement** must be:

```
<SubElement Name="NameInfo">
```

You can optionally include the **OnEvent** attribute if the **Source** for the sub-element is **"Event"**. If you specify **OnEvent**, the data for the sub-element is generated when the event occurs.

If the **Source** for the data is a storable class, the data is read from the database before the business event is published.

For example, this entry specifies that the data for the **NameInfo Sub-element** is read when the **nameinfo** event occurs in BRM:

```
<SubElement Name="NameInfo"
  OnEvent="/event/customer/nameinfo"/>
```

## Event Flist, Event Definition, and XML Output Example

The following figures show the **NameInfoUpdate** business event definition, how the data in the event flist is used to construct the business event, and the published XML document.

**Note:** These examples show only a few of the fields in the event flist and event definition.

Figure 17–3 shows a partial NameInfoUpdate event flist and the NameInfoUpdate definition:

**Figure 17–3 NameInfoUpdate Event Flist and Event Definition**

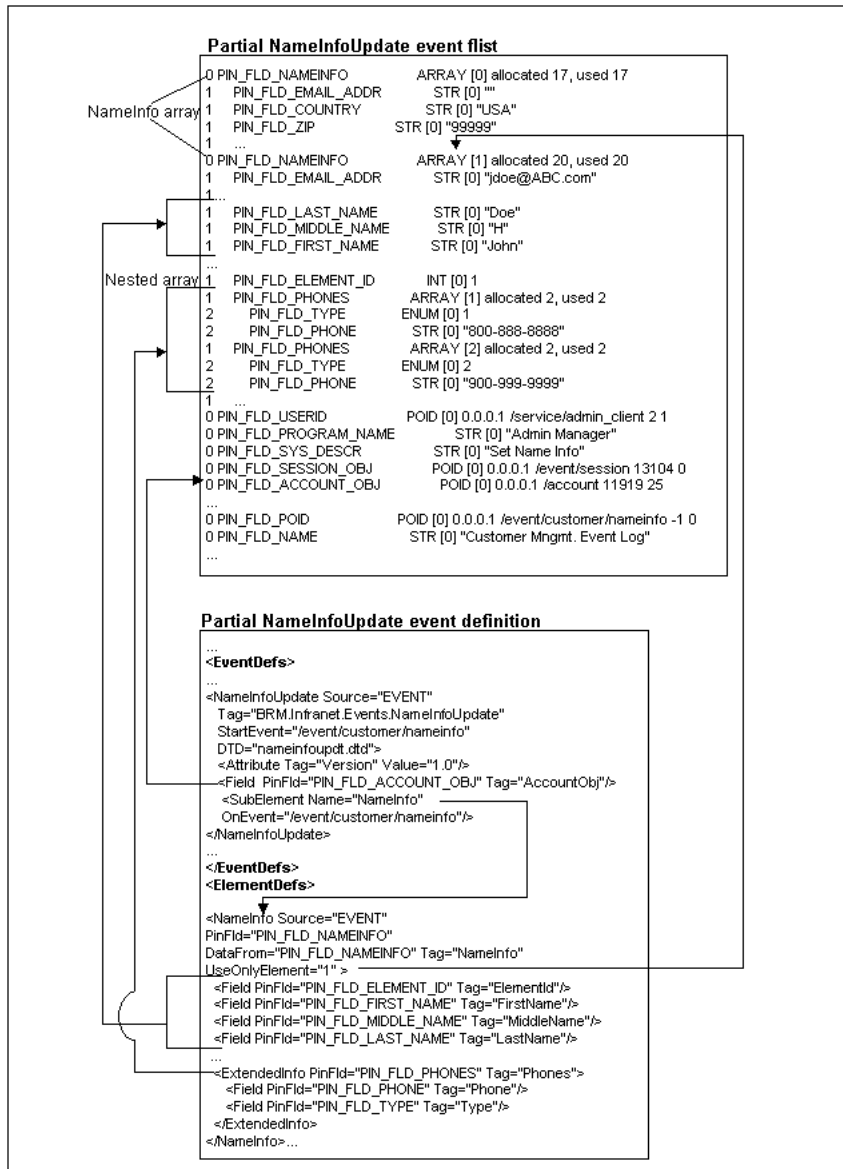


Figure 17–4 shows the published XML output of the NameInfoUpdate event in the previous example:



Figure 17-4 *NameInfoUpdate XML Output*

```

XML output of the NameInfoUpdate event

<?xml version="1.0"?>
<!DOCTYPE Portal.Infranet.Events.NameInfoUpdate
SYSTEM "nameinfoupdt.dtd" >
<Portal.Infranet.Events.NameInfoUpdate
Version="1.0">
<AccountObj>0.0.0.1 /account 11919 25</AccountObj>
  <NameInfo>
    <ElementId>1 </ElementId>
    <FirstName>John</FirstName>
    <MiddleName>H</MiddleName>
    <LastName>Doe</LastName>
    <Phones>
      <Phone>800-888-8888</Phone>
      <Type>1</Type>
    </Phones>
    <Phones>
      <Phone>900-999-9999</Phone>
      <Type>2</Type>
    </Phones>
  </NameInfo>
</Portal.Infranet.Events.NameInfoUpdate>

```

## About Filtering which Business Events Are Published

You can configure EAI Manager to filter which business events are published or not published based on business event attributes. You define the criteria a business event must meet, and only business events meeting the criteria are published.

You filter which business events are published and not published by creating a condition, which consists of the following:

- The **Condition** attribute. See "[About the Condition Attribute](#)".
- The criteria that the business event must meet to be published. See "[About the Condition Definition](#)".

### About the Condition Attribute

The **Condition** attribute specifies the name of your condition. You can use any name, such as MyCondition. You specify the condition name in the **<PublisherDefs>** section of the **payloadconfig.xml** file using the following format:

```
Condition=ConditionName
```

You indicate whether to apply the condition to a specific business event or to all business events in the publisher through the placement of the **Condition** attribute:

- For a specific business event, you add the **Condition** attribute after the appropriate business event. For example, to apply the condition to **BillInfoUpdate** business events:

```

<PublisherDefs>
  <Publisher DB="0.0.9.9" Format="FLIST">
    CustCreate,
    CustDelete,
    BillInfoUpdate Condition=MyCondition

```

```
</Publisher>
</PublisherDefs>
```

In this example, only the **BillInfoUpdate** business event will be filtered by **MyCondition**.

- For all business events in the publisher, you add the **Condition** attribute, surrounded by quotes, to the **<Publisher>** tag. For example:

```
<PublisherDefs>
  <Publisher DB="0.0.9.9" Condition="MyCondition" Format="FLIST"/>
    CustCreate,
    CustDelete,
    BillInfoUpdate
  </Publisher>
</PublisherDefs>
```

In this example, the **CustCreate**, **CustDelete**, and **BillInfoUpdate** business events will be filtered by **MyCondition**.

## About the Condition Definition

The condition definition defines the criteria that a business event must meet to be published. The condition definition must appear at the end of the **payloadconfig.xml** file in its own **<ConditionDefs>** section and follow this format:

```
<ConditionDefs>
  <ConditionName>
    <BooleanOperator>
      <BooleanExpression PinFld="FieldName" Value="FieldValue"
Operator="OpValue"/>
    </BooleanOperator>
  </ConditionName>
</ConditionDefs>
```

[Table 17-1](#) lists the elements in the **<ConditionDefs>** section.

**Table 17–1 Elements in ConditionDefs**

| Element                  | Syntax  | Description   |
|--------------------------|---|---|
| <i>ConditionName</i>     | <MyCondition>   | Opens the condition definition. <i>ConditionName</i> must match the name you defined in the <b>Condition</b> attribute. See <a href="#">"About the Condition Attribute"</a> .   |
| <i>BooleanOperator</i>   | <AndExpression>   | The Boolean operator to apply. Possible values are: <ul style="list-style-type: none"> <li>▪ <b>AndExpression</b> is the Boolean AND.</li> <li>▪ <b>OrExpression</b> is the Boolean OR.</li> <li>▪ <b>NotExpression</b> is the Boolean NOT.</li> </ul>  |
| <i>BooleanExpression</i> | <BooleanExpression<br>PinFld="PIN_FLD_FLAGS"<br>Value="128"<br>Operator="GT" /> | Contains the definition for the Boolean expression, including the field name, field value, and operator.<br><b>PinFld</b> specifies the business event flist field name. You can also use OP_FLAGS, which is the flag with which the business event was generated.<br><b>Value</b> specifies the value of the business event flist field.<br><b>Operator</b> can be one of the following: <ul style="list-style-type: none"> <li>▪ EQ is equal to.</li> <li>▪ NE is not equal to.</li> <li>▪ LT is less than.</li> <li>▪ GT is greater than.</li> <li>▪ LE is less than.</li> <li>▪ GE is greater than or equal to.</li> <li>▪ CHECK-BITS checks the specified bits for Integers.</li> <li>▪ CHECK-DB checks the database specified in the POID field.</li> <li>▪ CHECK-ID checks the ID of the POID field.</li> <li>▪ CHECK-TYPE checks the type of the POID field.</li> </ul> <b>Note:</b> The operators that can be used with each field depend on the field's data type: <ul style="list-style-type: none"> <li>▪ INT and ENUM data types support EQ, NE, GT, LT, GE, LE, and CHECK-BITS operators.</li> <li>▪ POID data types support EQ, NE, CHECK-DB, CHECK-ID, and CHECK-TYPE operators.</li> <li>▪ STR data types support EQ and NE operators.</li> <li>▪ DECIMAL and TSTAMP data types support EQ, NE, GT, LT, GE, LE operators.</li> </ul> |

## About Building a Connector Application

To provide access to BRM event data for enterprise applications, you need to build a module connector application that handles transaction management and transformation schemes specific to your environment.

The EAI DM calls the functions listed in [Table 17–2](#) when it starts, processes event data, and shuts down. You must implement these functions in your connector application.

**Table 17–2 Functions Called by EAI Data Manager**

| Function                          | Description   |
|-----------------------------------|---|
| <a href="#">AbortTransaction</a>  | Called by the EAI DM after the transaction is aborted in BRM.   |
| <a href="#">CommitTransaction</a> | Called by the EAI DM after BRM commits the transaction to its database.                                     |
| <a href="#">FreeGlobalContext</a> | Called when the EAI DM process is shutting down.  |
| <a href="#">GetGlobalContext</a>  | Called from a connector application to access the context initialized with <b>InitializeGlobalContext</b> . |
| <a href="#">Initialize</a>        | Called by the EAI DM when it starts.  |
| <a href="#">OpenTransaction</a>   | Called by the EAI DM before it calls <b>PublishEvent</b> .  |
| <a href="#">PrepareCommit</a>     | Called by the EAI DM when BRM is about to commit the transaction to the database.                           |
| <a href="#">PublishEvent</a>      | Called by the EAI DM when there is a business event to be published.  |
| <a href="#">SetIdentifier</a>     | Called from the connector application to set a return identifier for a published business event.            |
| <a href="#">Shutdown</a>          | Called by the EAI DM when it shuts down.  |

The **plugin\_flist.c** and **plugin\_xml.c** files in the *BRM\_Home/sys/dm\_eai* directory provide sample implementations of the EAI functions in flist and XML format.

After you build your connector application, configure EAI Manager. See "[Configuring EAI Manager](#)".

## Configuring EAI Manager

When you install EAI Manager, the installation program adds entries to the EAI DM and the CM **pin.conf** files and to the **Infranet.properties** file. After you build the connector application, you need to enable EAI by editing the **pin.conf** and **Infranet.properties** files to specify values for the entries relevant to EAI Manager.

### Configuring the Connection Manager for EAI

1. In a text editor, open the CM configuration file (*BRM\_Home\sys\cm\pin.conf*).  
This **pin.conf** file contains descriptions of all the entries and instructions for editing the entries.
2. In the EAI\_CM section of the file, assign values to the entries shown in [Table 17–3](#):

Table 17–3 EAI CM Entries

| Entry                       | Description   | Example                                    |
|-----------------------------|---|--|
| - fm_publish enable_publish | Specifies whether to publish events.<br>To publish events, specify 1. To not publish events, specify 0.   | - fm_publish enable_publish 1              |
| - cm em_pointer             | Specifies the host name and port number of the computer on which the Payload Generator EM runs.<br><br>The <b>em_pointer</b> entry includes the following values: <ul style="list-style-type: none"> <li>▪ Tag that refers to the EM type; for example, <b>publish</b> for the EAI EM.</li> <li>▪ The address type tag, <b>ip</b>.</li> <li>▪ IP address or host name of the computer where the Payload Generator EM runs.</li> <li>▪ Port number of the computer where the Payload Generator EM runs.</li> </ul> <b>Important:</b> The port number must match the port number in the <b>Infranet.properties</b> file in the <i>BRM_Home\sys\esai_js</i> directory. | - cm em_pointer publish ip 127.0.0.1 11930 |
| - cm em_group               | Specifies a member opcode in a group of opcodes provided by the Payload Generator EM.<br><br><b>Note:</b> This entry is automatically inserted in the configuration file by the installation program.<br><br>The <b>em_group</b> entry includes the following values: <ul style="list-style-type: none"> <li>▪ Tag that refers to the EM type; for example, <b>publish</b> for the EAI EM.</li> <li>▪ The opcode name or number.</li> </ul>   | - cm em_group publish 1301                 |
| - cm dm_pointer             | Specifies the database number, the IP address or host name, and port number of the computer where the EAI DM runs.<br><br><b>Important:</b> The database number must match the <b>DB</b> entry of the publisher definition in the <b>payloadconfig.xml</b> file. The database number and port number must match the <b>dm_db_no</b> and <b>dm_port</b> entries in the EAI DM <b>pin.conf</b> file.  | - cm dm_pointer 0.0.9.1 ip 127.0.0.1 11970 |

3. Save and close the file.
4. Stop and restart the CM:

```
cd BRM_Home/bin
pin_ctl bounce cm
```

## Configuring the EAI DM

1. In a text editor, open the EAI DM configuration file (*BRM\_Home*\sys\dm\_eai\pin.conf).
2. In the EAI\_PINCONF entries section, assign values to the entries shown in Table 17-4:

**Table 17-4 EAI\_PINCONF Entries**

| Entry            | Description  | Example                             |
|------------------|--|-------------------------------------|
| - dm plugin_name | Specifies the name of the module connector application that you implemented.   | - dm plugin_name ./dm_eai_plugin.so |
| - dm dm_db_no    | Specifies the database number assigned to the EAI DM.<br><br>The format of the entry is 0.0.0.n. 0, where <i>n</i> is your database number.<br><br><b>Important:</b> This number must match the DB entry for the publisher definition in the <b>payloadconfig.xml</b> file and the <b>dm_pointer</b> entry in the CM <b>pin.conf</b> file. | - dm dm_db_no 0.0.9.1 0             |
| - dm dm_port     | Specifies the port number of the computer where the EAI DM runs.<br><br><b>Important:</b> This number must match the port number in the <b>dm_pointer</b> entry in the CM <b>pin.conf</b> file.  | - dm dm_port 11970                  |
| - dm loglevel    | Specifies the log level of the EAI DM:<br>0 = no logging<br>1 = log only error messages (default)<br>2 = log error messages and warnings<br>3 = log error messages, warnings, and debugging messages   | - dm loglevel 1                     |

3. Save and close the file.
4. Stop and restart the EAI DM:

```
cd BRM_Home/bin
pin_ctl bounce dm_eai
```

## Configuring the Payload Generator EM

The Payload Generator has an **Infranet.properties** file that specifies the location of the **payloadconfig.xml** file:

To configure the Payload Generator:

1. In a text editor, open the Payload Generator configuration file (*BRM\_Home*\sys\ei\_js\Infranet.properties).
2. Specify the name and location of the **payloadconfig.xml** file:
  - If you are *not* using the **plugin\_http** module, verify that the **infranet.eai.configFile** entry points to the location of the **payloadconfig.xml** file.

---

**Important:** If you edited the `payloadconfig.xml` file and saved it with a different name, make sure you also change the name in this entry.

---

- If you *are* using the `plugin_http` module, change the `infranet.eai.configFile` entry to point to the location of the `payloadconfig_plugin_http.xml` file.

3. Verify that the file contains the following entry:

```
infranet.opcode.handler.PUBLISH_GEN_PAYLOAD=com.portal.eai.PublishHandler
```

4. Verify that the port number specified in the `infranet.server.portNR` entry matches the port number in the `em_pointer_publish` entry in the CM `pin.conf` file.

5. Save and close the file.

6. Stop and restart the Payload Generator EM:

```
cd BRM_Home/bin
pin_ctl bounce ePai_js
```

## Specifying the Date and Time Format for Business Events

In business events, the date field value uses the default EAI Manager format in the server's local time zone. You can configure the date field to use a different date and time format by using the following entry in the Payload Generator `Infranet.properties` file:

**infranet.eai.date\_pattern:** Specifies the date and time format based on the ISO-8601 standard. For example, you can set this entry to any of the following formats:

- `infranet.eai.date_pattern=dd/MMM/yyyy:hh:mm:ss`
- `infranet.eai.date_pattern=yyyy-MM-dd'T'hh:mm:ss`. Use this format if EAI Manager uses Oracle AIA to exchange data with external applications.

To specify the date and time format in business events:

1. In a text editor, open the Payload Generator configuration file (`BRM_Home\sys\eai_js\Infranet.properties`).

2. Specify the date format in the `infranet.eai.date_pattern` entry:

```
infranet.eai.date_pattern = Format
```

3. Save and close the file.

4. Stop and restart the Payload Generator EM:

```
cd BRM_Home/bin
pin_ctl bounce eai_js
```

## Defining Infinite Start Date and End Date Values

In some external applications, the infinite date value is represented as a NULL (empty XML element) value and in other external applications as the epoch time (01-01-1970 1200 AM UTC).

By default, when EAI Manager sends data to your external application, the infinite date value is the start of the epoch time.

You can define how EAI Manager sets infinite date values by using the `infranet.eai.xml_zero_epoch_as_null` entry in the Payload Configurator `Infranet.properties` file.

---

---

**Note:** The `infranet.eai.xml_zero_epoch_as_null` entry does not affect the flist payload.

---

---

To configure how EAI Manager sets infinite date values:

1. Open the `BRM_Home/sys/eai_js/Infranet.properties` file in a text editor.
2. Add the following entry:

```
infranet.eai.xml_zero_epoch_as_null = value
```

where *value* is:

- **TRUE** to use NULL to represent an infinite start or end date.
  - **FALSE** to use the epoch time to represent an infinite start or end date. This is the default.
3. Save and close the file.
  4. Stop and restart the Payload Generator EM:

```
cd BRM_Home/bin
pin_ctl bounce eai_js
```

## Configuring EAI Manager to Publish to an HTTP Port

You can use EAI Manager to publish information from your BRM database to an HTTP port for use by a third-party application. For example, you can send product information to a customer relationship manager (CRM), such as Siebel Communications. Information about the new products is posted to a specific HTTP port to enable the CRM to create product information.

To configure EAI Manager to publish to an HTTP port:

1. Configure Connection Manager for EAI. See "[Configuring the Connection Manager for EAI](#)".
2. Open the `dm_eai` configuration file (`BRM_Home\sys\dm_eai\pin.conf`) with a text editor such as `vi`.
3. Add the following line to specify the name of the `dm_http` module:

```
- dm plugin_name plugin_http.extension
```

where *extension* is the library extension for your operating system: **so** for Solaris, Linux, and HP-UX IA64; and **a** for AIX.

4. Add the following line to configure the header delimiter:

```
- dm dm_http_delim_crlf value
```

where *value* is:

- **0** to specify the delimiter `\n`
- **1** to specify the delimiter `\r\n`

The default is **0**.



5. Specify the HTTP host name and port number of the server to which the data should be sent:

- **dm dm\_http\_agent** *host\_name port\_number*

6. If required, specify the HTTP error handling options.

- **dm dm\_http\_error\_opt** *value*

where *value* is:

- 0 to indicate the EAI plug-in to report the error.
- 1 to indicate the EAI plug-in to ignore the error.

7. If required, specify the custom header attributes that a user want to post.

- **dm dm\_http\_header\_attrs** *attr\_name1=attr\_value1; attr\_name2=attr\_value2*

where *attr\_name1=attr\_value1; attr\_name2=attr\_value2* is the custom header attribute. For example,

- **dm dm\_http\_header\_attrs** *accept=text; content-length= 200*

8. If required, specify the response time for the HTTP server.

- **dm dm\_http\_recv\_timeout** *value*

where *value* is:

- Time after which the HTTP server return a time out error.

The default is 30 seconds.

9. If required, specify the URL for the HTTP server; for example:

- **dm dm\_http\_url** *http://10.1.6.78/HTTP\_Infranet/BTSHTTPRECEIVE.so*

---

**Note:** The URL might be required; for example, when you deploy EAI Manager in an IIS environment.

---

10. If your HTTP server requires the host name in the header, add this line to the **pin.conf** file:

- **dm dm\_http\_header\_send\_host\_name** *value*

where *value* is:

- 0 to indicate that the host name won't be included in the header.
- 1 to indicate that the host name will be included in the header.
- 2 to indicate that both the host name and the port number will be included in the header.

The default is 0.

11. If your HTTP server sends a **100-Continue** status code to clients that do not send a 100-Continue expectation, add this line to the **pin.conf** file:

- **dm dm\_http\_100\_continue** *value*

where *value* is:

- 0 to indicate that a 100-Continue status is not expected.
- 1 to indicate that a 100-Continue status is expected.

---

---

**Important:** Set *value* to **1** only if your server sends the 100-Continue status code to clients that do not send an expectation for it. Most servers do not send unexpected 100-Continue codes, but some do.

---

---

The default is **0**.

- 12.** Specify whether or not **dm\_http** should read the response codes sent by the HTTP server:

- **dm dm\_http\_read\_success** *value*

where *value* is:

- **0** to indicate that the module should not wait for a response code from HTTP receiver.
- **1** to indicate that the module should wait for a response code to be read from HTTP receiver.

The **dm\_http** module supports the success response codes **200** (OK) and **202** (request accepted for asynchronous processing).

The default is **0**.

- 13.** Save and close the file.
- 14.** Configure the payload generator. See "[Configuring the Payload Generator EM](#)".
- 15.** Load information for the **dm\_http** module into your system's event notification list.  
See "[Configuring Event Notification for EAI Manager](#)".
- 16.** Stop and restart BRM. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

## AbortTransaction

This function is called by the EAI DM after the transaction is aborted in BRM. For transactional systems, the transaction started with the **OpenTransaction** function needs to be rolled back with this function.

### Syntax

```
int  
AbortTransaction(  
    void    *context);
```

### Parameters

***\*context***

A pointer to the context returned by the **Initialize** function.

### Return Values

Returns **PIN\_RESULT\_PASS** if the operation is successful. Returns **PIN\_RESULT\_FAIL** if the operation fails.

## CommitTransaction

This function is called by the EAI DM after BRM commits the transaction to its database. You commit the transaction opened to your system with this function.

### Syntax

```
int  
CommitTransaction(  
    void    *context);
```

### Parameters

***\*context***

A pointer to the context returned by the **Initialize** function.

### Return Values

Returns **PIN\_RESULT\_PASS** if the operation is successful. Returns **PIN\_RESULT\_FAIL** if the operation fails.

---

---

**Note:** Failure to commit to your system does not abort the transaction within BRM.

---

---

## FreeGlobalContext

This function is called when the EAI DM process is shutting down. All resources allocated by the **InitializeGlobalContext** function are freed with this function.

### Syntax

```
void  
FreeGlobalContext(  
    void    *gblContext);
```

### Parameters

***\*gblContext***

A pointer to the global context initialized by **InitializeGlobalContext**.

### Return Values

This function returns nothing.

## GetGlobalContext

This function is called from a connector application to access the context initialized with **InitializeGlobalContext**.

### Syntax

```
void  
GetGlobalContext ();
```

### Parameters

This function has no parameters.

### Return Values

This function returns nothing.

---

## Initialize

This function is called by the EAI DM when it starts. This function all the initialization tasks such as resource allocations in this function implementation.

---

**Note:** **Initialize** is called once for each EAI DM back end. The number of back ends is specified in the EAI DM **pin.conf** file.

---

### Syntax

```
int
Initialize(
    void    **context,
    int     *output_type);
```

### Parameters

**\*\*context**

A pointer to an open context. *context* is a transparent Binary Large Object (BLOB) or cookie that is passed to the connector application during subsequent calls. You need to manage memory in your application for the context.

**\*output\_type**

Specifies the output format type: `TYPE_XML` or `TYPE_FLIST`. The format must match the value of the **Format** entry in the **payloadconfig.xml** file.

### Return Values

Returns `PIN_RESULT_PASS` if the operation is successful. Returns `PIN_RESULT_FAIL` if the operation fails.

## OpenTransaction

This function is called by the EAI DM before it calls the **PublishEvent** function. Open a transaction to your system during this call.

### Syntax

```
int  
OpenTransaction(  
    void    *context);
```

### Parameters

**\*context**

A pointer to the context returned by the **Initialize** function. You can save any transaction-specific information in the context.

### Return Values

Returns **PIN\_RESULT\_PASS** if the operation is successful. Returns **PIN\_RESULT\_FAIL** if the operation fails.



## PrepareCommit

This function is called by the EAI DM when BRM is about to commit the transaction to its database. If this function returns an error, the transaction within BRM is aborted.

### Syntax

```
int  
PrepareCommit(  
    void      *context);
```

### Parameters

***\*context***

A pointer to the context returned by the **Initialize** function.

### Return Values

Returns **PIN\_RESULT\_PASS** if the operation is successful. Returns **PIN\_RESULT\_FAIL** if the operation fails.

## PublishEvent

This function is called by the EAI DM when there is a business event to be published. There could be more than one **PublishEvent** call during a single transaction.

### Syntax

```
int  
PublishEvent(  
    void    *context,  
    void    *payload,  
    char    *servicep);
```

### Parameters

**\*context**

A pointer to the context returned by the **Initialize** function.

**\*payload**

A pointer to the event payload.

**\*servicep**

A pointer to the service that was used to log in when this business event was generated. You can use this parameter to identify duplicate logins.

### Return Values

Returns **PIN\_RESULT\_PASS** if the operation is successful. Returns **PIN\_RESULT\_FAIL** if the operation fails.

## SetIdentifier

This function is called from the connector application to set a return identifier for a published business event. If an identifier is set when the event is published, the DM returns the identifier when it sends a response flist.

### Syntax

```
void
SetIdentifier(
    void    *identifier,
    int     idLen);
```

### Parameters

***\*identifier***

A pointer to the identifier.

***idLen***

The length of the identifier.

### Return Values

This function returns nothing.

## Shutdown

This function is called by the EAI DM when it shuts down. You free all the resources allocated during initialization with this function.

---

---

**Note:** To ensure an orderly shutdown and make sure that resources are reallocated, the connector application should send a SIGQUIT signal to the EAI\_DM main process.

---

---

### Syntax

```
void  
Shutdown(  
    void    *context);
```

### Parameters

***\*context***

A pointer to the context returned by the **Initialize** function.

### Return Values

This function returns nothing.

---

---

## Using Events to Trigger Operations

This chapter describes how to use events to trigger operations in Oracle Communications Billing and Revenue Management (BRM).

Before reading this chapter, you should be familiar with the following:

- BRM flists and storable classes. See "[Understanding Flists and Storable Classes](#)".
- BRM opcodes. See "[Understanding the PCM API and the PIN Library](#)".

### About Using Events to Trigger Operations

*Event notification* is a workflow mechanism that automatically triggers BRM operations when a notification-triggering event occurs.

A *notification-triggering event* is an event listed in your system's `/config/notify` object and mapped in that object to one or more opcodes. The list of notification-triggering events is called the *event notification list*.

When *any* event occurs, the `PCM_OP_ACT_USAGE` opcode checks whether the event is in the event notification list (that is, whether it is a notification-triggering event). If it is, `PCM_OP_ACT_USAGE` calls the opcode or opcodes mapped to the event. The information in the event is passed to the opcodes in their input flists. Optionally, a flag can also be passed to the opcodes.

By default, event notification is not enabled. To enable and customize this feature, see "[Implementing Event Notification](#)".

### About the Event Notification List

The event notification list contains all the notification-triggering events in your BRM system. Each notification-triggering event in the event notification list is mapped to the opcode or opcodes that are called when the event occurs. The event notification list is stored in the `/config/notify` object in your BRM database.

By default, the event notification list is not loaded into the database. Before loading the list into the database, you must set it up in a configuration file.

Depending on which BRM features you use, your system may contain one or more of the following event notification configuration files. Each configuration file contains default triggering event-to-opcode mapping that supports event notification for one or more BRM features. All the event notification configuration files available in your system are in the `BRM_home/sys/data/config` directory, where `BRM_home` is the directory in which BRM is installed.

- `pin_notify`, which supports the following features:

- Automated Monitor Setup (AMS)
- Device management
- Discounting
- Email notification
- Event rerating
- Midcycle product rate-change calculations
- Resource reservation for disputes and settlements
- **pin\_notify\_eai**, which supports Enterprise Application Integration (EAI) Manager.
- **pin\_notify\_ifw\_sync**, which supports Account Synchronization and Suspense Manager.
- **pin\_notify\_ipc**, which supports policy-driven charging.
- **pin\_notify.ldap**, which supports Lightweight Directory Access Protocol (LDAP) Manager.
- **pin\_notify\_plugin\_http**, which supports the EAI Manager **dm\_http** plug-in. See ["Configuring EAI Manager to Publish to an HTTP Port"](#).
- **pin\_notify\_ra**, which supports Revenue Assurance Manager and Suspense Manager.
- **pin\_notify\_telco**, which supports Global System for Mobile Communications (GSM) Manager.

To modify the content of one of these files, see ["Editing the Event Notification List"](#).

If your system contains more than one of these files, merge their contents into a single file. See ["Merging Event Notification Lists"](#).

To load the content of the configuration file that contains your system's final event notification list (edited and merged as necessary) into the BRM database, see ["Loading the Event Notification List"](#).

---

---

**Note:** Configuring notification thresholds that result in large number of subscriber breaches can impact call detail record (CDR) throughput.

---

---

## Implementing Event Notification

By default, event notification is not enabled in BRM because the `/config/notify` object is not created during installation. To implement event notification:

1. (Optional) Enable regular expressions to be used in the event notification list. See ["Enabling the Use of Regular Expressions in the Event Notification List"](#).
2. If your system has multiple event notification configuration files, merge them. See ["Merging Event Notification Lists"](#).
3. (Optional) If necessary to accommodate your business needs, add events to or comment them out of the event notification configuration file that contains the list you want to load into the BRM database. See ["Editing the Event Notification List"](#).
4. (Optional) If necessary to accommodate your business needs, create custom operations not included in an existing policy opcode for event notification to trigger. See ["Using Event Notification to Trigger Custom Operations"](#).

5. Load your event notification list into the BRM database. See "[Loading the Event Notification List](#)".

## Enabling the Use of Regular Expressions in the Event Notification List

By default, each entry in the event notification list must match the full name of an event type. You can, however, use regular expressions to make a single entry apply to multiple event types.

For example, by default, to trigger BRM to call opcode 301 each time any session event occurs, you must include all the `/event/session` subclasses in the event notification list as follows:

```
301    0    /event/session/call
301    0    /event/session/dialup
301    0    /event/session/pcm_client
301    0    /event/session/telco
301    0    /event/session/telco/gprs
301    0    /event/session/telco/gprs/master
301    0    /event/session/telco/gprs/subsession
301    0    /event/session/gsm
301    0    /event/session/imt
301    0    /event/session/telco/pdc
```

To shorten the list, you can replace those entries with the following regular expression, which matches all subclasses of the `/event/session/` storable class:

```
301    0    /event/session/.*
```

By default, the use of regular expressions in the event notification list is disabled. When enabled, the notification list supports regular expressions that use the following special characters: asterisk (\*), dot (.), and dollar sign (\$).

To enable the use of regular expressions in the event notification list:

1. Open the `BRM_home/sys/cm/pin.conf` file in a text editor.
2. Set the following entry to 1:

```
- fm_act notify_mode 1
```

---



---

### Note:

- If the entry is not in the file, add it.
  - If the entry is commented out, uncomment it.
  - When the entry is set to 0, use of regular expressions in the event notification list is disabled.
- 
- 

3. Save and close the file.
4. Restart the Connection Manager (CM).

## Merging Event Notification Lists

Merge configuration files for event notification if either of the following is true:

- You are enabling event notification for the first time, and your system has multiple configuration files for event notification.

- Your BRM database already contains an event notification list, and you want to add an event notification list for another feature to the database.

---

---

**Caution:** If you load the additional feature's list before merging it with your system's current event notification list, you will disable event notification for the features supported by the current event notification list.

---

---

To merge event notification lists:

1. Save a copy of all the event notification configuration files you want to merge. By default, the files are in the *BRM\_home/sys/data/config* directory.
2. In a text editor, open all the event notification configuration files you want to merge.
3. Copy all the entries from the open files into one of the default files or into a new file.
4. Save and close the merged file.

---

---

**Tip:** You can give the merged file any name you want, and you can store it in any location.

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---

To edit the merged file, see ["Editing the Event Notification List"](#).

To load the merged file, see ["Loading the Event Notification List"](#).

## Editing the Event Notification List

To edit the event notification list:

1. In a text editor, open the event notification configuration file that contains your system's event notification list.

By default, the file is in the *BRM\_home/sys/data/config* directory.

2. Add entries to the list by using the following syntax:

```
opcode_number flag event
```

where:

- *opcode\_number* is the number associated with the opcode called when the notification-triggering event occurs. Opcode numbers are defined in header (\*.h) files in the *BRM\_home/include/ops* directory.
- *flag* is the name of the flag to pass to the opcode when it is called. 0 means no flag is passed.
- *event* is the name of the notification-triggering event that initiates the opcode call. You can use any BRM default or custom event defined in your system.

Notification-triggering events do not have to be saved in the database. For example, you can use notification events (see ["About Notification Events"](#)) and events that you have excluded from the BRM database (see ["Managing Database Usage"](#) in *BRM System Administrator's Guide*).



By default, you must use a full event name in each entry. Optionally, you can use regular expressions to make a single entry apply to multiple event types (see ["Enabling the Use of Regular Expressions in the Event Notification List"](#)).

For example:

```
301      0      /event/session
```

This example specifies that when an `/event/session` event occurs, opcode number 301, the `PCM_OP_ACT_POL_EVENT_NOTIFY` policy opcode, is called. The contents of the event are passed to the opcode, but no flag is passed.

To call multiple opcodes when a notification-triggering event occurs, see ["Calling Multiple Opcodes with One Notification-Triggering Event"](#).

3. Disable entries in the list by inserting a number sign ( # ) at the beginning of the entry. For example:

```
# 301  0  /event/session
```

4. Save and close the edited file.

---

**Tip:** You can give the file any name you want, and you can store it in any location.

---

5. Load the edited list into the BRM database. See ["Loading the Event Notification List"](#).

### Calling Multiple Opcodes with One Notification-Triggering Event

If a notification-triggering event is mapped to more than one opcode in the event notification list, the opcodes are called in the order they are listed whenever the event is generated. For example, the default event notification configuration file (`pin_notify`) includes the following entries in this order:

```
7854    0      /event/notification/service/create
7855    0      /event/notification/service/create
7856    0      /event/notification/service/create
```

This example specifies that when an `/event/notification/service/create` event is generated, BRM first calls opcode 7854 (`PCM_OP_MONITOR_ACCOUNT_HIERARCHY`), then calls opcode 7855 (`PCM_OP_MONITOR_BILLING_HIERARCHY`), and finally calls opcode 7856 (`PCM_OP_MONITOR_SERVICE_HIERARCHY`).

## Using Event Notification to Trigger Custom Operations

To use event notification to trigger custom operations not included in an existing policy opcode:

1. Add the operation to the `PCM_OP_ACT_POL_EVENT_NOTIFY` policy opcode. See ["Adding and Modifying Policy Facilities Modules"](#).
2. Add the following entry to your system's event notification list:

```
301  flag  event
```

For more information, see ["Editing the Event Notification List"](#).

---

---

**Note:** 301 is the opcode number of PCM\_OP\_ACT\_POL\_EVENT\_NOTIFY.

---

---

## Loading the Event Notification List

---

---

**Caution:** This utility replaces the current list in the `/config/notify` object with the list in the configuration file that you load. If you use event notification for multiple features, you must merge the old list with the new list *before* running this utility. Otherwise, you will lose existing event notification functionality. See "[Merging Event Notification Lists](#)".

---

---

To load the event notification list:

1. Go to the directory that contains the event notification configuration files whose contents you want to load.

By default, event notification configuration files are in the `BRM_home/sys/data/config` directory.

2. Save the event notification configuration file that contains the final list.

---

---

**Note:** You can give the file any name you want, and you can place the file anywhere you want.

---

---

3. Run the following command, which loads the event notification list:

```
load_pin_notify event_notification_configuration_file_name
```

where `event_notification_configuration_file_name` is the name of the event notification file that contains the final event notification list.

---

---

**Caution:** This utility overwrites all existing data in your system's `/config/notify` object. If you are updating the event notification list, you cannot load new or changed entries only. You must load the entire list each time you run the utility.

---

---

If you do not run the utility from the directory in which the configuration file is located, include the complete path to the file. For example:

```
load_pin_notify BRM_home/sys/data/config/event_notification_configuration_file_name
```

4. Stop and restart the CM.
5. (Only systems running EAI Manager) Stop and restart the EAI Data Manager (DM):

```
cd BRM_home/bin
stop_dm_eai
start_dm_eai
```

6. (Only systems running EAI Manager) Stop and restart the Payload Generator External Module (EM):

```
cd BRM_home/bin
stop_eai_js
start_eai_js
```

7. (Only systems running GSM Manager) Start the Provisioning DM:

```
start_dm_prov_telco
```

8. Verify that the event notification list was loaded by using Object Browser or the **testnap** utility's **rojb** command to display the **config/notify** object. See "[Reading Objects by Using Object Browser](#)" for information on how to use Object Browser. See "[Using testnap](#)" for general instructions on using **testnap**.

## About Notification Events

Any subclass of the **/event** storable class can be used to trigger event notification. When standard **/event** subclasses are used to trigger event notification, the information their instances contain is handled as follows:

- It is added to the input flist of the executed opcode or opcodes.
- It is stored in the BRM database.

For more information about standard **/event** subclasses, see *BRM Storable Class Reference*.

Unlike instances of standard events, instances of **/event/notification** subclasses (*notification events*) are not saved in the database. Instead, they are used only to populate the input flists of opcodes called by the event notification feature.



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---

## Writing Custom Batch Handlers

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) batch handler feature and explains the requirements for writing custom batch handlers.

### About Batch Handlers

Batch handlers are typically used to launch specific applications on a timed or occurrence-driven basis. Each batch handler can be any executable program or script that can be run from a command line. It can be written in Perl, shell script, C, Java, or any other language, so long as it can call an application and update the status and other fields in the BRM database.

Batch handlers run under the control of the Batch Controller. The Batch Controller lets you specify when to run programs or scripts automatically, either at timed intervals or upon creation of certain files, such as log files. For more information about the Batch Controller, see "Controlling Batch Operations" in *BRM System Administrator's Guide*.

### Configuration Parameters

For BRM-related parameters, each batch handler must use a standard **pin.conf** or **Infranet.properties** configuration file. For any other parameters, it can also use its own, separate, configuration file.

You can configure the Batch Controller's *handler\_name.start.string* parameter to pass parameters to your batch handler, using any options except **-p** and **-d**. The command that the Batch Controller issues is actually:

```
handler_name.start.string -p handler_poid -d failed_handler_poid
```

Therefore, the **-p** and **-d** options are reserved.

For more about configuration, see "Controlling Batch Operations" in *BRM System Administrator's Guide*.

### What a Batch Handler Has to Do

The Batch Controller uses status values, in the BRM database, to monitor the operation status of batch handlers. Handlers must be carefully coded to set this status to the right values at the right times.

## Status

As the handler proceeds, the BRM database keeps track of its status, according to [Table 19-1](#):

**Table 19-1** Status Values

| Status Keyword     | Value |
|--------------------|-------|
| NOT_STARTED        | -1    |
| STARTING           | 0     |
| STARTED            | 1     |
| INTERRUPTED        | 2     |
| COMPLETED          | 19    |
| FAILED_TO_START    | 50    |
| FAILED_TO_COMPLETE | 51    |

You can define other status values for the handler to set, for tracking its own internal status, but these custom status values must be 100 or greater.

---

**Important:** All values 99 and lower are reserved for BRM.

---

All values in this table, other than **STARTED** and **COMPLETED**, are set by the Batch Controller. A handler must never set the status of its handler object to any value other than **STARTED**, **COMPLETED**, or a value greater than 99. The controller relies on this value.

## Activation

When the Batch Controller detects a file or a time that is to trigger a batch handler, it creates a new object in the BRM database to record that occurrence. It then creates new handler objects in the database, with their status set to **NOT\_STARTED**.

The Batch Controller then checks to see if it can run a handler. Its configuration specifies a maximum number of handler instances for high-load times and a different maximum for low-load times.

If the applicable maximum has not been reached, the Batch Controller:

1. Sets the handler's status to **STARTING**.
2. Extracts the Portal object ID (POID) of the related handler object.
3. Issues this command:

```
handler_name.start.string -p handler_poid
```

to start the handler. The start string can include parameter options other than **-p** and **-d**.

## Handler Actions

Once the batch handler has started, it must:

1. Read its configuration file or files and configure itself.
2. Connect to the BRM database.

3. Find the corresponding handler object in the BRM database, using the POID that was passed with the **-p** option when the Batch Controller started the handler.
4. Set the status field to **STARTED**. The Batch Controller uses this field to monitor the status of running handlers.

If a handler object continues to show **STARTING** status after a waiting time specified in the Batch Controller's **Infranet.properties** file, the Batch Controller changes the status to **FAILED\_TO\_START**, and then issues this command to start a replacement copy of the handler:

```
handler_name.start.string -p handler_poid -d failed_handler_poid
```

The replacement handler gets its own POID in the **-p** option. It also gets the POID of the failed handler, in the **-d** option.

5. Perform its designed activity, which typically includes starting a BRM feature or other application.
6. Collect the return value of the application that the handler called, and change the status field accordingly:
  - a. If the activity has completed satisfactorily, set the status field to **COMPLETED**.
  - b. If the return value indicates that the activity was not successful, the handler must set the status field a value greater than 99. After the configured waiting time, if the related handler object does not show status either **COMPLETED** or greater than 99, the Batch Controller changes the status to **FAILED\_TO\_COMPLETE**. It does *not*, however, start a replacement copy of the handler.

---

**Note:** It is up to you to monitor the BRM database and the Batch Controller's log file, to see if any handler has failed to complete. If a handler does take longer than the timeout period to complete, for any reason, it can still update the status of its handler object to a value greater than 99; to satisfy the Batch Controller's timeout watcher.

---

7. End the handler's event session.
8. Exit.

When the Batch Controller detects the **COMPLETED** status, it decrements its count of currently running handlers.





---

---

## Creating iScripts and iRules

This chapter describes how to use the Application Programming Interface (API) to create custom Oracle Communications Billing and Revenue Management (BRM) iScript and iRules modules to process event detail records (EDRs) in the pipeline.

For information about Pipeline Manager, see "About Pipeline Rating" in *BRM Configuring Pipeline Rating and Discounting*.

For information about the iScript functions, see "[About iScript Functions](#)".

### About iScripts

iScript is a script language for analyzing and manipulating usage events. You can access any field within the usage structure and modify it. Using an iScript, you can implement and configure new guiding rules, mapping scenarios, discounting structures, interfaces to user-defined database objects and to reference data, and operating report files.

iScript is the Pipeline Manager script programming language that can be used to customize Pipeline Manager. It can be used for:

- Mapping operations that are not covered by standard modules.
- Adjusting values, such as normalizing phone numbers and IP addresses.
- Evaluating additional statistical data.
- Firing events.
- Performing splitting operations.
- Performing customer-specific pre- or post-rating or enrichment functionality.

You use iScripts to perform the same operation on every EDR. For example, if you have to enrich or normalize data in EDRs or if you have to evaluate EDRs before splitting them.

iScript makes it easier than C or C++ programming languages to implement custom functionality and business policies.

See "About Configuring iScripts" in *BRM System Administrator's Guide*.

### About iRules

An iRule consists of rule items that contain a number of conditions and a script to execute when a condition is fulfilled. Only the script for the first valid rule item is executed during the rule evaluation.

You create the scripts to be executed by using pattern-matching evaluation (for example, wildcards and logical expressions) as well as normal comparison operators (for example, equal to, less than, and greater than).

You use iRules when a function should be executed only on certain EDRs or under certain conditions. The rule-based engine offers an optimized method for defining logical conditions and extensive string comparisons. Therefore, iRules offer a faster way of implementing rule-based conditions than writing an iScript, which can include many "if-else" constructs.

You group rules and rule items into rule sets. A rule set defines the set of rules to be used by a particular iRule module. You specify the rule set in the FCT\_IRule module startup registry. See "About Configuring iRules" in *BRM System Administrator's Guide*.

---



---

**Note:** You can refer to only one EDR extension block in an iRule. For example, you cannot use `DETAIL.ASS_GSMW_EXT` and `DETAIL.ASS_SUSPENSE_EXT` extension blocks in the same iRule. Use an iScript instead to compare or evaluate fields from multiple EDR extension blocks.

---



---

You can create rules and rule items by using a description file or in Pricing Center. To create rules in Pricing Center, see the Online Help.

## Creating Rule Sets via Description Files

In addition to the database interface and the file interface, you can also use a description file to define a rule set. This is useful when you store the rule data in separate database tables or ASCII files. A rule set defined by a description file can only have one rule.

### Descriptions for Data from an ASCII File

In the following example description file:

- The rule name in is **ClassTypeMap**
- The source data is stored in an ASCII file called **/data/data.txt**.
- The variables, represented by **\${N}**, are replaced by values in the source data file.

```

RULE: ClassTypeMap
SOURCE: File
FILE: /data/data.txt
INIT_SCRIPT:
String code = edrString( DETAIL.SERVICE_CODE ) + edrString( DETAIL.SERVICE_
CLASS );
CONDITION:
code =~ "${1}";
edrString( DETAIL.CALL_CLASS ) =~ "${2}";
edrString( DETAIL.CALL_TYPE ) =~ "${3}";
RESULT:
edrString( DETAIL.CALL_TYPE ) = "${4}";
edrString( DETAIL.CALL_CLASS ) = "${5}";

```

The following example source data file contains the values that replace the variables (represented by **\${N}**) in the definition file.

- The source data file must contain at least the number of columns, separated by semicolons, as there are variables in the definition file.

- The column position corresponds to the variable number. For example, `#{2}` in the description file is replaced with the value in column 2 of the source data file.

```
CODE1;CC1*;CT*;NewCC1;NewCT
CODE2;CC2*;CT*;NewCC2;NewCT
CODE3;CC3*;CT*;NewCC3;NewCT
CODE4;CC4*;CT*;NewCC4;NewCT
CODE5;CC5*;CT*;NewCC5;NewCT
CODE6;CC6*;CT*;NewCC6;NewCT
CODE7;CC7*;CT*;NewCC7;NewCT
CODE8;CC8*;CT*;NewCC8;NewCT
```

## Descriptions for Data from a Database Table

In the following example description file:

- The rule name is **CZT\_MapRule**.
- The source data is retrieved from the **IFW\_CLASSTYPEZONE\_MAP** database table.
- The data is ordered first by the **ZONEMODEL** column and then by the **RANK** column.
- Each variable, represented by `#{COLUMN_NAME}`, is replaced by the value in that database table column.

```
SOURCE: Database
RULE: CZT_MapRule
TABLE: IFW_CLASSTYPEZONE_MAP
ORDERBY: ZONEMODEL
ORDERBY: RANK
INIT_SCRIPT:
String code =edrString( DETAIL.SERVICE_CODE ) + edrString( DETAIL.SERVICE_
CLASS );
CONDITION:
code =~ "#{CODE}"
edrString( DETAIL.CALL_TYPE ) =~ "#{CALLTYPE}";
edrString( DETAIL.CALL_CLASS ) =~ "#{CALLCLASS}";
edrString( DETAIL.SERVICE_CODE ) =~ "#{SERVICECODE}";
edrString( DETAIL.AOC_ZONE ) =~ "#{ZONE_WS}";
edrString( DETAIL.CHARGED_ZONE ) =~ "#{ZONE_RT}";
RESULT:
if ( length( "#{NEW_CALLTYPE}" ) > 0 )
{
edrString( DETAIL.CALL_TYPE ) = "#{NEW_CALLTYPE}";
}
if ( length( "#{NEW_ZONE_RT}" ) > 0 )
{
edrString( DETAIL.CHARGED_ZONE ) = "#{NEW_ZONE_RT}";
}
if ( length( "#{NEW_ZONE_WS}" ) > 0 )
{
edrString( DETAIL.AOC_ZONE ) = "#{NEW_ZONE_WS}";
}
}
```

## Importing and Exporting Validation Rules

You use the Database Storage and Extraction Tool for Validation Rules to extract validation rules from the Pipeline Manager database and to import them in the Pipeline Manager database. Pipeline Manager uses these validation rules for the roaming incollect and outcollect processes.

This tool uses DBI and DBD drivers which are not part of the Pipeline Manager installation. You download these drivers from [www.cpan.org](http://www.cpan.org) and compile and install them separately.

The Database Storage and Extraction Tool for Validation Rules consists of the following scripts:

- The **db2irules.pl** script extracts validation rules from the Pipeline Manager database.
- The **irules2db.pl** script adds validation rules to the Pipeline Manager database.

### About the Rule Set XML File

The Database Storage and Extraction Tool for Validation Rules extracts the validation rules from the database to a Rule Set XML file. When creating the XML file, it maps the Structured Query Language (SQL) tables from the database to the appropriate XML tag names. When you import rules and rule items in the database, the rank for each of these is determined by the order in which they appear in the Rule Set XML file. For example, the first rule row or rule item row found in the XML file is inserted into the database with a rank of 1, the second one is inserted with a rank of 2 and so forth.

Table 20–1 shows a possible mapping:

**Table 20–1 Possible Mappings for Validation**

| Pipeline Manager Database Table | Pipeline Manager Database Table Column | XML Tag               | Parent XML Tag |
|---------------------------------|--|-----------------------|----------------|
| N/A                             | N/A                                    | <RULESET_ROW>         | NONE           |
| IFW_RULESET                     | RULESET                                | <RULESET_RULESET>     | <RULESET_ROW>  |
| IFW_RULESETLIST                 | RULESET                                | <RULESET_RULESET>     | <RULESET_ROW>  |
| IFW_RULESET                     | NAME                                   | <RULESET_NAME>        | <RULESET_ROW>  |
| IFW_RULESET                     | DESCRIPTION                            | <RULESET_DESCRIPTION> | <RULESET_ROW>  |
| N/A                             | N/A                                    | <RULE_ROW>            | <RULESET_ROW>  |
| IFW_RULESETLIST                 | RULE                                   | <RULE_RULE>           | <RULE_ROW>     |
| IFW_RULE                        | RULE                                   | <RULE_RULE>           | <RULE_ROW>     |
| IFW_RULEITEM                    | RULE                                   | <RULE_RULE>           | <RULE_ROW>     |
| IFW_RULE                        | NAME                                   | <RULE_NAME>           | <RULE_ROW>     |
| IFW_RULESETLIST                 | NAME                                   | <RULE_NAME>           | <RULE_ROW>     |
| IFW_RULE                        | INIT_SCRIPT                            | <RULE_INIT_SCRIPT>    | <RULE_ROW>     |
| N/A                             | N/A                                    | <RULEITEM_ROW>        | <RULE_ROW>     |
| IFW_RULEITEM                    | NAME                                   | <RULEITEM_NAME>       | <RULEITEM_ROW> |
| IFW_RULEITEM                    | CONDITION                              | <RULEITEM_CONDITION>  | <RULEITEM_ROW> |
| IFW_RULEITEM                    | RESULT                                 | <RULEITEM_RESULT>     | <RULEITEM_ROW> |

### About the db2irules.pl Script

You use the **db2irules.pl** script to extract rule sets from the Pipeline Manager database to the Rule Set XML file. You can extract any number of rule sets at the same time. If you extract multiple rule sets, each rule set is written to a separate Rule Set XML file.

When **db2irules.pl** extracts rows from the database, the text of each database row is checked for the following XML reserved characters:

- Left angle bracket (<)
- Right angle bracket (>)
- Ampersand (&)

The XML parser uses these characters to find the start tags, end tags, and any references. It replaces them with the following HTML and XML flags:

- &lt;
- &gt;
- &amp;

These flags make the file XML compliant, so that any XML parser can parse this file successfully.

For more information, see "db2rules.pl" in *BRM Configuring Pipeline Rating and Discounting*.

### About the irules2db.pl Script

Use the **irules2db.pl** script to insert a rule set from Validation Rules XML file into the Pipeline Manager database. You can insert only one rule set at a time. To load multiple rule sets into the database, run this script separately for each rule.

When **irules2db.pl** imports rows to the database, each rule and rule set row of the XML file is checked for the following HTML and XML flags:

- &lt;
- &gt;
- &amp;

The XML parser uses these characters to find the start tags, end tags, and any references. It replaces them with the following XML-reserved characters:

- Left angle bracket (<)
- Right angle bracket (>)
- Ampersand (&)

If you specify an invalid file name for the rule set, the **irules2db.pl** script displays an error and terminates. If the file exists and can be opened, the script opens a transaction to the database and starts inserting the rule sets. If any of the rule sets specified already exists in the database, the **irules2db.pl** script reports an error, rolls back the transaction, and terminates. The error message contains information on which row in the XML file caused the error.

For more information, see "irules2db.pl" in *BRM Configuring Pipeline Rating and Discounting*.

### Updating a Rule Set

You can update rule sets that already exist in the database in two ways:

- Extract, update, and import a rule set
- Replace a rule set with an updated version

#### Extract, update, and import a rule set

To update a rule set that already exists in the database, export, update, and reimport the XML file:

1. Export the rule set to a Rule Set XML file by using the **db2irules.pl** script. For more information, see ["About the db2irules.pl Script"](#).

Example:

```
db2irules.pl [-u] dbi:Oracle:orcl scott tiger /home/data/CIBER_val
```

2. Delete the rule set from the database by using the **db2irules.pl** script. Specify the name of the rule set and set the **-d** parameter.

Example:

```
db2irules.pl [-d] dbi:Oracle:orcl scott tiger /home/data/CIBER_val
```

The script deletes all rules of a rule set recursively.

---

**Note:** If you use Pricing Center, you first have to delete each rule set separately and then can delete the rule set.

---

For more information, see "db2irules.pl" in *BRM Configuring Pipeline Rating and Discounting*.

3. Update the rule set in the XML file. For more information, see ["About the Rule Set XML File"](#).
4. Import the rule set to the database by using the **irules2db.pl** script. For more information, see ["About the irules2db.pl Script"](#).

Example:

```
irules2db.pl dbi:Oracle:orcl scott tiger /home/data/CIBER_val_2002_07_01_17-15-39.xml
```

### Replace a rule set with an updated version

To replace an existing rule set with an updated version that you didn't extract from the database, you can import the rule set and create a backup of the old rule set by using the **-f** parameter.

Example:

```
irules2db.pl -f dbi:Oracle:orcl scott tiger /home/data/CIBER_val /home/data/backup
```

The **-f** parameter causes the **db2irules** extraction script to be invoked and extract the original file from the database before loading the new file. A backup file of the original rule set is stored in the specified backup location.

For more information, see "irules2db.pl" in *BRM Configuring Pipeline Rating and Discounting*.

## Supported iScript Data Types

iScript supports the following data types in [Table 20–2](#):

**Table 20–2** Supported iScript Data Types

| Data Type | Description   |
|-----------|---|
| Bool      | For Boolean values TRUE and FALSE.                  |
| String    | For 8-bit character strings of an unlimited length. |

**Table 20–2 (Cont.) Supported iScript Data Types**

| Data Type | Description   |
|-----------|---|
| Long      | For signed integer values in the interval from -9223372036854775808 (2 <sup>63</sup> ) to 9223372036854775807 (2 <sup>63</sup> -1). |
| Date      | For date/time values in the interval from the 1901/01/01 00:00:00 to the 2037/02/05 00:00:00.                                       |
| Decimal   | For floating pointer to numbers with a precision of 26 digits.  |
| File      | As a handle for files.  |

---

**Note:** Based on the data types listed above, you can also use hash and arrays.

---

## Supported iScript Constants

iScript supports constants described in this section.

### Constants for Normalizing National Access Codes

[Table 20–3](#) lists the iScript constants used to normalize national access codes.

**Table 20–3 National Access Code Normalizing iScript Constants**

| Constant        | Type   | Value | Description                        |
|-----------------|--------|-------|------------------------------------|
| NORM_NAC        | String | "0"   | "National access code"             |
| NORM_IAC        | String | "00"  | "International access code array"  |
| NORM_IAC_STRING | String | "00"  | "International access code string" |
| NORM_CC         | String | NA    | Country code array                 |
| NORM_CC_STRING  | String | "49"  | "Country code string"              |
| NORM_MCC        | String | "262" | "Mobile country code"              |
| NORM_IAC_SIGN   | String | "+"   | "International country code sign"  |
| NORM_NDC        | String | "172" | "Network destination code"         |

### Date Constants

[Table 20–4](#) lists the Date constants.

**Table 20–4 Date Constants**

| Constant | Type | Value               | Description   |
|----------|------|---------------------|---|
| MAX_DATE | Date | 05.02.2037 23:59:59 | Maximum value for the date. The date is stored as the number of seconds since 00:00:00.<br><br>The MAX_DATE value is the last date that can be represented with a four-byte unsigned long, which is February 5, 2037. The internal representation is adjusted to the time zone of the system. |
| MIN_DATE | Date | 01.01.1901 00:00:00 | Minimum value for the date. The date is stored as the number of seconds since 00:00:00.<br><br>The MIN_DATE value is January 1, 1901. The internal representation is adjusted to the time zone of the system.   |

## Database Connection Constants

Table 20–5 describes the database connection constants.

**Table 20–5 Database Connection Constants**

| Constant           | Type | Value | Description                                      |
|--------------------|------|-------|--|
| INVALID_CONNECTION | Long | -1    | Invalid database connection handle               |
| INVALID_RESULT     | Long | -1    | Invalid result handle                            |
| NO_MORE_RESULTS    | Long | 0     | No more results                                  |
| NO_MORE_ROWS       | Long | 0     | No more rows                                     |
| NEXT_ROW           | Long | 1     | Next row to be retrieved from the database table |
| NEXT_RESULT        | Long | 1     | Next result from db query                        |

## Decimal Constants

Table 20–6 lists the decimal constants.

**Table 20–6 Decimal Constants**

| Constant        | Type    | Value                          | Description           |
|-----------------|---------|--------------------------------|-----------------------|
| INVALID_DECIMAL | Decimal | Decimal::initInvalidDecimal(); | Invalid Decimal value |

## Decimal Rounding Constants

Table 20–7 lists the decimal rounding constants.



**Table 20–7** Decimal Rounding Constants

| Constant      | Type | Value | Description   |
|---------------|------|-------|---|
| ROUND_PLAIN   | Long | 0     | If the digit to the right of the specified decimal place is equal to or greater than 5, add one to the digit at the specified decimal place, then truncate any digits to the right. Otherwise, truncate all digits to the right of the specified decimal place. |
| ROUND_UP      | Long | 1     | If the digits the right of the specified decimal place are non-zero, add one to the digit at the specified decimal place and truncate any digits to the right.  |
| ROUND_DOWN    | Long | 2     | Truncate all digits to the right of the specified decimal place.  |
| ROUND_BANKERS | Long | 3     | If incrementing the digit at the specified decimal place results in an even number, increment it and truncate the digits to its right. Otherwise, truncate the digits to the right of the specified decimal place.  |

## EDR Container Content Constants

Table 20–8 lists the EDR container content constants.

**Table 20–8** EDR Container Constants

| Constant              | Type | Value | Description   |
|-----------------------|------|-------|---|
| EDR_UNKNOWN_CONT      | Long | 1     | Unknown EDR content type                            |
| EDR_HEADER            | Long | 2     | EDR header record                                   |
| EDR_DETAIL            | Long | 3     | EDR detail record                                   |
| EDR_TRAILER           | Long | 4     | EDR trailer record                                  |
| EDR_START             | Long | 5     | Service container that tells pipeline starts        |
| EDR_STOP              | Long | 6     | Service container that tells pipeline shutting down |
| EDR_BEGIN             | Long | 7     | Service container that tells EDR processing begins  |
| EDR_END               | Long | 8     | Service container that tells EDR processing ends    |
| EDR_BEGIN_TRANSACTION | Long | 9     | Service container that tells transaction begins     |
| EDR_END_TRANSACTION   | Long | 10    | Service container that tells transaction ends       |

## EDR Container Characters Deletion Constants

Table 20–9 lists the EDR container content deletion constants.

**Table 20–9** EDR Container Content Deletion Constants

| Constant       | Type | Value | Description   |
|----------------|------|-------|---|
| STRIP_LEADING  | Long | True  | Roguewave constant used to delete the special leading characters in an EDR string, for example, white spaces at the beginning of the EDR container.                   |
| STRIP_TRAILING | Long | True  | Roguewave constant used to delete the special trailing characters in an EDR string, for example, white spaces at the end of the EDR container.                        |
| STRIP_BOTH     | Long | True  | Roguewave constant used to delete both the special leading and trailing characters in an EDR string, for example, white spaces at the beginning of the EDR container. |

## EDR Input State Constants

Table 20–10 lists the EDR input state constants.

**Table 20–10 EDR Input State Constants**

| Constant          | Type | Value | Description                       |
|-------------------|------|-------|-----------------------------------|
| EDR_INPUT_MISSING | Long | 0     | Not supplied in input data        |
| EDR_INPUT_EMPTY   | Long | 1     | Supplied with no value            |
| EDR_INPUT_OTHER   | Long | 2     | Other "uninteresting" input state |

## EDR Internal State Constants

Table 20–11 lists the EDR internal state constants.

**Table 20–11 EDR Internal State Constants**

| Constant            | Type | Value | Description  |
|---------------------|------|-------|--|
| STATE_CLEARED       | Long | 0     | EDR value is cleared                                     |
| STATE_CONNECTED     | long | 1     | EDR value is connected with a field from an input record |
| STATE_INITIALIZED   | long | 2     | EDR value is initialized                                 |
| STATE_SET           | long | 3     | EDR value is set   |
| STATE_RESTORED      | long | 4     | EDR value is restored                                    |
| STATE_RESTOREDASSET | long | 5     | EDR value is restored as set                             |
| CONTAINER_HEADER    | Long | 2     | Header record descriptor in container                    |
| CONTAINER_DETAIL    | Long | 3     | Detail record descriptor in container                    |
| CONTAINER_TRAILER   | Long | 4     | Trailer record descriptor in container                   |
| CONTAINER_UNKNOWN   | Long | 1     | Unknown record type in container                         |

## POID Constants

Table 20–12 lists the Portal object ID (POID) constants.

**Table 20–12 POID Constants**

| Constant      | Type | Value                      | Description          |
|---------------|------|----------------------------|----------------------|
| NULL_PPOID    | POID | BAS::Identifier(0, "", 0); | Null POID pointer    |
| INVALID_PPOID | POID | BAS::Identifier            | Invalid POID pointer |

## TAM Transaction Constants

Table 20–13 lists the TAM transaction constants.

**Table 20–13 TAM Transaction Constants**

| Constant         | Type | Value | Description                     |
|------------------|------|-------|---------------------------------|
| TAM_NORMAL       | Long | 0     | Normal transaction              |
| TAM_RECYCLE      | Long | 1     | Recycle transaction             |
| TAM_RECYCLE_TEST | Long | 2     | Recycle transaction for testing |
| TAM_UNKNOWN      | Long | -1    | Unknown transaction type        |

## Supported Regular Expressions

iScript supports the regular expressions listed in [Table 20–14](#):

**Table 20–14 Regular Expressions Supported by iScript**

| Expression | Description  |
|------------|--|
| .          | Matches any single character except the newline character <code>\n</code> .  |
| \          | Introduces metacharacters, and as part of the escape sequences. For example, <code>\n</code> , a newline character, and <code>\*</code> , is a literal asterisk. You can use it with three digits representing a number between 0 and 255 (ASCII code) to get the corresponding character. For example, <code>\065</code> is matched to the character <b>A</b> . |
| [ ]        | A character class which matches any character within the brackets. If the first character is a circumflex (^), it changes the meaning to match any character except the ones within the brackets. A dash inside indicates a character range. For example <code>[0-9]</code> means the same thing as <code>[0123456789]</code> .                                  |
| { }        | Indicates how many times to match the previous pattern when the pattern has one or two numbers, e.g. <code>A{1,3}</code> matches one to three occurrences of the letter <b>A</b> .   |
| *          | Matches zero or more copies of the preceding expression.   |
| +          | Matches one or more copies of the preceding expression. For example. <code>[0-9]+</code> matches 1, 111, or 123456 but not an empty string.  |
| ?          | Matches zero or one copy of the preceding expression. For example. <code>-?[0-9]+</code> matches a signed number including an optional leading minus.  |
|            | Matches either the preceding expression or the following expression.   |
| ( )        | Groups a series of expressions into a new expression. Useful when building up complex patterns with <code>*</code> , <code>+</code> , and <code> </code> .   |
| !          | Negates the complete expression. It must be the first character in the expression.   |

## iScript Variable Declarations

The syntax of the variable declaration is similar to the C/C++ syntax:

```
Type Name [=Value];
```

As an option, you can declare variables to be constants:

```
const Type Name = Value;
```

For example:

```
Long x;
String serviceCode = "Tel";
const Decimal pi = 3.1415927
```

## iScript Arrays and Hashes

All data types except File can be used in arrays or hashes:

```
Long a[ ]; // A normal array declaration
String dist [ ] [ ]; // A 2-dimensional string array
String ndc { } [ ]; // An associative array
String cli { } [ ]; // An associative array or arrays
```

You do not have to specify the dimension of the arrays and hashes. The data structures are resized automatically and are initialized by default values. For numerical values, this is 0; for strings, it is an empty string and dates become invalid.

You can access arrays and associative arrays in the following way:

```
a [3] = 4711;
ndc { "040" } = Hamburg;
cli { "Max Mueller" } [0] = "0171123456789";
cli { "Max Mueller" } [0] = "0177471111245";
```

---

---

**Important:** If you use arrays and hashes in functions, clear them at the start of the functions, as in this example:

```
function myFunction
{
    String str[];
    arrayClear(str);
    // ...
}
```

Arrays and hashes aren't initialized at the start of functions. They behave like static variables. If they are not cleared in a function, they retain values from the last time the function was executed

---

---

## iScript Function Declarations

A function declaration has the following syntax:

```
function [returnType] identifier [( parameter [,parameter...])]
```

where *returnType* is optional. If you do not specify any return type, the default is VOID. A function can have an unlimited number of arguments. You can use the basic types as return and parameter types.

For example:

```
function Long square (Long x)
{
    return x*x;
}
```

---



---

**Important:** Avoid nesting functions. Nested functions can create unexpected results, as in this example:

```
function myFunction
{
    Long i = 5;
    // ...
    myFunction();
    // Here the variable i is assigned the value set in
    the nested function.
    // ...
}
```

---



---

## iScript Control Structures

The syntax of the control structures is similar to the C++ syntax, but because there are no implicit type casts, the following expression is *not* valid in iScript:

```
if ( i ) ...
```

You must use explicit type casts:

```
if ( i != 0 )...
```

There are AND and OR operators for Boolean expressions. Empty statements in FOR loops are not valid in iScript and there is no increment operator.

For example:

```
for ( ; i<100; i++ )
```

in C++ has to be replaced with

```
for ( i ; i<100; i=i+1)
```

in iScript.

## iScript Function Blocks

A function block that is followed by a control structure must be enclosed in curly braces { }. This is also true if only one statement is in the function block.

For example:

```
if ( (edrString ( DETAIL.RECORD_TYPE) == "H"))
{
    logStdout ("Header detected\n");
}
else
{
}
```

## Using iScript Switch Statements

iScript provides switch statements for String values, Long values, and regular expressions. The syntax of the switch statement is similar to the C syntax. Follow these rules when including switch statements:

- Specify only one statement per **case** label.
- Use a statement block and enclose several statements between curly braces ({}).
- Terminate every **case** label by a **break** statement. Otherwise the statement of the following **case** label is also executed.
- For *regular expressions*, use the **regExprSwitchCase** statement instead of **switch**.

### Examples for Switch Statements

#### Switch statements (Long)

```
switch ( edrLong ( DETAIL.RECORD_LENGTH ) )
{
  case 104:
    logStdout ( "Header record!" );
    break;
  case 685:
    {
      detail = detail + 1;
      logStdout ( "Detail record" );
    }
    break;
  default:
    logStdout ( "unknown record type" );
}
```

#### Switch statements (String)

```
switch ( edrString ( DETAIL.ERROR_TEXT ) )
{
  case "ERR_DATETIME":
    logStdout ( "invalid date/time" );
    break;
  case "ERR_NOIMSI":
    logStdout ( "IMSI not specified" );
  case "":
    logStdout ( "no error detected" );
    break;
  ...
}
```

#### Switch statements for regular expressions

```
regExprSwitch ( edrString ( DETAIL.A_NUMBER ) )
{
  case "0049171.*":
    logStdout ( "D1-call\n" );
    break;
  case "0049172.*":
    logStdout ( "D2-call\n" );
    break;
}
```

## Including Other iScript Source Files in Your iScript

You can use the **include** statement in your iScript to include other iScript source files.

Use the following syntax and specify each **include** statement in a separate line:

```
include "iScriptFile.isc";
```

Before an iScript is compiled, a preprocessor evaluates and processes the **include** statements. If the included iScript file has an absolute path, the preprocessor tries to include the file with the absolute path. Otherwise, the preprocessor uses a semicolon-separated list of include directories specified in the **ISCRIPY\_INCLUDE** environment variable.

If the **ISCRIPY\_INCLUDE** environment variable is not set, the preprocessor uses only the current directory as the input directory. If the environment variable is set, it does not contain the current working directory by default. You must explicitly add the current working directory to the list by using a dot (.) as the path. For example:

**bash** and **sh**:

```
export ISCRIPY_INCLUDE="/home/integRate/iscript include;/usr/iscript;."
```

**csh** and **tsch**:

```
setenv ISCRIPY_INCLUDE "/home/integRate/iscript_include;/usr/iscript;."
```

## About iScript Functions

You use the iScript functions to perform the following operations:

- Perform arithmetic operations. See "Arithmetic Functions" in *BRM Developer's Reference*.
- Manipulate ASN.1 objects. See "ASN.1 Functions" in *BRM Developer's Reference*.
- Connect to the database and perform database operations. See "Database Connection Functions" in *BRM Developer's Reference*.
- Normalize data. See "Data Normalizing Functions" in *BRM Developer's Reference*.
- Manipulate date and time values. See "Date Functions" in *BRM Developer's Reference*.
- Access and manipulate EDR containers. See "EDR Container Functions" in *BRM Developer's Reference*.
- Read and write files and their contents. See "File Manipulation Functions" in *BRM Developer's Reference*.
- Manipulate flists. See "Flist Manipulation Functions" in *BRM Developer's Reference*.
- Manipulate hashes and arrays. See "Hash and Array Functions" in *BRM Developer's Reference*.
- Perform mapping between old and new values. See "Mapping Functions" in *BRM Developer's Reference*.
- Call opcodes. See "Opcode Calling Functions" *BRM Developer's Reference*.
- Communicate with the pipeline system. See "Pipeline System Functions" in *BRM Developer's Reference*.
- Perform static operations. See "Static Functions" in *BRM Developer's Reference*.

- Create and manipulate mutex and start and stop processes. See "Standard Functions" in *BRM Developer's Reference*.
- Work with strings. See "String Functions" in *BRM Developer's Reference*.
- Access the Transaction Manager. See "Transaction Management Functions" in *BRM Developer's Reference*.

## About Special iScript Functions

Pipeline Manager includes a basic iScript interpreter and an extended interpreter that calls special iScript functions on external events, such as **onHeaderEdr** or **onDetailEdr**. These special functions are function hooks that you can use to implement any actions you want to perform at specific situations, such as when a transaction is rolled back, during EDR processing.

For example, to perform custom actions when a transaction rolls back, you can include the following function block in an iScript:

```
Function onRollback
{
  logStdout("onRollback() \n");
  /* Define rollback-related actions here. */
}
```

## Pipeline-Related Function Hooks

Use the functions listed in [Table 20–15](#) to perform the actions you want at various stages of the pipeline process:

**Table 20–15 Pipeline-Related Functions**

| Function                 | Description   |
|--------------------------|---|
| <b>BEGIN</b>             | Called when Pipeline Manager starts and after the iScript is compiled.              |
| <b>END</b>               | Called when Pipeline Manager is shut down.  |
| <b>onMessageReceived</b> | Deprecated.   |
| <b>onStartEdr</b>        | Called when a pipeline starts. It is called once in the life of a pipeline process. |
| <b>onStopEdr</b>         | Called when a pipeline stops. It is called once in the life of a pipeline process.  |

## EDR Processing-Related Function Hooks

Use the functions listed in [Table 20–16](#) to perform the actions you want during various stages of EDR processing:

**Table 20–16 EDR-Processing Related Functions**

| Function                  | Description  |
|---------------------------|--|
| <b>onBeginEdr</b>         | Called when a BEGIN EDR container for each file opened in a transaction passes through a module. |
| <b>onBeginTransaction</b> | Called when a BEGIN_TRANSACTION EDR container passes through a module.                           |
| <b>onDetailEdr</b>        | Called when a DETAIL EDR container passes through a module.                                      |



**Table 20–16 (Cont.) EDR-Processing Related Functions**

| Function                  | Description   |
|---------------------------|---|
| <b>onEndEdr</b>           | Called when an END EDR container for each file opened in a transaction passes through a module. |
| <b>onEndTransaction</b>   | Called when an END_TRANSACTION EDR container passes through a module.                           |
| <b>onHeaderEdr</b>        | Called when a HEADER EDR container passes through a module.                                     |
| <b>onInvalidDetailEdr</b> | Called when an EDR with invalid detail record is received by a module.                          |
| <b>onTrailerEdr</b>       | Called when a trailer container passes through a module.  |

## Input Grammar-Related Function Hooks

Use the function hooks listed in [Table 20–17](#) in the input grammar to execute the actions you want when the input module parses a stream:

**Table 20–17 Input Grammar-Related Functions**

| Function             | Description  |
|----------------------|--|
| <b>onParseEnd</b>    | Called when the input module finishes parsing a stream.                  |
| <b>onParseError</b>  | Called when the input module encounters an error while parsing a stream. |
| <b>onParseStart</b>  | Called when the input module starts processing a stream.                 |
| <b>streamIsEmpty</b> | Called when an empty stream is encountered.                              |

## Transaction-Manager Related Function Hooks

Use these functions listed in [Table 20–18](#) to perform the actions you want during a transaction.

For more information on transaction management and the communication between pipeline modules and the transaction manager, see "About Pipeline Manager Transactions" in *BRM System Administrator's Guide*.

**Table 20–18 Transaction Manager Related Functions**

| Function               | Description   |
|------------------------|---|
| <b>onCancel</b>        | Called when a transaction needs to be cancelled.  |
| <b>onCommit</b>        | Called when the transaction manager notifies that a transaction is committed.           |
| <b>onPrepareCommit</b> | Called when the transaction manager sends a request to prepare to commit a transaction. |
| <b>onRollback</b>      | Called when a transaction needs to be rolled back.                                      |

## About iScript Flist Extension Functions

You use the iScript flist extension functions to manipulate data in flists. For example, you can use the functions to retrieve information from an flist so that you can add it to the EDR container. You can also use the functions to add data taken from an EDR to an flist.

There are functions for creating flists, retrieving data from fields, setting field values, setting and unsetting the current array, deleting fields and arrays, and retrieving error text.

Here is a simple example of moving data from an EDR to an flist. Suppose you have the following EDR data block:

```
DETAIL.ASS_DATA
  String NAME
  Decimal VALUE
  Long QUANTITY
```

You can convert that EDR block to an flist in this format:

```
0 PIN_FLD_ARRAY    ARRAY
1  PIN_FLD_STRING  STRING
1  PIN_FLD_DECIMAL DECIMAL
1  PIN_FLD_INT     INT
```

The following is an example of iScript code to convert the EDR block to an flist:

```
fListPushElem( "PIN_FLD_ARRAY", 0 );
fListSetString( "PIN_FLD_STRING", edrString( DETAIL.ASS_DATA.NAME, 1 ) );
fListSetDecimal( "PIN_FLD_DECIMAL", edrDecimal( DETAIL.ASS_DATA.VALUE, 1 ) );
fListSetLong( "PIN_FLD_INT", edrLong( DETAIL.ASS_DATA.QUANTITY, 1 ) );
fListPopElem();
```

See "Flist Manipulation Functions" in *BRM Developer's Reference* for a list of the flist extension functions and information about their syntax.

## iScript External Modules

The following iScript extensions include additional iScript functions:

- Use EXT\_Converter to convert and normalize phone numbers and IP addresses. See "Data Normalizing Functions" in *BRM Developer's Reference*.
- Use EXT\_AsnTree to output ASN.1 data. See "ASN.1 Tree Functions" in *BRM Developer's Reference*.
- Use EXT\_FList to retrieve and set data in flists. See "Flist Manipulation Functions" in *BRM Developer's Reference*.
- Use EXT\_Opcode to call opcodes. See "Opcode Calling Functions" in *BRM Developer's Reference*.

## Improving Pipeline Performance in Custom iScripts and iRules

This section provides some guidelines to reduce pipeline startup time and memory usage in your custom iScripts and iRules.

When the pipeline framework loads an iRule, a finite state machine (FSM) is built in memory. The number of objects the FSM creates in memory affects the pipeline startup and memory usage. FSMs create decision trees in memory at startup-time which affect pipeline startup, but decision trees help the pipeline work efficiently at run-time.

To reduce pipeline startup time and memory usage, follow these guidelines while creating iRules:

- Split the database entries because the number of rows in the loaded table affects memory usage and startup time of Rules.

- When writing rules, review the condition and reduce the number of compare patterns.
- Keep the regular expressions as simple as possible.
- If you have complex rules, place them at the beginning of an iRule.
- To improve processing performance, split big iRules if you have CPUs to allocate for new threads.

To improve pipeline processing performance, follow these guidelines when creating iScripts:

- If you can use an iRule instead of an iScript, use an iRule.
- Keep iScripts simple.
- Whenever possible, use standard modules instead of creating custom modules.
- Avoid database read access from the iScript when processing EDRs. Instead, load data during startup into hashes, and use that data when processing EDRs.
- Avoid functions that duplicate EDRs. They are performance intensive.
- Avoid writing to a database within an iScript. If you do, make sure you handle transactions properly.



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## Managing Devices with BRM

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) Device Management framework and explains how to use its components to build custom device management systems.

Before you read this chapter, you should have a good understanding of BRM opcodes and storable classes. See ["Understanding the PCM API and the PIN Library"](#) and ["Understanding Flists and Storable Classes"](#).

If you plan to develop device management applications, you should also read ["Adding New Client Applications"](#) and the client applications chapter that covers the programming language you will use.

### About the Device Management Framework

The Device Management framework enables you to write applications to manage devices in BRM or to connect an existing device management system to BRM. The Device Management framework is used by BRM optional components such as SIM (Subscriber Identity Module) Manager and Number Manager to facilitate their device management features.

The Device Management framework is part of Inventory Manager, which is an optional, separately purchased feature.

In BRM, a *device* can be physical, such as a set-top box, or "virtual," such as a phone number. Both types of devices are represented in BRM as storable objects.

The Device Management framework provides a storable class, `/device`, which can be subclassed to accommodate specific device types. Each `/device` or its `/device` subclass represents an individual device.

*Device management* involves creating device objects, associating them with services and accounts, controlling their life cycles, and removing them when they are no longer needed. The framework provides storable classes, standard and policy opcodes, and utilities for these purposes. See ["Device Management Tasks"](#) for details.

### Device Management Tasks

The Device Management framework includes opcodes and objects that are used to store and manage devices. It provides the following functionality:

- [Creating Devices](#)
- [Managing the Device Life Cycle](#)
- [Changing Device Brands](#)

- [Managing Device Attributes](#)
- [Associating Devices and Services](#)
- [Deleting Devices](#)
- [Tracking Device History](#)

## Creating Devices

Each device that you track in BRM is represented by a `/device` object. The way these objects are created depends on your business. For example, if you supply the devices yourself, you might create `/device` objects in bulk with a custom-designed application. When a customer is assigned a device, you would use one of the already existing `/device` objects.

On the other hand, if your business works with devices such as SIM cards that customers supply themselves, you might use a custom graphic user interface (GUI) tool to create `/device` objects at the same time that you set up customer accounts.

While there are many scenarios for device creation, the actual process used is always the same: all device-creation applications call `PCM_OP_DEVICE_CREATE`. This opcode creates `/device` objects using the device type, initial state, and attributes specified in the input flist. See "[Managing the Device Life Cycle](#)" for more information about device states and "[Managing Device Attributes](#)" for more information about device attributes.

Because your business may need to manage several types of devices, the `/device` storable class can be subclassed to represent *device types*. Each device type is a group of devices that have similar characteristics. For example, the BRM Number Manager creates `/device/num` objects while the SIM Manager creates `/device/sim` objects.

You use Storable Class Editor, part of Developer Center, to create new subclasses. See "[Creating Custom Fields and Storable Classes](#)".

A policy opcode, `PCM_OP_DEVICE_POL_CREATE`, enables you to customize the device creation process. For example, you can customize the policy to ensure that all devices have unique numbers.

`/device` objects are brand aware. Their brand affiliation is determined by the brand affiliation of the login used to create them. See "[Device Management and Brands](#)" for more information.

## Managing the Device Life Cycle

Devices pass through various stages in their life cycle. For example, a set-top box moves from manufacturing to a service provider's inventory, where it might be pre-provisioned. From there it is assigned to a retailer or perhaps directly to a subscriber. After it reaches the end-user, it could be returned for repair, obsoleted, or stolen.

A device management system must keep track of these stages or *device states*. In BRM, the device state is represented by the `PIN_FLD_DEVICE_STATE` field in a `/device` object. The value of this field represents the current state of the device. The set of possible device states and state transitions defines the *life cycle* of a `/device` object.

Device life cycles are regulated by `/config/device_state` objects in the database. You define device states and state changes in a configuration file and load it into the database by using the `load_pin_device_state` utility. See "[Defining the Device Life Cycle](#)" for more information.

Device management applications call the `PCM_OP_DEVICE_UPDATE` opcode to change device states (or `PCM_OP_DEVICE_SET_STATE` for state changes only). The opcode validates the change specified in the opcode against the `/config/device_state` object for that device type and brand.

There are two ways to add validation checks or other business logic to a device state change. One way is to modify the `PCM_OP_DEVICE_POL_SET_STATE` policy opcode. This opcode is called automatically by `PCM_OP_DEVICE_SET_STATE` before changing the device state. Another way is to add additional validation checks to the policy opcode of your choice or a custom policy opcode, and reference the opcode in the `/config/device_state` object. You do this by adding opcode numbers to the configuration file that you create for each device, and loading the data in the file into `/config/device_state` by using the `load_pin_device_state` utility. BRM invokes the opcodes specified for each device type and brand. For more information, see ["Customizing Device State Changes"](#) and `load_pin_device_state`.

The device life cycle is unique for each device type in each brand. The same device type could have different life cycles in different brands. See ["Device Management and Brands"](#) for more information.

### Changing Device Brands

In a branded environment, devices are only available to a single brand at a time. The `/device` objects are associated with the `/account` object of a brand when they are created. You can change this brand association later by calling `PCM_OP_DEVICE_UPDATE` (or `PCM_OP_DEVICE_SET_BRAND` individually). See ["Device Management and Brands"](#).

### Managing Device Attributes

Devices have attributes such as descriptions, serial numbers, and manufacturer names that a device management system needs to track the devices. These attributes can be used to identify devices in GUI device management applications such as Customer Center.

Device attributes are stored in `/device` object fields. Attributes applicable to all devices (device ID, description, manufacturer, and model) appear in the base `/device` class. You can add fields to `/device` subclasses for attributes specific to particular device types. For example, `/device/sim` contains attributes specific to SIM cards.

Applications call `PCM_OP_DEVICE_UPDATE` (or `PCM_OP_DEVICE_SET_ATTR` individually) to set device attributes. This opcode can be used to change the common attributes mentioned above and the attributes introduced in subclasses. It cannot be used to change the brand association, device state, or service association.

### Associating Devices and Services

Devices are associated with services. For example, a set-top box requires movies or other content to be useful. The reverse is also true; a video-on-demand service requires a device to display it.

In BRM, these device-to-service associations are represented by the association of `/device` objects with `/service` objects. For example, when a CSR provisions an account with a service that requires a device, the POID of the `/service` object is added to the `PIN_FLD_SERVICES` array in the `/device` object. The `/account` object POID associated with the service is also added to the `/device` object.

These device-to-service associations can take place on a many-to-many basis. One device may require multiple services and one service may require multiple devices. For example, a SIM card can be provisioned with several different wireless services.

The `/config/device_permit_map` object determines which service types can be associated with which device types. You define the valid device-to-service mappings in a configuration file and load it into the `/config/device_permit_map` object by running the `load_pin_device_permit_map` utility. See "[Defining Device-to-Service Associations](#)".

Applications call `PCM_OP_DEVICE_ASSOCIATE` to associate and disassociate devices and services for a particular account or at the account level. A flag in the input flist determines whether the services and devices are associated or disassociated. This opcode validates the associations against the `/config/device_permit_map` object for the device type and brand specified in the input flist. Invalid associations cause the opcode to fail.

### Deleting Devices

Devices can be removed from service for a variety of reasons. They might be returned by the customer, lost, stolen, or become obsolete. You can call `PCM_OP_DEVICE_DELETE` to remove the device object from the database when it is no longer needed.

Before you delete a device object, you should disassociate services from the device. During device deletion, the `PCM_OP_DEVICE_POL_DELETE` opcode checks for services associated with the device. If associations are found, the opcode generates an error and aborts the transaction. If desired, you can modify the policy to prevent the association check or to automatically remove associations before the device object is deleted.

In some cases you may want to replace a device object while keeping service associations intact. In this case, you should disassociate the services from the old device object and reassociate them with the new device in the same transaction. After the services have been reassociated, you can delete the original device object.

See "[Associating Devices and Services](#)" for more information about device-to-service associations.

### Tracking Device History

All operations on a `/device` object, such as device creation, state transitions, and changes to attributes, are recorded in the database as events. Recording events allows you to track the history of a device from a client application such as Customer Center or a custom device management system.

You can turn off event recording and turn on auditing to maintain a device history without storing details. For information about choosing which events to record, see "Managing Database Usage" in *BRM System Administrator's Guide*. For an introduction to auditing and links to more detailed information, see "About Maintaining an Audit Trail of BRM Activity" in *BRM Managing Customers*.

Two BRM Reports enable you to monitor the status and device history of devices. See "About the BRM Reports Packages" in *BRM Reports*.

## Device Management and Brands

The Device Management framework supports branding. For example, in Customer Center, a CSR can see and assign only devices in brands for which they have permissions. Similarly, devices can be associated only with services in the same brand.

Branding in the device management framework is implemented by associating brands with both `/device` objects and the `/config` objects used to configure them. Each `/device`



or `/config` object includes a `PIN_FLD_ACCOUNT_OBJ` field, which in turn contains the POID of the `/account` object of the brand.

The brand affiliation of `/device` and `/config` objects is determined by the BRM login used to create them:

- For `/device` objects, this might be the login of a Customer Center user or the user of a bulk device creation tool.
- For `/config` objects (`/config/device_state` and `/config/device_permit_map`) the brand is determined by the login in the `Infranet.properties` file for the load utilities used to create the objects. See ["Defining the Device Life Cycle"](#) and ["Defining Device-to-Service Associations"](#) for more information about the load utilities.

Access permissions ensure that only logins associated with the correct brands can read, write, and create `/device` objects and their `/config` objects:

- `/device` objects have read permission set to Brand Lineage and write permission set to Ancestral Lineage. See ["Branding Access Permissions"](#).
- `/config` objects have read permissions set to Brand, write permissions set to Self, and create permissions set to Brand Owner. See ["Branding Access Permissions"](#).

You can set up device management features to work differently for devices in different brands. For example, you might define a different life cycle for a device type in Brand A than for the same device type in Brand B. See ["Defining the Device Life Cycle"](#) and ["Defining Device-to-Service Associations"](#).

You can change the brand affiliation of a `/device` object by using `PCM_OP_DEVICE_UPDATE` (or `PCM_OP_DEVICE_SET_BRAND` individually). The caller of the opcode must have access permissions that allow it to change objects in both the old and new brands. In some cases, this may require the use of a `root` login.

## Device Management and Multischema Environments

The Device Management framework supports multischema environments, with some restrictions:

- A `/device` object can be associated only with `/account` and `/service` objects located in the same database schema as the `/device` object.
- `/device` objects are not available across schemas. Device management `/config` objects (`/config/device_state` and `/config/device_permit_map`) are available, however.
- You cannot move `/device` objects from one schema to another. You can delete the objects and re-create them in another schema, but service and account associations are lost.
- You can enforce device number uniqueness across schemas, but this requires the use of global search opcodes and may result in slow performance.

## Configuring Event Notification for Device Management

When a device state changes, Device Management uses event notification to call opcodes that perform the appropriate follow-up operations.

Although any subclass of the `/event` class can be used to trigger event notification (see ["About Notification Events"](#)), Device Management generates `/event/notification/device/state` specifically to use for event notification.

Before you can use Device Management, you must configure the event notification feature as follows:

1. If your system has multiple configuration files for event notification, merge them. See ["Merging Event Notification Lists"](#).
2. Ensure that the merged file includes the following information from the `BRM_Home/sys/data/config/pin_notify` file, where `BRM_Home` is the directory in which you installed BRM components:

```
# Device Management Framework related event notification
2706 0 /event/notification/device/state
```
3. (Optional) If necessary to accommodate your business needs, add, modify, or delete entries in your final event notification list. See ["Editing the Event Notification List"](#).
4. (Optional) If necessary to accommodate your business needs, create custom code for event notification to trigger. See ["Using Event Notification to Trigger Custom Operations"](#).
5. Load your final event notification list into the BRM database. See ["Loading the Event Notification List"](#).

For more information, see ["Using Events to Trigger Operations"](#).

## Defining the Device Life Cycle

You define the life cycle for device objects in BRM by editing or creating a configuration file and then loading the data into a `/config/device_state` object in the database.

Each `/config/device_state` object contains definitions of the possible device states and state changes for one device type and brand. `/config/device_state` objects also contain information about which policy opcodes to call during state changes.

See `load_pin_device_state` for detailed information about the syntax of the configuration file and running the load utility. See ["Customizing Device State Changes"](#) for information about calling policy opcodes.

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**Note:** You must load the life cycle definitions into the database *before* using any device management features. Because device management configuration data is always customized, no default values are loaded during BRM installation.

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While the life cycle for every `/device` object is unique, the general pattern for all `/device` objects is the same:

- During device creation, a `/device` object moves from **Raw** state (state 0) to an initial state that is defined for that device type and brand. `/device` objects cannot be saved in **Raw** state.
- During the life of the `/device` object, it moves from state to state in ways that are defined in a `/config/device_state` object. For example, a device might be able to move from a **Pre-provisioned** state to an **Assigned to Dealer** state, but not directly from **Assigned to Subscriber** state. Each device type and brand has its own `/config/device_state` object, so you can define different life cycles to meet your business needs.

- At the end of the working life of the `/device` object, it moves into a final state such as **Stolen** or **Obsolete**. Depending on business needs, the object could then be deleted to save space.

There can be any number of device states, each of which is assigned a number in the device state configuration file. State 0 is reserved for **Raw** state, but other numbers can be freely assigned.

There are four *state types* that correspond to the stages in the general pattern described above. These state types are defined in the `pin_device.h` header file and cannot be changed.

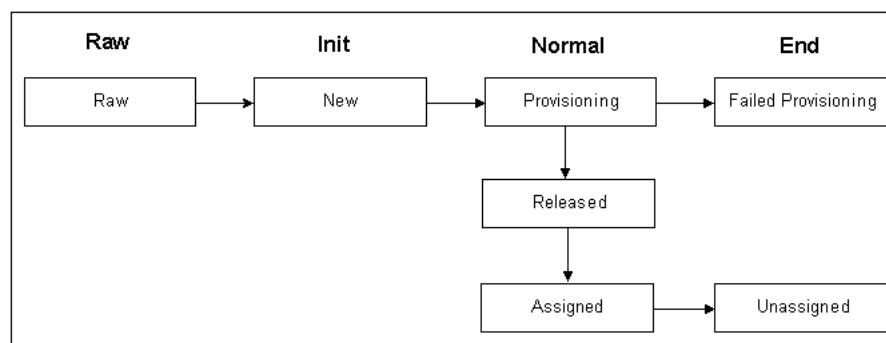
When you define device states, they must be assigned to one of these types:

- **Raw** - There can be only one device state of this type for each device type and brand. `/device` objects are in raw state only during the creation process. They can never be saved in a raw state. Raw states can transition only to Init states.
- **Init** - This state type is for states in which the object can first be saved to the database. There can be more than one initial state for a particular device type and brand. For example, you might want the device to be initialized to one state when created by a batch device creation tool and to another state when created by a CSR using a GUI tool. Init states can transition to Init, Normal, or End states.
- **Normal** - Normal device states are all those that occur between the object's initial state and its end state. You can think of these as the "working" states for the device. There can be any number of Normal device states. Normal states can transition to Init states, other Normal states, and End states.
- **End** - Devices cannot transition from End states. Because there are many possible end-of-life scenarios, you can include any number of End states.

When you define a device life cycle, be sure to consider all the stages in the life cycle of the actual device and all the possible relationships between them. You should also consider the level of detail that is useful to track in your device management system.

Figure 21–1 shows a relatively simple device life cycle for wireless phone SIM cards. The life cycles for your devices may be more complex depending on the characteristics of the devices and your business needs.

**Figure 21–1 Wireless Phone SIM Card Life Cycle**



Because `/config/device_state` objects are brand aware, you must load an object for each unique combination of device type and brand. For example, if you have two device types (A and B) that occur in two brands (1 and 2) and a third device type (C) that occurs only in Brand 1, you must load `/config/device_state` objects for these five combinations: A1, A2, B1, B2, and C1.

If the state changes for a device type are the same for all brands, you can create a single `/config/device_state` object for that device type by using the `root` login when you run `load_pin_device_state`. The device management opcodes automatically check the `/config/device_state` object associated with `root` if they can't find an object associated with a device's brand. See ["Device Management and Brands"](#) for more information.

To define the life cycle for a device type in a particular brand:

1. If necessary, edit the `infranet.connection` entry in the `BRM_Home/apps/device_management/Infranet.properties` file to use a login associated with the brand you are working on.
2. Enter device state change definitions in a new text file or edit `BRM_Home/sys/data/config/pin_device_state`.

See `load_pin_device_state` for information about the syntax of the file.

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**Caution:** The `load_pin_device_state` utility overwrites existing device states for a device type and brand. If you are updating device states, you cannot load new device states only. You must load complete sets of device states for the device type and brand each time you run the `load_pin_device_state` utility.

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3. Save the configuration file. For ease of maintenance, use a file name that reflects the device type and brand.
4. Use the following command to run the `load_pin_device_state` utility, where `state_change_file` represents the path and name of the configuration file you saved:  

```
load_pin_device_state state_change_file
```
5. Stop and restart the CM. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

To verify that the state change file was loaded, you can display the `/config/device_state` objects by using the Object Browser, or use the `robj` command with the `testnap` utility. (See ["Reading an Object and Writing Its Contents to a File"](#).)

## Localizing Device State Names

The names you use for device states can be localized for display in a GUI application. You must define the state names as text strings and load the definitions into the database. To localize the device state names, you edit a copy of the `device_states.en_US` sample file in the `BRM_Home/sys/messages/devicestates` directory and save the edited version with the correct locale file extension. You then use the `load_localized_strings` utility to load the contents of the file into the `/strings` objects.

When you run the `load_localized_strings` utility, use this command:

```
load_localized_strings device_states.locale
```

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**Note:** If you're loading a localized version of this file, use the correct file extension for your locale. For a list of file extensions, see ["Locale Names"](#).

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For information on loading the `device_states.locale` file, see ["Loading Localized or Customized Strings"](#). For information on creating new strings for this file, see ["Creating New Strings and Customizing Existing Strings"](#).

## Customizing Device State Changes

PCM\_OP\_DEVICE\_UPDATE is used to change device states. It calls PCM\_OP\_DEVICE\_SET\_STATE to actually make the change. During the processing of PCM\_OP\_DEVICE\_SET\_STATE opcode, there are two opportunities to call policy opcodes:

- The first policy call takes place during the state change itself, just before the transaction is committed to the database.
- The second occurs just after the transaction that changes the device state.

You can use these two policy calls for different purposes. For example, you might want to customize the process for assigning a SIM card to a customer, which involves a state change. During the first policy call by PCM\_OP\_DEVICE\_SET\_STATE, the policy opcode could check the customer's handset to ensure compatibility with the SIM card. If the two devices are compatible, the state change takes place. In the second policy call, after the state change transaction is complete, the policy opcode could provision the SIM card by calling PCM\_OP\_DEVICE\_ASSOCIATE.

PCM\_OP\_DEVICE\_POL\_SET\_STATE is the default policy opcode for device state changes. You can create any number of custom policy opcodes to replace or supplement it. You can also specify additional policy opcodes to call for each state change in the device-specific configuration file that defines the device life cycle. For each state change, you can specify an opcode for one, both, or neither of the two potential policy calls.

For information on naming and setting up this configuration file, see `load_pin_device_state`. For information about the state change opcodes, see:

- PCM\_OP\_DEVICE\_UPDATE
- PCM\_OP\_DEVICE\_SET\_STATE
- PCM\_OP\_DEVICE\_POL\_SET\_STATE

## Defining Device-to-Service Associations

You define which device and service types can be associated by editing or creating a configuration file and then loading the data into a `/config/device_permit_map` object in the database.

Each `/config/device_permit_map` object contains device-to-service mapping information for all the device types in one brand. However, you load the information separately for each device type in the brand.

See `load_pin_device_permit_map` for detailed information about running the load utility and about the syntax of the configuration file. See PCM\_OP\_DEVICE\_ASSOCIATE and PCM\_OP\_DEVICE\_POL\_ASSOCIATE for more information about the device-to-service mapping opcodes.

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**Important:** You must load the mapping information into the database *before* using any device management features. Because device management configuration data is always customized, default values are not loaded during BRM installation.

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Device and service types can be associated in any combination. One device can have any number of associated services. Likewise, one service may require multiple devices.

You must load device-to-service mapping information for each unique combination of device type and brand. For example, if the same device type exists in several different brands, you must load mapping information for that device type into the `/config/device_permit_map` object for each brand.

If the mapping definitions are the same for all brands or if you are not using branding, you can create a single `/config/device_permit_map` object by using the **root** login when you run `load_pin_device_permit_map`. The device management opcodes automatically check the `/config/device_permit_map` object associated with **root** if they can't find an object associated with a device's brand. See "[Device Management and Brands](#)" for more information.

The device-to-service mapping information that you define determines which associations are valid in a particular brand. If `PCM_OP_DEVICE_ASSOCIATE` attempts to associate a device to a service that is not defined in the `/config/device_permit_map` object, the association fails.

To map devices and services within a brand:

1. If necessary, edit the **infranet.connection** entry in the `BRM_Home/apps/device_management/Infranet.properties` file to use a login associated with the brand you are working on.
2. Enter device-to-service mapping definitions into a new text file or edit `BRM_Home/sys/data/config/pin_device_permit_map`.

See `load_pin_device_permit_map` for information about the syntax of the file.

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**Caution:** The `load_pin_device_permit_map` utility overwrites existing mapping definitions for the device type in this brand. If you are updating mapping definitions, you cannot load only the new mappings. You must load complete sets each time you run the utility.

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3. Save the configuration file. For ease of maintenance, use a file name that reflects the device type and brand.
4. Use the following command to run the `load_pin_device_permit_map` utility, where `map_file` represents the path and name of the configuration file you saved:  

```
load_pin_device_permit_map map_file
```
5. Stop and restart the Connection Manager (CM). See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.
6. To verify that the map file was loaded, display the `/config/device_permit_map` object by using the Object Browser, or use the **robj** command with the **testnap** utility. (See "[Reading an Object and Writing Its Contents to a File](#)".)

By default, when you associate a device with a service or disassociate a device from a service, BRM updates the status of the service and the associated supplementary features.

You can configure BRM to not update the status of a service when you associate a device with a service or disassociate a device from a service. For more information, see "Configuring Service Status Change for Device-to-Service Associations" in *BRM Telco Integration*.

## Creating Custom Device Management Systems

You can create custom device management systems using the Device Management framework. A device management system could be a separate, stand-alone application that performs all necessary tasks, or it could be an enabling application that connects an existing device management system.

A device management application is no different from any other BRM application except that it makes use of the opcodes and storable classes provided by the framework.

For information about creating BRM client applications, see the chapters in *Creating custom client applications*. "[Adding New Client Applications](#)" provides a general overview as well as information about writing applications in C. Other chapters provide information about additional programming languages.

You will need to complete some or all of the following tasks to implement a device management system:

1. Create a subclass of the `/device` storable class for every new device type. Each subclass should include fields for the unique attributes of the device type.  
You use Storable Class Editor to create fields and classes. See "[Creating Custom Fields and Storable Classes](#)".
2. If necessary, write a new FM for any unique functionality required by your device management system.  
See "[Writing a Custom Facilities Module](#)".
3. If necessary, modify the Device FM policy opcodes to customize the default device management functionality.  
See "[Adding and Modifying Policy Facilities Modules](#)" for general information and "Device FM Policy Opcodes" in *BRM Developer's Reference* for specific information about the Device policy opcodes.
4. Write a custom application that calls the Device standard and policy opcodes as well as any custom opcodes you have created.  
See "[Adding New Client Applications](#)" for general information as well as information about writing applications in C. See the other chapters in *Creating custom client applications* about writing applications in other languages.
5. Define the life cycles and device-to-service mappings for your devices.  
See "[Defining the Device Life Cycle](#)" and "[Defining Device-to-Service Associations](#)".

## About the Device Management Opcodes

You use the following opcodes to manage devices in BRM:

- To create devices, use `PCM_OP_DEVICE_CREATE` and `PCM_OP_DEVICE_POL_CREATE`. See "[Creating /device Objects](#)".
- To change any combination of device attributes, brands, and states, use `PCM_OP_DEVICE_UPDATE`. This wrapper opcode calls these opcodes to make the separate changes within a single transaction:
  - `PCM_OP_DEVICE_SET_ATTR` and `PCM_OP_DEVICE_POL_SET_ATTR` change existing device attribute values. See "[Changing the Attributes of /device Objects](#)".

- PCM\_OP\_DEVICE\_SET\_BRAND and PCM\_OP\_DEVICE\_POL\_SET\_BRAND associate devices with brands, or changes brand associations. See "[Associating /devices and /brand Objects](#)".

PCM\_OP\_DEVICE\_SET\_STATE and PCM\_OP\_DEVICE\_POL\_SET\_STATE change device states. See "[UseElementId](#)".

You can also call these opcodes individually.

- To associate or disassociate services with devices, use PCM\_OP\_DEVICE\_ASSOCIATE and PCM\_OP\_DEVICE\_POL\_ASSOCIATE. See "[Associating /service and /device Objects](#)".
- To delete devices, use PCM\_OP\_DEVICE\_DELETE and PCM\_OP\_DEVICE\_POL\_DELETE. See "[Deleting /device Objects](#)".

## Creating /device Objects

Use PCM\_OP\_DEVICE\_CREATE to create **/device** objects in the BRM database.

This opcode calls the PCM\_OP\_DEVICE\_POL\_CREATE policy opcode before it creates any **/device** objects. By default, this policy opcode is an empty hook, but you can customize it to validate IDs, check that all mandatory attributes are specified, or perform other custom tasks.

For example, if devices of a particular type require a device ID with certain characteristics, you can validate the ID supplied by the input flist. Similarly, you can use the opcode to ensure that all mandatory attributes of a particular device type are included in the new object.

To create devices, your custom device-creation application must call PCM\_OP\_DEVICE\_CREATE directly and pass in the following data:

- A type-only POID that specifies the device type
- The target database schema
- The name of the program calling the opcode
- The physical ID of the device
- The initial state to which the device should be set

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**Note:** Depending on the device type, additional inputs may be required for other device attributes.

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PCM\_OP\_DEVICE\_CREATE performs these tasks:

1. Calls PCM\_OP\_DEVICE\_POL\_CREATE to perform any custom validation.
2. Checks **/config/device\_permit\_map** to validate any device-to-service associations.
3. Sets the brand of the **/device** object.
4. Creates a **/device** object of the type specified in the input flist. This object includes all mandatory attributes for the device type.
5. Calls PCM\_OP\_DEVICE\_SET\_STATE to set the initial device state. See "[UseElementId](#)".
6. If events are being recorded, generates an **/event/device/create** object.

PCM\_OP\_DEVICE\_CREATE stops processing under these circumstances:



- When the validation of the device-to-service association fails.
- When PCM\_OP\_DEVICE\_POL\_CREATE fails during the validation process.
- When PCM\_OP\_DEVICE\_SET\_STATE fails while setting the object's initial device state.

If PCM\_OP\_DEVICE\_CREATE is not successful, it logs an error in the CM **pinlog** file, indicating the reason for the failure. The transaction is rolled back and no **/device** object is created.

## Changing Device Attributes, Brands, and States

Use PCM\_OP\_DEVICE\_UPDATE to change any combination of device attribute values, brands, and states with a single call. This opcode calls PCM\_OP\_DEVICE\_SET\_ATTR, PCM\_OP\_DEVICE\_SET\_BRAND, and PCM\_OP\_DEVICE\_SET\_STATE individually to make the changes. These individual opcodes in turn, call their respective policy opcodes to perform any validation checks that you have added as explained in the following sections.

### Changing the Attributes of /device Objects

Use PCM\_OP\_DEVICE\_SET\_ATTR to change device attribute values, such as the device manufacturer and model number.

Each type of device can have different attributes. For example, a **/device/sim** object has different attributes than a **/device/num** object. Attributes common to all devices, such as the text description stored in the PIN\_FLD\_DESCR field, are contained in the base **/device** object. Attributes specific to a particular type of device are stored in the **/device** subclass.

PCM\_OP\_DEVICE\_SET\_ATTR calls the PCM\_OP\_DEVICE\_POL\_SET\_ATTR policy opcode before it sets attributes. By default, this policy opcode is an empty hook, but you can customize it to validate device IDs or perform other validation tasks.

To change device attributes, your custom device-creation application must call PCM\_OP\_DEVICE\_SET\_ATTR directly and pass in the following data:

- The POID of the **/device** object.
- The name of the program calling the opcode.
- The fields to change, along with their new values. If the opcode is changing the attributes of a **/device** subclass, it can include fields introduced in the subclass.

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**Note:** You can't use PCM\_OP\_DEVICE\_SET\_ATTR to change the brand association, device state, or service association. If the input list includes these fields, they are ignored.

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PCM\_OP\_DEVICE\_SET\_ATTR performs these operations:

1. Calls PCM\_OP\_DEVICE\_POL\_SET\_ATTR to perform any custom validation.
2. Updates the **/device** object to include the new attribute values.
3. If events are being recorded, generates an **/event/device/attribute** object.

PCM\_OP\_DEVICE\_SET\_ATTR stops processing under these circumstances:

- When PCM\_OP\_DEVICE\_POL\_SET\_ATTR fails.
- When an attribute to be changed doesn't exist in the **/device** object.

## Associating /devices and /brand Objects

Use `PCM_OP_DEVICE_SET_BRAND` to change the brand associated with a device. For example, you use this opcode when a `/device` object was created in one brand, but you need to change the brand before assigning it to an account.

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**Important:** Devices and their associated services and accounts must all have the same brand.

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The brand associated with the BRM login that calls this opcode determines which brand changes are possible. `/device` objects have ancestral lineage write permissions, so the caller of this opcode must be in the ancestral lineage of both the old and new brands. If the old and new brands are too distantly related for this to be possible, the opcode caller must have `root` permissions.

This opcode calls the `PCM_OP_DEVICE_POL_SET_BRAND` policy opcode before it changes any brand associations. By default, this policy opcode is an empty hook, but you can customize it to check brand types or perform other validations. For example, you could limit brand changes to certain device types or situations.

To associate devices with brands, your custom device-creation application must call `PCM_OP_DEVICE_SET_BRAND` directly and pass in the following data:

- The POID of the `/device` object.
- The name of the program calling the opcode.
- The `/account` object POID of the new brand.

`PCM_OP_DEVICE_SET_BRAND` performs these operations:

1. Calls `PCM_OP_DEVICE_POL_SET_BRAND` to perform any custom validation.
2. Validates permissions to ensure that the caller has permissions for both the new and old brands.
3. Replaces the old brand account value with the new one.
4. If events are being recorded, generates an `/event/device/brand` object.

The value of the `PIN_FLD_FLAGS` field in the `PCM_OP_DEVICE_SET_BRAND` input flist determines whether the opcode associates or disassociates objects. When the last bit is `1`, the opcode associates. When the last bit is `0`, the opcode disassociates.

`PCM_OP_DEVICE_SET_BRAND` stops processing under these circumstances:

- When the caller does not have permissions for both the new and old brands.
- When `PCM_OP_DEVICE_POL_SET_STATE` fails.

If the opcode is not successful, it logs an error in the CM `pinlog` file, indicating the reason for the failure. The transaction is rolled back and no brand change takes place.

## Changing the State of a /device Object

Use `PCM_OP_DEVICE_SET_STATE` to change the state of a `/device` object.

This opcode checks the validity of each state change by using the `/config/device_state` object for this device type and brand. The `/config/device_state` object includes an array that lists valid transitions from each device state. You create these rules in a configuration file and load them into `/config/device_state` objects by running the `load_pin_device_state` utility. See "[Defining the Device Life Cycle](#)".

The opcode calls policy opcodes at two points. The first takes place during the state change itself and the other just after it. You specify which policy opcodes to call by using the `pin_device_state` file. By default, it calls the `PCM_OP_DEVICE_POL_SET_STATE` policy opcode.

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**Note:** `PCM_OP_DEVICE_SET_STATE` uses the event notification feature. Before using this opcode, you must configure event notification for device management. See "[Configuring Event Notification for Device Management](#)".

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To set device states, your custom device-creation application must call `PCM_OP_DEVICE_SET_STATE` directly and pass in the following data:

- The POID of the `/device` object.
- The name of the program calling the opcode.
- The old state ID.
- The new state ID.

`PCM_OP_DEVICE_SET_STATE` performs these operations:

1. Determines whether the state change is valid by checking the `config/device_state` object for this device type and brand.
2. Calls the opcode specified in `/config/device_state` for the in-transition event.
3. Changes the `/device` object's `PIN_FLD_DEV_STATE_ID` field to the new state.
4. If events are being recorded, generates an `/event/device/state` object.
5. Calls the opcode specified in `/config/device_state` for the post-transition event.

`PCM_OP_DEVICE_SET_STATE` stops processing under these circumstances:

- When the device state change is invalid based on the `/config/device_state` object for this device type.
- When a `/config/device_state` object cannot be found for this device type.
- When the input flist attempts to change the device state from `RAW` to any type other than `INIT`, or attempts to change the device state from `END` to any other state.
- When an error occurs during the event notification process or when a policy opcode is called.

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**Note:** The second policy call occurs after the state change has been recorded. If this policy fails, the state change is *not* rolled back.

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`PCM_OP_DEVICE_POL_SET_STATE` allows customization during device state changes. For example, you might want to customize the process for assigning a SIM card to a customer. During this process, the state is changed from `Inventory` to `Assigned`. During the first policy call by `PCM_OP_DEVICE_SET_STATE`, the policy opcode could check the customer's handset to ensure compatibility with the SIM card. If the two devices are compatible, the state change takes place. In the second policy call, after the state change transaction is complete, the policy opcode could provision the SIM card by calling `PCM_OP_DEVICE_ASSOCIATE`.

By default, PCM\_OP\_DEVICE\_POL\_SET\_STATE is an empty hook provided to facilitate customization.

## Associating /service and /device Objects

Use PCM\_OP\_DEVICE\_ASSOCIATE to associate or disassociate services with devices.

When an account is provisioned with a device through Customer Center or some other application, this opcode associates the **/device** object with one or more **/service** objects. (One device can support multiple services. Conversely, one service may require multiple devices.) To facilitate searching, the account associated with the services is also associated with the device.

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**Note:** The services that can be associated with a particular device type and brand are determined by the **/config/device\_permit\_map** object. You enter the device-to-service mapping information in a device-specific configuration file and load it into the database by running the **load\_pin\_device\_permit\_map** utility. For the configuration file syntax, see "[load\\_pin\\_device\\_permit\\_map](#)".

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PCM\_OP\_DEVICE\_ASSOCIATE calls the PCM\_OP\_DEVICE\_POL\_ASSOCIATE policy opcode before it associates any objects. By default, this policy opcode does nothing, but you can customize it to limit the number of device associations or perform other validation tasks.

To associate services with devices, your custom device-creation application must call PCM\_OP\_DEVICE\_ASSOCIATE directly and pass in the following data:

- The POID of the **/device** object.
- The name of the program calling the opcode.
- A flag to indicate association or disassociation.
- An array that includes the POIDs of the services and the account to be associated or disassociated.

PCM\_OP\_DEVICE\_ASSOCIATE performs these operations:

1. Determines whether to associate or disassociate the objects by checking the PIN\_FLD\_FLAGS field.
  - When the last bit is **1**, the opcode *associates*.
  - When the last bit is **0**, the opcode *disassociates*.
2. Determines whether the device is already associated with the specified service by checking the **/device** object.
3. When associating objects, validates the device-to-service association by checking the **/config/device\_permit\_map** object. This validation includes ensuring that the brand of the device and service are the same.
4. Calls PCM\_OP\_DEVICE\_POL\_ASSOCIATE to perform any custom validation.
5. When associating objects, writes new fields for the services and account into the **/device** object's PIN\_FLD\_SERVICES array.
6. When disassociating objects, deletes the appropriate service and account fields from the **/device** object.
7. If events are being recorded, generates an **/event/device/associate** object.

PCM\_OP\_DEVICE\_ASSOCIATE stops processing under these circumstances:

- For associations, when a service listed in the input flist already exists in the **/device** object.
- When the validation of the device-to-service association fails.

If the opcode stops processing, it logs an error in the CM **pinlog** file, indicating the reason for the failure. The transaction is rolled back and no association or disassociation takes place.

## Deleting /device Objects

Use PCM\_OP\_DEVICE\_DELETE to delete **/device** objects.

This opcode calls the PCM\_OP\_DEVICE\_POL\_DELETE policy opcode before it deletes any device objects. By default, this policy opcode checks whether the device is associated with any services, and if it is, stops the transaction. You can customize this opcode to bypass this check or to perform other validation steps.

By default, PCM\_OP\_DEVICE\_POL\_DELETE stops processing under these circumstances:

- When the device is still associated with a service.
- When there is an error in the syntax of the input flist.

To delete devices, your custom device-creation application must call PCM\_OP\_DEVICE\_DELETE directly and pass in the following data:

- The POID of the **/device** object.
- The name of the program calling the opcode.

PCM\_OP\_DEVICE\_DELETE performs these operations:

1. Calls PCM\_OP\_DEVICE\_POL\_DELETE for validation.
2. Deletes the object.
3. If events are being recorded, generates an **/event/device/delete** object.

The opcode stops processing if PCM\_OP\_DEVICE\_POL\_DELETE fails.



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## Managing Orders

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) Order Management framework and explains how to use its components to build custom order management systems.

Before you read this chapter, you should have a good understanding of BRM opcodes and storable classes. See ["Understanding the PCM API and the PIN Library"](#) and ["Understanding Flists and Storable Classes"](#).

If you plan to develop order management applications, you should also read ["Adding New Client Applications"](#) as well as the client applications document that covers the programming language you will use.

### About the Order Management Framework

The *Order Management framework* enables you to write applications to manage orders and sub-orders in BRM or to connect an existing order management system to BRM. The Order Management framework is used by optional BRM products such as voucher manager to facilitate their order management features.

The Order Management framework is part of Inventory Manager, which is an optional, separately purchased feature.

In BRM, an *order* is a request for a physical or virtual object such as voucher cards or SIM cards. Both types of orders are represented in BRM as Storable objects. You use your Order Management framework to create orders for device inventory such as vouchers and SIM cards. The Order Management framework provides the `/order` storable class, which you can subclass to represent specific order types. Each object in `/order` or its subclasses represents an individual order.

Order management includes creating the order objects, controlling their life cycles and their attributes, processing orders, tracking their history, and removing orders when they are no longer needed. The framework provides storable classes, standard and policy events, and utilities for these purposes.

### Order Management Tasks

The Order Management framework provides the following functionality:

- [Creating Orders](#)
- [Processing Order Response Files](#)
- [Managing the Order Life Cycle](#)
- [Associating or Disassociating Orders with Master Orders](#)

- [Managing Order Attributes](#)
- [Deleting Orders](#)
- [Tracking Order History](#)
- [Managing the Order History Log](#)

## Creating Orders

Each order that you track in BRM is represented by an **/order** object. The way these objects are created depends on your business. You can create orders and sub-orders, and you can associate sub-orders with master orders.

While there are many scenarios for order creation, the actual process used is always the same: all order-creation applications call PCM\_OP\_ORDER\_CREATE. This opcode creates BRM **/order** objects that use the order type, initial state, and attributes specified in the input list. See "[Creating /order Objects](#)".

A policy opcode, PCM\_OP\_ORDER\_POL\_CREATE, enables you to customize the order creation process.

Because your business may need to manage several types of orders, the **/order** storable class can be subclassed to represent *order types*. Each order type is a group of orders that have similar characteristics. For example, Voucher Manager creates the **/order/voucher** order type.

You use Storable Class Editor, an application in Developer Center, to create new subclasses. See "[Creating Custom Fields and Storable Classes](#)".

The **/order** objects are brand aware. Their brand affiliation is determined by the brand affiliation of the login used to create the objects. See "[Order Management and Brands](#)" for more information.

## Processing Order Response Files

After you create an order, you send it to the vendor or manufacturer and request an order response file. The manufacturer returns an order response file that lists the set of devices that are created. You then process this response file to store the data in the BRM database.

A policy opcode, PCM\_OP\_ORDER\_POL\_PROCESS, enables you to customize the **/order** object when you process an order.

Processing order response files includes creating devices such as vouchers in the database and updating the status of the requested order to either *Received* or *Partially Received*.

## Managing the Order Life Cycle

Real-world orders pass through various stages. For example, an order can be new, received, or canceled. An order management system must keep track of these stages, or *order states*. In BRM, the order state is represented by the PIN\_FLD\_STATUS field in the **/order** object. The value of this field represents the current state of the order. The set of possible order states and state transitions defines the *life cycle* of an **/order** object.

Order life cycles are regulated by **/config/order\_state** objects in the database. You define order states and state changes in a configuration file and load it into the database by using the **load\_pin\_order\_state** utility. See "[About Defining the Order Life Cycle](#)" for more information.



Order management applications call PCM\_OP\_ORDER\_UPDATE. This opcode is a wrapper opcode that calls one of the following opcodes to change order states, depending on the input flist provided for this opcode:

- PCM\_OP\_ORDER\_SET\_STATE
- PCM\_OP\_ORDER\_SET\_ATTR
- PCM\_OP\_ORDER\_SET\_BRAND

PCM\_OP\_ORDER\_UPDATE also validates the change specified in the opcode against the `/config/order_state` object for that order type and brand. Invalid order states or state changes cause the opcode to fail.

The order life cycle is unique for each order type in each brand. The same order type could have different life cycles in different brands. See "[Order Management and Brands](#)" for more information.

### Associating or Disassociating Orders with Master Orders

You can associate or disassociate orders with other orders. You can create orders and make them master orders by including or associating sub-orders with them. You can do this while creating the orders, or you can create orders and later associate them with other orders.

Applications call PCM\_OP\_ORDER\_ASSOCIATE and the PCM\_OP\_ORDER\_POL\_ASSOCIATE policy opcode to associate and disassociate orders and create orders in different levels. A flag in the input flist determines whether the order is associated or disassociated. PCM\_OP\_ORDER\_ASSOCIATE validates the associations against the order types, master orders, sub-orders, and brands in question. Invalid associations cause the opcode to fail. PCM\_OP\_ORDER\_ASSOCIATE updates the order array to include or exclude sub-orders. See "[Associating and Disassociating /order Objects](#)".

### Managing Order Attributes

Each order has a unique ID, the *order ID*, that identifies the order for tracking by the order management system. This order ID is used to identify orders, search for orders, create a request file, modify orders, and delete orders.

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**Note:** To modify or delete an order, the state of the order must be *New*.

---

You can add fields to `/order` objects for attributes specific to particular order types. For example, `/order/voucher` contains attributes specific to voucher cards.

Applications call PCM\_OP\_ORDER\_SET\_ATTR and the PCM\_OP\_ORDER\_POL\_SET\_STATE policy opcode to set order attributes and order state. PCM\_OP\_ORDER\_SET\_ATTR can be used to change the common attributes mentioned above and the attributes introduced in subclasses. It cannot be used to change the order state or to cancel an order or brand association.

### Deleting Orders

Orders can be deleted for a variety of reasons. You can call PCM\_OP\_ORDER\_DELETE to remove the order object from the database when it is no longer needed.

During order deletion, the PCM\_OP\_ORDER\_POL\_DELETE policy opcode searches for the order by using the order ID. If the order ID is not found, the opcode generates

an error. You can modify the policy to bypass the check and automatically remove the order object to be deleted.

---

---

**Note:** If you delete a master order, the sub-orders associated with it are automatically deleted as well.

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See "[Associating or Disassociating Orders with Master Orders](#)" for more information about master order-to-sub-order associations.

### Tracking Order History

All order operations, such as order creation, state transitions, and changes to attributes, are recorded in the database as events. Recording events enables you to track the history of an order from a client application such as Customer Center or a custom order management system.

You can turn off event recording and turn on auditing to maintain order history without storing details. For information about choosing which events to record, see "Managing Database Usage" in *BRM System Administrator's Guide*. For an introduction to auditing and links to more detailed information, see "About Maintaining an Audit Trail of BRM Activity" in *BRM Managing Customers*.

Two BRM reports enable you to monitor the status and history of orders. See "About the BRM Reports Packages" in *BRM Reports*.

### Managing the Order History Log

All operations related to the `/order` object, including order creation, setting order states, setting order attributes, and deleting orders, are logged in the database.

Customers can search the logging history for any `/order` object in the database. This data is used by different BRM components such as Customer Center and Pipeline Manager.

## Installing the Order Management Framework

The Order Management framework software is included in both the Voucher Manager and the Inventory Manager installation packages.

The hardware and software requirements for Order Management framework software are the same as for Voucher Manager.

The default installation of Voucher Manager installs both the Voucher Manager and Order Management framework software. To install only the Order Management software, select **Order Manager** when prompted during a custom install.

For more information, see "Installing Voucher Manager" in *BRM Telco Integration*.

Follow the instructions in "[Installing the Order Management Framework](#)" section, if you do not use the Voucher Manager and use Inventory Manager.

## Installing the Order Management Framework

To install Order Manager:

1. Download the software to a temporary directory (*temp\_dir*).

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**Important:**

- If you download to a Windows workstation, use **FTP** to copy the **.bin** file to a temporary directory on your UNIX server.
  - You must increase the heap size used by the Java Virtual Machine (JVM) before running the installation program to avoid "Out of Memory" error messages in the log file. For information, see "Increasing Heap Size to Avoid "Out of Memory" Error Messages" in *BRM Installation Guide*.
- 
- 

2. Go to the directory where you installed the Third-Party package and source the **source.me** file.

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---

**Caution:** You must source the **source.me** file to proceed with installation, otherwise "suitable JVM not found" and other error messages appear.

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Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

3. Go to the *temp\_dir* directory and enter this command:

```
7.5.0_InventoryMgr_platform_opt.bin
```

where *platform* is the operating system name.

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**Note:** You can use the **-console** parameter to run the installation in command-line mode. To enable a graphical user interface (GUI) installation, install a GUI application such as X Windows and set the **DISPLAY** environment variable before you install the software.

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4. Follow the instructions displayed during installation.

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**Note:** The installation program does not prompt you for the installation directory if BRM or Inventory Manager is already installed on the machine and automatically installs the package at the *BRM\_Home* location, where *BRM\_Home* is the directory in which you installed BRM components.

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5. Go to the directory where you installed the Inventory Manager package and source the **source.me** file:

Bash shell:

```
source source.me.sh
```

C shell:

```
source source.me.csh
```

6. Go to the `BRM_Home/setup` directory and run the `pin_setup` script.

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**Note:** The `pin_setup` script starts all required BRM processes.

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## Uninstalling the Order Management Framework

To uninstall the Order Management framework, run the `BRM_Home/uninstaller/InventoryMgr/uninstaller.bin`.

## Order Management and Brands

The Order Management framework supports branding. For example, a Customer Service Representative (CSR) using Customer Center can see and assign orders only in brands for which they have permissions.

You implement branding by associating brands with both `/order` objects and the `/config` objects used to configure them. Each `/order` and `/config` object contains the POID of the `/account` object of the brand.

The brand affiliation of `/order` and `/config` objects is determined by the BRM login used to create them:

- For `/order` objects, this might be the login of a Customer Center user or the user of a bulk order creation tool.
- For `/config` objects (`/config/order_state`), the brand is determined by the login in the `Infranet.properties` file for the load utilities used to create the objects. See ["About Defining the Order Life Cycle"](#) for more information about the load utilities.

Access permissions ensure that only the logins associated with the correct brands can read, write, and create `/order` objects and their `/config` objects for the brand:

- `/order` objects have read permission set to Brand Lineage and write permission set to Ancestral Lineage. See ["Branding Access Permissions"](#).
- `/config` objects have read permission set to Brand, write permission set to Self, and create permission set to Brand Owner. See ["Branding Access Permissions"](#).

You can set up order management features to work differently for orders in different brands. For example, you might define a different life cycle for an order in Brand A than for the same order in Brand B. See ["About Defining the Order Life Cycle"](#) for more information.

You can change the brand affiliation of an `/order` object by using `PCM_OP_ORDER_SET_BRAND` and the `PCM_OP_ORDER_POL_SET_BRAND` policy opcode. The caller of the opcode must have access permissions that permit changing objects in both the old and new brands. In some cases this may require the use of a `root` login.

## Order Management and Multischema Environments

The Order Management framework supports multischema environments, with some restrictions:

- An `/order` object and the corresponding `/event/order` objects are stored in the specified database schema when an order is created.

- The master order object cannot be linked to sub-orders that reside in other schemas.
- You cannot move **/order** objects from one schema to another. You can delete the objects and re-create them in another schema, but master order and sub-order associations are lost.

## About Defining the Order Life Cycle

You define the life cycle for order objects in BRM by editing or creating a configuration file and then loading the data into a **/config/order\_state** object in the database.

Each **/config/order\_state** object contains definitions of the possible order states and state changes for one order type and brand. **/config/order\_state** objects also contain information about which policy opcodes to call during state changes.

For detailed information about the syntax of the configuration file and running the load utility, see **load\_pin\_order\_state**.

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**Note:** You must load the life cycle definitions into the database *before* using any order management features. Because order management configuration data is always customized, no default values are loaded during BRM installation.

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While the life cycle for every **/order** object is unique, the general pattern for all **/order** objects is the same:

- During order creation, an **/order** object moves from state 0 to an initial state that is defined for that order type and brand.
- During the life of the **/order** object, it moves from state to state in the manner defined in a **/config/order\_state** object. For example, an order might be able to move from the *New* state to the *Request* state, but not directly from the *New* state to the *Received* state. Each order type and brand has its own **/config/order\_state** object, so you can define different life cycles to meet your business needs.
- At the end of the working life of the **/order** object, it moves into a final state such as *Received* or *Cancelled*. Depending on your business needs, the object could also be deleted to save space.

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**Note:** You can delete an order only when its order state is *New*.

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There can be any number of order states, each of which is assigned a number in the order state configuration file. State 0 is reserved for the Raw state, but other numbers can be freely assigned.

There are four *state types* that correspond to the stages in the general pattern described above. These state types are defined in the **pin\_order.h** header file and cannot be changed.

- State 0 indicates that the order is in Raw state.
- State 1 indicates that the order is in Init state.
- State 2 indicates that the order is in Normal state.
- State 3 indicates that the order is in End state.

When you define order states, they must be assigned to one of these types:

- **Raw:** There can be only one order state of this type for each order type and brand. */order* objects are in raw state only during the creation process. They can never be saved in the raw state. Raw states can transition only to Init states.
- **Init:** This state type is for states in which the object is first saved to the database. There can be more than one initial state for a particular order type and brand. For example, you might want the order to be initialized to one state when created by a batch order creation tool and to another state when created by a CSR using a GUI tool. Init states can transition to *Init*, *Normal*, or *End* states. The order state *New* uses the *Init* state type.
- **Normal:** Normal order states are those that occur between the object's initial state and its end state. You can think of these as the working states for the order. There can be any number of Normal order states. *Normal* states can transition to *Init* states, other *Normal* states, and *End* states. The order states *Request* and *Partially Received* use the *Normal* state type.
- **End:** Orders cannot transition from *End* states. Because there are many possible end-of-life scenarios, you can include any number of *End* states. The order states *Received* and *Cancelled* use the *End* state type.

A typical order moves through the following states:

- **New:** The */order* objects have this state when the order is created.
- **Request:** The */order* objects have this state when an order is sent to the manufacturer for order creation.
- **Partially Received:** The */order* objects have this state when the order is partially received.
- **Received:** The */order* objects have this state when the order is completely received.
- **Cancelled:** The */order* objects have this state when the order is canceled.

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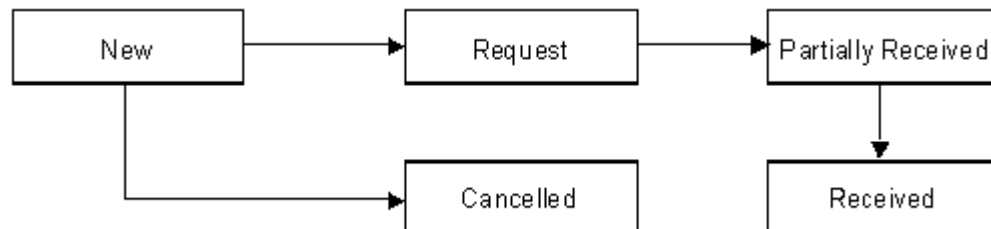
**Note:** Only orders that have the order state *New* can be canceled.

---

When you define an order life cycle, be sure to consider all the stages in the life cycle of the order and all the possible relationships between them. You should also consider the level of detail that is useful to track in your order management system.

Figure 22–1 shows a simple order life cycle for voucher cards. The life cycles for your orders may be more complex depending on the characteristics of the orders and your business needs.

**Figure 22–1 Simple Order Life Cycle for Voucher Cards**



Because `/config/order_state` objects are brand aware, you must load an object for each unique combination of order type and brand. For example, if you have two order types (A and B) that occur in two brands (1 and 2) and a third order type (C) that occurs only in Brand 1, you must load `/config/order_state` objects for these five combinations: A1, A2, B1, B2, and C1.

If the state changes for an order type are the same for all brands, you can create a single `/config/order_state` object for that order type by using the `root` login when you run `load_pin_order_state`. The order management opcodes automatically check the `/config/order_state` object associated with `root` if they can't find an object associated with an order's brand. See "[Order Management and Brands](#)" for more information.

The names you use for order states can be localized for display in GUI applications. You must define the state names as text strings and load the definitions into the database by using the `load_localized_strings` utility.

## Defining an Order Life Cycle

To define the life cycle for an order type in a particular brand:

1. If necessary, edit the `infranet.connection` entry in the `BRM_Home/apps/order_management/Infranet.properties` file to use a login associated with the brand you are working on.
2. Enter order state change definitions in a new text file or edit the `BRM_Home/sys/data/config/pin_order_state` file.

See `load_pin_order_state` for information about the syntax of the file.

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**Caution:** The `load_pin_order_state` utility overwrites existing order states for an order type and brand. If you are updating order states, you cannot load new order states only. You must load complete sets of order states for the order type and brand each time you run the `load_pin_order_state` utility.

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3. Save the configuration file.

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**Tip:** For ease of maintenance, use a file name that reflects the order type and brand.

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4. Use the following command to load the `pin_order_state` file:

```
load_pin_order_state state_change_file
```

where `state_change_file` represents the path and name of the configuration file you saved.

5. Restart the Connection Manager (CM). See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

To verify that the state change file was loaded, you can display the `/config/order_state` objects by using the Object Browser, or use the `robj` command with the `testnap` utility. (See "[Reading an Object and Writing Its Contents to a File](#)".)

## Creating Custom Order Management Systems

You can create custom order management systems using the Order Management framework. An order management system can be a separate, standalone application that performs all necessary tasks, or it can be an enabling application that connects BRM to an existing order management system.

["Adding New Client Applications"](#) provides a general overview as well as information about writing applications in C. Other sections provide information about additional programming languages.

You need to complete some or all of the following tasks to implement an order management system:

1. Create a subclass of the `/order` storable class for every new order type. Each subclass should include fields for the unique attributes of the order type.

You use Storable Class Editor to create fields and classes. See ["Creating Custom Fields and Storable Classes"](#).

2. If necessary, write a new Facility Module (FM) for any unique functionality required by your order management system.

See ["Writing a Custom Facilities Module"](#).

3. If necessary, modify the Order FM policy opcodes to customize the default order management functionality.

See ["Adding and Modifying Policy Facilities Modules"](#) for general information and ["Order FM Policy Opcodes"](#) in *BRM Developer's Reference* for specific information about the Order Manager policy opcodes.

4. Write a custom application that calls the Order Manager standard and policy opcodes as well as any custom opcodes you created.

See ["Adding New Client Applications"](#) for general information as well as information about writing applications in C.

5. Define the life cycles and order associations for your orders.

See ["About Defining the Order Life Cycle"](#) and ["Associating or Disassociating Orders with Master Orders"](#).

## About the Order Management Opcodes

Use the following opcodes to manage orders:

- To create an order, use `PCM_OP_ORDER_CREATE`. See ["Creating /order Objects"](#).
- To process an order request from a vendor or manufacturer, use `PCM_OP_ORDER_PROCESS`. See ["Processing Order Response Files"](#).
- To associate an order with a master order or a sub-order, use `PCM_OP_ORDER_ASSOCIATE`. See ["Associating and Disassociating /order Objects"](#).
- To update the state, brand, or attributes of an existing order, use `PCM_OP_ORDER_UPDATE`. See ["Updating /order Objects"](#).
- To delete an existing order, use `PCM_OP_ORDER_DELETE`. See ["Deleting /order Objects"](#).



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**Important:** These standard opcodes call Order FM policy opcodes prior to committing changes to the database. By default, the policies check whether the Portal object ID (POID) type is voucher and, if it is, call Voucher FM policy opcodes. However, you can customize the Order FM policy opcodes to perform additional validation. For information about Voucher Manager, see "About Managing Voucher Inventory" in *BRM Telco Integration*.

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## Creating /order Objects

Use PCM\_OP\_ORDER\_CREATE to create an **/order** object. See "[Creating Orders](#)".

This opcode can be called by a custom order creation application or by Customer Center.

This opcode takes a type-only POID as input, which specifies the order type and the target database. PCM\_OP\_ORDER\_CREATE performs these operations:

1. Calls the PCM\_OP\_ORDER\_POL\_CREATE policy opcode for validation. This opcode checks the POID type and calls other related Facilities Modules (FMs) and policy FMs to perform any validation checks those opcodes require. For example, if the POID type is voucher, the PCM\_OP\_ORDER\_POL\_CREATE policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_CREATE policy opcode to validate information in the input flist.
2. Sets the brand of the **/order** object based on the brand of the creator.
3. Creates an **/order** object of the type specified in the input flist. This object includes all mandatory attributes for the order type.
4. Calls PCM\_OP\_ORDER\_SET\_STATE to set the initial order state. See "[Setting the State in /order Objects](#)".
5. If events are being recorded, generates an **/event/order/create** object.
6. If necessary, calls PCM\_OP\_ORDER\_ASSOCIATE to associate the order with any master orders or sub-orders. See "[Associating and Disassociating /order Objects](#)".
7. Returns the POID of the **/order** object.

PCM\_OP\_ORDER\_CREATE stops processing under these circumstances:

- When the PCM\_OP\_ORDER\_POL\_CREATE policy opcode fails.
- When PCM\_OP\_ORDER\_SET\_STATE fails.

If PCM\_OP\_ORDER\_CREATE is not successful, it logs an error in the CM **pinlog** file, indicating the reason for the failure. The transaction is rolled back and no **/order** object is created.

### Customizing Order Creation

Use the PCM\_OP\_ORDER\_POL\_CREATE policy opcode to customize any validation or checks to be performed before the actual processing starts.

For example, if orders of a particular type require an order ID with certain characteristics, you can validate the ID supplied by the input flist. Similarly, you can use the opcode to ensure that all mandatory attributes of a particular order type are included in the new object.

## Processing Order Response Files

Use PCM\_OP\_ORDER\_PROCESS to process order response files from the vendor or manufacturer. This opcode creates the devices in the BRM database and then updates the order status. See ["Processing Order Response Files"](#).

PCM\_OP\_ORDER\_PROCESS performs these operations:

1. Retrieves data about the order from the `/order` object.
2. Calls the PCM\_OP\_ORDER\_POL\_PROCESS policy opcode for validation. This policy opcode calls other FMs and Policy FMs depending on the POID type passed in. For example, if the POID type is *voucher*, the PCM\_OP\_ORDER\_POL\_PROCESS policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_PROCESS policy opcode to validate information in the input flist.
3. Calls PCM\_OP\_DEVICE\_CREATE to create the specified devices in the BRM database. See ["Managing Devices with BRM"](#).
4. Calls PCM\_OP\_ORDER\_UPDATE to update the status of the `/order` object.
5. If events are being processed, generates an `/event/order/process` object.
6. Returns the POID of the `/order` object.

PCM\_OP\_ORDER\_PROCESS stops processing under these circumstances:

- When a `/config/order_state` object cannot be found for this order type.
- When the order state change is invalid based on the `/config/order_state` object for this order type.

### Customizing Order Processing

The PCM\_OP\_ORDER\_POL\_PROCESS policy opcode allows you to customize any validation or checks to be performed before the actual processing starts.

You can use this opcode to perform validation of `/order` objects when you process the order.

## Associating and Disassociating /order Objects

Use PCM\_OP\_ORDER\_ASSOCIATE to associate or disassociate a sub-order with a master order. For information, see ["Associating or Disassociating Orders with Master Orders"](#).

You can associate or disassociate orders during account creation or when required. When associating sub-orders with master orders, it contains the POID of the master order.

PCM\_OP\_ORDER\_ASSOCIATE performs these operations:

1. Determines whether to associate or disassociate by checking the PIN\_FLD\_FLAGS field:
  - When the flag is set to **1**, the opcode *associates* the specified objects.
  - When the flag is set to **0**, the opcode *disassociates* the specified objects.
2. For association only, validates the order-to-sub-order association. This validation includes ensuring that the orders have the same brand.
3. Calls the PCM\_OP\_ORDER\_POL\_ASSOCIATE policy opcode for validation. This policy opcode calls other FMs and policy FMs depending on the POID type passed in. For example, if the POID type is *voucher*, the PCM\_OP\_ORDER\_POL\_

ASSOCIATE policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_ASSOCIATE policy opcode to validate information in the input flist.

4. Associates or disassociates the objects.
5. If events are being recorded, generates an `/event/order/associate` or `/event/order/disassociate` object.
6. Returns the POID of the `/order` object.

PCM\_OP\_ORDER\_ASSOCIATE stops processing if an order listed in the input flist already exists in the `/order` object.

### Customize How to Validate Association and Disassociation

Use the PCM\_OP\_ORDER\_POL\_ASSOCIATE policy opcode to customize any validation, in addition to the standard validation, or any checks to be performed before the actual order association or disassociation starts.

For example, you could limit the number of associations for particular order types or trigger a state change after certain associations or disassociations.

## Updating /order Objects

Use PCM\_OP\_ORDER\_UPDATE to update the brand, state, or attributes of an existing `/order` object.

This opcode takes as input the POID of the `/order` object to change, the program that is calling the opcode, and the fields to change, along with their new values. If the opcode is changing the attributes of an `/order` subclass, it can include fields introduced in the subclass.

PCM\_OP\_ORDER\_UPDATE is a wrapper opcode that calls other opcodes to perform the actual modification to the order. The opcode determines whether to update the brand association, order state, or order attributes by checking the fields passed in on the input flist:

- When the PIN\_FLD\_ACCOUNT\_OBJ field is passed in, the opcode changes the *brand association* by calling PCM\_OP\_ORDER\_SET\_BRAND. See "[Changing /order Object Brand Associations](#)".
- When the PIN\_FLD\_STATUS field is passed in, PCM\_OP\_ORDER\_UPDATE changes the *order state* by calling PCM\_OP\_ORDER\_SET\_STATE. See "[Setting the State in /order Objects](#)".
- When the PIN\_FLD\_EXTENDED\_INFO array is passed in, the opcode changes the *order attributes* by calling PCM\_OP\_ORDER\_SET\_ATTR. See "[Changing /order Object Attributes](#)".

PCM\_OP\_ORDER\_UPDATE stops processing under these circumstances:

- When the PCM\_OP\_ORDER\_POL\_SET\_ATTR, PCM\_OP\_ORDER\_POL\_SET\_BRAND, or PCM\_OP\_ORDER\_POL\_SET\_STATE policy opcode fails.
- When an attribute to change doesn't exist in the `/order` object.

### Changing /order Object Brand Associations

Use PCM\_OP\_ORDER\_SET\_BRAND to change an order's brand association. This opcode is called by PCM\_OP\_ORDER\_UPDATE to update an existing order. See "[Order Management and Brands](#)".

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**Important:** A master order and its associated sub-orders must all use the same brand.

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All **/order** objects have Ancestral Lineage write permissions, so the caller of PCM\_OP\_ORDER\_SET\_BRAND must be in the ancestral lineage of both the old and new brands. If the old and new brands are too distantly related, the opcode caller must have **root** permissions.

PCM\_OP\_ORDER\_SET\_BRAND takes as input the POID of the **/order** object to change, the program that is calling the opcode, and the **/account** object of the new brand.

PCM\_OP\_ORDER\_SET\_BRAND performs these operations:

1. Calls the PCM\_OP\_ORDER\_POL\_SET\_BRAND policy opcode for validation. This policy opcode calls other FMs and policy FMs depending on the POID type passed in. For example, if the POID type is *voucher*, the PCM\_OP\_ORDER\_POL\_SET\_BRAND policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_SET\_BRAND policy opcode to validate information in the input flist.
2. Validates permissions to ensure that the caller has permissions for both the new and old brands.
3. Replaces the old brand account value with the new one.
4. If events are being recorded, generates an **/event/order/brand** object.
5. Returns the POID of the **/order** object.

PCM\_OP\_ORDER\_SET\_BRAND stops processing under these circumstances:

- When the caller does not have permissions for both the old and new brands.
- When the PCM\_OP\_ORDER\_POL\_SET\_BRAND policy opcode fails.

### Customizing Brand Association

The PCM\_OP\_ORDER\_POL\_SET\_BRAND policy opcode allows you to customize any validation or checks to be performed before the actual processing starts.

You can use this policy opcode to provide validation or customization of brand changes for a given order ID. For example, you could limit brand changes to certain order types or situations.

### Setting the State in /order Objects

Use PCM\_OP\_ORDER\_SET\_STATE to set or change the state of an **/order** object. During the processing of this opcode, there are two opportunities to call policy opcodes for validation:

- The first policy call takes place during the state change itself, just before the transaction is committed to the database.
- The second occurs just after the transaction that changes the order state.

You specify which policy opcodes to call for each state change in the same configuration file where you define the order life cycle. For each state change, you can specify an opcode for one, both, or neither of the two potential policy calls.

The PCM\_OP\_ORDER\_POL\_SET\_STATE policy opcode is supplied as the default policy opcode for order state changes. You can create any number of custom policy

opcodes to replace or supplement it. You enter the numbers of the policy opcodes in the configuration file.

For more information, see "[Managing the Order Life Cycle](#)".

PCM\_OP\_ORDER\_SET\_STATE takes as input the POID of the `/order` object, the calling program, the old state ID, and the new state ID. It then performs these operations:

1. Checks the validity of the state change based on the `/config/order_state` object for this order type and brand. If the state change is not allowed, this opcode stops processing.
2. Calls the policy opcode specified in `/config/order_state` for the in-transition event.
3. Changes the PIN\_FLD\_STATUS field in the `/order` object to the new state.
4. Calls the policy opcode specified in `/config/order_state` for the post-transition event.
5. If events are being recorded, generates an `/event/order/state` object.
6. Returns the POID of the `/order` object.

PCM\_OP\_ORDER\_SET\_STATE stops processing under these circumstances:

- When the order state change is not valid based on the `/config/order_state` object for this order type.
- When a `/config/order_state` object cannot be found for this order type.
- When the input flist attempts to change the order from a *Raw* state type to any state type other than *Init* or attempts to change the order from an *End* state type to any other state.

### Customizing How to Validate State Changes

The PCM\_OP\_ORDER\_POL\_SET\_STATE policy opcode allows you to customize any validation or checks to be performed before the actual processing starts.

You can customize this policy opcode to provide additional validation or functionality during order state changes.

### Changing /order Object Attributes

Use PCM\_OP\_ORDER\_SET\_ATTR to change the attributes for an existing `/order` object. This opcode is called by PCM\_OP\_ORDER\_UPDATE to update the object's attributes. See "[Managing Order Attributes](#)".

Different order types can have different attributes. The attributes common to all orders, such as the text description stored in the PIN\_FLD\_DESCR field, are contained in the main `/order` object. Attributes specific to particular order types are stored in their subclasses.

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**Note:** You cannot use PCM\_OP\_ORDER\_SET\_ATTR to change the brand association, order state, or order association. If the input flist includes these fields, they are ignored.

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PCM\_OP\_ORDER\_SET\_ATTR performs these operations:

1. Calls the PCM\_OP\_ORDER\_POL\_SET\_ATTR policy opcode for validation. This policy opcode calls other FMs and policy FMs based on the POID type passed in. For example, if the POID type is *voucher*, the PCM\_OP\_ORDER\_POL\_SET\_ATTR

policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_SET\_ATTR policy opcode to validate information in the input flist.

2. Updates the **/order** object to include the new attribute values.
3. If events are being recorded, generates an **/event/order/attribute** object.
4. Returns the POID of the **/order** object.

PCM\_OP\_ORDER\_SET\_ATTR stops processing under these circumstances:

- When the PCM\_OP\_ORDER\_POL\_SET\_ATTR policy opcode fails.
- When an attribute to change doesn't exist in the **/order** object.

### Customizing the opcode

The PCM\_OP\_ORDER\_POL\_SET\_ATTR policy opcode allows you to customize any validation or checks to be performed before the actual processing starts.

You can use this opcode to perform validations or to set the attributes for the order object. For example, you can write code to validate the order ID in the input flist to conform to the pattern for a particular order type.

## Deleting /order Objects

Use PCM\_OP\_ORDER\_DELETE to delete an **/order** object. See ["Deleting Orders"](#).

PCM\_OP\_ORDER\_DELETE performs these operations:

1. Calls the PCM\_OP\_ORDER\_POL\_DELETE policy opcode for validation. This policy opcode calls other FMs and policy FMs based on the POID type. For example, if the POID type is *voucher*, the PCM\_OP\_ORDER\_POL\_DELETE policy opcode calls the PCM\_OP\_VOUCHER\_POL\_ORDER\_DELETE policy opcode to validate information in the input flist.
2. If the specified object is a sub-order, calls PCM\_OP\_ORDER\_ASSOCIATE to disassociate the object from the master order.
3. Deletes the specified **/order** object from the BRM database.
4. If events are being recorded, generates an **/event/order/delete** object.
5. Returns the POID of the **/order** object.

PCM\_OP\_ORDER\_DELETE stops processing if the PCM\_OP\_ORDER\_POL\_DELETE policy opcode fails.

### Customizing How to Delete Orders

The PCM\_OP\_ORDER\_POL\_DELETE policy opcode allows you to customize any validation or checks to be performed before the actual processing starts.

You can use this policy opcode to customize the order-deletion process. For example, you can disable the service association check that is performed by default.

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## Monitoring Your System with System Manager

This chapter describes how to use Oracle Communications Billing and Revenue Management (BRM) Manager to monitor your BRM system.

For information about System Manager opcodes, see "System Manager FM Standard Opcodes" in *BRM Developer's Reference*.

### About System Manager

System Manager, in conjunction with Node Managers, manages and monitors BRM servers. The System Manager lets you:

- Start, stop, and monitor Connection Managers (CMs), Connection Manager Master Processes (CMMPs), and Data Managers (DMs).
- Detect failure if a server stops or fails.
- Centralize log management.

System Manager also provides a framework that you can use to create enhanced management and control functions.

You can use System Manager's command-line utilities and the **testnap** testing utility to send opcodes to System Manager. For information on using **testnap**, see "[Testing Your Applications and Custom Modules](#)" and "[testnap](#)".

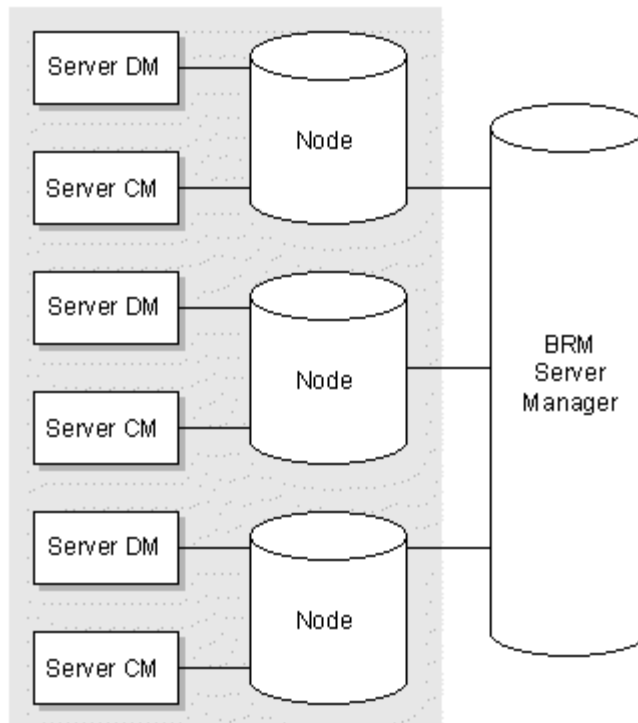
For an example of how to use System Manager with **testnap**, see "[Getting the Status of the Servers on All Nodes](#)".

### Terminology

To understand System Manager, you need to know these terms:

- **server**: An instance of a server process, such as a Connection Manager (CM) or a Data Manager (DM).
- **node**: A computer running one or more servers.

[Figure 23–1](#) shows the relationships among these components:

**Figure 23–1 System Manager Component Relationships**

## BRM Server States

You can obtain the status of servers by using System Manager or a Node Manager. Each BRM server always has one of these states:

- **Starting state**

The initial state of the server. A BRM Server can be started by a Node Manager or by another method.
- **Running state**

After the BRM servers start, each server gets the address of the Node Manager from the input parameters, connects to that address, and sends a message to the Node Manager that it has started. When the Node Manager gets a message from a BRM server, it changes the state of that server to the running state.
- **Stopping state**

When the Node Manager gets a message to stop a server, it updates the state of the server to stopping. There are two ways a server can be shutdown: immediately or after completing the current transactions.

  - **Soft Shutdown:** After receiving a Soft Shutdown message, servers complete current transactions and stop accepting new requests. After current transactions are finished, the servers terminate their own processes. This is the default mode.
  - **Immediate Shutdown:** After receiving an Immediate Shutdown message, servers abort all transactions and terminate their own processes. You can set a flag in the input list to activate the Immediate Shutdown mode. This can be useful if, for example, your system has stopped responding.
- **Down state**



If the Node Manager cannot start a server in the stopping state after several tries, Node Manager stops trying and changes the state of the server to the down state.

## Understanding the Node Manager

Each Node Manager controls and manages BRM server processes running on a computer node. Each computer node has one Node Manager which is responsible for managing BRM on that node. The Node Manager needs the following information about each BRM server:

- Server name
- Server executable
- Server working directory

When a Node Manager is started, it reads its configuration file. If the **start\_servers** switch there is set to **1**, Node Manager starts the servers. Once a server has been started with the Node Manager, the server notifies the Node Manager that it has started.

As long as the Node Manager configuration file includes the correct **server\_info** entries for the CM and DM, you can manage these servers, even if they are started by another method. See "[Editing the Node Manager Configuration File](#)" for information about these entries.

For example, you can use the command **pin\_ctl start all** to start the CM and DM processes before the Node Manager starts. Even though these processes weren't initially started by the Node Manager, you will still be able to use the System Manager to stop and start the CM and DM.

### Client Connection to Node Manager

Node Manager is a multithreaded program that uses the PCM protocol for communication. You should initially use **PCM\_CONNECT** or the **pin\_nmgr\_connect** routine to make the connection to the Node Manager. The Node Manager creates one thread for monitoring servers and creates one thread for each client connection.

### Node Manager Opcodes

Node Manager uses these opcodes:

- **PCM\_OP\_INFMGR\_GET\_INFO**: Gets information about servers that are configured on a node.
- **PCM\_OP\_INFMGR\_GET\_STATUS**: Gets status of servers on a node.
- **PCM\_OP\_INFMGR\_START\_SERVER**: Starts servers on a node.
- **PCM\_OP\_INFMGR\_STOP\_SERVER**: Stops servers running on a node.
- **PCM\_OP\_INFMGR\_MODIFY\_MONITOR\_INTERVAL**: Modifies the monitoring interval. The default monitoring interval is two minutes. After each interval, System Manager gets the latest status of BRM servers.

## Understanding System Manager

System Manager lets you check or manage BRM servers. When it starts, it reads all Node Manager addresses from its configuration file and connects to the Node Managers. After making the connection, System Manager gets configuration information from each node.

System Manager includes a log manager that monitors a well-known address and collects all log messages sent by Node Managers. Its monitoring component checks the status of servers at each monitoring interval. The default monitoring interval is two minutes, but you can change it while System Manager is running.

You can use this facility through the System Manager opcodes or the "[System Manager Command-Line Interface](#)".

### System Manager Command-Line Interface

Using the command-line interface, `infmgr_cli`, to issue commands to System Manager is simpler than using `testnap` or passing an opcode through `PCM_OP()`. (For an example of using `testnap` to issue commands to System Manager, see "[Getting the Status of the Servers on All Nodes](#)".)

To use the command-line interface for controlling System Manager:

1. Ensure that System Manager and any Node Managers are running.
2. If necessary, modify the configuration file of `infmgr_cli` to specify the host name and port number where System Manager is running.
3. Run `infmgr_cli`.
4. Enter any of the supported commands at the prompt.

[Table 23-1](#) lists the supported commands:

**Table 23-1 System Manager Command-Line Interface**

| Command                | Description   |
|------------------------|---|
| <code>gi</code>        | Gets information for a node or servers.                                 |
| <code>gs</code>        | Gets status for a node, or server.                                      |
| <code>sdt</code>       | Schedules downtime for a server.  |
| <code>cdt</code>       | Cancels scheduled downtime for a server.                                |
| <code>sfw</code>       | Tells a satellite CM to start or resume passing opcodes to the main CM. |
| <code>startserv</code> | Starts the server.  |
| <code>stopserv</code>  | Stops the server.   |
| <code>efw</code>       | Tells a satellite CM to stop passing opcodes to the main CM.            |
| <code>h</code>         | Displays help messages.   |
| <code>?</code>         | Displays help messages.   |
| <code>q</code>         | Quits the command-line interface.                                       |

The `h`, `?`, and `q` commands take no parameters. The syntax for the other commands is:

- `gi` (get information)  
`gi [-u] [-c|-n|-s name]`

where

- `-u` specifies to System Manager to get information from Node Managers and update the local cache. If `-u` is not specified, System Manager gets the information from the local cache.
- `-c name` specifies a cell (not yet supported).

- **-n** *name* specifies a node.
- **-s** *name* specifies a server.

The node or server name is the name specified in the Node Manager's configuration file. This command accepts only one node or server name.

This command calls the PCM\_OP\_INFMGR\_GET\_INFO opcode.

- **gs** (get status)

**gs** [-u] [-c|-n|-s *name*]

where

- **-u** specifies to System Manager to get information from Node Managers and update the local cache. If **-u** is not specified, System Manager gets the information from the local cache.
- **-c** *name* specifies a cell (not yet supported).
- **-n** *name* specifies a node.
- **-s** *name* specifies a server.

The node or server name is the name specified in the Node Manager's configuration file. This command accepts only one node or server name.

This command calls the PCM\_OP\_INFMGR\_GET\_STATUS opcode.

- **sdt** (schedule downtime)

**sdt** [*server\_name*] [*start\_time*] [*end\_time*]

where

- *server\_name* specifies the server.
- *start\_time* specifies when the downtime is to begin.
- *end\_time* specifies when the downtime is to finish.

Use this format for *start\_time* and *end\_time*:

*month/date/year hour:minute*

where

- *month* uses two digits to specify the month.
- *date* uses two digits to specify the date.
- *year* uses four digits to specify the year.
- *hour* uses two digits to specify the hour, based on the 24-hour clock.
- *minute* uses two digits to specify the minute.

This command calls the PCM\_OP\_INFMGR\_SCHEDULE\_DOWNTIME opcode.

- **cdt** (cancel scheduled downtime)

**cdt** [*server\_name*]

where *server\_name* specifies the server.

This command calls the PCM\_OP\_INFMGR\_CANCEL\_DOWNTIME opcode.

- **sfw** (start forwarding)

**sfw** [*cm\_ptr*]

where *cm\_ptr* specifies the satellite CM that is to start or resume forwarding opcodes to the main CM. The CM name must be as given in the System Manager's configuration file.

This command calls the PCM\_OP\_INFMGR\_SATELLITE\_CM\_START\_FORWARDING opcode.

- **efw** (end forwarding)

**efw** [*cm\_ptr*]

where *cm\_ptr* specifies the satellite CM that is to stop forwarding opcodes to the main CM. The CM name must be as given in the System Manager's configuration file.

This command calls the PCM\_OP\_INFMGR\_SATELLITE\_CM\_STOP\_FORWARDING opcode.

- **startserv**[*server name*]

where *server name* is the name given to a server in the configuration file of Node Manager.

- **stopserv**[*server name*]

where *server name* is the name given to a server in the configuration file of Node Manager.

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**Important:** A server can be stopped by System Manager only if it is started by Node Manager.

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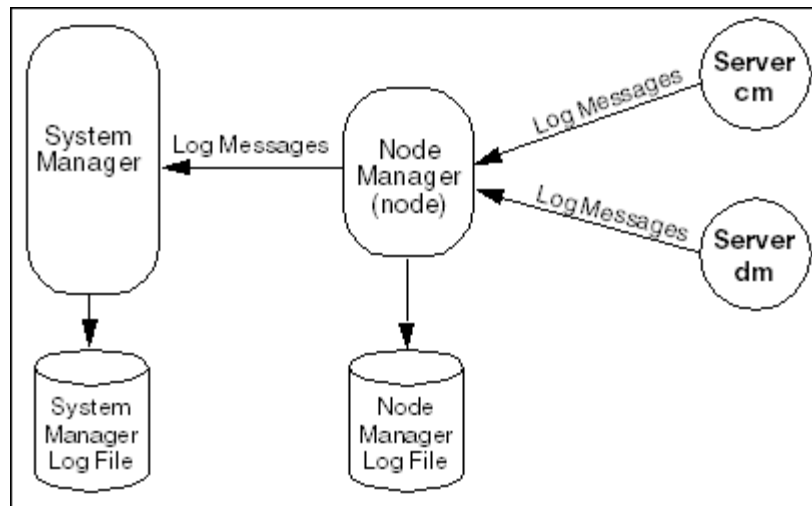
## Centralized Log Management

System Manager provides centralized log management when log manager options are enabled for System Manager and Node manager.

The **PINLOG** module writes messages (default error messages) for each individual server into the Node Manager log file. When a Node Manager starts a server, all error messages that are generated by the server are stored in the Node Manager log file.

You can configure the Node Manager to monitor its own log file or route log file messages to a destination that you specify using the *logmgr\_ptr* entry of the Node Manager configuration file. The destination you choose for the log file messages can be the System Manager log file or your own defined log collector. If the *logmgr\_ptr* entry is used in a Node Manager configuration file, the Node Manager sends messages from its log file to the host and port you specified in that entry. If *logmgr\_port* is used in the System Manager configuration file, System Manager starts a log collector thread and collects all log messages that are sent by Node Managers. [Figure 23–2](#) illustrates the log-management options:

Figure 23–2 Log Management Options



## Installing System Manager and Node Manager

Both System Manager and Node Manager are installed along with BRM. Startup information for the managers is included in the `init-d.pin.nmgr` and `init-d.pin.infmgr` files. This information is read during the installation of BRM.

You start and stop the manager using the `pin_ctl` command, as shown in [Table 23–2](#):

Table 23–2 `pin_ctl` Commands for System and Node Managers

| Manager        | Start                             | Stop                             | Start then Stop                    |
|----------------|-----------------------------------|----------------------------------|------------------------------------|
| System Manager | <code>pin_ctl start infmgr</code> | <code>pin_ctl stop infmgr</code> | <code>pin_ctl bounce infmgr</code> |
| Node Manager   | <code>pin_ctl start nmgr</code>   | <code>pin_ctl stop nmgr</code>   | <code>pin_ctl bounce nmgr</code>   |

## Configuring System Manager and Node Manager

To configure the System Manager and Node Manager, edit the configuration file in `BRM_Home/sys/infmgr` and `BRM_Home/sys/nmgr` directories, where `BRM_Home` is the directory in which you installed BRM components.

### Editing the Node Manager Configuration File

Node Manager monitors servers (CMs and DMs). Each server is specified in the configuration file of Node Manager by a `server_info` entry in this format:

```
server_info process_name program_path working_path host_name port
```

where

- `process_name` is the name of the server. This name has to be unique among all servers in the BRM network.
  - For a CM, `process_name` must contain substring `cm` and not substring `dm`.
  - For a DM, `process_name` must contain substring `dm` and not substring `cm`.
- `program_path` is the path to the executable program for the process.
- `working_path` is the path to the working directory for the process, where the configuration file for that process can be found.

- *host\_name* is the component host name.
- *port* is component port number.

For example:

```
server_info dm1 /BRM_Home/bin/dm /BRM_Home/sys/dm_oracle frisco 11961
server_info cm_master /BRM_Home/bin/cm /BRM_Home/sys/cm joe 21331
```

For information about other entries in the configuration file, refer to the comments preceding each entry in the file.

## Editing the System Manager Configuration File

System Manager monitors one or more Node Managers, which can be running on different computers. You specify each Node Manager by a **node\_ptr** entry in the configuration file of System Manager, in this format:

```
infmgr node_ptr node_name host_name port_number
```

where

*node\_name* is the name of the Node Manager. This name must be unique among all Node Managers running in the BRM network.

*host\_name* is the host name or IP address of the computer running this node.

*port\_number* is the port number of the computer running this node.

For information about other entries in the configuration file, refer to the comments preceding each entry in the file.

## Getting the Status of the Servers on All Nodes

You can use the **testnap** utility or the command-line interface to connect to System Manager and get information. To use the **testnap** utility, you first create a file to be used for the input flist. When **testnap** reads this file, it generates an flist and sends it to System Manager. In the example below, you create a file called **nodes** with two entries:

- The first entry is the POID.
- The second entry tells System Manager that you want to search all nodes.

To get the status of all the servers on all nodes, perform these steps:

1. Edit your **testnap** configuration file to connect to System Manager:

```
#
- nap cm_ptr 11980                                #"well known port" for System
Manager
- nap cm_name creator                              # where System Manager runs
- -   userid 0.0.0.1 /service/pcm_client 1 # userid
#
- nap login_type      1                            # type 1 is with password
- nap login_name      root.0.0.0.1
- nap login_pw        password
#
```

2. Create a file with these entries and save it:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /service 1 0
0 PIN_FLD_TYPE          ENUM [0] 2
```

**3. Read the file you created with `testnap`:**

```
r filename 1
```

Example:

```
r nodes 1
```

**4. Use opcode 802 to get the status of all servers:**

```
xop 802 - 1
```

The returned result is:

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /service 1 0
0 PIN_FLD_RESULT        ENUM [0] 0
0 PIN_FLD_NODES         ARRAY [0] allocated 4, used 4
1   PIN_FLD_NODE_NAME   STR [0] "pinpc43_node"
1   PIN_FLD_RESULTS     ARRAY [0] allocated 2, used 2
2     PIN_FLD_SERVER_NAME STR [0] "dm1"
2     PIN_FLD_STATUS     ENUM [0] 2
1   PIN_FLD_RESULTS     ARRAY [1] allocated 2, used 2
2     PIN_FLD_SERVER_NAME STR [0] "cm1"
2     PIN_FLD_STATUS     ENUM [0] 2
1   PIN_FLD_RESULT      ENUM [0] 0
0 PIN_FLD_NODES         ARRAY [2] allocated 4, used 4
1   PIN_FLD_NODE_NAME   STR [0] "creator_node"
1   PIN_FLD_RESULTS     ARRAY [0] allocated 2, used 2
2     PIN_FLD_SERVER_NAME STR [0] "dm2"
2     PIN_FLD_STATUS     ENUM [0] 2
1   PIN_FLD_RESULTS     ARRAY [1] allocated 2, used 2
2     PIN_FLD_SERVER_NAME STR [0] "cm2"
2     PIN_FLD_STATUS     ENUM [0] 2
1   PIN_FLD_RESULT      ENUM [0] 0
```

The results show that:

- BRM servers are configured under two nodes named **pinpc43\_node** and **creator\_node**.
- Two servers named **cm1** and **dm1** are configured under node **pinpc43\_node**.
- Two servers named **cm2** and **dm2** are configured under node **creator\_node**.
- All servers are in the running state.





# Part III

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## Creating and Customizing Client Applications

Part III describes how to create and customize Oracle Communications Billing and Revenue Management (BRM) client applications. It contains the following chapters:

- [Adding New Client Applications](#)
- [Creating Client Applications by Using Java PCM](#)
- [Creating Client Applications by Using Perl PCM](#)
- [Creating Client Applications by Using PCM C++](#)
- [Creating BRM Client Applications by Using the MTA Framework](#)
- [Adding or Changing Login Options](#)
- [Creating Custom Search Templates for Event Browser](#)



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## Adding New Client Applications

This section describes how to add new client applications and how those applications function within the Oracle Communications Billing and Revenue Management (BRM) system. It includes general information about writing client applications in all supported languages and specific information about writing applications in C. The section also contains links to sample applications and their corresponding makefiles.

To create a custom application that communicates with BRM, you need to understand the following BRM components:

- Storable classes and storable objects  
See "[Understanding Flists and Storable Classes](#)".
- Portal Object ID (POID) management routines  
See "[Portal Object ID \(POID\)](#)".
- Flists (field lists) and flist routines  
See "[About Flists](#)".
- PCM (Portal Communication Module) opcodes and the PIN (Portal Information Network) library routines  
See "[Understanding the PCM API and the PIN Library](#)".
- Error-handling routines  
See "[Understanding API Error Handling and Logging](#)".

### About Adding New Client Applications

Client applications can be virtually any type of program, including GUI-based tools, Web-based tools, network-enabled applications, batch jobs, cron jobs, and so on. You can write custom application programs to create, manipulate, delete, and display custom storable objects, which in turn implement a business policy.

The base BRM system comes with a set of client applications that manipulate storable objects within the database. You may, however, require custom applications. The most common custom application captures external events of some type. These events are then submitted to BRM, details of the event stored, and the event charges assessed if necessary.

For example, a Web hosting application needs to track the number of bytes downloaded and disk space used. This requires an application to analyze disk-space usage and send it to real-time rating at the end of each month. This also requires a new event type and new policy code that picks the rate category or quantity for the event.

Web servers do not provide an Application Programming Interface (API) to display the web usage automatically, so you might want to write an application that looks at the Web log files and generates events in BRM. Because of the potential number of records in the Web logs, you can aggregate the data externally, and then send the summary to BRM as events daily or monthly.

BRM includes a set of client libraries that make it easier to create custom applications. Existing BRM applications use these client libraries. These libraries are supported on Solaris, AIX, and Linux. For more information about the libraries, see "[About the BRM Client Access Libraries](#)".

## Ways to Add Custom Applications

You can use the following options when you add custom applications to BRM:

- [Using Existing System Opcodes](#)
- [Using Custom Opcodes](#)
- [Using a Custom Data Manager \(DM\)](#)

### Using Existing System Opcodes

You use the base opcodes to create, read, write, delete, and search storable objects. The base opcodes also provide programmatic access to transaction commands. More complex opcodes are implemented by the Facilities Modules (FMs). You use the policy opcodes to implement business decisions. These higher-level opcodes are translated by the FMs to base opcodes and sent to Data Managers (DMs) for processing.

For more information on the different categories of opcodes and how they are used, see "[Understanding the PCM API and the PIN Library](#)".

In a client application, you use opcodes to record events such as purchasing a product, changing a credit limit, creating an account or service, changing customer information, charging for use of a resource, verifying a password, and looking up names and addresses.

In your application, you can call any of the BRM opcodes without changing the BRM system. You need to determine when to use a particular system opcode, what constitutes an event, and then call the appropriate opcode in your application.

Your application must include the header files corresponding to the opcodes you use. All FM opcodes include the header file for base opcodes, so you do not need to include it unless your application uses only base opcodes.

For a list of opcodes and their corresponding header files, see "[Header Files](#)".

### Using Custom Opcodes

If the system opcodes do not provide the required functionality, you can create custom opcodes. However, you must implement your new opcodes in a custom FM and configure the custom FM with each Connection Manager (CM).

For the application to communicate with the custom FM, the application and the FM have to agree on the opcodes to pass and the contents of their input and output flists, error buffers, and flags. The custom FM translates the new opcodes into base opcodes. Then, it can send the opcodes directly to a DM, or it can call other opcodes implemented by the standard FMs.

For information on how to create a custom FM and link it to a CM, see ["Writing a Custom Facilities Module"](#).

You call the custom opcodes in the same way with the same API by using PCM\_OP() as the system opcode. Therefore, you must supply all the parameters, just as in the case of a system opcode.

Create a header file in which you define your custom opcodes. Include the header file in both the application and the custom FM source files. Compile the application and the custom FM with the new header file.

For examples of including opcodes in the header file, see the header files (.h) in the *BRM\_Home/include* directory, where *BRM\_Home* is the directory in which you installed BRM components.

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**Tip:** Defining your custom opcodes in a separate .h file helps you avoid updating FM header files when you upgrade to a new release of BRM.

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## Using a Custom Data Manager (DM)

Your application can communicate with a custom DM if the custom DM and the application agree on the semantics of the input and return flists.

You attach fields to the input flist that have meaning to the custom DM. These new fields act as opcodes to the custom DM. The return flist is the mirror image of the input flist in the sense that the application and custom storage manager agree on the meaning of the field-value pairs returned by the storage manager. The storage manager is responsible for setting error buffer values.

For information on creating and implementing a custom DM, see ["Writing a Custom Data Manager"](#).

You create new fields with the PIN\_MAKE\_FLD macro. For information on the PIN\_MAKE\_FLD macro, see **pcm.h** in the *BRM\_Home/include* directory for field value ranges and examples of PIN\_MAKE\_FLD.

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**Tip:** To avoid updating the Portal .h files every time you upgrade BRM, define your custom fields in a separate header file and include that file in your application.

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## Using Transactions

Transactions enable an application to perform operations on multiple objects as if they were executed simultaneously. This guarantees the integrity of the data when related changes need to be made to a set of storable objects.

In your application, you can call PCM\_OP\_TRANS\_OPEN before calling an opcode and PCM\_OP\_TRANS\_ABORT or PCM\_OP\_TRANS\_COMMIT after the opcode calls.

By default, all opcodes except the password opcodes are surrounded by transactions if transactions are not open when they are called.

Only one transaction at a time can be opened on a PCM context. A transaction is opened on a specific database schema specified by the POID database number in the input flist. All operations performed in an open transaction must manipulate data within the same database.

Any changes made within an open transaction can be aborted at any time and all changes are completely erased. These actions abort an open transaction:

- You use the PCM\_OP\_TRANS\_ABORT opcode.
- The application exits or closes the PCM context.
- A system error occurs and connectivity is lost between the application and the database.

The system tracks the transaction along with the context argument used by most of the PCM Library macros. If the context pointer passed has an outstanding transaction, it is used automatically.

Keeping a transaction open for a long time can affect performance because the system maintains a frozen view of the data while changes are made by other applications. It is recommended that you do not leave transactions open while long-latency tasks, such as prompting a user for input, are performed.

In general, any PCM opcode can be executed within an open transaction, and its effect follows the transactional rules. However, some Facilities Module opcodes that interface to legacy systems or external systems do not follow the transactional rules (that is, they can't be undone). Opcodes with this limitation must check for an open transaction and return an error if an application attempts to run the opcode within the open transaction.

## Types of Transactions

When you use the PCM\_OP\_TRANS\_OPEN opcode to open a transaction, you can use the following flags to open different types of transactions:

- PCM\_TRANS\_OPEN\_READONLY. See ["Read-Only Transactions"](#).
- PCM\_TRANS\_OPEN\_READWRITE. See ["Read-Write Transactions"](#).
- PCM\_TRANS\_OPEN\_LOCK\_OBJ. See ["Transaction with a Locked Storable Objects"](#).
- PCM\_TRANS\_OPEN\_LOCK\_DEFAULT. See ["Transaction with a Locked Default Balance Group"](#).

---

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**Note:** For J2EE-compliant applications, use JCA Resource Adapter to open extended architecture (XA) transactions through the XAResource interface. For more information, see "About JCA Resource Adapter Transaction Management" in *BRM JCA Resource Adapter*.

---

---

### Read-Only Transactions

Use the PCM\_TRANS\_OPEN\_READONLY flag to open a read-only transaction.

Use this type if operations will not change any data in the transaction.

From the application's point of view, a read-only transaction freezes the data in the database. The application does not see any changes to data made by other applications while the transaction is open. This allows data to be examined in a series of operations without being changed in mid-process.

Read-only transactions are more efficient and should be used when possible. Any number of read-only transactions can be open against a database at once.

## Read-Write Transactions

Use the PCM\_TRANS\_OPEN\_READWRITE flag to open a read-write transaction.

A read-write transaction freezes the data in the database from the application's point of view, and allows changes to be made to the data set. These changes are not seen by any other application until the transaction is committed. This allows the effects of a series of operations performed on storable objects to occur simultaneously when the transaction is committed.

Any number of read-write transactions can be open against a database at once.

## Transaction with a Locked Storable Objects

Use the PCM\_TRANS\_OPEN\_LOCK\_OBJ flag to open a transaction and lock a storable object as part of the transaction.

A lock-object transaction is useful when two applications must synchronize the operations they perform on the same storable object. Lock-object transactions are the same as read-write transactions, with the addition of the storable object lock. If you use a lock-object transaction, you must specify the PCM\_TRANS\_OPEN\_READWRITE flag.

If an application tries to open a lock-object transaction on a storable object that is already locked by another application, it will be held off until the application that currently holds the object finishes its transaction and unlocks the storable object.

## Transaction with a Locked Default Balance Group

Use the PCM\_TRANS\_OPEN\_LOCK\_DEFAULT flag to open a transaction and lock the default balance group object only as part of the transaction.

Most opcode transactions lock the account object, if used, at the beginning of a transaction. This provides reliable data consistency but in systems that use account hierarchies, it can also cause a lot of serialization which decreases the throughput of the system. You can use the PCM\_TRANS\_OPEN\_LOCK\_DEFAULT flag to open a transaction that locks only the default balance group for the account instead of the sum of all the account objects in the hierarchy. See "[Locking Specific Objects](#)".

If you use a lock default balance group transaction, you must specify the PCM\_TRANS\_OPEN\_READWRITE flag and not specify the PCM\_TRANS\_OPEN\_LOCK\_OBJ flag.

If an application tries to open a transaction on a balance group that is already locked by another application, it will be held off until the application that currently holds the object finishes its transaction and unlocks the storable object.

## About Committing Transactions

Changes made within an open transaction are not permanent or visible to other applications until the transaction has been successfully committed.

Committing a transaction has these effects:

- The transaction is closed and all data changes made within the open transaction take effect in the data set. The changes become visible to all other applications (subject to their open transactions).
- The application's view of the data set is no longer frozen in time, so changes made by other applications are now visible to the application.
- If a storable object was locked, it is unlocked.

- The application is free to open another transaction. Subsequent operations on the PCM context are unrelated to the closed transaction.

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**Note:** For J2EE-compliant applications, use JCA Resource Adapter to commit XA transactions through the XAResource interface. The adapter supports both single-phase and two-phase commits. For more information, see "About JCA Resource Adapter Transaction Management" in *BRM JCA Resource Adapter*.

---

---

## About Cancelling Transactions

Cancelling a transaction has the following effects:

- All data changes made within the open transaction are discarded, so no data is changed by operations related to the transaction.
- If a storable object was locked, it is unlocked.
- The transaction is closed, and subsequent operations on the PCM context are unrelated to the closed transaction. The application is free to open another transaction.
- The application's view of the data set is no longer frozen in time, so changes made by other applications are visible to the application.

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**Note:** For J2EE-compliant applications, use JCA Resource Adapter to roll back XA transactions through the XAResource interface. For more information, see "About JCA Resource Adapter Transaction Management" in *BRM JCA Resource Adapter*.

---

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## About the Transaction Base Opcodes

Use the following opcodes to manage transactions:

- To open transactions, use PCM\_OP\_TRANS\_OPEN.
- To commit transaction, use PCM\_OP\_TRANS\_COMMIT.
- To cancel transactions, use PCM\_OP\_TRANS\_ABORT.

### Customizing How to Open Transactions

To customize how to open transactions, use PCM\_OP\_TRANS\_POL\_OPEN.

This opcode gets the same flist that PCM\_OP\_TRANS\_OPEN does. The return flist then becomes the transaction ID flist; it can contain whatever fields that you want to put on it. This flist then is also the input to PCM\_OP\_TRANS\_POL\_COMMIT and PCM\_OP\_TRANS\_POL\_ABORT. The return flists from those opcodes are ignored.

### Customizing the Verification Process for Committing a Transaction Opcode

To customize how to verify the readiness of an external system to commit a transaction opcode, use PCM\_OP\_TRANS\_POL\_PREP\_COMMIT.

This opcode provides BRM with preparatory notice of a pending commit process for transaction policies working with an external system. This is its overall process:

1. Open a transaction in each system.



2. Do the work authorized by the transaction.
3. Verify that the external system will be able to commit the transaction.
4. Commit the transaction in BRM.
5. Commit the transaction in the external system.

PCM\_OP\_TRANS\_POL\_PREP\_COMMIT verifies that the external system will be able to commit the transaction. If the transaction is successfully committed, the CM calls PCM\_OP\_TRANS\_COMMIT, and upon a successful commit transaction of that opcode it calls PCM\_OP\_TRANS\_POL\_COMMIT.

If PCM\_OP\_TRANS\_POL\_PREP\_COMMIT fails, the CM automatically aborts the transaction using PCM\_OP\_TRANS\_ABORT and PCM\_OP\_TRANS\_POL\_ABORT.

### Customizing How to Commit a Transaction

To customize how to commit a transaction, use PCM\_OP\_TRANS\_POL\_COMMIT.

The return flist from PCM\_OP\_TRANS\_POL\_OPEN becomes the transaction ID flist; it can contain whatever fields that you want to put on it. This flist then is also the input to PCM\_OP\_TRANS\_POL\_COMMIT. The return flist from this opcode is ignored.

### Customizing How to Cancel Transactions

To customize how to cancel transactions, use PCM\_OP\_TRANS\_POL\_ABORT.

The return flist from PCM\_OP\_TRANS\_POL\_OPEN becomes the transaction ID flist; it can contain whatever fields that you want to put on it. This flist then is also the input to PCM\_OP\_TRANS\_POL\_ABORT. The return flist from this opcode is ignored.

## Implementing Timeout for Requests in Your Application

You can specify a timeout value for each connection to the CM. This allows you to set different timeout values for different operations. For example, you can set different timeout values for authorization and stop-accounting requests, or you can dynamically increase or decrease the timeout value for different operations based on the system load.

To specify a timeout value in milliseconds for a connection, pass the PIN\_FLD\_TIMEOUT\_IN\_MS field in the input flist to the PCM\_CONTEXT\_OPEN function. The PIN\_FLD\_TIMEOUT\_IN\_MS value is applicable after the client connects to the server. Before the connection happens this setting is not effective. It does not report a time out if the client cannot connect to the server at all.

The timeout value you specify applies to all the opcodes called during that open session and overrides the value in the client configuration file. You must ensure that your client application handles the timeout, closes its connection to the CM by calling PCM\_CONTEXT\_CLOSE, and cleans up the transaction context.

---



---

**Note:** When the timeout happens, the CM does not provide any feedback about the success or failure of the request it received. When the CM detects the closed connection, it rolls back the ongoing transaction and shuts down.

---



---

## Configuring Your Custom Application

You must set up the following applications to access the same database schema:

- The client application
- At least one CM
- At least one DM

The client application makes the connection by using the BRM database number in all three configuration files: the application's, the CM's, and the DM's. The database number is arbitrary, but it is determined before the system is installed. After the system is installed, you cannot change this number because it is encoded in every storable object in the database schema.

The client application must use POIDs with the correct database number. The system routes storable object requests on the basis of POIDs, which include the database number.

In your custom application, use the database number returned by `PCM_CONNECT()`. If you are using `PCM_CONTEXT_OPEN()`, call `PCM_GET_USERID()` and then `PIN_POID_GET_DB()` on the POID.

---

---

**Caution:** Do not get the database number or the userid POID from the configuration file by calling `pin_conf()` in your application.

---

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## Creating a Client Application in C

You write client applications by using the PCM opcodes, which send and receive flists to the BRM database. Each opcode has a corresponding input and return flist.

Flists are used to hold return values for two important reasons:

- The macro call itself does not return a value.
- An flist can contain an arbitrary number of fields and values that is frequently not known in advance.

Your custom applications must include the header files that correspond to the FM opcodes you use. Which file to include depends on which opcodes you use. The header file for base opcodes needs to be included if you are using only base opcodes, which is unlikely. For information on header files and a list of opcodes and their corresponding header files, see "[Header Files](#)".

You use the `PCM_OP()` macro to pass PCM opcodes and flists to BRM. The system returns an flist. You create input flists for the call to `PCM_OP()` and routine returns the results in an flist. You use the return flists and then destroy them.

The following pseudo-code shows the format of most client programs:

```
#include "pcm.h"
/* header file corresponding to the FM opcode you're using */
#include "ops/file.h"
#include "pin_errs.h"
main()
.
.
.
    /* open a database context */
    PCM_CONTEXT_OPEN()

    /* clear error buffer */
    PIN_ERRBUF_CLEAR(&ebuf);
```

```

        /* send opcode to system, based on user activity or application
        function. */

PCM_OP(input_flist, opcode, return_flist, &ebuf)

        /* check for errors */
        if (PIN_ERRBUF_IS_ERR(&ebuf)) {
            /* handle error */
        } else {
            /* ok - no errors */
        }
        .
        .
        .

        /* close database context */
        PCM_CONTEXT_CLOSE()
        .
        .
        .
        exit(0);

```

## Compiling and Linking Your Programs

You do not have to follow any special precompilation or other steps to compile and link applications. Both static and dynamic versions of BRM libraries are provided.

UNIX client libraries are multi-thread safe.

To compile and link your application:

1. Compile using the **include** files in the *BRM\_SDK\_Home/include* directory.
2. Link to the libraries in *BRM\_SDK\_Home/lib*.

See the sample applications and their make files for more information.

[Table 24–1](#) lists the supported compilers:

**Table 24–1 Supported Compilers**

| Operating System | Compiler  |
|------------------|---|
| Solaris          | Standard SUNPro C compiler, default mode (-Xa).<br>BRM is compiled with -xcg92.<br><b>Note:</b> gcc is not supported. Use the <b>-munaligned-doubles</b> option to ensure proper linking. |
| Linux            | gcc compiler  |
| AIX              | xlc 8   |

## Guidelines for Developing Applications in C on UNIX Platforms

Follow these guidelines to develop custom applications in C on Solaris, Linux, and AIX:

- Include the appropriate library file at link time:
  - **libportal.so** for Solaris and Linux
  - **libportal.a** for AIX
- Add *BRM\_SDK\_Home/include* to the list of **include** file directories to search.

- In the preprocessor directives, be sure to include the following symbol:

```
PIN_USE_ANSI_HDRS.
```

## Using the Sample Applications

BRM SDK includes sample applications and code as well as source code for policy FMs that you can refer to for coding examples.

### Sample Applications

BRM SDK includes sample applications and code in C, C++, Java, and Perl. For a complete list of the sample applications, see "Sample Applications" in *BRM Developer's Reference*.

Before you write your program, try compiling and linking copies of these programs to familiarize yourself with the system. These programs are located in *BRM\_SDK\_Home/source/samples*. This directory also includes a sample application configuration file.

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**Caution:** Do not run the sample programs on a production system. Some programs fill the database with test storable objects. Remove the test storable objects before building your production system.

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### Policy FM Source Files

BRM SDK includes the source code for all the policy opcodes. You can refer to them for BRM coding examples. You can find the Customer Policy FM opcode source files in *BRM\_SDK\_Home/source/sys*. Each policy FM has its own directory containing the source files for the included opcodes as well as a make file and other support files.

For more information, see the transaction handling information on each opcode reference page, "[About Transaction Usage](#)", and "[Context Management Opcodes](#)".

## Adding Branding to Your Application

Brand Manager allows a single hosting BRM site to support multiple virtual BRM sites. Each virtual Internet service provider (ISP) is known as a brand and requires a secured view of its own data. At the same time, the hosting site maintains administrative oversight of the entire system, which may include many independent BRM sites.

### The Brand as an Independent Virtual Workspace

Two kinds of accounts exist in a branded service management setting: standard accounts and brand accounts. The brand account is a special entity that serves as a complete miniature BRM system. Each brand accesses the database according to its own rules. To effectively implement brands, "data scoping" is required.

### Data Scoping

Data scoping is the ability to restrict database access so that only authorized users can access data and services. The concept of an account is essential to effective data scoping. Most objects are account-centric. For example, services and profiles are designed to be associated with an account. Events and pricing objects also "belong" to

an account. Therefore, to implement data scoping in a branded environment, all objects must be associated with an account.

## Pointing a Base Level Object to a Brand Account

To enforce scoping restrictions, the system associates all objects with an account. This association is done via the `PIN_FLD_ACCOUNT_OBJ` reference in the every base level object.

```
! Account object to which data belongs
field PIN_FLD_ACCOUNT_OBJ (
type = PIN_FLDT_POID,
perms = MW,
```

## Defining a Brand Account

There are two account types: standard and brand. The following tag specifies the account type:

```
! Brand object or normal object
field PIN_FLD_ACCOUNT_TYPE (
type = PIN_FLDT_ENUM
```

This flag is set when the account is created and cannot be modified later. The flag can have one of these values:

- For brand accounts, `PIN_ACCOUNT_TYPE_BRAND`
- For standard accounts, `PIN_ACCOUNT_TYPE_STANDARD`

## Providing Access to Brands

In a branded environment, it's often necessary for an object to have distinct read and write access rules. For example, all members of a brand account may have read access to a pricing object while write access may be more restricted. To meet this requirement, the following fields have been added to each account object that define read and write access rules for the object. These fields are controlled by the system and filled in by the Data Manager with values specified in the data dictionary.

- `PIN_FLD_READ_ACCESS`: Specifies who has permission to read data
- `PIN_FLD_WRITE_ACCESS`: Specifies who has permission to modify data

## Branding Access Permissions

[Table 24–2](#) defines the permissions that can be assigned for read and write access:

**Table 24–2 Branding Access Permissions**

| Permission | Description  |
|------------|--|
| Global     | Any user can read or write the object. Many <code>/config</code> objects are globally readable.  |
| Brand      | Any user with brand access can read or write the object. For example, pricing objects, such as products and deals, are brand-readable.                   |
| Self       | Only the brand owner can read or write the data. Pricing objects are self-writable and brand-specific to prevent unauthorized changes to the price list. |

**Table 24–2 (Cont.) Branding Access Permissions**

| Permission        | Description  |
|-------------------|--|
| Ancestral Lineage | The brand owner or any superior billing group leader can read or write the data. For example, <code>/device</code> objects have Ancestral Lineage write permissions.   |
| Brand Lineage     | The owner, or any superior billing group leader within the brand, can read or write the data. Used with many objects, including services, profiles, and events to ensure brand segregation and data privacy. |

## Providing Access to Pricing Information

All pricing related objects available for system use are associated at the brand level. Therefore, Pricing FM opcodes only look for pricing objects associated with the brand.

### Read Access to Pricing Data

Each brand in a BRM system maintains its own pricing data. Because everyone who accesses the brand should be able to read pricing information, objects related to pricing have read access set to the Brand Group Scope level. Thus objects of the following types are all of the type `PIN_FLD_READ_ACCESS = B (brand)`: `/product`, `/rate`, `/fold`, `/plan_list`.

### Write Access to Pricing Data

Since the ability to modify pricing information is generally much more restricted, write access to pricing objects are set locally. This ensures that only the owner of the pricing object can modify pricing data.

## Billing Groups

Billing groups act as containers for grouping accounts. A billing group leader has access to all account data owned by the billing group, as well as information owned by any of the billing group members. Thus a group leader can look down an entire tree of billing groups and its associated accounts within the brand. In this way, billing groups are used as the primary mechanism for categorizing scoping classes.

### Providing Billing Group Access with an Access Control List (ACL)

A new group object, `/group/acl`, has been created to define access for the billing group. The group `acl` includes a list of group members along with a pointer to the brand account or accounts to which group members have access.

### Managing Custom Applications

A host ISP may manage many brand accounts. Each brand may in turn have access to a variety of multi-brand applications. BRM's client interface simplifies an administrator's task. Once a user enters an authorized login and password, BRM displays a list of available brands. A user can then set the current connection scope by selecting a brand to customize.

## Creating Brands Programmatically

Use the `PCM_OP_CUST_COMMIT_CUSTOMER` opcode to create a new brand account. This opcode creates and initializes `/account` and `/service` storable objects. Once the account has been created, the account type flag must be set:

```
! Brand object or normal object
field PIN_FLD_ACCOUNT_TYPE (
type = PIN_FLDT_ENUM
```

This flag is set when the account is created, and cannot be modified later. The flag can have one of two values:

- For brand accounts: PIN\_ACCOUNT\_TYPE\_BRAND
- For standard accounts: PIN\_ACCOUNT\_TYPE\_STANDARD

Set the flag to PIN\_ACCOUNT\_TYPE\_BRAND to specify this account as a brand.

## Writing Brand-Aware Applications

Applications can be customized to meet the requirements of a brand. To do this, the administrator must first retrieve a list of available brands and then set the connection scope to the specific brand to be customized.

### Displaying a List of User Authorized Brands

Use the PCM\_OP\_PERM\_GET\_CREDENTIALS opcode to display a list of the brands which have access to an application. Usually this opcode is called at startup time. After the user enters an authorized login and password, the system displays a list of brands which have access to the application along with the currently active brand and billing group.

### Setting the Current Connection Scope

Because each brand represents an independent virtual workspace with its own data and access rules, a user must select a single brand (or billing subgroup) with which to work. Use the PCM\_OP\_PERM\_SET\_CREDENTIALS opcode to set the current connection scope.

## About Adding Multischema Support to Your Applications

BRM supports the ability to add multiple database schemas for the purpose of scaling your BRM system. This chapter explains the programming considerations of creating an application to work with a BRM system using multiple schemas.

For instructions on installing a multischema system, see "Installing a Multischema System" in *BRM Installation Guide*.

For instructions on maintaining a multischema system, see "Managing a Multischema System" in *BRM System Administrator's Guide*.

This section contains information you need to know before you design a new application or enhance an existing program to take advantage of the BRM multischema feature.

## About Working with Multiple Schemas

Generally, making applications work with multiple database schemas is not all that different from making them work with a single schema.

Accounts are distributed across schemas, but applications log in to the correct schema for an account based on the login name and service type. When an application logs in to BRM, it gets the schema context for the account it logged in as. An event for the login session for that application is created in the schema that hosts the account.

After the application has logged in, it has access to the entire BRM database for reads and writes on all classes that are modifiable. In most cases, after an account context is established, all subsequent operations for the account are performed in the single schema where the context was opened.

## Creating Accounts

The `PCM_OP_CUST_COMMIT_CUSTOMER` opcode has been enhanced to work with multiple database schemas. Use that opcode to create accounts just as you would for a single-schema system. The opcode uses the `/config/distribution` object created by using the `load_config_dist` utility to determine which schema your account is created in.

You can specify which schema new accounts should be created in by editing the `config_dist.conf` configuration file. For more information, see "Setting Database Priorities" in *BRM System Administrator's Guide*.

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**Important:** Billing groups, including all accounts with the same brand, must reside in the same schema.

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## Maintaining Transactional Integrity

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**Important:** Remember, after you find an account to modify data in, confine all operations possible to that schema.

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---

Although an application can connect to multiple database schemas and manipulate data in any schema, a transaction can only manipulate data in a single schema. To perform a transaction on more than one schema, you must close the existing transaction, open a context to the other schema, and open another transaction. An application that needs to perform the same operation on all accounts (such as billing or invoicing) should be run as a separate instance in each schema.

You must use the database number returned by `PCM_CONNECT` or `PCM_CONTEXT_OPEN` for all transactions within the context you open. These opcodes pass in an account's user name and return the database number for that account. To prevent losing transactional integrity, avoid opening contexts to multiple schemas whenever possible.

The exception to this rule is the rare occasion when you need to access information in any of the pricing storable classes. Embedded in these classes is the account information (including database number) of the person who changed that information. All account references are exact references. Dealing with this information can require you to switch contexts to another schema with a new call to `PCM_CONNECT` or `PCM_CONTEXT_OPEN`.

## Searching for Accounts across Database Schemas

This section describes how to search for accounts across database schemas.

### Searching for a Single Account

You can use the following opcodes to find a single account:



- Use the PCM\_OP\_ACT\_FIND opcode to find an account based on the login and service type. This opcode finds and returns the account POID (including the correct database number) of a single account.
- Use the PCM\_OP\_GLOBAL\_SEARCH opcode to find an account based on other account attributes. This opcode returns any fields that you specify on the input flist.

### Searching for Multiple Accounts (Global Search)

Use the PCM\_OP\_GLOBAL\_SEARCH opcodes to find and return the Portal object IDs (POIDs) of multiple accounts across multiple database schemas at the same time. The global search opcodes can also be used to search for a set of objects that reside in multiple database schemas (for example, all events from a particular day). See ["Searching for Objects in the BRM Database"](#) for a complete discussion of searching for accounts across multiple database schemas.

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**Important:** Remember to use nonglobal searches for better performance whenever possible. After you get the results of a global search, you can improve your application's overall performance by dividing the database read and write operations among database schemas.

---

## Finding How Many Database Schemas You Have with testnap

Use the **testnap** utility to find the number of database schemas connected to your BRM system. The following example shows **testnap** being started and then displays the contents of an flist named **1**. This flist is designed to match all **root** accounts. In the next step, this flist is passed to PCM\_OP\_GLOBAL\_SEARCH (opcode number **25**), which searches all database schemas. In the final step, **testnap** searches all database schemas for their **root** accounts. Each database schema has only one **root** account (in the **/service** class), so the result of this search is a listing of all the database schemas currently connected to your BRM system. In this example, there are two: 0.0.0.1 and 0.0.0.2.

```
testnap
input flist:

d 1
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_FLAGS        INT [0] 0
0 PIN_FLD_TEMPLATE     STR [0] "select X from /service
where F1 like V1 and F2 = V2 "
0 PIN_FLD_ARGS         ARRAY [1]
1   PIN_FLD_LOGIN      STR [0] "root.0.0.0%"
0 PIN_FLD_ARGS         ARRAY [2]
1   PIN_FLD_POID      POID [0] 0.0.0.0 /service/pcm_client -1 0
0 PIN_FLD_RESULTS     ARRAY [0]
1   PIN_FLD_POID      POID [0] NULL
1 PIN_FLD_LOGIN       STR [0] ""

result:

XOP PCM_OP_GLOBAL_SEARCH 0 1
XOP: opcode 25, flags 0
# number of field entries allocated 3, used 3
0 PIN_FLD_POID          POID [0] 0.0.0.1 /search -1 0
0 PIN_FLD_RESULTS     ARRAY [0] allocated 2, used 2
```

```

1 PIN_FLD_POID POID [0] 0.0.0.2 /service/pcm_client 1 1
1 PIN_FLD_LOGIN STR [0] "root.0.0.0.2"
0 PIN_FLD_RESULTS ARRAY [1] allocated 2, used 2
1 PIN_FLD_POID POID [0] 0.0.0.1 /service/pcm_client 1 1
1 PIN_FLD_LOGIN STR [0] "root.0.0.0.1"

```

## Bill Numbering

Applications must now avoid hard-coding bill numbers. Bill numbers are now coded to the database schema they were created in, and BRM relies on the new numbering scheme. The `/data/sequence` class still tracks bill numbers to ensure that they are unique. This class has been enhanced to make sure that bill numbers are unique across database schemas.

## About Adding Virtual Column Support to Your Applications

This section explains the programming considerations of creating an application to work with BRM virtual columns and applies to custom applications that interact with the BRM database directly. For information about using virtual columns in the BRM database, see the discussion on generating virtual columns in *BRM System Administrator's Guide*.

---

---

### Caution:

- Always use the BRM API to manipulate data. Changing data in the database without using the API can corrupt the data.
  - Do not use SQL commands to change data in the database. Always use the API.
- 
- 

Custom applications can perform read operations on virtual columns but cannot perform update or insert operations. The values of virtual columns are computed dynamically, and attempts to modify them directly result in an error.

BRM creates virtual columns for the POID `field_name_type` columns on event tables in the BRM database. If your custom applications must update or insert data in these physical columns after they have been converted to virtual columns, you must make your applications interact with the virtual columns' respective supporting column.

Each BRM virtual column is associated with a supporting column that stores the storable class ID. The supporting columns can be modified and use the suffix `field_name_type_id` (the virtual columns use the suffix `field_name_type`).

The following examples demonstrate how custom applications can perform update and insert operations on the supporting columns of physical columns that have become virtual-column enabled.

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**Note:** The `get_object_id` function shown in the examples is available in the `PIN_VIRTUAL_COLUMNS` package.

---

---

Consider a table `event_t` with virtual column `session_obj_type`. The virtual column has a `session_obj_type_id` supporting column, which stores the ID corresponding to the type value of the virtual column.

- **Update operation example**

Any custom application/PL/SQL updating the column `session_obj_type` using SQL

```
update event_t set session_obj_type = '/service/telco';
```

will have to be modified to

```
update event_t set session_obj_type_id = pin_virtual_column.get_object_id('/service/telco');
```

- **Insert operation example**

Any custom application/PL/SQL inserting values into column `session_obj_type` with SQL

```
insert into event_t (poid_type) values (pin_virtual_columns.get_object_id('/event'));
```

will have to be modified to

```
insert into event_t (poid_type_id) values (pin_virtual_columns.get_object_id('/event'));
```



---

# Creating Client Applications by Using Java PCM

This chapter provides information on creating Java client applications that communicate with Oracle Communications Billing and Revenue Management (BRM) by using the Java Portal Communication Module (Java PCM) Application Programming Interface (API).

For information on customizing Customer Center and Self-Care Manager, BRM Java customer management applications, see ["Customizing the Customer Center Interface"](#) and ["Customizing the Self-Care Manager Interface"](#).

## About Using the Java PCM API

You use the classes and their methods in the Java PCM API to write Java client APIs, see *Java PCM API*.

To use the Java PCM package, you must have the following skills and experience:

- Experience in developing Java applications
- A good understanding of the BRM architecture and the following concepts:
  - PCM opcodes
  - Portal Information Network (PIN) libraries
  - flists (field lists)
  - Context (**PortalContext**)
  - Buffers (**Buffer**, **FileBuffer**, **ByteBuffer**)
  - Fields (**Fields**)
  - Portal object IDs (POIDs)

For information on BRM architecture and concepts, see the following topics:

- BRM System Architecture
- [Understanding the PCM API and the PIN Library](#)
- [Understanding the BRM Data Types](#)
- [Understanding Flists and Storable Classes](#)

## Software Requirements

Use the Java PCM API on a supported version of the Java Development Kit (JDK). See "BRM Software Compatibility" in *BRM Installation Guide*.

## About the Java PCM API and the C API

The Java PCM API consists of a set of Java classes that represent the BRM C data structures, such as flists, fields, context, and POIDs, that are defined in the **pcm.h** file.

For information on BRM data types, see "[Understanding the BRM Data Types](#)".

For information on flists, see "[Understanding Flists and Storable Classes](#)".

The Java API differs from the C API in the following ways:

- Timestamps and strings are represented by the **Date** and **String** Java classes. There is a separate array class for flist arrays (**SparseArray**).
- The information stored in the C error buffer is part of **EbufException** in the Java PCM package.
- In the Java PCM package, opcodes are constants in the **PortalOp** class and are named without the **PCM\_OP** prefix. For example, **PCM\_OP\_READ\_FIELD** in the C API is **PortalOp.READ\_FIELD** in the Java PCM package.
- For type safety, field names are provided as classes.

Field names follow the Java class-naming conventions and use mixed case without the underscores. The Java field classes in the Java PCM package use the C **#define** name without the **PIN\_** prefix. For example, **PIN\_FLD\_NAME\_INFO** in C becomes **FldNameInfo** in Java.

- Field instances are shared to improve performance; therefore, you pass a field to a method by using the following syntax:

```
obj.method(FldNameInfo.getInst());
```

where *obj* is the object that calls the *method* method.

## Using the Java PCM API

Follow these steps when using the Java PCM API:

- Make sure that the **pcm.jar** and **pcmext.jar** files are in your **CLASSPATH**.
- Include the following import statements in the Java files that use PCM classes:
  - **import com.portal.pcm.\*;**
  - **import com.portal.pcm.fields.\*;**
- When you run a Java program that communicates with BRM, make sure the **Infranet.properties** files and the custom **.CLASS** files are in the **CLASSPATH**.

## About Creating Client Applications by Using the Java PCM API

When you create client applications that use the Java PCM API, you can use either the synchronous mode or the asynchronous mode of handling requests.

## About Synchronous and Asynchronous Modes

In BRM, when you create a client application to process requests in synchronous mode, the application sends a request and waits for a response from the Connection Manager (CM) before it sends the next request. If there is an error on the server side in processing the request, the client application may have to wait indefinitely. To address this, you can set a timeout value for the request your client application sends to the CM. If the CM does not respond within the time specified in the request, the PCP connection layer returns an error message to the client application and closes the connection. See "[Specifying a Timeout Value for Requests](#)".

Alternately, when you create a client application to process requests in asynchronous mode, it sends a request to BRM and then, instead of waiting for a response to the request, the client application continues to perform other operations. Throughput is improved in this mode because client applications can make multiple requests. When the response for a request becomes available, the client application retrieves the response and proceeds further with its processing of that request. See "[Using the Asynchronous PCP Mode in Java PCM Client Libraries](#)".

## Actions Performed by BRM Java Client Applications

A BRM Java client application does the following.

1. Opens a connection.
2. Clears the error buffer.
3. Performs PCM operations.
4. Checks for errors.
5. Closes the connection.

For more information, see "[Creating a Client Application in C](#)".

When you call an opcode, you need to create an flist and pass it as an input. See the input flist specification in the opcode descriptions for information on the structure of the flist.

For information on how to create an flist, see "[Flist Creation Samples](#)".

## Opening a PCM connection

You open a connection to BRM by using the Java PCM API, all communication is performed through the **PortalContext** class. You can use one of the following methods to open a connection:

- Call the **open()** method on the context class with all the login information needed, including the host name and the port number.
- Use the **connect()** method, if you want your program to log in automatically to BRM. You must store all the necessary login information in the **Infranet.properties** file and make sure that file is in the **CLASSPATH**.

For information on creating an **Infranet.properties** file, see "[Setting Global Options](#)".

---

---

**Note:** Use the **Infranet.properties** file for configuring Java applications instead of the **pin.conf** file used by C applications.

---

---

If your custom application supports multiple database schemas, you must use the database number returned by the `PCM_CONNECT()` or `PCM_CONTEXT_OPEN()` opcodes for all transactions within the context you open. The `open()` and `connect()` methods call these opcodes to open a connection to BRM. For more information, see ["Maintaining Transactional Integrity"](#).

To open a transaction on a specific database schema, use the `opcode` method within the `PortalContext` class to execute the opcode `PCM_OP_TRANS_OPCODE` with the schema POID specified in the input flist. For more information, see `PCM_OP_TRANS_OPEN`.

## Using Custom Fields in Java Applications

You use Storable Class Editor to create custom fields and to generate Java source files that you compile into classes. See ["Creating, Editing, and Deleting Fields and Storable Classes"](#) and Storable Class Editor Help for more information.

You can use custom fields in flists in your Java code in the same manner as BRM fields. Before class names are created from the fields, the prefix `PIN_` is removed from the BRM fields and custom field names are used as they are for class names.

To create and use custom fields in the Java PCM package:

1. Start Storable Class Editor and create your storable classes and fields.  
For information, see the Storable Class Editor Help.
2. From the **File** menu, choose **Generate Custom Fields Source** to create source files for your custom fields. See the Storable Class Editor Help system for detailed instructions.  
  
Storable Class Editor creates a C header file called `cust_flds.h`, a Java properties file called `InfranetPropertiesAdditions.properties`, and a Java source file for each custom field.
3. For each Java application that will use these fields, copy the contents of the `InfranetPropertiesAdditions.properties` file and paste it into each application's `Infranet.properties` file.
4. In the directory where Storable Class Editor created the Java source files, compile the source files:  

```
javac -d . *.java
```
5. Package the class files created in step 4 into a **JAR** file:  

```
jar cvf filename.jar *.class
```
6. In the `CLASSPATH`, add the location of the **JAR** file.

## Creating Custom Classes

You use Storable Class Editor to create custom classes. See ["Creating, Editing, and Deleting Fields and Storable Classes"](#) and Storable Class Editor help for instructions. After you commit the classes in Storable Class Editor, create the object in Java:

```
Poid aPoid = new Poid(database, -1, "/customClass");
inFlist.set(FldPoid.getInst(), aPoid);
/*... set other fields*/
FList outFList = ctx.opcode(PortalOp.CREATE_OBJ, inFlist);
```



## Calling Custom Opcodes

To call custom opcodes:

1. Write and define your custom opcodes on the server:

```
#define custom_opcode1 10001
```

2. Call the appropriate method of the **PortalContext** class in Java. The method you call depends on the opcode processing mode:
  - Synchronous mode: Use the **opcode** method. See ["Using Synchronous Mode for Opcode Processing"](#).
  - Asynchronous mode: Use the **opcodeSend** method. See ["How Asynchronous Mode for Opcode Processing Works"](#).

For more information on creating custom opcodes, see ["Defining New Opcodes"](#).

For maintainability, you can create a class with all your opcodes, as shown in the following example:

### Example 25–1 Creating a Class for Custom Opcodes

```
class CustomOpcode{
    public static final int OPCODE1 = 10001;
    public static final int OPCODE2 = 10002;
    /*more custom opcodes here*/
}
```

## Using Synchronous Mode for Opcode Processing

To create client applications that use the synchronous mode of opcode processing, call the **opcode** method of the **PortalContext** class. For example, the following syntax would be used to call *OPCODE1*, the custom opcode shown in [Example 25–1](#):

```
ctx.opcode(CustomOpcode.OPCODE1, inFlist);
```

Internally, the **opcode** method sends the information on the custom opcode (*OPCODE1*) to the BRM server and waits for a response. Your client application is blocked during this time interval and can resume further action only after the output is received from the execution of *OPCODE1*.

## Getting a Text Format of an Flist

When debugging a client application, it is often useful to read a text representation of an flist. The **flist** API provides the following methods:

- **toString()** method for general purposes
- **dump()** method to display on standard output

## Handling Exceptions

Any call that causes a PCM-related error throws an **EbufException** exception. If partial information was available in an flist from an opcode call, you can retrieve it from the **EbufException** exception in the Java package.

---



---

**Tip:** For efficiency, catch exceptions at the highest possible level.

---



---

For help on the available options and usage, type ? at the prompt.

---

---

**Note:** All the information available in the C error buffer is available in the Java **EbufException** exception when that exception is caught. For more information see, "[Error Buffer](#)".

---

---

## Logging Errors and Messages

The **ErrorLog** class contains the API for logging status, errors, and other messages to a file or buffer. You can access the default log through the **PortalContext** class. Always use the log to ensure that you get the expected output.

Even when the error log function is used from an applet in a Web browser, where the **Security Manager** denies access to the file system, a log is generated in a buffer. You must access and display the log from the applet.

**Infranet.properties** has several options for controlling debugging, including automatic logging of all **EbufException** exceptions. For more information on the options, see "[Setting Global Options](#)".

The Java log function does not have an indefinite list of arguments. You must use string concatenation to form a simple string message. For example:

```
errorlog.log(ErrorLog.Error, "Here's the error and flist:\n" + error.toString() +
"\n" + flist.toString());
```

## Specifying a Timeout Value for Requests

You can specify a timeout value for each request to the CM in your client application. For more information on implementing timeout values, see "[Implementing Timeout for Requests in Your Application](#)".

To specify a timeout value in milliseconds for a connection, pass the `PIN_FLD_TIMEOUT_IN_MS` field in the input flist to the **PortalContext** class constructor or the **open()** or **connect()** methods of the **PortalContext** class. The `PIN_FLD_TIMEOUT_IN_MS` value is applicable after the client connects to the server. Before the connection happens this setting is not effective. It does not report a time out if the client cannot connect to the server at all.

For more information on the **PortalContext** class, see *BRM PCM Java API Reference*.

The timeout value you specify applies to all the opcodes called during that open session and overrides the value in the client properties file. You must ensure that your client application handles the timeout, closes its connection to the CM by calling `PCM_CONTEXT_CLOSE`, and cleans up the transaction context.

---

---

**Note:** When the timeout happens, the CM does not provide any feedback about the success or failure of the request it received. When the CM detects the closed connection, it rolls back the ongoing transaction and shuts down.

---

---

## Using the Asynchronous PCP Mode in Java PCM Client Libraries

When a Java client application uses the Java PCM library and calls a BRM opcode, the PCP connectors forward the request and wait for the responses from BRM.

Asynchronous mode of processing enables client applications to handle multiple requests and improve the throughput of opcode calls.

When you create a client application that uses asynchronous mode processing, you can call the **opcodeSend** method for as many opcode processing requests as required. As the responses from the execution of these opcode operations become available, your client application can call the **opcodeReceive** method to receive the responses and act upon them.

Asynchronous mode processing can be used for base opcodes as well as custom opcodes.

The following classes in the Java PCM client libraries enable you to create client applications that make use of the asynchronous mode:

- **PCPSelector**, the PCP connection's socket channel selector. See "[About PCPSelector](#)".
- **PortalContextListener**, the abstract listener. See "[About PortalContextListener](#)".

## About PCPSelector

**PCPSelector** is the PCP connection's socket channel selector that uses Java NIO mechanism during the asynchronous mode. (NIO stands for New I/O, a set of non-blocking APIs for Java programming language that offer features for intensive Input/Output operations.)

This Java class provides a Java method named **process** and also internally calls other interfaces responsible for:

- Registering the socket channels with the selector.
- Changing the socket channel's interest to READ (data available) operation after the opcode is sent.
- Sending the notification to **PortalContextListener** once the data has arrived.

The client application that you create must extend the **PCPSelector** class and implement its **Runnable** interface. To take full advantage of the multithreaded selector capabilities of the **PCPSelector** class, you must call the **process** method in your implementation's **run** method, as shown in the following example:

### **Example 25-2 Extending PCPSelector**

```
public class SDPPCPSelector extends PCPSelector implements Runnable {

    private static SDPPCPSelector instance = null;
    private SDPPCPSelector() throws IOException {
        super();
    }

    public static synchronized SDPPCPSelector getInstance() throws IOException
    {
        if (instance == null) {
            instance = new SDPPCPSelector();
        }
        return instance;
    }

    public void run(){
        System.out.println("inside Run of SDP PCPSelector");
        process();
    }
}
```

Below, an instance of the `SDPPCPSelector` class is created. It can be used to spawn multiple threads.

```
PCPSelector pcpSelector = SDPPCPSelector.getInstance();
Thread t = new Thread((Runnable) pcpSelector);
t.start();
```

For more information on **PCPSelector**, see *BRM PCM Java API Reference*.

## About PortalContextListener

**PortalContextListener** is an abstract listener. It forces the client application to implement the notification-handling interface that is used when opcode operations are performed in an asynchronous mode. The **handlePortalContextEvent** method of **PortalContextListener** supplies the **PortalContext** object with the related event that has occurred recently.

The PCM library supports notifications for the following:

- `EVENT_READ_DATA_AVAILABLE`
- `EVENT_CHANNEL_CLOSED`

Client applications can extend **PortalContextListener** and use the child class to register their interest in these two events by calling the **addListener** method of **PCPSelector**.

For example:

### **Example 25–3 Extending PortalContextListener**

```
public class ClientListener extends PortalContextListener {
    ClientListener () {
        pcpSelector = SDPPCPSelector.getInstance();
        pcpSelector.addListener(this, EventType.EVENT_READ_DATA_AVAILABLE);
        pcpSelector.addListener(this, EventType.EVENT_CHANNEL_CLOSED);
    }
    public void handlePortalContextEvent(PortalContext portalContext,
        EventType eventType) {
        // use another thread mechanism to call actual opcodeReceive()
        ...
    }
}
```

For more information on **PortalContextListener**, see *BRM PCM Java API Reference*.

## How Asynchronous Mode for Opcode Processing Works

The asynchronous mode for opcode processing works in the following manner:

1. Your client application calls the **opcodeSend** method of the **PortalContext** class. For example code:

```
ctx.opcodeSend(CustomOpcode.OPCODE1, inFlist);
```

Internally, the **opcodeSend** method of the **PortalContext** class sends the information on the opcode (*OPCODE1*) to the BRM server, but it does not wait for the response from the opcode operation. Immediately after calling **opcodeSend**, the client application can perform other tasks.

The BRM framework takes care of monitoring the sockets to check if the **PortalContext** data (that is, the response from the opcode operation) is available. When this data is available, the **handlePortalContextEvent** method of the **PortalContextListener** object in your client application is called automatically.

2. When your client application receives the notification through the **handlePortalContextEvent** method, it invokes the **opcodeReceive** method to receive the response of the opcode operation from BRM. See [Example 25-3](#).

---

**Note:** For better performance, Oracle recommends that you use a separate thread to call the **opcodeReceive** method rather than calling the **opcodeReceive** method directly from the **handlePortalContextEvent** method.

---

For information on **PortalContext**, see *BRM PCM Java API Reference*.

## Creating Client Applications for Asynchronous Mode of Opcode Processing

For the client application to use the asynchronous opcode processing feature in BRM:

- Set up your client applications so that they have multiple threads of the **PCPSelector** object. To ensure asynchronous opcode processing, pass the **PCPSelector** object when you create the **PortalContext** object. For example:
 

```
PortalContext portalContext = new PortalContext(pcpSelector);
```
- Register the client application's interest for specific events by calling the **addListener** method of the **PCPSelector** object.
- Set up the client application to have multiple **PortalContextListener** objects, if necessary. Each **PortalContextListener** object provides a notification mechanism through its **handlePortalContextEvent** method.
- If the client application uses multiple **PortalContextListener** objects, make the readable **PortalContext** object available to any one or all of the **PortalContextListener** objects.

To make the readable **PortalContext** object available to a *specific* **PortalContextListener**, use the **registerContextToListener** method, as shown in [Example 25-4](#):

### **Example 25-4** Making **PortalContext** Data Available to Specific **PortalContextListener** Object

```
PortalContextListener pListener = new CustomPortalContextListener();
PortalContextListener qListener = new CustomPortalContextListener();
PortalContext portalContext = new PortalContext(pcpSelector);
pListener.registerContextToListener(portalContext);
```

When this sample code executes, one specific **PortalContextListener** object (pListener) is registered with the **PortalContext** object. When data becomes available on the **PortalContext** object and that object is ready to call the **opcodeReceive** method, a notification is sent to that specific **PortalContextListener** object (pListener).

To make the readable **PortalContext** object available to all **PortalContextListener** objects, omit the **registerContextToListener** method, as in [Example 25-5](#):

**Example 25–5 Making PortalContext Data Available to All PortalContextListener Objects**

```
PortalContextListener pListener = new CustomPortalContextListener();
PortalContextListener qListener = new CustomPortalContextListener();
PortalContext portalContext = new PortalContext(pcpSelector);
```

None of the **PortalContextListener** objects is registered with the **PortalContext** object (because the **registerContextToListener** method was not called for any **PortalContextListener** object). As a result, when data becomes available on the **PortalContext** object and that object is ready to call the **opcodeReceive** method, the notification is sent to all the **PortalContextListener** objects.

- You can set up your client application for multiple opcode processing. For example, [Example 25–6](#) issues a second **opcodeSend** request without waiting for the actual response from the first opcode operation:

**Example 25–6 Multiple Opcode Processing**

```
PortalContext portalContext1 = new PortalContext(pcpSelector);
portalContext1.open(login_params_flist);
portalContext1.opcodeSend(opcode_name, input_flist);

PortalContext portalContext2 = new PortalContext(pcpSelector);
portalContext2.open(login_params_flist);
portalContext2.opcodeSend(opcode_name, input_flist);
```

- **PortalContext** provides different APIs that your client application can use to check the status of the socket channel.

For more information on the **PortalContext** class, see *BRM PCM Java API Reference*.

## Setting Global Options

**Infranet.properties** is an optional configuration file that contains entries to control *all* connections from Java applications to BRM. Java PCM looks in the **Infranet.properties** file for information not provided in the login flist. You must include the **Infranet.properties** file in the **CLASSPATH**.

The content of the **Infranet.properties** file conforms to the Java properties file conventions. Options are key-value pairs separated by the equal sign (=). For example, **host=ip://test2:11960** and **log.file=mylog.log**.

---



---

**Important:** You *must* include an entry of the form **type = 1** in the **Infranet.properties** file if that entry is not in the login flist.

---



---

### Default Entries in the Infranet.properties File

[Table 25–1](#) lists the predefined entries and their types:

Table 25–1 Entries in *Infranet.Properties*

| Entry                       | Value  | Notes   |
|-----------------------------|--|---|
| <b>Infranet.login.type</b>  | 0 or 1   | Specifies the type of login. A type 1 login requires the application to provide a user name and password. A type 0 login is a trusted login that comes through a CM Proxy, for example, and does not require a user name and password in the properties file.   |
| <b>Infranet.connection</b>  | <p><b>For a type 1 login:</b><br/>pcp://username:password@hostname:port/service:1</p> <p><b>For a type 0 login:</b><br/>pcp://hostname:port/database_no/service:1</p> <p>Where:</p> <ul style="list-style-type: none"> <li>▪ <i>username</i> is the login name to use for connecting to BRM.</li> <li>▪ <b>Note:</b> <i>username</i> cannot contain the characters : and @. The / character is allowed.</li> <li>▪ <i>password</i> is the password for the specified user name.</li> <li>▪ <b>Note:</b> <i>password</i> cannot contain the characters : and @. The / character is allowed.</li> <li>▪ <i>hostname</i> is the name or IP address of the computer running the CM or CMMP.</li> <li>▪ <i>port</i> is the TCP port number of the CM or CMMP on the host computer. The port number must match the corresponding <b>cm_ports</b> entry in the CM or CMMP configuration file.</li> <li>▪ <i>service</i> is the service type. The trailing 1 is the POID of the service.</li> <li>▪ <i>database_no</i> is the number assigned to your BRM database when the BRM Data Manager was installed.</li> </ul> | <p>Specifies the full URL to the BRM service.</p> <p>For a type 1 login, the URL must include a user name and password. You must specify the service name and service POID ("1"), but the CM determines the database number.</p> <p>A type 0 login requires a full POID, including the database number.</p>   |
| <b>Infranet.failover.nn</b> | pcp://hostname:port  | <p>Specifies the alternative CM hosts that the application can use to connect to BRM if the main host (specified in the connection entry) is unavailable.</p> <p>The user name, password, and service for these alternative hosts is the same as for the main host and is not specified in the failover entries. Failover entries are numbered sequentially, starting with 1.</p> |

## Optional Entries in the *Infranet.properties* File

The *Infranet.properties* file can contain other entries. Some of these are based on keys in the Java PCM API, and others are written specifically for an application or tool.

Table 25–2 shows entries from the Java PCM API:

**Table 25–2** *Optional Entries in Infranet.properties*

| Entry                               | Description   |
|-------------------------------------|---|
| <b>Infranet.log.file</b>            | The file path. The default is <b>javapcm.log</b> .  |
| <b>Infranet.log.logallebuf</b>      | Boolean. If <b>true</b> , forces all <b>EbufException</b> exceptions to be logged automatically.  |
| <b>Infranet.log.level</b>           | Specifies how much information the application should log: <ul style="list-style-type: none"> <li>▪ <b>0</b>: no logging</li> <li>▪ <b>1</b>: log ERROR messages</li> <li>▪ <b>2</b>: log ERROR and WARNING messages</li> <li>▪ <b>3</b>: log ERROR, WARNING, and DEBUG messages</li> </ul>                 |
| <b>Infranet.pcp.debug.enabled</b>   | <b>true</b> or <b>false</b>   |
| <b>Infranet.pcp.debug.flags</b>     | <b>0</b> : to log nothing<br><b>1</b> : to log errors<br><b>0x1fff</b> : to log all messages  |
| <b>Infranet.log.opcodes.enabled</b> | Boolean. If <b>true</b> , enables a log that records the input and output list for every opcode called by all client applications that support this feature.<br><br>For more information, including the list of applications, see " <a href="#">Controlling Opcode Logging from a Client Application</a> ". |
| <b>Infranet.log.opcodes.file</b>    | The file path.  |

[Table 25–3](#) shows entries used for NamedLogs. The *log\_name* variable specifies the NamedLog name, such as the application doing the logging.

**Table 25–3** *Named Log Entries*

| Entry                              | Description   |
|------------------------------------|---|
| <b>Infranet.log.log_name.file</b>  | Full path to the log file for the application.<br><br>The log file shows errors, warnings, and debugging messages associated with the application, as specified by the <b>Infranet.log.log_name.level</b> entry.  |
| <b>Infranet.log.log_name.style</b> | Specifies the logging control style.<br><br>The value for this entry can be: <ul style="list-style-type: none"> <li>▪ <b>priority</b>: Logs messages according to their priority level, specified by the <b>Infranet.log.log_name.level</b> entry.</li> <li>▪ <b>flag</b>: Logs messages according to their type, specified by the <b>Infranet.log.log_name.level</b> entry.</li> </ul>   |
| <b>Infranet.log.log_name.level</b> | Specifies how much information the application should log.<br><br>Possible values depend on the log control style specified by the <b>Infranet.log.log_name.style</b> entry:<br><br>For <b>priority</b> style, set the level as a decimal value. All messages with a priority level lower than this level are logged. (Low number = high priority)<br><br>For <b>flag</b> style, set the level to one of these values: <ul style="list-style-type: none"> <li>▪ <b>0</b>: no logging</li> <li>▪ <b>1</b>: log ERROR messages</li> <li>▪ <b>2</b>: log ERROR and WARNING messages and</li> <li>▪ <b>3</b>: log ERROR, WARNING, and DEBUG messages</li> </ul> |



**Table 25–3 (Cont.) Named Log Entries**

| Entry   | Description   |
|---|---|
| <code>Infranet.log.log_name.logallebuf</code> | Boolean. If <b>true</b> , forces all <b>EbufException</b> exceptions to be logged automatically.        |
| <code>Infranet.log.log_name.name</code>       | Specifies the name of the log where all messages of a specific type are written to.                     |
| <code>Infranet.log.log_name.enabled</code>    | Enables or disables NamedLog logging.<br>To disable logging, set to <b>f</b> , <b>n</b> , or <b>0</b> . |

Table 25–4 shows an entry that you can use to display a list of hosts:

**Table 25–4 Entries used to List Hosts**

| Entry  | Description  |
|--|--|
| <code>Infranet.application_name.host.nn</code> | A list of hosts, (for example, <b>host.1</b> , <b>host.2</b> ), and so on, displayed when a user opens the application.<br><br>The user can select to connect to any host in the list.<br><br>Host entries, each consisting of a pair of values for <i>hostname</i> and <i>port</i> , are numbered sequentially, starting with <i>1</i> . Other connection information, such as service, comes from the standard <b>Infranet.connection</b> entry. |

## Example Infranet.properties File

```
infranet.connection=pcp://sommachine:11960/service/admin_client 1
infranet.login.type=1
infranet.log.file=fullOutput.log
infranet.log.logallebuf=true
infranet.log.level=3
infranet.pcp.debug.flags=0x3FFFFFFF
infranet.pcp.debug.enabled=true
```

## Controlling Opcode Logging from a Client Application

An opcode log contains the input and output flist for every opcode called by the following applications:

- Payment Center
- Permissioning Center
- Pricing Center
- Resource Editor
- Revenue Assurance Center
- Suspense Management Center
- Zone Mapper

You can dynamically turn opcode logging on and off for an individual application from the application itself, independent of the global opcode logging settings in the **Infranet.properties** file and without having to restart the application.

---

**Note:** If you do not define an **Infranet.log.opcodes.file** entry in the **Infranet.properties** file and turn logging on using this procedure, the default is **opcodes.log**.

---

To turn opcode logging on or off:

1. In the application, click **Help** then **About**, and then click **System Information**.
2. In the System Information dialog box, press CTRL+SHIFT and click three times on the label above the table to open the Opcode Logging dialog box.
3. Select or clear the **Log Opcodes** check box for an application to turn logging on or off.

## Running the jnap Utility

The Java package includes the **jnap** test utility. You use **jnap** to test the database connection, load flists from files, use the flists as input when calling opcodes on the server, and display output flists.

The **jnap** utility is similar to and provides a subset of the functionality of **testnap**, the utility used for testing applications written using the BRM C API. You can use many of the same commands in **jnap** that you use in **testnap**. Unlike **testnap**, however, **jnap** uses Java PCM to communicate with BRM.

When you start **jnap**, you must include the **Infranet.properties**, **pcm.jar**, and **pcmext.jar** files in the CLASSPATH. In Windows, for example, if the **Infranet.properties** file is in the current directory and the **pcm.jar** and **pcmext.jar** files are in **C:\Portal\jars**, you would enter:

```
java -classpath .;c:\Portal\jars\pcm.jar;c:\Portal\jars\pcmext.jar
com.portal.pcm.jnap
```

If you plan to use **jnap** frequently, you can also set CLASSPATH as an environment variable.

## Getting Help with jnap

You can get command-line help for **jnap** by entering **help** at the prompt. You see a list of valid commands and variables:

```
jnap> help
jnap command set::
r    <file> <bufnum>    - read flist from file into buffer
i    <bufnum>           - insert flist from STDIN into buf
d    <flist>            - displays flist
w    <buf> <file>       - save buf to file
l                    - list buf nums used
login                    - login using values in Infranet.properties
login <flist>           - login using specified flist
logout                   - logout and close context
xop  <op> <flags> <flist> - execute op and set 'incoming' buf
q                    - quit
loop  <flist>          - stream out/in flist
pcpdebug <dbgflags>    - set pcp debug flags
h or ? or help         - displays this help
```

where

```
<flist> :: <file> | <buf>
<op>    :: <num> | <opname>
<opname>:: READ_OBJ | commit_customer | TRANS_OPEN ...
<buf>   :: <bufnum> | incoming
<flags> :: <number> | <flags>'+'<flag>
<flag>  :: calc|meta|rev|count|add|poid|rdres|nores|ro|rw|lock
<dbgflags> :: <number> | <dbgflags>'+'<dbgflag>
```

```
<dbgflag>  :: none|errors|flist_req|flist_resp|read|write|
             read_wh|write_wh|read_dump|
             write_dump|open|connect|trans|op|all
```

## Example of Using jnap

This section includes an example of using **jnap**. In this example, you create an flist and then use it as input to the PCM\_OP\_ACT\_TEST\_LOOPBACK opcode. This opcode tests the database connection and returns the same flist as output.

1. Use a text editor to create a simple flist and save it as **flist1**.

```
0 PIN_FLD_PROGRAM_NAME      STR [0] "Example"
0 PIN_FLD_POID              POID [0] 0.0.0.1 -1 0
0 PIN_FLD_NAME              STR [0] "Test"
```

2. Read **flist1** into buffer 1.

```
jnap> r flist1 1
```

3. To ensure that the flist was saved, display the contents of buffer 1.

```
jnap> d 1
```

4. Log in to the database.

```
jnap> login
```

5. Run the PCM\_OP\_ACT\_TEST\_LOOPBACK opcode with the **xop** command. Include the opcode without the PCM\_OP\_ACT prefix, **0** for the opcode flag, and **1** for the buffer you will use for the input flist.

```
xop TEST_LOOPBACK 0 1
```

The output of the opcode is displayed. In this case, the output is the same as the input.

6. Log out.

```
jnap> logout
```

7. Quit **jnap**.

```
jnap> q
```

## About the Sample Program

For a sample program for creating a client application, see **CreateContext.java**.

This program creates a customer account by performing these steps:

- Opening a database channel
- Retrieving a price plan
- Adding customer information to the account
- Creating the customer account
- Closing the database channel

To run **CreateContext.java**, first edit the **Infranet.properties** file to change the entry *your server* to the host name of the computer where BRM is installed. Then include the file in your CLASSPATH. For an example of the **Infranet.properties** file, see ["Example](#)

[Infranet.properties File](#)".

---

## Creating Client Applications by Using Perl PCM

This chapter introduces the Perl extension to the Oracle Communications Billing and Revenue Management (BRM) Portal Communications Module (PCM) library.

For information on using the functions in the Perl PCMIF library, see "Perl Extensions to the PCM Libraries" in *BRM Developer's Reference*.

### About the Perl API

The Perl extension to the PCM library, `pcmif`, allows you to use Perl scripts to perform the following PCM operations:

- Connect to PCM.
- Perform PCM opcode operations, such as creating an object, searching for objects, deleting an object.
- Convert flists (field lists) between text and binary formats.
- Generate error reports.

For more information, see the following documents:

- For a description of the Application Programming Interface (API), see "Perl Extensions to the PCM Libraries" in *BRM Developer's Reference*.
- For sample scripts, see "Example Perl Scripts" in *BRM Developer's Reference*.
- For the latest information on the Perl extension, see `pod2text` (text format) or `pod2html` (HTML format) in the *BRM\_SDK\_Home/lib/pcmif.pm*.

### Differences between the Perl API and the C API

The API functions in `pcmif` are wrappers for a subset of the underlying C functions. You can use the Perl API functions to perform any BRM PCM opcode operation.

The `pcmif` API functions use the following naming conventions:

- If the C function and its corresponding Perl function use exactly the same arguments, they have the same name.
- If the arguments are different, the Perl equivalent to the C function `pin_function()` is named `pin_perl_function()` to differentiate them.

### Guidelines for Using the Pcmif Module

To perform PCM operations by using Perl scripts, follow these guidelines:

- Make sure your scripts include the following information:

The path to the Perl binaries in the first line:

```
#!/BRM_SDK_Home/perl/bin/perl;
```

The Perl module to use:

```
use pcmif;
```

- Use Perl 5.0004, included with BRM.

If you use a different version of Perl, make sure you specify the path to the pcmif files in the Perl command line or by including the **use lib <path>** line in the beginning of your Perl scripts.

- Add the class prefix **pcmif::** to the functions, which specifies that these functions are from the pcmif package. For example:

```
pcmif::pcm_perl_new_ebuf();
```

- Make sure you use the *PerlScriptName.bat* instead of the *PerlScriptName.pl*.

## Performing PCM Operations

To write Perl scripts that perform BRM operations, follow these guidelines:

- Connect to PCM by opening a PCM connection and a PCM context to the BRM.

See "Connection Functions" in *BRM Developer's Reference* for a description of the API.

If your custom application supports multiple database schemas, you must use the database number returned by `PCM_CONNECT()` or `PCM_CONTEXT_OPEN()` for all transactions within the context you open. For more information, see "[Maintaining Transactional Integrity](#)".

- Check for errors after each action.

See "Error-Handling Functions" in *BRM Developer's Reference* for a description of the API.

- Convert flists between text and binary formats:

- Convert strings that you create in your Perl script to flist format before performing PCM operations.

For example, if you use a "here" document to assign a flist string to a variable in your Perl scripts, convert the variable to flist format before searching for an object by using `PCM_OP_SEARCH`.

- Convert flists to string format before using them in Perl functions. For example, to pass an flist as input to Perl functions such as string matching, first convert the flist to a string.

See "Flist Conversion Functions" in *BRM Developer's Reference* for a description of the flist conversion functions.

- Perform the PCM operations.

See "Error-Handling Functions" in *BRM Developer's Reference* for a description of the API.

- Delete the flists and error buffers you no longer need.

See "Error-Handling Functions" and "List Conversion Functions" in *BRM Developer's Reference* for a description of the functions to use.

- Disconnect from PCM by closing the PCM context.

See "Connection Functions" in *BRM Developer's Reference* for a description of the API.





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## Creating Client Applications by Using PCM C++

This chapter explains how to create C++ client applications that communicate with a Oracle Communications Billing and Revenue Management (BRM) system by using the Portal Communication Module (PCM) C++ Application Programming Interface (API).

Before using PCM C++, read "[Comparison of the PCM C++ and PCM C APIs](#)".

### About PCM C++

Use the classes and their member functions in the PCM C++ API to write C++ client applications that communicate with BRM. PCM C++ is a set of wrappers around the PCM C client library. The C++ classes represent the BRM C data structures. These structures, including flists, fields, context, and POIDs, are defined in the `pcm.h` file.

However, C++ provides several advantages over C: improved runtime memory, type checking, compile time, and reliability. C++ provides hooks for assertions in debugging. If programmed properly, smart pointers can make memory management easier for programmers. In addition, C++ allows object oriented programming, a more powerful approach than is possible in C. PCM C++ allows you to take advantage of these C++ capabilities.

For information on BRM data types, see "[Understanding the BRM Data Types](#)".

For information on flists, see "[Understanding Flists and Storable Classes](#)".

### Skills Required

To use the PCM C++ package, you must have the following skills and experience:

- Experience in developing C++ applications and an understanding of smart pointers.

For information on PCM C++, see "[Using the PCM C++ API](#)".

- A good understanding of BRM architecture and the following concepts:
  - PCM opcodes
  - Portal Information Network (PIN) libraries
  - Flists (field lists)
  - Context (**PortalContext**)
  - Buffers (**Buffer**)
  - Fields (**Fields**)
  - Portal object IDs (**POIDs**)

For detailed information on BRM architecture and concepts, see:

- BRM System Architecture
- [Understanding the PCM API and the PIN Library](#)
- [Understanding the BRM Data Types](#)
- [Understanding Flists and Storable Classes](#)

## Installation

PCM C++ is installed automatically as part of the BRM SDK. For installation and configuration information, including software requirements, see "[About BRM SDK](#)".

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**Note:** PCM C++ is sometimes be referred to as PCM CPP.

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## Comparison of the PCM C++ and PCM C APIs

[Table 27-1](#) compares the functionality available in the PCM C++ and PCM C APIs:

**Table 27-1 Comparison of C++ and C APIs in PCM**

| PCM C API                | PCM C++ API  |
|--------------------------|--|
| PCM_CONNECT              | PinContextOwner PinContext::create( );   |
| PCM_CONTEXT_OPEN         | PinContextOwner PinContext::create(PinFlistBase & inFlist);  |
| PCM_CONTEXT_CLOSE        | void PinContext::close();  |
| PCM_OP                   | NA   |
| PIN_FLIST_CONCAT         | NA   |
| PIN_FLIST_COPY           | PinFlistOwner PinFlist::clone() const;   |
| PIN_FLIST_COUNT          | NA   |
| pin_flist_sort           | void PinFlist::sort(PinFlistBase &sortlist, int32 descending=0, int32 sortDefault=0);  |
| pin_flist_recursive_sort | void PinFlist::sortRecursively(PinFlistBase &sortlist, int32 descending=0, int32 sortDefault=0);   |
| PIN_FLIST_FLD_DROP       | void PinFlist::drop(const PinXXXTypeField &fld);<br>// For field types, where XXX is<br>// Int, Uint, Num, Enum, Tstamp, Str, Binstr, Poid, BigDecimal                       |
| PIN_FLIST_FLD_GET        | PinXXXObserver<br>PinFlist::get(const PinXXXTypeField &fld, PinBool optional=false);<br>//Where XXX is<br>//Int, Uint, Num, Enum, Tstamp, Str, Binstr, Poid, BigDecimal, Sub |
| PIN_FLIST_FLD_PUT        | void PinFlist::set(const PinXXXTypeField &fld, PinXXXOwner &val);<br>// For field types, where XXX is<br>// Int, Uint, Num, Enum, Tstamp, Str, Binstr, Poid, BigDecimal, Sub |

**Table 27–1 (Cont.) Comparison of C++ and C APIs in PCM**

| PCM C API                | PCM C++ API  |
|--------------------------|--|
| PIN_FLIST_FLD_SET        | void PinFlist::set(const PinXXXTypeField &fld, PinXXX val);<br>// Value based setter for simple field types, where XXX is<br>// Int, Uint, Num, Enum, Tstamp, Str, Binstr<br>void PinFlist::set(const PinXXXTypeField &fld, PinXXXBase &val);<br>// For field types, where XXX is<br>// Int, Uint, Num, Enum, Tstamp, Str, Binstr, Poid, BigDecimal, Sub |
| PIN_FLIST_FLD_TAKE       | PinXXXOwner PinFlist::take(const PinXXXTypeField &fld, PinBool optional=false);<br>// For field types, where XXX is<br>// Int, Uint, Num, Enum, Tstamp, Str, Binstr, Poid, BigDecimal, Sub   |
| PIN_FLIST_ELEM_ADD       | PinFlistObserver PinFlist::add(const PinArrayTypeField &fld, PinRecId id)  |
| PIN_FLIST_ELEM_COUNT     | int PinFlist::count(const PinArrayTypeField& fld);   |
| PIN_FLIST_ELEM_DROP      | void PinFlist::drop(const PinArrayTypeField& fld, PinRecId id);  |
| PIN_FLIST_ELEM_GET       | PinFlistObserver<br>PinFlist::get(const PinArrayTypeField& fld, PinRecId id, PinBool optional = PIN_BOOLEAN_FALSE);  |
| PIN_FLIST_ELEM_GET_NEXT  | PinElemObservingIterator::next();  |
| PIN_FLIST_ELEM_PUT       | void PinFlist::put(const PinArrayTypeField& fld, PinFlistOwner&, PinRecId id);   |
| PIN_FLIST_ELEM_SET       | void PinFlist::set(const PinArrayTypeField& fld, PinFlistBase&, PinRecId id);  |
| PIN_FLIST_ELEM_TAKE      | PinFlistOwner<br>PinFlist::take(const PinArrayTypeField &fld, PinRecId id, PinBool optional = PIN_BOOLEAN_FALSE);  |
| PIN_FLIST_ELEM_TAKE_NEXT | PinElemObservingIterator::next();  |
| PIN_FLIST_SUBSTR_ADD     | NA   |
| PIN_FLIST_SUBSTR_DROP    | NA   |
| PIN_FLIST_SUBSTR_GET     | NA   |
| PIN_FLIST_SUBSTR_PUT     | NA   |
| PIN_FLIST_SUBSTR_SET     | NA   |
| PIN_FLIST_SUBSTR_TAKE    | NA   |
| PIN_FLIST_TO_STR         | // String toString();<br>PinBool PinFlist::isNull() const;pin_flist_t*<br>PinFlist::get();pin_flist_t* PinFlist::release();  |
| PIN_POID_COMPARE         | int PinPoid::compare(const PinPoidBase &poid, int checkRev=0) const;<br>//isEqual() returns a boolean<br>//unlike compare() which acts like //strcmp();PinBool PinPoid::isEqual(const PinPoidBase &poid, int checkRev=0) const;  |
| PIN_POID_COPY            | PinPoidOwner<br>PinPoid::clone() const;  |

**Table 27–1 (Cont.) Comparison of C++ and C APIs in PCM**

| PCM C API                 | PCM C++ API   |
|---------------------------|---|
| PIN_POID_CREATE           | static PinPoidOwner<br>PinPoid::create(PinPoidDb db, PinPoidType type, PinPoidId id);   |
| NA                        | static PinPoidObserver<br>PinPoid::createAsObserved(poid_t *pdp);<br>static PinPoidOwner<br>PinPoid::createAsOwned(poid_t *pdp);  |
| PIN_POID_DESTROY          | static void PinPoid::destroy(PinPoid *obj);   |
| PIN_POID_GET_DB           | PinPoidDb PinPoid::getDb() const;   |
| PIN_POID_GET_ID           | PinPoidId PinPoid::getId() const;   |
| PIN_POID_GET_TYPE         | PinPoidType PinPoid::getType() const;   |
| PIN_POID_GET_REV          | PinPoidRev PinPoid::getRev() const;   |
| PIN_POID_IS_NULL          | PinBool PinPoid::isNull() const;  |
| PIN_POID_IS_TYPE_ONLY     | PinBool PinPoid::isTypeOnly() const;  |
| PIN_POID_TO_STR           | void PinPoid::toString(char buf[ ], int bufsize, int skiprev=0) const;  |
| pbo_decimal_abs           | PinBigDecimal::abs() const;   |
| pbo_decimal_abs_assign    | NA  |
| pbo_decimal_add           | PinBigDecimal::operator+(const PinBigDecimal& val);<br>PinBigDecimal::operator+=(const PinBigDecimal& val);   |
| pbo_decimal_add_assign    | NA  |
| pbo_decimal_compare       | int PinBigDecimal::compare(const PinBigDecimal& val) const;<br>PinBool PinBigDecimal::isZero() const;PinBool<br>PinBigDecimal::isLessThanZero() const;PinBool<br>PinBigDecimal::isGreaterThanZero() const;                              |
| pbo_decimal_copy          | NA  |
| pbo_decimal_divide        | PinBigDecimal::operator/(const PinBigDecimal& val);<br>PinBigDecimal::operator/=(const PinBigDecimal& val);<br>// same result:<br>PinBigDecimal::divide(const PinBigDecimal& val, int decimalPlaces, int mode =<br>DEF_ROUNDING_MODE);  |
| pbo_decimal_divide_assign | NA  |
| pbo_decimal_from_double   | PinBigDecimal::setDouble(double val, int decimalPlaces, int mode = DEF_<br>ROUNDING_MODE);  |
| pbo_decimal_from_str      | NA  |
| pbo_decimal_is_null       | PinBool PinBigDecimal::isNull() const;  |
| pbo_decimal_is_zero       | See pbo_decimal_compare   |
| pbo_decimal_multiply      | PinBigDecimal::operator*(const PinBigDecimal& val);<br>PinBigDecimal::operator*=(const PinBigDecimal& val);<br>// same result:<br>PinBigDecimal::multiply(const PinBigDecimal& val, int decimalPlaces,int mode<br>= DEF_ROUNDING_MODE); |

**Table 27–1 (Cont.) Comparison of C++ and C APIs in PCM**

| PCM C API                   | PCM C++ API   |
|-----------------------------|---|
| pbo_decimal_multiply_assign | NA  |
| pbo_decimal_negate          | PinBigDecimal::negate() const;  |
| pbo_decimal_negate_assign   | NA  |
| pbo_decimal_round           | NA  |
| pbo_decimal_round_assign    | NA  |
| pbo_decimal_signum          | int PinBigDecimal::sigNum()   |
| pbo_decimal_subtract        | PinBigDecimal::operator-(const PinBigDecimal& val);<br>PinBigDecimal::operator-=(const PinBigDecimal& val); |
| pbo_decimal_subtract_assign | NA  |
| pbo_decimal_to_double       | PinBigDecimal::getDouble() const;   |
| pbo_decimal_to_str          | char* PinBigDecimal::toString(char* pbuf, int bufSize, int decimalPlaces = -1)<br>const;                    |

## Understanding PCM C++ Concepts

While there are several similarities between the PCM C and PCM C++ APIs, there are also some key differences. This section explains these differences in detail and explains how to approach some specific programming functions. Understanding this information allows you to take advantage of PCM C++ capabilities and should make coding easier in areas such as memory management.

### Passing Arguments

Using the C++ wrappers, you can minimize the need for dealing with untyped void pointers and explicit casting. In addition, PCM C++ includes methods that accept typed arguments. These two contrasting examples illustrate this point:

Using pointers in C:

```
time_t *endp = NULL;
time_t end_time;

endp = (time_t *) PIN_FLIST_FLD_GET(inflistp, PIN_FLDT_END_T, 1, ebufp);
end_time = (endp) ? *endp : pin_virtual_time(NULL);

PIN_FLIST_FLD_SET(outflistp, PIN_FLD_END_T, &end_time, ebufp);
```

Passing arguments in C++ :

```
PinTstampObserver endt = inflist->get(tsf_PIN_FLD_END_T, PIN_BOOLEAN_TRUE);

PinTstamp endTime = endt->isNull() ? pin_virtual_time(NULL):: endt->value();

outflist->set(tsf_PIN_FLD_END_T, endTime);
```

In the C++ example:

- When retrieving *END\_T* from the flist, no explicit casting is needed to convert from "void\*" to "time\_t\*".
- When setting the value of *END\_T* in the flist, you pass a typed argument (value) instead of an untyped pointer (pointer to the value).

## Using Arrays

To walk through elements of an array in a flist, PCM C exposes a cookie-based interface, where it is the responsibility of the caller to initialize the cookie and pass it to a series of calls to retrieve the members of the array:

```
//Example in C initializting and passing a cookie
pin_cookie_t cookie = NULL;
while ((elem = PIN_FLIST_ELEM_GET_NEXT
        (flistp, PIN_FLD_BALANCES, &elemid, 1, &cookie, ebufp)) != NULL) {
    ...
}
```

In contrast, PCM C++ uses iterator objects, which eliminate some common programming mistakes and also introduce commonly used patterns. A sample of iterator objects in C++:

```
//Example in C++ using iterator objects
PinElemObservingIterator iter;
for (iter = flist->getElements(tsf_PIN_FLD_BALANCES);
     iter.hasMore();) {

    PinFlistObserver aResource = iter.next();
    cout << "Resource id: " << iter.getRecId();
    ...
}
```

## Using Smart Pointers to Manage Memory

C++ wrappers use constructs, generically called smart pointers, which are similar to the *auto\_ptr* in the standard C++ library. Smart pointers are objects designed to look and act like built-in pointers, but offer greater functionality: smart pointers overload the operator `->` (and sometimes the operator `*`).

PCM C++ uses smart pointers to eliminate the need for careful and explicit memory management that is required in PCM C. Because the smart pointer objects used to manipulate flists, POIDs, and connections are eliminated when the object is deleted or goes out of scope, the underlying resource, such as the flist, Portal object ID (POID), or connection, is freed.

---

---

**Note:** Though it is common for smart pointers to be implemented using C++ templates, the PCM C++ implementation of smart pointers does not use them. This ensures consistent behavior on all BRM platforms.

---

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### Construction and Destruction

All flist, POID, and connection manipulations in PCM C++ are accomplished by using smart pointers. Smart pointers delete the object they point to when the last smart pointer pointing to that object is destroyed. This nearly eliminates resource leaks.

This example shows how a smart pointer is used to create an input flist:

```
void
function1()
{
    // Create input flist
    PinFlistOwner input = PinFlist::create();
}
```

```

    // Note that at the end of this block, the destructor
    // for "input" will get invoked. The destructor will
    // automatically destroy the underlying flist.
}

```

The smart pointer implementations in PCM C++ do not allow multiple smart pointer references to the same underlying object. Some of the reasons are:

- The underlying C implementation of flist does not allow reference counting, which adds overhead.
- A typical flist usage pattern requires a single pointer to an flist.
- Even done correctly, multiple pointers to the same flist can result in errors that are difficult to debug.

## Copying and Assignment

In PCM C++, object ownership is transferred when the copy constructor or the assignment operator is invoked on a smart pointer. This is similar to the *auto\_ptr* that is a standard C++ template library object. To copy the underlying data, use **clone()**. Because object ownership is transferred when the copy constructor is called, passing these smart pointers by value is not recommended.

The correct usage is to pass smart pointers using references, as shown below:

```

void function1()
{
    // Connect to Portal
    PinContextOwner context = PinContext::create();

    // Get the plan list
    // (Note that the context smart pointer is passed by reference, not by value.
    // If it were passed by value, the underlying connection would have been
    destroyed
    // when function2() finishes and also "context" would be pointing to
    // a freed connection!!)
    function2(context);
}

void function2(
    PinContextBase &context)
{
    ...
}

```

## Using Field Value Ownership

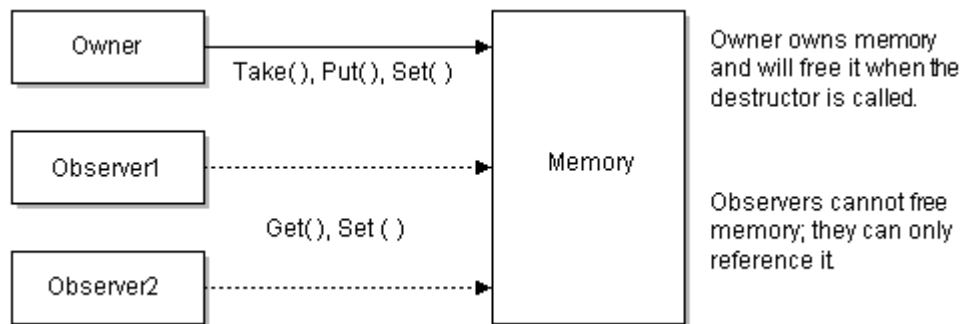
Manipulating flists is done differently in PCM C++ than in PCM C. The PCM C API provides different sets of functions to manipulate flists.

- `PIN_FLIST_FLD_GET()`, `PIN_FLIST_SUBSTR_GET()`, and `PIN_FLIST_ELEM_GET()` are used to access to the contents of the flist using pointers. This is like peeking inside the flist. The underlying flist retains ownership of the memory.
- With `PIN_FLIST_XXX_TAKE()`, the underlying flist relinquishes ownership of the pointed to block of memory and returns a pointer to the caller. The caller is now responsible for freeing the contents.
- `PIN_FLIST_XXX_SET()` is used to add new fields into an flist. The flist makes a copy of the passed in memory block and owns the copied block.
- `PIN_FLIST_XXX_PUT()` transfers ownership of field values to the flist.

PCM C++ provides overloaded methods in the **PinFlist** class to deal with these four methods: **get()**, **take()**, **set()**, **put()**. Correct memory management is enforced by defining two types of smart pointers: observers and owners as shown in [Figure 27-1](#).

- Observers do not delete the wrapped BRM data structure (object) pointed to when they are destroyed.
- Owners delete the object pointed to when they are destroyed, unless they are assigned or passed to a copy constructor.

**Figure 27-1 Owner and Observer Memory Management**



The **PinFlist::get()** method returns an observer. The **take()** method returns an owner style smart pointer. Similarly, the **put()** method accepts only an owner. The **set()** method accepts either an observer or an owner. Relying on method signatures to do clean memory management is preferable to manual and careful programming. The following example shows the proper usage:

```

PinIntObserver flags = input->get(tsf_PIN_FLD_FLAGS);
// The following put() call will not compile because
// you cannot transfer ownership of something that you
// do not own!!
//      output->put(tsf_PIN_FLD_FLAGS, flags);

// The set() will work fine...because a copy is made.
output->set(tsf_PIN_FLD_FLAGS, flags);
  
```

## Using PinBigDecimal

The PCM C++ **PinBigDecimal** class can be used with many standard C++ programming features. However, there are some differences which are documented in this section.

For a sample program illustrating **PinBigDecimal**, see **sample\_PinBD.cpp** located in **BRM\_SDK\_Home\source\samples\apps\C++**.

### Field Value Ownership

The PCM C++ class **PinBigDecimal** does not formally support the owner/observer model used by other PCM C++ classes. This alternative approach allows you to directly create and manipulate a **PinBigDecimal**, which makes it much easier to use in arithmetic expressions.

**PinBigDecimal** creates a base *object*, which is destroyed automatically when it goes out of scope. This concept is described in "[Using Smart Pointers to Manage Memory](#)".



This sample shows how to use **PinBigDecimal**. As noted above, PCM C++ creates a **PinBigDecimal** object that is destroyed automatically when it goes out of scope (in this example, when the function is exited).

```
{
    PinBigDecimal num1( "22.57" );
    ...
}
```

### Using PinBigDecimal with Flists

PCM C+ uses a different approach than PCM C to setting (or getting) a *PinBigDecimal* value into (or from) an flist. In PCM C, you must carefully program using low-level functions: the `PIN_FLIST_FLD_SET` macro with the **PinBigDecimal.get()** method to retrieve the pointer to the actual big decimal number in *pin\_decimal\_t\**. This is shown below:

```
PinBigDecimal sum = num3 + num4;

PinErrorBuf ebuf;
pin_flist_t* flistp = PIN_FLIST_CREATE( &ebuf );
PIN_FLIST_FLD_SET( flistp, PIN_FLD_DUE, sum.get(), &ebuf );
::printFlist( "The Flist I just created with C API...", flistp );
PinBigDecimal due( (pin_decimal_t*) PIN_FLIST_FLD_GET( flistp, PIN_FLD_DUE, 1,
&ebuf ));
PIN_FLIST_DESTROY( flistp, 0 );
due.toString( buf, sizeof( buf ), due.getNumDecimalPlaces() );
::printf( "The value pulled from the Flist for PIN_FLD_DUE is: %s\n\n", buf );
```

In PCM C++, this low-level approach is unnecessary. Because C++ is object oriented and type safe, you can **set()** a **PinBigDecimal** *object* to the flist, which is shown below:

```
PinBigDecimal num3( 22.578979, 5 );
PinBigDecimal num4( double_val, 2, ROUND_HALF_DOWN );
PinBigDecimal sum = num3 + num4;

PinFlistOwner cpp_flist = PinFlist::create();
cpp_flist->set( tsf_PIN_FLD_DUE, sum );
::printFlist( "The Flist I just created with the C++ API...", cpp_flist->get() );
due = cpp_flist->get( tsf_PIN_FLD_DUE )->get();
due.toString( buf, sizeof( buf ), due.getNumDecimalPlaces() );
::printf( "The value pulled from the Flist for PIN_FLD_DUE is: %s\n\n", buf );
```

### Using the toString() Method

To use **PinBigDecimal** with **toString()**, you must pass a parameter containing the number of decimal places to be set in the returned string. To do this, call **PinBigDecimal::getNumDecimalPlaces()**.

---

**Note:** In some implementations, this is unnecessary because there is a default value for the number of decimal places. This is not yet implemented in PCM C++.

---

The following sample shows one method of converting a **PinBigDecimal** to a string by passing the necessary parameters.

```
char buf[100];
PinBigDecimal num1( "22.57" );
PinBigDecimal num2( "99" );
```

```
PinBigDecimal sum = num1 + num2;

PinErrorBuf ebuf;
pin_flist_t* flistp = PIN_FLIST_CREATE( &ebuf );
PIN_FLIST_FLD_SET( flistp, PIN_FLD_DUE, sum.get(), &ebuf );
::printFlist( "The Flist I just created with C API...", flistp );

PinBigDecimal due( (pin_decimal_t*) PIN_FLIST_FLD_GET( flistp, PIN_FLD_DUE, 1,
&ebuf ));
PIN_FLIST_DESTROY( flistp, 0 );
due.toString( buf, sizeof( buf ), due.getNumDecimalPlaces() );
::printf( "The value pulled from the Flist for PIN_FLD_DUE is: %s\n\n", buf );
```

## Using the Divide Method

Because the decimal result can be infinite (for example  $1/3=.333333\dots$ ), the divide method of **PinBigDecimal** requires you to define the number of decimal places in the result. (The number of decimal places is called the scale.) Limiting the scale of the result introduces a rounding question, which is answered by defining the rounding method to be used. Defaults for both the scale and rounding method are defined in the **PinBigDecimal.h** file: the default scale is 10 [*DEF\_DIV\_DECIMAL\_PLACES (10)*] and the default rounding method is "half up" [*DEF\_ROUNDING\_MODE (ROUND\_HALF\_UP)*].

This sample shows the divide method of **PinBigDecimal** using the default scale:

```
char buf[100];
char buf1[100];
char buf2[100];

PinBigDecimal num1 = "18.4328";
PinBigDecimal num2 = "3.4937";

PinBigDecimal num3 = num1 / num2;

num1.toString( buf, sizeof( buf ), num1.getNumDecimalPlaces() );
num2.toString( buf1, sizeof( buf1 ), num2.getNumDecimalPlaces() );
num3.toString( buf2, sizeof( buf2 ), num3.getNumDecimalPlaces() );

cout << buf << " / " << buf1 << " is: " << buf2 << endl;
```

To programmatically specify the number of decimal places and/or the rounding mode, you must call the **divide** method, as shown in this example:

```
// The above statement "num3 = num1 / num2" will NOT be the same as the following
call
// to the divide method.

PinBigDecimal num4 = num1;
num4.divide( num2, 9, ROUND_HALF_UP );
num4.toString( buf2, sizeof( buf2 ), num4.getNumDecimalPlaces() );

cout << buf << " divided by " << buf1 << " is: " << buf2 << endl;
```

To programmatically specify the number of decimal places and/or the rounding mode, you must call the **divide** method.

## Using a Null Pointer

You can use a special *null* pointer as a value to indicate that a feature is unused. For example, if a customer chooses not to enroll in an optional stock purchase plan, you

can pass an flist with a null pointer for this option to the database to indicate that the customer is not participating.

Performing an arithmetic function on a **PinBigDecimal** variable containing a null pointer causes the **class PinBigDecimal** to throw an exception. However, you can use a null pointer successfully with the **try** and **catch** commands. This sample code illustrates this:

```
char* pnull = 0;
PinBigDecimal null_val = PinBigDecimal( pnull );
try
{
    PinBigDecimal bad_idea; // The default constructor will set the value to
zero.
    bad_idea += null_val;
    ::printf( "The program should NEVER get here...\n\n" );
}
catch ( const PinEbufExc& /*cExcpn*/ )
{
    null_val.toString( buf, sizeof( buf ), 2 );
    ::printf( "The string value of a null PinBigDecimal is: %s\n\n", buf );
}
```

---

**Note:** **PinEbufExc** is the specific error thrown under these circumstances.

---

## Handling Exceptions

PCM C is macro-based and uses series-style **ebuf**-based error checking. Since the same structure is used by all the function calls, all calls return immediately without any action after the first error is recorded in the **ebuf**. This style avoids an explicit error check after every line and allows you to group error handling logic toward the end of the function. The disadvantage is that almost every line following the error-inducing statement has the potential to be executed.

In PCM C++, exceptions are used instead, which takes advantage of the support provided by the language run-time. The error handling in PCM C++ primarily uses an exception class, **PinEbufExc**, which is a wrapper for the underlying C data structure (*pin\_errbuf\_t*). Use the class, **PinErrorBuf**, to access *pin\_errbuf\_t*.

There is one important difference: in the C API, when returning errors from a function using **ebuf**, you can return other values, such as output flists, by using output parameters. However, in C++, when an exception is thrown, the normal path of return is not available. To accommodate passing error flists back, the **PinEbufExc** class has a data member, **PinFlistOwner**.

This example shows error handling in PCM C++ using this method:

```
ostream&
operator<<(
ostream &os,
PinEbufExc &exc)
{
    os << "Pin Exception";
    os << exc.getFlistRef() << endl;
    PIN_LOG(exc, PIN_ERR_LEVEL_ERROR, "");
    return os;
};
```

This example shows error handling in PCM C++ using the exception buffer:

```
try {
    // Connect to Portal
    PinContextOwner context = PinContext::create();

} catch (const PinEbufExc &exc) {
    // Handle the error.
    PIN_LOG(exc, PIN_ERR_LEVEL_ERR, "Connect failed");
}
```

See **Pin\_Log** for more information.

If an error occurs while processing an flist, the returned flist contains the error message. The following three code excerpts show how to print the flist to various devices.

This example shows the special overridden operator used to print out an flist:

```
ostream&
operator<<(ostream &os, PinFlistBase &flist)
{
    char *strp = NULL;
    PinErrorBuf ebuf;
    int32 len = 0;

    pin_flist_t *fp = NULL;
    if (! flist.isNullWrapperPtr()) {
        fp = flist->get();
    }
    // convert to string
    PIN_FLIST_TO_STR(fp, &strp, &len, &ebuf);
    // print out to current stream
    os << strp;

    if (strp != NULL) {
        pin_free(strp);
    }

    return os;
};
```

To print the flist to the console:

```
// Print output flist
cout<<"outFlist:"<<endl<<outFlist<<endl;
```

The **PinEbufExc** object contains the **PinErrorBuf** object, which is inherited from the PCM C structure, *pin\_errbuf*. This buffer contains all the information about the error.

In PCM C++, define your own operator <<:

```
ostream&
operator<<(ostream &os, PinEbufExc &exc)
{
    os << "Pin Exception";
    os << exc.getFlistRef() << endl;
    PIN_LOG(exc, PIN_ERR_LEVEL_ERROR, "");
    return os;
};
```

and then use it to print **PinEbufExc** to the console and write information

to **PinLog**:

```
} catch (PinEbufExc &exc) {
    cout << exc << endl;
}
```

## Logging to pinlog

The **PinLog** class is a minimalist class. It only provides type-safe wrappers that accept the PCM C++ class instances as arguments to the overloaded **log()** method.

Two macros, **PIN\_LOG** and **PIN\_MSG**, use the **PinLog** class. They allow you to pick up the current file and line number. Three examples of logging are:

```
PIN_LOG(flist, PIN_ERR_LEVEL_DEBUG, "Input to XXX");

PIN_LOG(ebufException, PIN_ERR_LEVEL_ERROR, "Create Account:");

PIN_MSG(PIN_ERR_LEVEL_WARNING, "Exceeding Cache Size");
```

For more information, see **Pin\_Log** and **Pin\_Msg**.

## Accessing Configuration Values by Using pin.conf

The **PinConf** class provides static methods to get configuration values from a **pin.conf** file. Since the underlying **pin\_conf()** PCM C library function returns an allocated memory block, the **PinConf** class type safe methods return owner-style smart pointers.

This example uses **PinConf** to access configuration values in a **pin.conf** file:

```
PinIntOwner dbg = PinConf::getInt("ldap_ds", "debug", 1);
int32 pinLdapDebug = (dbg->isNull() ? 0 : dbg->value());
```

## Using PCM C++ with PCM C

There are many situations where you might want to mix the PCM C and PCM C++ APIs.

- Although PCM C++ provides useful abstractions, it is not complete. For example, it does not support buffer data types.
- New functionality based on PCM C++ might be developed and has to coexist with legacy code written in PCM C API. Also, this approach allows you to experiment and become familiar with PCM C++ without having to rewrite entire applications.
- Some PCM C API code is needed in rare situations, for example, invoking the **PCM\_OP\_SEARCH** opcode. PCM C++ enables the coexistence and mixing of the two APIs within the same application as follows:

```
PinFlistObserver flist = PinFlist::create();
// Get the underlying C flist data structure
pin_flist_t *flistp = flist->get();
// Pass the C data structure to some C function
PIN_FLIST_PRINT(flistp, 0, ebufp);
```

- This allows access to the underlying PCM C API objects that PCM C++ manages. For example, the **PinFlist** class can access the PCM C flist it holds. Obviously, doing destructive things to the underlying C object will make the C++ object inconsistent.

Factory methods of the various PCM C++ classes take in pointers to PCM C API data structures, in addition to default factory methods that can create the PCM C

API data structure automatically. Also, depending on the model of interfacing with the PCM C API, you can control the lifetime of the C data structures by creating observer or owner smart pointers, as in this example:

```
main() {
    pcm_context_t *ctxp = (pcm_context_t*) NULL;
    int64 dbno = 0;
    PCM_CONNECT(&ctxp, &dbno, ebufp);
    ...
}
PinContextObserver context = PinContext::createAsObserved(ctxp);
```

## Using the PCM C++ API

The basic structure of a BRM PCM C++ client application is similar to other BRM client applications:

1. Open a connection using **PinContext**.
2. Create an flist.
3. Perform PCM operations.
4. Check for errors.
5. Close the connection.

## Opening a PCM Connection

The **PinContext** class is a wrapper around the *pcm\_context* data structure in the PCM C API. The data structure represents a connection from a BRM client to the server--a Connection Manager (CM).

Use the factory method **create()** to initiate a connection to the CM. This method uses the connection parameters from either an flist or as specified in the **pin.conf** file of the client application. Use either of these methods to open a connection:

- Call the **create()** factory method in the **PinContext** class. Using parameters contained in an flist, provide all the login information needed, including the host name and the port number. A program to be used by CSRs can use this method to force authentication.

For a C++ sample, look for the **create\_context.cpp** sample file in *BRM\_Home/source/samples/context/C++* directory, where *BRM\_Home* is the directory in which you installed BRM components. For more information, see **PCM\_CONTEXT\_OPEN**.

- If you want your program to automatically log in to BRM, use the **create()** method without parameters. You must store all the necessary login information in the *cm\_ptr* and the *userid* connection parameters in your application's **pin.conf** file. Use one **pin.conf** file to configure C++ and C applications. A billing application run from a cron job would use this method.

For more information on the **pin.conf** file, see ["Adding or Changing Login Options"](#).

For more information, see **PCM\_CONTEXT\_OPEN** and **PCM\_CONNECT**.

---



---

**Important:** In your application, when you open a context and connect to the BRM server, perform all the PCM operations before closing the context. Connections add a significant overhead to the system which affects performance. Therefore, to improve performance, perform all the operations within an open context instead of opening and closing contexts frequently. Use CM proxy for applications that cannot maintain an open context for a long time. For more information, see "Using CM Proxy to Allow Unauthenticated Log on" in *BRM System Administrator's Guide*.

---



---

Like the other PCM C++ classes, **PinContext** class instances are manipulated by using smart pointer classes: **PinContextOwner** and **PinContextObserver**.

This example shows a connection that gets the logon parameters from the application's **pin.conf** file:

```
try {
    // Connect to Portal. Get the connection info from the pin.conf file of
    the
    // client application.
    PinContextOwner context = PinContext::create();

    // The connection is terminated automatically and the PinContext
    // object managed by the PinContextOwner is destroyed automatically.

} catch (PinEbufException &exc) {
    // Deal with the error.
    PIN_LOG(exc, PIN_ERR_LEVEL_ERR, "Connect failed");
}
```

When you create a context using either method (**PinContextOwner** or **PinContextObserver**), a *pcm\_context\_t* data structure is created automatically in C. A pointer to the data structure is automatically returned (access it by using **call Get()**). You can create additional context objects by using this pointer. Use this to pass a data structure to another application.

## Closing a PCM Connection

Close a connection to BRM by using PCM C++ with one of the following methods:

- A context can be closed automatically by going out of scope. This occurs when smart pointers have been used. The context is automatically closed when the function ends.
- If you want to close the connection context (opened as an Observer) with the server (and the data structure in *pcm\_context\_t*) before the function ends, use this method:

```
void close(int how=n)
```

- To close the connection context (opened as an Owner) with the server and to destroy a **PinContext** object before the function ends, use this method:

```
static void destroy(PinContext *obj)
```

---



---

**Note:** If the context was opened as Owner, **destroy** also closes the connection context.

---



---

The parameters shown above are described in `PCM_Context` class.

For more information on `PinContext` functions, see `PinContext`.

## Creating Custom Fields

To create custom fields using PCM C++:

1. In the `customfld.h` file, create your `#define` manually. For example, assume that a custom int field called `CUSTOM_FLD_AGE` is defined as follows:

```
#define CUSTOM_FLD_AGE      10001
...
#define CUSTOM_FLD_AGE PIN_MAKE_FLD(PIN_FLDT_INT, 10001)
```

The following table lists the field ID ranges for Oracle-only use and for customer use:

**Table 27–2 BRM Field ID Restrictions**

| Field ID Range              | Reserved For    |
|-----------------------------|-----------------|
| 0 through 9999              | Oracle use only |
| 10,000 through 999,999      | Customer use    |
| 1,000,000 through 9,999,999 | Oracle use only |
| Over 10,000,000             | Customer use    |

2. Instantiate a new C++ object:

```
const PinIntTypeField tsf_CUSTOM_FLD_AGE(CUSTOM_FLD_AGE);
```

---

**Note:** By convention, the prefix `tsf_` is used for the C++ version of the field. `tsf` is an acronym for type-safe field.

---

3. Include `customfld.h` in your application.
4. Use the custom field with the `PinFlist` class:

```
flist->set(tsf_CUSTOM_FLD_AGE, 22);
```

## Creating an Flist

To create and use flists in PCM C++, use the flist factory method.

1. Create the input flist using `PinFlist::create()`.
2. `set` the values into the flist using the methods available in the `PinFlist` class. The suggested convention is to preface the variable name with "tsf\_" (type safe field).

Several sample programs are available that illustrate:

- Simple flists.
- Flists with arrays.
- Flists with substructs.

For more information on the PCM C++ sample files, see "About Using the PCM C++ Sample Programs" in *BRM Developer's Reference*.



## Getting an Flist in Text Format

When debugging, it is often useful to read a text representation of an flist. The **FList** API provides the `toString()` method for general purposes. See "[Using the toString\(\) Method](#)".

## Debugging PCM C++ Programs

Write a sample C++ program to test connections, load flists from files, use the flists as input when calling opcodes on the server, and to display the returned flist.

For more information on error handling, see "[Handling Exceptions](#)".

This sample uses overloaded `<<` operators to print information about lists and POIDs to the console. This is helpful in debugging.

```
ostream&
operator<<(ostream &os, PinPoidBase &poid)
{
    char str[512];
    poid->toString(str, sizeof(str));
    os<<str;
    return os;
};
```

## Troubleshooting

In PCM C++, object ownership is transferred when the copy constructor or the assignment operator is invoked on a smart pointer. This behavior can cause errors that are difficult to debug, as shown below:

```
class function1
{
    PinPoidOwner m_AcctPoid
    ...
};

...

function1::process()
{
    ;process()
    {
        PinPoidOwner t=m_AcctPoid;
        // The assignment owner took the memory. When the block ends, t goes
        // out of scope, the destructor is called, and the memory is freed.
        // An error might occur because m_AcctPoid now points to freed memory.
        ...
    }
    ...

    // The following will crash because memory was freed when t went out of scope.

    Print(m_AcctPoid);
```



---

## Creating BRM Client Applications by Using the MTA Framework

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) multithreaded application (MTA) framework and how to use the framework to create BRM multithreaded client applications.

Before using the MTA framework, you must be familiar with the following:

- BRM flists and storable classes. See ["Understanding Flists and Storable Classes"](#).
- PCM opcodes and PIN libraries. See ["Understanding the PCM API and the PIN Library"](#).
- Error handling routines. See ["Understanding API Error Handling and Logging"](#).

### About the BRM MTA Framework

You use BRM multithreaded application (MTA) framework to create customizable multithreaded BRM client applications. A multithreaded application uses multiple threads that run in parallel to process a single task. By using multiple worker threads, BRM MTAs are able to process jobs more quickly.

BRM MTAs use a standard program structure, making it easier to code and maintain. In each application, one main thread is responsible for getting data from the BRM database, and a number of worker threads process the job in parallel. The BRM MTA framework manages all thread handling seamlessly, allowing your application to ignore thread management.

Typically, you use a multithreaded BRM client application when you have a *large* job that can be grouped into batches and processed concurrently. For example, BRM's **pin\_deferred\_act**, **pin\_bill\_accts**, **pin\_collect**, and **pin\_cycle\_fees** billing utilities use the MTA framework to retrieve information from the BRM database for the accounts that they process.

The BRM MTA framework is based on a multi-layered architecture that allows you to create customizable BRM MTAs. For information about this architecture, see ["BRM MTA Framework Layers"](#).

The BRM MTA framework provides function and opcode hooks that you implement to create customizable multithreaded applications. Each callback function and policy opcode is called at fixed places during application execution. For information about these execution stages, see ["MTA Stages"](#).

Information about the application, such as configuration settings and search flists are stored in a global flist. The global flist makes application information available to all three layers: Framework, Application, and Customization. For information about the

global flist structure, see ["MTA Global Flist Structure"](#).

*Function hooks* are provided as MTA callback functions, which you use to implement your application's business logic in the Application layer. See ["Creating a Multithreaded BRM Client Application"](#).

*Opcode hooks* are custom policy opcodes that you write to customize the business logic in the Customization layer. See ["Customizing BRM Multithreaded Client Applications"](#).

Each callback function and policy opcode provides a specific functionality. For details, see ["Using the BRM MTA Framework"](#).

## BRM MTA Framework Layers

The BRM MTA framework has three layers:

- **Framework layer**

This layer is implemented at the application tier in the BRM four-tier architecture. This layer implements the main thread that controls application workflow. The main thread performs database searches, distributes jobs to worker threads, and calls the callback functions in the Application layer and the custom policy opcodes in the Customization layer.

- **Application layer**

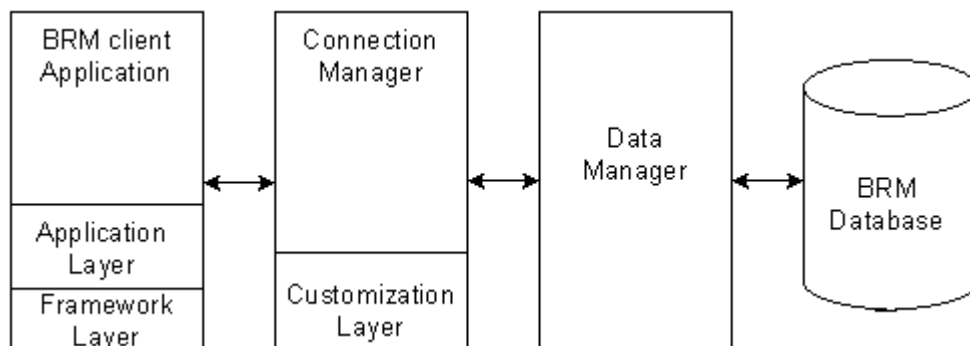
This layer is implemented at the application tier. This layer consists of the MTA callback functions. You use callback functions to implement your application business logic, such as calling billing opcodes to perform billing or generate invoices.

- **Customization layer**

This layer is implemented at the Connection Manager (CM) tier. This layer consists of custom policy opcodes. You use policy opcodes to customize the application business logic implemented in the Application layer.

[Figure 28–1](#) shows the architecture of the BRM MTA framework layers:

**Figure 28–1 BRM MTA Framework Architecture**

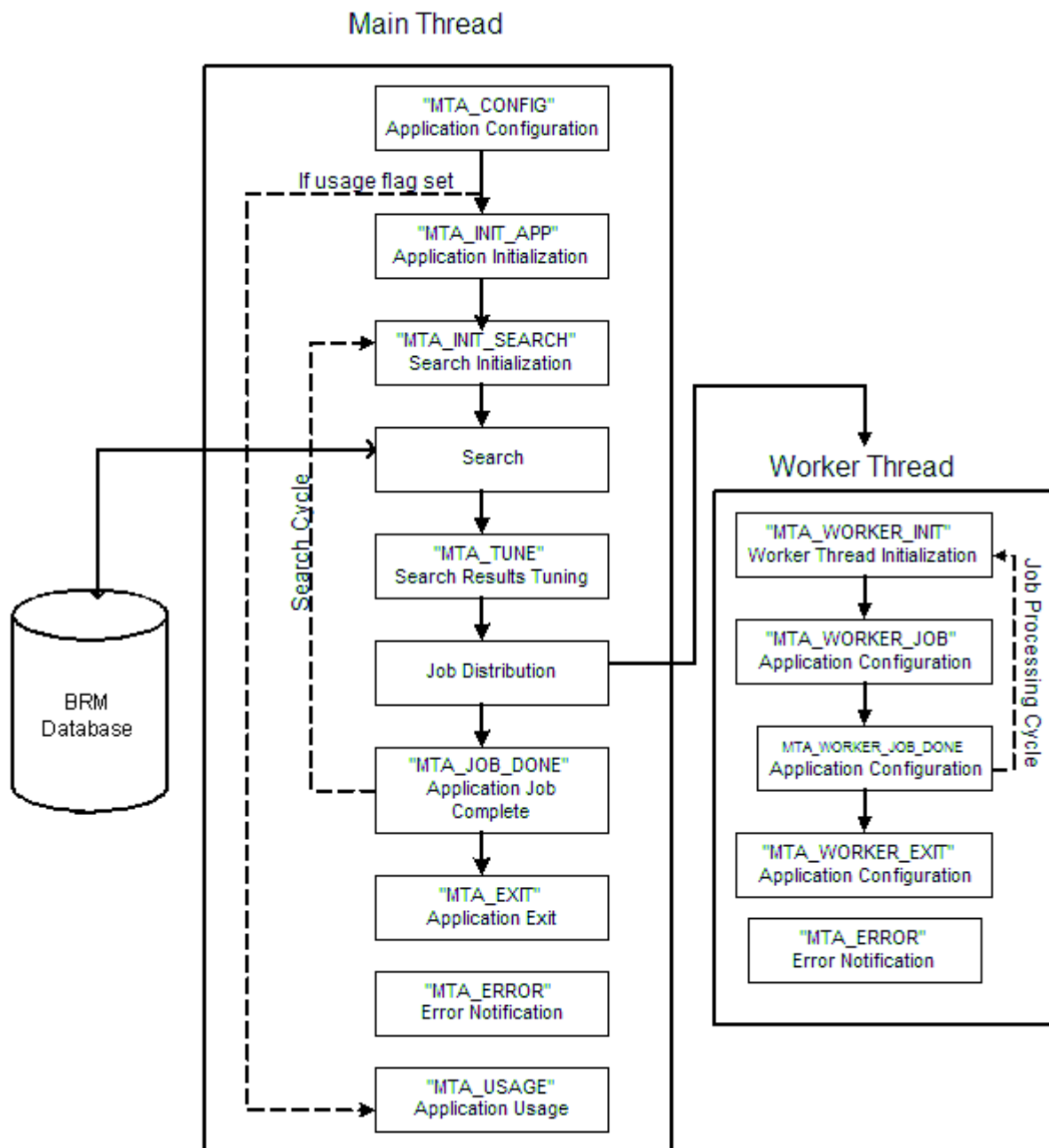


## MTA Stages

Each BRM multithreaded application has a standard program structure and standard execution stages. The main thread manages the application workflow by calling the MTA functions and policy opcodes in a set order at each execution stage.

[Figure 28–2](#) shows the BRM MTA execution stages and workflow.

Figure 28–2 BRM MTA Execution Stages and Workflow



### MTA\_CONFIG Execution Stage

Each BRM multithreaded client application requires a configuration file (**pin.conf**) and can have command-line parameters. The MTA framework performs default application configuration based on the information in the **pin.conf** file and command-line parameters. You can write custom policy opcodes to provide custom configurations.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

1. [pin\\_mta\\_config](#)
2. [MTA\\_CONFIG](#)

- [pin\\_mta\\_post\\_config](#)

### MTA\_INIT\_APP Execution Stage

Application initialization occurs after the application has been configured successfully. The main thread spawns a number of worker threads, and the application completes all tasks that are required before the main search execution is performed.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

- [pin\\_mta\\_init\\_app](#)
- [MTA\\_INIT\\_APP](#)
- [pin\\_mta\\_post\\_init\\_app](#)

### MTA\_INIT\_SEARCH Execution Stage

During search initialization, the search flist is prepared. This flist is provided as the input to the search opcodes. You can write custom policy opcodes to modify the search flist.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

- [pin\\_mta\\_init\\_search](#)
- [MTA\\_INIT\\_SEARCH](#)
- [pin\\_mta\\_post\\_init\\_search](#)

### Search Execution

At the search execution stage, the main thread calls the search opcodes (PCM\_OP\_SEARCH, PCM\_OP\_STEP\_SEARCH, and PCM\_OP\_STEP\_NEXT) to find the objects or search results.

---

---

**Note:** The search results are sent to the client a block at a time. The block size is equal to the fetch size specified in the application's **pin.conf** file. The search opcodes are called as many times as needed until all the search results are received. For more information, see "[Configuring your Multithreaded Application](#)".

---

---

### MTA\_TUNE Execution Stage

After a block of search results is passed to the application, the results can be tuned or modified before they are distributed in batches to the worker threads for processing.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

- [pin\\_mta\\_tune](#)
- [MTA\\_TUNE](#)
- [pin\\_mta\\_post\\_tune](#)

### Job Distribution

The basic purpose of a BRM multithreaded client application is to manage the distribution of a job to worker threads. After search execution and search results

tuning, the main thread adds the search results to the job pool and notifies worker threads to begin processing.

### **MTA\_JOB\_DONE Execution Stage**

After worker threads have been notified of an available job in the job pool, the main thread waits for notification back from the worker threads that their assigned jobs are completed. When all results from the main search have been processed and the job pool is empty, the next search cycle is executed until there are no more search results remaining in the database.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

1. [pin\\_mta\\_job\\_done](#)
2. [MTA\\_JOB\\_DONE](#)
3. [pin\\_mta\\_post\\_job\\_done](#)

### **MTA\_EXIT Execution Stage**

When there are no more jobs to process, the application terminates all threads, closes the database connection, and exits.

The main thread calls the following MTA callback functions and the custom policy opcode hook in this order:

1. [pin\\_mta\\_exit](#)
2. [MTA\\_EXIT](#)
3. [pin\\_mta\\_post\\_exit](#)

### **MTA\_WORKER\_INIT Execution Stage**

Worker threads are spawned at the application initialization stage. After initialization, the worker threads remain in wait mode until they are notified by the main thread of an available job in the job pool.

The following MTA callback functions and the policy opcode hook are called in this order by each worker thread:

1. [pin\\_mta\\_worker\\_init](#)
2. [MTA\\_WORKER\\_INIT](#)
3. [pin\\_mta\\_post\\_worker\\_init](#)

### **MTA\_WORKER\_JOB Execution Stage**

After worker threads have been notified of an available job in the job pool, they receive their assigned batch of search results and then call the main opcode to process the work. The input flist for the main opcode is prepared here prior to the opcode call.

The following MTA callback functions and the policy opcode hook are called by each worker thread in this order:

1. [pin\\_mta\\_worker\\_job](#)
2. [MTA\\_WORKER\\_JOB](#)
3. [pin\\_mta\\_post\\_worker\\_job](#)

### Worker Thread Job Execution

Each worker thread calls the "[pin\\_mta\\_worker\\_opcode](#)" callback function and passes the search results for processing.

### MTA\_WORKER\_JOB\_DONE Execution Stage

When worker threads have completed their assigned job, they notify the main thread and return to wait mode until more work becomes available.

After a worker thread has completed its job, it calls the following callback functions and policy opcode hook to perform any required tasks:

1. [pin\\_mta\\_worker\\_job\\_done](#)
2. [MTA\\_WORKER\\_JOB\\_DONE](#)
3. [pin\\_mta\\_post\\_worker\\_job\\_done](#)

### MTA\_WORKER\_EXIT Execution Stage

Worker threads are terminated when there are no more jobs for the application to process.

The following MTA callback functions and the custom policy opcode hook are called in this order by each worker thread to perform any tasks before the thread exits:

1. [pin\\_mta\\_worker\\_exit](#)
2. [MTA\\_WORKER\\_EXIT](#)
3. [pin\\_mta\\_post\\_worker\\_exit](#)

## MTA Global Flist Structure

The BRM MTA framework includes a global flist that stores information specific to the application, such as configuration settings, search flists, and search results. Information stored in the global flist is accessed by the MTA callback functions and custom policy opcodes.

The global flist contains the following fields:

```
0 PIN_FLD_CONFIG_OBJ          SUBSTRUCT [0]
0 PIN_FLD_APPLICATION_INFO    SUBSTRUCT [0]
0 PIN_FLD_SEARCH_FLIST        SUBSTRUCT [0]
0 PIN_FLD_SEARCH_RESULTS      SUBSTRUCT [0]
0 PIN_FLD_EXTENDED_INFO       SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO      SUBSTRUCT [0]
```

The `PIN_FLD_CONFIG_OBJ` substruct is populated with information from the `/config/mta` object. This information is used by the BRM MTA framework to determine which custom policy opcodes to call during application execution. For more information about the fields in the `PIN_FLD_CONFIG_OBJ` substruct, see "[Configuring the MTA Policy Opcodes](#)".

The `PIN_FLD_APPLICATION_INFO` substruct contains the application's configuration settings.

This substruct includes the following fields:

```
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1 PIN_FLD_NAME              STR [0]
1 PIN_FLD_CHILDREN          INT [0]
1 PIN_FLD_STEP_SIZE         INT [0]
```



```

1 PIN_FLD_BATCH_SIZE          INT [0]
1 PIN_FLD_FETCH_SIZE         INT [0]
1 PIN_FLD_NUM_RETRIES        INT [0]
1 PIN_FLD_FLAGS              INT [0]
1 PIN_FLD_MAX_ERROR          INT [0]
1 PIN_FLD_MAX_TIME           INT [0]
1 PIN_FLD_HOTLIST_FILENAME   STR [0]
1 PIN_FLD_MONITOR_FILENAME   STR [0]
1 PIN_FLD_LOGFILE            STR [0]
1 PIN_FLD_LOGLEVEL           INT [0]
1 PIN_FLD_POID_VAL           POID [0]/*Specifies the DB no.

```

where:

- PIN\_FLD\_NAME is the application name.
- PIN\_FLD\_FLAGS contains application bit flags. Flags can be added by Application layer and Customization layer developers. See `pin_mta.h` for the default MTA flags.

For details about all other PIN\_FLD\_APPLICATION\_INFO substruct fields, see ["Configuring your Multithreaded Application"](#).

The PIN\_FLD\_SEARCH\_FLIST substruct contains the search flist that is passed to the search opcodes.

This substruct includes the following fields:

```

0 PIN_FLD_SEARCH_FLIST        SUBSTRUCT [0]
1 PIN_FLD_POID                POID [0]
1 PIN_FLD_FLAGS              INT [0]
1 PIN_FLD_TEMPLATE           STR [0]
1 PIN_FLD_ARGS               ARRAY [1]
2 PIN_FLD_XXX                 STR [0]
1 PIN_FLD_RESULTS           ARRAY [0]
2 PIN_FLD_XXX                 POID [0]
1 PIN_FLD_FILENAME          STR [0]
1 PIN_FLD_COUNT              INT [0]

```

For details about these fields, see ["Configuring your Multithreaded Application"](#).

The PIN\_FLD\_SEARCH\_RESULTS substruct contains the search flist that is passed to the search opcodes.

This substruct includes the following fields:

```

0 PIN_FLD_SEARCH_RESULTS     ARRAY [0]
1 PIN_FLD_MULTI_RESULTS      ARRAY [0]
2 PIN_FLD_RESULTS           ARRAY [0]
3 PIN_FLD_XXX                POID [0]

```

where:

- PIN\_FLD\_MULTI\_RESULTS is an array containing the search results. The number of results is equal to the step size specified in the `pin.conf` file.
- PIN\_FLD\_RESULTS is an array that specifies the objects received from the database.

The PIN\_FLD\_EXTENDED\_INFO substruct is reserved for the Customization layer.

The PIN\_FLD\_OPERATION\_INFO substruct contains statistics and audit-related information.

This substruct includes the following fields:

```

1  PIN_FLD_PID          INT [0]
1  PIN_FLD_HOSTNAME    STR [0]
1  PIN_FLD_START_T     TSTAMP [0]
1  PIN_FLD_THREAD_INFO ARRAY [0]
2      PIN_FLD_START_T     TSTAMP [0]
2      PIN_FLD_END_T     TSTAMP [0]
2      PIN_FLD_ERROR_INFO ARRAY [0]
3          PIN_FLD_ERROR_NUM     INT [0]
3          PIN_FLD_SYS_ERROR_NUM INT [0]
3          PIN_FLD_ERROR_CODE    STR [0]
3          PIN_FLD_ERROR_DESCR   STR [0]
3          PIN_FLD_TRACKING_ID   STR [0]

```

where:

- PIN\_FLD\_PID specifies the process ID number.
- PIN\_FLD\_HOSTNAME specifies the host where the application runs.
- PIN\_FLD\_START\_T specifies the process or main thread start time.
- PIN\_FLD\_END\_T specifies the process end time.
- PIN\_FLD\_ERROR\_NUM specifies the total number of errors for all threads.
- PIN\_FLD\_SYSTEM\_ERROR\_NUM specifies the total number of system errors.
- PIN\_FLD\_ERROR\_CODE specifies the error code from the application **pinlog** file.
- PIN\_FLD\_ERROR\_DESCRIPTION is the description of the error from the application **pinlog** file.
- PIN\_FLD\_TRACKING\_ID specifies the correlation ID from the application **pinlog** file.

## Using the BRM MTA Framework

The BRM MTA framework is compiled as a static library. It provides a set of callback functions as hooks that you implement to develop multithreaded client applications for BRM.

### What the MTA Framework Includes

The MTA framework is included in the BRM SDK. For installation instructions and an overview, see "[About BRM SDK](#)".

The MTA framework includes the files listed in [Table 28–1](#), in the *BRM\_SDK\_Home* directory:

**Table 28–1 Files Included in MTA Framework**

| File  | Description   |
|---|---|
| <code>/include/pin_mta.h</code>                     | MTA header file   |
| <code>/lib/libmta.a</code>                          | MTA library file  |
| <code>/bin/pin_mta_monitor</code>                   | Sample monitoring utility                                       |
| <code>/source/apps/mta_sample/pin_mta_test.c</code> | Sample application using the MTA framework                      |
| <code>/source/apps/mta_sample/Makefile</code>       | Makefile to build the sample application, <b>pin_mta_test.c</b> |
| <code>/source/apps/mta_sample/pin.conf</code>       | Sample configuration file                                       |

## MTA Callback Functions

The BRM MTA callback functions (see [Table 28–2](#)) are hooks. You implement the functions in your application by providing application-specific contents.

---

**Important:** You do not have to implement all of the callback functions; however, you *must* implement `pin_mta_config` to process application command-line parameters, `pin_mta_init_search` to specify search criteria, and `pin_mta_worker_opcode` to specify the main opcode call. You implement other functions as needed.

---

**Table 28–2** MTA Callback Functions

| Function                                  | Description  |
|---|--|
| <code>pin_mta_config</code>               | Can be used for default application configuration.   |
| <code>pin_mta_exit</code>                 | Can be used for any tasks that are required before the application exits.  |
| <code>pin_mta_init_app</code>             | Can be used for application initialization and all required tasks before execution of main search.                       |
| <code>pin_mta_init_search</code>          | Can be used for preparation of the search flist.   |
| <code>pin_mta_job_done</code>             | Can be used for any tasks that are required after search results have been processed, such as validation and logging.    |
| <code>pin_mta_post_config</code>          | Can be used for post-configuration tasks such as configuration validation and logging.                                   |
| <code>pin_mta_post_exit</code>            | Can be used for any tasks that are required before the application exits, such as validation and logging.                |
| <code>pin_mta_post_init_app</code>        | Can be used for any post-initialization tasks such as initialization validation and logging.                             |
| <code>pin_mta_post_init_search</code>     | Can be used for any tasks that are required after search initialization, such as validation and logging.                 |
| <code>pin_mta_post_job_done</code>        | Can be used for any tasks that are required after search results have been processed, such as validation and logging.    |
| <code>pin_mta_post_tune</code>            | Can be used for any tasks that are required after search results have been tuned, such as validation and logging.        |
| <code>pin_mta_post_usage</code>           | Can be used to display application help information.   |
| <code>pin_mta_post_worker_exit</code>     | Performs any cleanup tasks and logging after a worker thread exits.  |
| <code>pin_mta_post_worker_init</code>     | Can be used for any tasks that are required after worker threads are initialized, such as validation and logging.        |
| <code>pin_mta_post_worker_job</code>      | Can be used for any validation of the search results received by worker threads as well as any logging that is required. |
| <code>pin_mta_post_worker_job_done</code> | Performs any cleanup tasks and logging that are required after a worker thread completes its assigned job.               |
| <code>pin_mta_tune</code>                 | Can be used for any filtration and tuning of the search results before the results are distributed to worker threads.    |

**Table 28–2 (Cont.) MTA Callback Functions**

| Function                                | Description   |
|---|---|
| <a href="#">pin_mta_usage</a>           | Can be used to prepare application help information for display.                                  |
| <a href="#">pin_mta_worker_exit</a>     | Performs cleanup tasks and other functions required before a worker thread exits.                 |
| <a href="#">pin_mta_worker_init</a>     | Can be used for initialization of the worker thread.  |
| <a href="#">pin_mta_worker_job</a>      | Can be used to prepare the main opcode input flist.   |
| <a href="#">pin_mta_worker_job_done</a> | Can be used for any functions that are required after a worker thread completes its assigned job. |
| <a href="#">pin_mta_worker_opcode</a>   | Executes the main opcode to process the job.  |

## MTA Helper Functions

Table 28–3 lists the MTA helper functions used to manipulate data in global flist data structures.

**Table 28–3 MTA Helper Functions**

| Function  | Description  |
|---|--|
| <a href="#">pin_mta_get_decimal_from_pinconf</a>        | Loads decimal fields from the <b>pin.conf</b> file.  |
| <a href="#">pin_mta_get_int_from_pinconf</a>            | Loads integer fields from the <b>pin.conf</b> file.  |
| <a href="#">pin_mta_get_str_from_pinconf</a>            | Loads string fields from the <b>pin.conf</b> file.   |
| <a href="#">pin_mta_global_flist_node_get_no_lock</a>   | Gets the global flist field; does not set the lock on the field; multithread unsafe.         |
| <a href="#">pin_mta_global_flist_node_get_with_lock</a> | Gets the global flist field; sets the lock on the field to prevent access; multithread safe. |
| <a href="#">pin_mta_global_flist_node_put</a>           | Puts the global flist field to the flist specified; multithread safe.                        |
| <a href="#">pin_mta_global_flist_node_release</a>       | Releases the lock from the global flist field; multithread safe.                             |
| <a href="#">pin_mta_global_flist_node_set</a>           | Sets the global flist field to the flist specified; multithread safe.                        |
| <a href="#">pin_mta_main_thread_pcm_context_get</a>     | Gets the main thread context.  |

## MTA Policy Opcode Hooks

This section lists MTA policy opcode hooks.

All MTA policy opcodes use Transition: supports.

For information about the flist specification, see *Opcode Flist Reference*.

To customize your BRM multithreaded client application, you implement the MTA policy opcode hooks (listed in Table 28–4) in your application by providing application-specific contents.

---

**Note:** You do not have to implement all of the policy opcodes. You specify your own policy opcode names. For example, for MTA\_CONFIG policy opcode, you might use PCM\_OP\_MTA\_POL\_CONFIG.

---

**Table 28–4 MTA Policy Opcode Hooks**

| Policy opcode                       | Description  |
|-------------------------------------|--|
| <a href="#">MTA_CONFIG</a>          | Called at MTA_CONFIG execution stage. Allows customization of the default application configuration.   |
| <a href="#">MTA_ERROR</a>           | Allows processing of error notifications.  |
| <a href="#">MTA_EXIT</a>            | Called at MTA_EXIT execution stage. Allows any processing that may be required before the application exits.   |
| <a href="#">MTA_INIT_APP</a>        | Called at MTA_INIT_APP execution stage. Allows customization of the default application initialization.  |
| <a href="#">MTA_INIT_SEARCH</a>     | Called at MTA_INIT_SEARCH execution stage. Allows customization of the search list.  |
| <a href="#">MTA_JOB_DONE</a>        | Called at MTA_JOB_DONE execution stage. Allows any processing that may be required at the completion of search results processing.   |
| <a href="#">MTA_TUNE</a>            | Called at MTA_TUNE execution stage. Allows modification of the search results.   |
| <a href="#">MTA_USAGE</a>           | Allows display of application help information.  |
| <a href="#">MTA_WORKER_EXIT</a>     | Called at MTA_WORKER_EXIT execution stage. Allows any processing that may be required before the worker thread exits.  |
| <a href="#">MTA_WORKER_INIT</a>     | Called at MTA_WORKER_INIT execution stage. Allows customization of worker thread initialization.   |
| <a href="#">MTA_WORKER_JOB</a>      | Called at MTA_WORKER_JOB execution stage. Allows modification of search results received by the worker thread and preparation of the input list passed to the main opcode. |
| <a href="#">MTA_WORKER_JOB_DONE</a> | Called at MTA_WORKER_JOB_DONE execution stage. Allows any processing that may be required at completion of the worker thread job assignment.                               |

## Creating a Multithreaded BRM Client Application

Before you create a multithreaded BRM client application, you should have a good understanding of the BRM MTA execution flow and the global list structure. See ["About the BRM MTA Framework"](#).

You create a multithreaded BRM client application by implementing the MTA callback functions in your application and by providing application-specific content.

These callback functions are called by the MTA framework at fixed execution points to configure, initialize, search, process data, and exit the application. For information about the syntax and description of these functions, see ["MTA Callback Functions"](#).

The BRM MTA framework supports three search options; see ["Searching Different Data Sources"](#).

For information about displaying usage information, see ["Displaying Application Help Information"](#).

For processing errors that occur during application execution, see ["Error Notifications"](#).

The sample file `BRM_SDK_Home/source/samples/apps/c/mta_sample/pin_mta_test.c` provides sample implementations of MTA callback functions. Use this as a code

sample to build your own multithreaded application. For information on how to compile and run the sample application, see "About Using the PCM C Sample Programs" in *BRM Developer's Reference*.

For general information on creating new client applications, see ["Adding New Client Applications"](#).

Each BRM client application has its own configuration file (**pin.conf**). After you build your application, you need to create a configuration file. See ["Configuring your Multithreaded Application"](#).

To customize your multithreaded application, you implement the MTA policy opcode hooks. See ["Customizing BRM Multithreaded Client Applications"](#).

## Searching Different Data Sources

The BRM MTA framework supports three search options: search for objects stored in the BRM database, search for objects stored in a file, and passing objects directly to the search opcode. You specify the search option in the PIN\_FLD\_SEARCH\_FLIST substruct in the global flist.

To search for objects in the BRM database, you specify the POID of the `/search` object that defines the search template.

For example:

```
0 PIN_FLD_SEARCH_FLIST      SUBSTRUCT [0]
1   PIN_FLD_POID            POID [0]  "/search/pin" -1 0
1   PIN_FLD_FLAGS          INT [0]  0
1   PIN_FLD_TEMPLATE       STR [0]  "select X from /account where F1 = V1"
1   PIN_FLD_ARGS           ARRAY [1]
2     PIN_FLD_FIRST_NAME   STR [0]  "name"
1   PIN_FLD_RESULTS        ARRAY [0]
2     PIN_FLD_POID         POID [0]
```

To search for objects in a file, you specify the name of the file where the objects are stored.

For example:

```
0 PIN_FLD_SEARCH_FLIST      SUBSTRUCT [0]
1   PIN_FLD_FILENAME       STR [0]  "file name"
1   PIN_FLD_COUNT          INT [0]  2
```

---



---

**Important:** The file specified in PIN\_FLD\_FILENAME *must* be a text file and *must* have the same format as the search results flist.

---



---

The following is an example of the text file:

```
0 PIN_FLD_RESULTS          ARRAY [0]
1   PIN_FLD_ACCOUNT_OBJ    POID [0]  "/account" 123 0
0 PIN_FLD_RESULTS          ARRAY [1]
1   PIN_FLD_ACCOUNT_OBJ    POID [0]  "/account" 345 0
```

To pass objects directly in the search flist, you specify the POIDs of the objects.

For example:

```
0 PIN_FLD_POID             POID [0]  0.0.0.1 /account 1 0
0 PIN_FLD_RESULTS          ARRAY [0]
1   PIN_FLD_ACCOUNT_OBJ    POID [0]  "/account" 123 0
```

```

0 PIN_FLD_RESULTS          ARRAY [1]
1  PIN_FLD_ACCOUNT_OBJ    POID [0] "/account" 345 0

```

---

**Important:** When objects are provided in the search template, the data is taken from `PIN_FLD_SEARCH_FLIST` and put into `PIN_FLD_SEARCH_RESULTS`. Do not free memory from `PIN_FLD_SEARCH_FLIST`, otherwise the application will error out. If your application performs the search operation in a loop, add new data to `PIN_FLD_SEARCH_FLIST` node by preparing the flist in the `pin_mta_init_search` function. The application will exit as soon as no new data is provided in `PIN_FLD_SEARCH_FLIST` node.

---

For information about the search flist and search results flist, see "[MTA Global Flist Structure](#)".

## Displaying Application Help Information

The BRM MTA framework provides callback functions that you can implement in your application to display application help information. The usage callback function is called by specifying the `-help` parameter in the command line or when the application fails to configure or initialize because the command-line options specified were invalid or incomplete. When an error occurs during application configuration, the MTA framework sets the `PIN_FLD_FLAGS` field in the `PIN_FLD_APPLICATION_INFO` substruct in the global flist. For a list of all predefined flags, see `pin_mta.h`.

---

**Note:** The command-line parameters `-help`, `-verbose`, and `-test` are processed by the MTA framework layer. When these parameters are specified with additional parameters (for example, `-verbose xyz`), the framework layer processes the `-verbose` parameter and ignores `xyz`. In this case, you might want to display a usage error message in your custom application. To do this, set the MTA flag in the `pin_mta_config` callback function as follows:

```
mta_flags = mta_flags | MTA_FLAG_VERSION_NEW
```

When this flag is set, the MTA framework generates a usage error when the `-help`, `-verbose`, or `-test` parameter is specified with additional parameters.

---

To display application help information, the main thread calls the following callback functions and the policy opcode hook in this order for the `-help`, `-verbose`, or `-test` parameters:

1. [pin\\_mta\\_usage](#)
2. [MTA\\_USAGE](#)
3. [pin\\_mta\\_post\\_usage](#)

You implement `pin_mta_usage` to prepare the help text message, and you implement `pin_mta_post_usage` to display the message. You can customize the help text by implementing the usage policy opcode hook.

---

---

**Important:** You *must* set the PIN\_FLD\_DESCR field in the PIN\_FLD\_EXTENDED\_INFO substruct in the global flist to the help text, so that it can be accessed by the usage policy opcode and **pin\_mta\_post\_usage**.

---

---

Depending on the parameter specified in the command line, the framework layer processes the parameters as follows:

- **-help:** Sets the PIN\_FLD\_FLAGS field in the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist to MTA\_FLAG\_USAGE\_MSG, calls **pin\_mta\_usage** and then **pin\_mta\_exit**, and displays the valid command line options on the standard output.
- **-verbose:** Sets the PIN\_FLD\_FLAGS field in the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist to MTA\_FLAG\_VERBOSE\_MODE, flushes the **stdout** buffer, and displays the number of data errors encountered, the total number of errors encountered, and the additional output for threads information on the standard output.
- **-test:** Sets the PIN\_FLD\_FLAGS field in the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist to MTA\_FLAG\_TEST\_MODE and displays the total number of prepared job units for batch processing and the total number of spawned worker threads on the standard output.

For information about the global flist, see "[MTA Global Flist Structure](#)".

The application usage policy opcode is called *only* if it's configured in `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

## Error Notifications

In a multithreaded application, errors can occur in the main thread or the worker threads. In BRM MTA, errors that occur in the main thread are handled differently than errors in the worker threads.

Generally, an error in the main thread is an indication of a serious problem that prevents the application from continuing its normal execution. When an error occurs in the main thread, the BRM MTA framework exits the application immediately.

Errors that occur in the worker threads are not as severe and therefore it is not necessary for the application to exit immediately. When an error occurs in a worker thread, the MTA framework checks to see if the maximum error threshold has been reached. The MTA framework exits the application when the number of errors in the worker threads exceeds the threshold.

When the application exits due to error conditions, the MTA framework calls the error notification policy opcode to allow exit processing that may be required at the Customization layer.

---

---

**Important:** The error notification policy opcode is called by the BRM MTA framework only if it is configured in `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---

---

You can implement the error notification policy opcode in your application to process errors. For information about the input and output flist, see "[MTA\\_ERROR](#)".



## Customizing BRM Multithreaded Client Applications

Before you customize a multithreaded BRM client application, you should have a good understanding of the BRM MTA execution flow and the global flist structure. See ["About the BRM MTA Framework"](#).

The BRM MTA framework provides policy opcode hooks for customization of BRM MTAs. For example, you can create a custom billing utility by customizing BRM's `pin_bill_accts` MTA. You implement these policy opcode hooks by providing your business-specific contents.

These policy opcode hooks are called by the BRM MTA framework at fixed places during the application execution. Unlike the MTA callback functions, the MTA policy opcode hooks *must* be configured using the `/config/mta` object.

To customize a BRM MTA, you need to do the following:

1. [About Shadow Objects](#)
2. [Configuring the MTA Policy Opcodes](#)

### Implementing the MTA Policy Opcodes

You use the MTA policy opcode hooks to customize multithreaded BRM client applications. They do not have default implementations; therefore, they aren't in the BRM System Facilities Modules (FM). You need to write a *custom* policy FM to include your custom policy opcodes.

The policy opcode hooks do not have predefined opcode names; you create your own. For example, you could name the `MTA_CONFIG` policy opcode `PCM_OP_MTA_POL_CONFIG`.

For more information about writing a custom FM, see ["Writing a Custom Facilities Module"](#).

---

---

**Important:** The MTA policy opcode hooks have predefined input and output specifications. You *must* write your custom policy opcodes based on these specifications.

---

---

For a list of all the policy opcodes and details about the input and output specifications, see ["MTA Policy Opcode Hooks"](#).

### Configuring the MTA Policy Opcodes

The MTA policy opcodes are called by the main thread at specific execution stages in the application workflow. At application startup, the MTA framework reads the `/config/mta` object to determine if custom policy opcodes are implemented at the Customization layer.

You use `testnap` or Developer Center to populate the `PIN_FLD_OPCODE_MAP` array in the `/config/mta` object to specify the policy opcode names and the execution stages that these opcodes are called from.

For information about the fields and field types in `/config/mta`, see `/config/mta`.

---

**Important:** The execution stage names are predefined. You must use these names when populating the PIN\_FLD\_FUNCTION field in the `/config/mta` object. Otherwise, the application will not load the object at startup and instead it will exit. For details about the policy opcode and its execution stage names, see ["MTA Policy Opcode Hooks"](#).

---

In this example, the MTA application `pin_mta_test` calls custom policy opcodes at the MTA\_CONFIG, MTA\_INIT\_ERROR, and MTA\_USAGE execution stages:

```

0 PIN_FLD_CONFIG_MTA    ARRAY [0]
1  PIN_FLD_NAME        STR [0] "pin_mta_test"
1  PIN_FLD_OPCODE_MAP  ARRAY [0]
2    PIN_FLD_FUNCTION  STR [0] "MTA_CONFIG"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_CONFIG"
1  PIN_FLD_OPCODE_MAP  ARRAY [1]
2    PIN_FLD_FUNCTION  STR [0] "MTA_ERROR"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_ERROR"
1  PIN_FLD_OPCODE_MAP  ARRAY [2]
2    PIN_FLD_FUNCTION  STR [0] "MTA_USAGE"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_USAGE"

```

In this example, the MTA application `pin_mta_test` calls custom policy opcodes at the MTA\_INIT\_SEARCH, MTA\_TUNE, and MTA\_WORKER\_JOB\_DONE execution stages:

```

0 PIN_FLD_CONFIG_MTA    ARRAY [0]
1  PIN_FLD_NAME        STR [0] "pin_mta_test"
1  PIN_FLD_OPCODE_MAP  ARRAY [0]
2    PIN_FLD_FUNCTION  STR [0] "MTA_INIT_SEARCH"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_INIT_SEARCH"
1  PIN_FLD_OPCODE_MAP  ARRAY [1]
2    PIN_FLD_FUNCTION  STR [0] "MTA_TUNE"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_TUNE"
1  PIN_FLD_OPCODE_MAP  ARRAY [2]
2    PIN_FLD_FUNCTION  STR [0] "MTA_WORKER_JOB_DONE"
2    PIN_FLD_NAME      STR [0] "PCM_OP_MTA_POL_WORKER_JOB_DONE"

```

In extremely rare cases, you might create a dynamic library to implement custom MTA callback functions that is not feasible by using the MTA policy opcodes.

You can use the `/config/mta` object to specify custom callback functions. In this case, you must populate the PIN\_FLD\_FUNCTION\_MAP array to map the custom function name to the MTA callback function name. The function names specified in PIN\_FLD\_FUNCTION must match the default MTA callback function names. The MTA framework will call the custom callback function instead of the default callback function. For a list of all MTA callback functions, see ["MTA Callback Functions"](#).

---

**important:** If custom functions are configured, the MTA framework calls the custom function *in place of* the default MTA callback function. In this case, the default functionality is lost.

---

```

0 PIN_FLD_CONFIG_MTA    ARRAY [0]
1  PIN_FLD_LIBRARY     STR [0] "libpin_mta_test_lib.so"
1  PIN_FLD_NAME        STR [0] "pin_mta_test"
1  PIN_FLD_FUNCTION_MAP ARRAY [0]
2    PIN_FLD_FUNCTION  STR [0] "pin_mta_post_init_app"

```

```

2     PIN_FLD_NAME          STR [0] "pin_mta_post_init_app_lib"
1     PIN_FLD_FUNCTION_MAP ARRAY [1]
2     PIN_FLD_FUNCTION     STR [0] "pin_mta_post_tune"
2     PIN_FLD_NAME        STR [0] "pin_mta_post_tune_lib"
1     PIN_FLD_FUNCTION_MAP ARRAY [2]
2     PIN_FLD_FUNCTION     STR [0] "pin_mta_config"
2     PIN_FLD_NAME        STR [0] "pin_mta_config_lib"
1     PIN_FLD_FUNCTION_MAP ARRAY [3]
2     PIN_FLD_FUNCTION     STR [0] "pin_mta_init_search"
2     PIN_FLD_NAME        STR [0] "pin_mta_init_search_lib"
1     PIN_FLD_FUNCTION_MAP ARRAY [4]
2     PIN_FLD_FUNCTION     STR [0] "pin_mta_tune"
2     PIN_FLD_NAME        STR [0] "pin_mta_tune_lib"

```

## Configuring your Multithreaded Application

The sample configuration file in the *BRM\_Home/source/samples/apps/C/mta\_sample/pin.conf* directory specifies the configuration information for a multithreaded application to connect to the BRM database and process data. (*BRM\_Home* is the directory in which you installed BRM components.)

For each multithreaded application that you create, you need to include a similar configuration file in your application's directory with entries specific to the application.

For a list of configuration file entries, see "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---



---

**Note:** You can create additional configuration entries that are required for your MTA application.

---



---

## Applying Configuration Entries to Specific Utilities

To apply an entry to all the MTA applications, use **pin\_mta**. For example:

- pin\_mta children 5
- pin\_mta fetch\_size 10000
- pin\_mta per\_batch 100

To apply an entry only to a particular MTA, use **pin\_application\_name**. For example, **pin\_bill\_accts**:

- pin\_bill\_accts children 5
- pin\_bill\_accts fetch\_size 10000
- pin\_bill\_accts per\_batch 100

## Using Multithreaded Applications with Multiple Database Schemas

To use a multithreaded application with a multischema BRM installation, you must change the **multi\_db** entry in the application **pin.conf** file. For example, to use the global search feature to search across schemas, you must enable multischema support. Set the **multi\_db** entry to **1** to enable multischema support.

## MTA Policy Opcode Hooks

This section lists MTA policy opcode hooks.

### MTA\_CONFIG

This policy opcode allows customization of the default application configuration.

This policy opcode is called by the MTA framework at the MTA\_CONFIG execution stage. It is called after **pin\_mta\_config**. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to perform custom application configuration. For example, you can write code to retrieve configuration parameters from a database object.

---

**Important:** This policy opcode is called *only* if it is configured in the **/config/mta** object. See "[Configuring the MTA Policy Opcodes](#)".

---

### Sample Input Flist

This is a sample input flist for **pin\_mta\_test.c**.

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO    SUBSTRUCT [0]
1  PIN_FLD_NAME                STR [0] "pin_mta_test"
1  PIN_FLD_CHILDREN            INT [0] 2
1  PIN_FLD_STEP_SIZE           INT [0] 5
1  PIN_FLD_BATCH_SIZE          INT [0] 10
1  PIN_FLD_FETCH_SIZE          INT [0] 100
1  PIN_FLD_NUM_RETRIES         INT [0] 0
1  PIN_FLD_FLAGS               INT [0] 2
1  PIN_FLD_MAX_ERROR           INT [0] 5
1  PIN_FLD_MAX_TIME            INT [0] 360
1  PIN_FLD_HOTLIST_FILENAME    STR [0] "hotlist"
1  PIN_FLD_MONITOR_FILENAME    STR [0] "monitor"
1  PIN_FLD_LOGFILE             STR [0] "mta.pinlog"
1  PIN_FLD_LOGLEVEL            INT [0] 3
1  PIN_FLD_POID_VAL            POID [0] 0.0.0.1 /account 1 0
1  PIN_FLD_INCR_AMOUNT         INT [0] 1
1  PIN_FLD_HEADER_NUM          INT [0] 155
0 PIN_FLD_EXTENDED_INFO      SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO     SUBSTRUCT [0]
1  PIN_FLD_PID                 INT [0] 2485
1  PIN_FLD_HOSTNAME            STR [0] "test"
1  PIN_FLD_START_T             TSTAMP [0] (1070784000) Sun Dec  7 00:00:00 2003

```

### MTA\_ERROR

This policy opcode allows processing of error notifications.

This policy opcode is called by the MTA framework when an error occurs in the main thread or when the maximum error threshold has been reached for the worker threads. You set the maximum error limit in the application's **pin.conf** file. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to process error notifications at the Customization layer.

For example, you can write code to log appropriate error messages in the application's log file.

---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---

## Sample Input Flist

This is a sample input from a worker thread.

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1   PIN_FLD_NAME        STR [0] "pin_mta_test"
1   PIN_FLD_CHILDREN    INT [0] 7
1   PIN_FLD_STEP_SIZE   INT [0] 3
1   PIN_FLD_BATCH_SIZE  INT [0] 2
1   PIN_FLD_FETCH_SIZE  INT [0] 8
1   PIN_FLD_NUM_RETRIES INT [0] 0
1   PIN_FLD_FLAGS       INT [0] 2
1   PIN_FLD_MAX_ERROR   INT [0] 5
1   PIN_FLD_MAX_TIME    INT [0] 360
1   PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1   PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1   PIN_FLD_OBJ_TYPE    STR [0] "/config/mta"
1   PIN_FLD_LOGFILE     STR [0] "a.pinlog"
1   PIN_FLD_LOGLEVEL    INT [0] 3
1   PIN_FLD_POID_VAL    POID [0] 0.0.0.1 /account 1 0
1   PIN_FLD_ATTRIBUTE   INT [0] 8
1   PIN_FLD_INCR_AMOUNT INT [0] 1
1   PIN_FLD_HEADER_NUM  INT [0] 157
1   PIN_FLD_OPS_ERROR   INT [0] 1000
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_THREAD_INFO   ARRAY [7]
1   PIN_FLD_START_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
1   PIN_FLD_ERROR_INFO   ARRAY [0]
2     PIN_FLD_ERROR_NUM  INT [0] 1
2     PIN_FLD_SYS_ERROR_NUM INT [0] 0
2     PIN_FLD_ERROR_CODE STR [0] "PIN_ERR_NOT_FOUND"
2     PIN_FLD_ERROR_DESCR STR [0] "\t          <location=PIN_ERRLOC_
DM:4 class=UNKNOWN:0 errno=PIN_ERR_NOT_FOUND:3>\n\t          <field num=0:0,0
recid=0 reserved=0 reserved2=0 time(sec:usec)=0:0>\n\t          <facility=0 msg_
id=0 version=0>\n"
2     PIN_FLD_TRACKING_ID STR [0] "1:plot:pin_mta_
test:26291:7:8:1062547949:3"

```

## MTA\_EXIT

This policy opcode allows any processing required before the application exits.

This policy opcode is called by the MTA framework at the MTA\_EXIT execution stage. This is when there are no more jobs to be processed. This policy opcode can also be called when an error occurs during application execution. This policy opcode is called after `pin_mta_exit`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to process errors, perform logging, clean up procedures, or other functionality.

For example, you can write code to process errors and to log appropriate error messages in the application's log file.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1  PIN_FLD_NAME          STR [0] "pin_mta_test"
1  PIN_FLD_CHILDREN      INT [0] 2
1  PIN_FLD_STEP_SIZE     INT [0] 5
1  PIN_FLD_BATCH_SIZE    INT [0] 10
1  PIN_FLD_FETCH_SIZE    INT [0] 100
1  PIN_FLD_NUM_RETRIES   INT [0] 0
1  PIN_FLD_FLAGS         INT [0] 2
1  PIN_FLD_MAX_ERROR     INT [0] 5
1  PIN_FLD_MAX_TIME      INT [0] 360
1  PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1  PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1  PIN_FLD_LOGFILE       STR [0] "mta.pinlog"
1  PIN_FLD_LOGLEVEL      INT [0] 3
1  PIN_FLD_POID_VAL      POID [0] 0.0.0.1 /account 1 0
1  PIN_FLD_INCR_AMOUNT   INT [0] 1
1  PIN_FLD_HEADER_NUM    INT [0] 155
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1  PIN_FLD_PID           INT [0] 2485
1  PIN_FLD_HOSTNAME      STR [0] "test"
1  PIN_FLD_START_T       TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
1  PIN_FLD_THREAD_INFO   ARRAY [8]
2      PIN_FLD_START_T    TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
2      PIN_FLD_END_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
1  PIN_FLD_THREAD_INFO   ARRAY [4]
2      PIN_FLD_START_T    TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
2      PIN_FLD_END_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003

```

## MTA\_INIT\_APP

This policy opcode allows customization of the default application initialization.

This policy opcode is called by the MTA framework at the `MTA_INIT_APP` execution stage. It is called after `pin_mta_init`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to perform custom application initialization.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1  PIN_FLD_NAME          STR [0] "pin_mta_test"
1  PIN_FLD_CHILDREN      INT [0] 2

```

```

1 PIN_FLD_STEP_SIZE      INT [0] 5
1 PIN_FLD_BATCH_SIZE    INT [0] 10
1 PIN_FLD_FETCH_SIZE    INT [0] 100
1 PIN_FLD_NUM_RETRIES   INT [0] 0
1 PIN_FLD_FLAGS         INT [0] 2
1 PIN_FLD_MAX_ERROR     INT [0] 5
1 PIN_FLD_MAX_TIME      INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE       STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL      INT [0] 3
1 PIN_FLD_POID_VAL      POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT   INT [0] 1
1 PIN_FLD_HEADER_NUM    INT [0] 155
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1 PIN_FLD_PID           INT [0] 2485
1 PIN_FLD_HOSTNAME     STR [0] "test"
1 PIN_FLD_START_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003

```

## MTA\_INIT\_SEARCH

This policy opcode enables customization of the search flist.

This policy opcode is called by the MTA framework at the MTA\_INIT\_SEARCH execution stage. It is called after `pin_mta_init_search`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to modify the search flist that is passed to the search opcodes PCM\_OP\_SEARCH, PCM\_OP\_STEP\_SEARCH, and PCM\_OP\_STEP\_NEXT. In a multischema search, the search flist is passed to PCM\_OP\_GLOBAL\_SEARCH, PCM\_OP\_GLOBAL\_STEP\_SEARCH, and PCM\_OP\_GLOBAL\_STEP\_NEXT.

For example, you can use this opcode to customize information in the search template.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See ["Configuring the MTA Policy Opcodes"](#).

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```

0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1 PIN_FLD_NAME         STR [0] "pin_mta_test"
1 PIN_FLD_CHILDREN     INT [0] 2
1 PIN_FLD_STEP_SIZE    INT [0] 5
1 PIN_FLD_BATCH_SIZE   INT [0] 10
1 PIN_FLD_FETCH_SIZE   INT [0] 100
1 PIN_FLD_NUM_RETRIES  INT [0] 0
1 PIN_FLD_FLAGS        INT [0] 2
1 PIN_FLD_MAX_ERROR    INT [0] 5
1 PIN_FLD_MAX_TIME     INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE      STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL     INT [0] 3
1 PIN_FLD_POID_VAL     POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT  INT [0] 1

```

```
1 PIN_FLD_HEADER_NUM INT [0] 155
0 PIN_FLD_SEARCH_FLIST SUBSTRUCT [0]
1 PIN_FLD_POID POID [0] 0.0.0.1 /search/pin -1 0
1 PIN_FLD_FLAGS INT [0] 0
1 PIN_FLD_TEMPLATE STR [0] "select X from /data where F1 = V1 "
1 PIN_FLD_ARGS ARRAY [1]
2 PIN_FLD_HEADER_NUM INT [0] 155
1 PIN_FLD_RESULTS ARRAY [0]
2 PIN_FLD_POID POID [0] NULL poid pointer
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1 PIN_FLD_PID INT [0] 2485
1 PIN_FLD_HOSTNAME STR [0] "test"
1 PIN_FLD_START_T TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
```

## MTA\_JOB\_DONE

This policy opcode allows any processing required at completion of search results processing.

This policy opcode is called by the MTA framework at the MTA\_JOB\_DONE execution stage. This is after the worker threads have completed their assigned jobs, there are no more search results to process, and the job pool is empty. This policy opcode is called after **pin\_mta\_job\_done**. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to perform validation, logging, or other functionality that may be required.

For example, you can write code to analyze the percentage of a job that was processed successfully and to create a log of those threads that failed.

If another search is required, you can write code to loop through the search cycle again.

---

---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---

---

## Sample Input Flist

This is a sample input flist for **pin\_mta\_test.c**.

```
0 PIN_FLD_POID POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1 PIN_FLD_NAME STR [0] "pin_mta_test"
1 PIN_FLD_CHILDREN INT [0] 2
1 PIN_FLD_STEP_SIZE INT [0] 5
1 PIN_FLD_BATCH_SIZE INT [0] 10
1 PIN_FLD_FETCH_SIZE INT [0] 100
1 PIN_FLD_NUM_RETRIES INT [0] 0
1 PIN_FLD_FLAGS INT [0] 2
1 PIN_FLD_MAX_ERROR INT [0] 5
1 PIN_FLD_MAX_TIME INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL INT [0] 3
1 PIN_FLD_POID_VAL POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT INT [0] 1
1 PIN_FLD_HEADER_NUM INT [0] 155
```



```

0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1 PIN_FLD_PID INT [0] 2485
1 PIN_FLD_HOSTNAME STR [0] "test"
1 PIN_FLD_START_T TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003

```

## MTA\_TUNE

This policy opcode allows modification of the search results.

This policy opcode is called by the MTA framework at the MTA\_TUNE execution stage. This opcode is called after `pin_mta_tune`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to preprocess the search results before they are distributed to the worker threads for processing.

For example, you can write code to perform validation of the search results and to modify or filter the results.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See ["Configuring the MTA Policy Opcodes"](#).

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```

0 PIN_FLD_POID POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1 PIN_FLD_NAME STR [0] "pin_mta_test"
1 PIN_FLD_CHILDREN INT [0] 2
1 PIN_FLD_STEP_SIZE INT [0] 5
1 PIN_FLD_BATCH_SIZE INT [0] 10
1 PIN_FLD_FETCH_SIZE INT [0] 100
1 PIN_FLD_NUM_RETRIES INT [0] 0
1 PIN_FLD_FLAGS INT [0] 2
1 PIN_FLD_MAX_ERROR INT [0] 5
1 PIN_FLD_MAX_TIME INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL INT [0] 3
1 PIN_FLD_POID_VAL POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT INT [0] 1
1 PIN_FLD_HEADER_NUM INT [0] 155
0 PIN_FLD_SEARCH_RESULTS SUBSTRUCT [0]
1 PIN_FLD_MULTI_RESULTS ARRAY [0]
2 PIN_FLD_POID POID [0] 0.0.0.1 /search/pin -1 0
2 PIN_FLD_RESULTS ARRAY [0]
3 PIN_FLD_POID POID [0] 0.0.0.1 /data 1 1634
2 PIN_FLD_RESULTS ARRAY [1]
3 PIN_FLD_POID POID [0] 0.0.0.1 /data 2 1631
2 PIN_FLD_RESULTS ARRAY [2]
3 PIN_FLD_POID POID [0] 0.0.0.1 /data 3 1633
1 PIN_FLD_MULTI_RESULTS ARRAY [1]
2 PIN_FLD_POID POID [0] 0.0.0.1 /search/pin -1 0
2 PIN_FLD_RESULTS ARRAY [0]
3 PIN_FLD_POID POID [0] 0.0.0.1 /data/sequence 300 151
2 PIN_FLD_RESULTS ARRAY [1]
3 PIN_FLD_POID POID [0] 0.0.0.1 /data/sequence 302 1633

```

```

2     PIN_FLD_RESULTS      ARRAY [2]
3     PIN_FLD_POID         POID [0] 0.0.0.1 /data/sequence 303 1631
1     PIN_FLD_MULTI_RESULTS ARRAY [2]
2     PIN_FLD_POID         POID [0] 0.0.0.1 /search/pin -1 0
2     PIN_FLD_RESULTS      ARRAY [0]
3     PIN_FLD_POID         POID [0] 0.0.0.1 /data/sequence 304 1279
2     PIN_FLD_RESULTS      ARRAY [1]
3     PIN_FLD_POID         POID [0] 0.0.0.1 /data/sequence 305 1277
0     PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0     PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1     PIN_FLD_PID          INT [0] 2485
1     PIN_FLD_HOSTNAME     STR [0] "test"
1     PIN_FLD_START_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003

```

## MTA\_USAGE

This policy opcode allows display of application help information.

This policy opcode is called when the user explicitly requests the application's usage information by specifying the **-help** parameter at the command line. This policy opcode is also called by the MTA framework during application configuration when it fails to configure the application using the command-line parameters specified. This policy opcode is called after **pin\_mta\_usage**. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to customize help information.

For example, you can write code to display a custom help message for custom command-line options.

---



---

**Important:** This policy opcode is called *only* if it is configured in the **/config/mta**. See "[Configuring the MTA Policy Opcodes](#)".

---



---

## Sample Input Flist

This is a sample input flist for **pin\_mta\_test.c**.

```

0     PIN_FLD_POID         POID [0] 0.0.0.1 /config/mta 15380 0
0     PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1     PIN_FLD_NAME         STR [0] "pin_mta_test"
1     PIN_FLD_CHILDREN     INT [0] 2
1     PIN_FLD_STEP_SIZE    INT [0] 5
1     PIN_FLD_BATCH_SIZE   INT [0] 10
1     PIN_FLD_FETCH_SIZE   INT [0] 100
1     PIN_FLD_NUM_RETRIES  INT [0] 0
1     PIN_FLD_FLAGS        INT [0] 2
1     PIN_FLD_MAX_ERROR    INT [0] 5
1     PIN_FLD_MAX_TIME     INT [0] 360
1     PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1     PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1     PIN_FLD_LOGFILE      STR [0] "mta.pinlog"
1     PIN_FLD_LOGLEVEL     INT [0] 3
1     PIN_FLD_POID_VAL     POID [0] 0.0.0.1 /account 1 0
1     PIN_FLD_INCR_AMOUNT  INT [0] 1
1     PIN_FLD_HEADER_NUM   INT [0] 155
0     PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0     PIN_FLD_OPERATION_INFO SUBSTRUCT [0]
1     PIN_FLD_PID          INT [0] 2485
1     PIN_FLD_HOSTNAME     STR [0] "test"

```

---

```
1 PIN_FLD_START_T TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
```

## MTA\_WORKER\_EXIT

This policy opcode allows any processing required before the worker thread exits.

This policy opcode is called by the MTA framework at the MTA\_WORKER\_EXIT execution stage. This is when the worker thread is notified that the application is about to exit. This policy opcode is called after `pin_mta_worker_exit`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to perform any cleanup procedures or other functionality before the worker thread is terminated.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```
0 PIN_FLD_POID POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1 PIN_FLD_NAME STR [0] "pin_mta_test"
1 PIN_FLD_CHILDREN INT [0] 2
1 PIN_FLD_STEP_SIZE INT [0] 5
1 PIN_FLD_BATCH_SIZE INT [0] 10
1 PIN_FLD_FETCH_SIZE INT [0] 100
1 PIN_FLD_NUM_RETRIES INT [0] 0
1 PIN_FLD_FLAGS INT [0] 2
1 PIN_FLD_MAX_ERROR INT [0] 5
1 PIN_FLD_MAX_TIME INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL INT [0] 3
1 PIN_FLD_POID_VAL POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT INT [0] 1
1 PIN_FLD_HEADER_NUM INT [0] 155
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_THREAD_INFO ARRAY [4]
1 PIN_FLD_START_T TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
```

## MTA\_WORKER\_INIT

This policy opcode allows customization of worker thread initialization.

This policy opcode is called by the MTA framework at the MTA\_WORKER\_INIT execution stage. It is called after `pin_mta_worker_init`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement for customization of worker thread initialization.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1  PIN_FLD_NAME          STR [0] "pin_mta_test"
1  PIN_FLD_CHILDREN      INT [0] 2
1  PIN_FLD_STEP_SIZE     INT [0] 5
1  PIN_FLD_BATCH_SIZE    INT [0] 10
1  PIN_FLD_FETCH_SIZE    INT [0] 100
1  PIN_FLD_NUM_RETRIES   INT [0] 0
1  PIN_FLD_FLAGS         INT [0] 2
1  PIN_FLD_MAX_ERROR     INT [0] 5
1  PIN_FLD_MAX_TIME      INT [0] 360
1  PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1  PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1  PIN_FLD_LOGFILE       STR [0] "mta.pinlog"
1  PIN_FLD_LOGLEVEL      INT [0] 3
1  PIN_FLD_POID_VAL      POID [0] 0.0.0.1 /account 1 0
1  PIN_FLD_INCR_AMOUNT   INT [0] 1
1  PIN_FLD_HEADER_NUM    INT [0] 155
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_THREAD_INFO    ARRAY [4]
1  PIN_FLD_START_T       TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
```

## MTA\_WORKER\_JOB

This policy opcode allows modification of search results received by worker threads and preparation of the input flist passed to the main opcode.

This policy opcode is called by the MTA framework at the `MTA_WORKER_JOB` execution stage. This is when the worker thread has received a batch of search results to be processed and the worker thread prepares the input flist that is passed to the main opcode responsible for processing the search results in the batch. This policy opcode is called after **`pin_mta_worker_job`**. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you implement to perform any processing required before the main opcode is executed.

For example, you can write code to modify the main opcode input flist or to modify the search results in the batch.

---

---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See "[Configuring the MTA Policy Opcodes](#)".

---

---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```
0 PIN_FLD_POID          POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO SUBSTRUCT [0]
1  PIN_FLD_NAME          STR [0] "pin_mta_test"
1  PIN_FLD_CHILDREN      INT [0] 2
1  PIN_FLD_STEP_SIZE     INT [0] 5
1  PIN_FLD_BATCH_SIZE    INT [0] 10
1  PIN_FLD_FETCH_SIZE    INT [0] 100
1  PIN_FLD_NUM_RETRIES   INT [0] 0
1  PIN_FLD_FLAGS         INT [0] 2
1  PIN_FLD_MAX_ERROR     INT [0] 5
```

```

1 PIN_FLD_MAX_TIME          INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME STR [0] "monitor"
1 PIN_FLD_LOGFILE          STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL        INT [0] 3
1 PIN_FLD_POID_VAL         POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT      INT [0] 1
1 PIN_FLD_HEADER_NUM       INT [0] 155
0 PIN_FLD_IN_FLIST         SUBSTRUCT [0]
1 PIN_FLD_POID             POID [0] 0.0.0.1 /data 1 1634
0 PIN_FLD_EXTENDED_INFO    SUBSTRUCT [0]
0 PIN_FLD_THREAD_INFO      ARRAY [4]
1 PIN_FLD_START_T          TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003

```

## MTA\_WORKER\_JOB\_DONE

This policy opcode allows processing required after worker thread job completion.

This policy opcode is called by the MTA framework at the MTA\_WORKER\_JOB\_DONE execution stage. This is when the worker thread notifies the main thread that it has completed processing the batch of search results and is waiting for the next batch. This policy opcode is called after `pin_mta_worker_job_done`. See *BRM Developer's Reference*.

By default, this policy opcode is an empty hook that you can implement to perform any processing that may be required after the worker thread has completed the assigned job.

For example, you can write code to validate or analyze the output flist from the main opcode call.

---



---

**Important:** This policy opcode is called *only* if it is configured in the `/config/mta`. See ["Configuring the MTA Policy Opcodes"](#).

---



---

## Sample Input Flist

This is a sample input flist for `pin_mta_test.c`.

```

0 PIN_FLD_POID              POID [0] 0.0.0.1 /config/mta 15380 0
0 PIN_FLD_APPLICATION_INFO  SUBSTRUCT [0]
1 PIN_FLD_NAME              STR [0] "pin_mta_test"
1 PIN_FLD_CHILDREN          INT [0] 2
1 PIN_FLD_STEP_SIZE         INT [0] 5
1 PIN_FLD_BATCH_SIZE        INT [0] 10
1 PIN_FLD_FETCH_SIZE        INT [0] 100
1 PIN_FLD_NUM_RETRIES       INT [0] 0
1 PIN_FLD_FLAGS             INT [0] 2
1 PIN_FLD_MAX_ERROR         INT [0] 5
1 PIN_FLD_MAX_TIME          INT [0] 360
1 PIN_FLD_HOTLIST_FILENAME  STR [0] "hotlist"
1 PIN_FLD_MONITOR_FILENAME  STR [0] "monitor"
1 PIN_FLD_LOGFILE           STR [0] "mta.pinlog"
1 PIN_FLD_LOGLEVEL          INT [0] 3
1 PIN_FLD_POID_VAL          POID [0] 0.0.0.1 /account 1 0
1 PIN_FLD_INCR_AMOUNT       INT [0] 1
1 PIN_FLD_HEADER_NUM        INT [0] 155
0 PIN_FLD_OUT_FLIST         SUBSTRUCT [0]
1 PIN_FLD_POID              POID [0] 0.0.0.1 /data/sequence 307 1278
1 PIN_FLD_HEADER_NUM        INT [0] 156

```

```
0 PIN_FLD_EXTENDED_INFO SUBSTRUCT [0]
0 PIN_FLD_THREAD_INFO   ARRAY [3]
1   PIN_FLD_START_T      TSTAMP [0] (1070784000) Sun Dec 7 00:00:00 2003
```

## MTA Callback and Helper Functions

The MTA callback and helper functions are listed here, in alphabetical order.

The MTA helper functions can be used to manipulate data in global flist data structures.

---

---

**Important:** Multithread-safe helper functions can be used with all MTA callback functions. Multithread-unsafe functions cannot be used with **pin\_mta\_worker** thread functions.

---

---

---

## pin\_mta\_config

This function processes command-line arguments.

This function is called at application configuration for processing application-specific command-line arguments, configuration settings in the application's **pin.conf** file, or storable objects. It also sets the usage flag when there is an error during configuration, to halt application execution and display a help message.

### Syntax

```
void
pin_mta_config(
    pin_flist_t      *param_flistp,
    pin_flist_t      *app_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

#### ***param\_flistp***

A pointer to the flist containing information about the command-line parameters. Information from *param\_flistp* is used to populate the PIN\_FLD\_APPLICATION\_INFO substruct in the application's global flist.

---

---

**Tip:** Removing elements from *param\_flistp* as they are processed may help to recognize unexpected command-line options and to set the usage flag, if necessary.

---

---

#### ***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

#### ***ebufp***

A pointer to the error buffer.

## pin\_mta\_exit

This function shuts down the application.

This function is called when the application is about to exit. It is a hook for implementing functions that are required (such as validation) and logging.

### Syntax

```
void  
pin_mta_exit(  
    pin_flist_t    *app_flistp,  
    pin_errbuf_t   *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.



---

## pin\_mta\_get\_decimal\_from\_pinconf

This function loads decimal fields from the **pin.conf** file and sets them to the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

---

**Important:** This function is not multithread safe and can be used *only* in **pin\_mta\_config**.

---

### Syntax

```
void
pin_mta_get_decimal_from_pinconf(
    pin_flist_t    *app_info_flistp,
    char           *pinconf_name,
    int32          field,
    int32          optional,
    pin_errbuf_t   *ebufp);
```

### Parameters

***app\_info\_flistp***

A pointer to the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

***pinconf\_name***

A pointer to the **pin.conf** file.

***field***

The name of the field in the **pin.conf** file.

***optional***

Specifies whether the field is optional or mandatory. If it is mandatory and does not exist in the **pin.conf** file, the error buffer is set.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_get\_int\_from\_pinconf

This function loads integer fields from the **pin.conf** file and sets them to the value in the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

---

---

**Important:** This function is multithread unsafe and cannot be used with **pin\_mta\_worker** thread functions.

---

---

### Syntax

```
void
pin_mta_get_int_from_pinconf(
    pin_flist_t    *app_info_flistp,
    char           *pinconf_name,
    int32          field,
    int32          flag,
    int32          optional,
    pin_errbuf_t   *ebufp);
```

### Parameters

**app\_info\_flistp**

A pointer to the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

**pinconf\_name**

A pointer to the **pin.conf** file.

**field**

The name of the field in the **pin.conf** file.

**flag**

The PIN\_FLD\_FLAGS value in the PIN\_FLD\_APPLICATION\_INFO substruct is set to this value. For a list of predefined MTA flags, see **pin\_mta.h**.

**optional**

Specifies whether the field is optional or mandatory. If it is mandatory and does not exist in the **pin.conf** file, the error buffer is set.

**ebufp**

A pointer to the error buffer.

---

## pin\_mta\_get\_str\_from\_pinconf

This function loads string fields from the **pin.conf** file and sets them to the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

---

**Important:** This function is multithread unsafe and cannot be used with **pin\_mta\_worker** thread functions.

---

### Syntax

```
void
pin_mta_get_str_from_pinconf(
    pin_flist_t    *app_info_flistp,
    char           *pinconf_name,
    int32          field,
    int32          optional,
    pin_errbuf_t   *ebufp);
```

### Parameters

***app\_info\_flistp***

A pointer to the PIN\_FLD\_APPLICATION\_INFO substruct in the global flist.

***pinconf\_name***

A pointer to the **pin.conf** file.

***field***

The name of the field in the **pin.conf** file.

***optional***

Specifies whether the field is optional or mandatory. If it is mandatory and does not exist in the **pin.conf** file, the error buffer is set.

***ebufp***

A pointer to the error buffer.

---

## pin\_mta\_global\_flist\_node\_get\_no\_lock

This function gets the global flist field and does not lock the field.

---

**Important:** This function is multithread unsafe and cannot be used with **pin\_mta\_worker** thread functions.

---

### Syntax

```
pin_flist_t*
pin_mta_global_flist_node_get_no_lock(
    pin_fld_num_t    field,
    pin_errbuf_t     *ebufp);
```

### Parameters

**field**

The global flist field; for example, PIN\_FLD\_APPLICATION\_INFO.

**ebufp**

A pointer to the error buffer.

## pin\_mta\_global\_flist\_node\_get\_with\_lock

This function gets the global flist field and sets the lock to prevent access to the field. Used together with `pin_mta_global_flist_node_release`.

### Syntax

```
pin_flist_t*
pin_mta_global_flist_node_get_with_lock(
    pin_fld_num_t    field,
    pin_errbuf_t    *ebufp);
```

### Parameters

***field***

The global flist field; for example, PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_global\_flist\_node\_put

This function puts the global flist field with the specified flist.

### Syntax

```
void  
pin_mta_global_flist_node_put(  
    pin_flist_t      *in_flistp,  
    pin_fld_num_t    field,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***in\_flistp***

A pointer to the flist to set in the global flist.

***field***

The global flist field to set; for example, PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_global\_flist\_node\_release

This function releases the lock from the global flist field. Used together with **pin\_mta\_global\_flist\_node\_get\_with\_lock**.

---

---

**Important:** Do not use this function to release locks unless the locks were set using **pin\_mta\_global\_flist\_node\_get\_with\_lock**.

---

---

### Syntax

```
void
pin_mta_global_flist_node_release(
    pin_fld_num_t    field,
    pin_errbuf_t     *ebufp);
```

### Parameters

**field**

The global flist field; for example, PIN\_FLD\_APPLICATION\_INFO.

**ebufp**

A pointer to the error buffer.

## pin\_mta\_global\_flist\_node\_set

This function sets the global flist field with the specified flist.

### Syntax

```
void  
pin_mta_global_flist_node_set(  
    pin_flist_t      *in_flistp,  
    pin_fld_num_t    field,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***in\_flistp***

A pointer to the flist to set in the global flist.

***field***

The global flist field to set; for example, PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.



## pin\_mta\_init\_app

This function, called at application initialization, is a hook to implementing functionality that is required before the main search execution.

### Syntax

```
void  
pin_mta_init_app(  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_init\_search

This function prepares the search flist.

This function is called at search initialization. It prepares the search flist that is passed as the input flist to the search opcodes. The search flist is prepared according to the search opcode input flist specification. This function can also be used to update the search flist for subsequent searches.

---

---

**Important:** The select query should be designed to fetch a new set of records each time it is executed, otherwise **pin\_mta\_search** will return the same records each time, causing your MTA application to hang.

---

---

One way to accomplish this is to update the objects in the database during processing by the worker threads so that these objects are not returned by the select query when it is executed again. For example, suppose a billing application uses the following select query to process accounts that have not been billed:

```
select bill_obj_id0 from account_t where actg_next_t <= current_time
```

The application updates the account by setting **actg\_next\_t** to the next cycle after the account is processed. When **pin\_mta\_search** is executed again, the select query returns a new set of accounts that have not been billed. Accounts that have already been processed do not meet the search criteria, therefore they are not returned in the result set.

Another way to ensure that new records are fetched each time would be to use **order by** in your select query so that the returned results are ordered. For example:

```
select bill_obj_id0 from account_t where actg_next_t <= current_time order by  
poid_id0
```

When you execute the query again, start from the previous search maximum **poid\_id**. For example:

```
select bill_obj_id0 from account_t where actg_next_t <= current_time and poid_id >  
previous_maximum_poid_id order by poid_id0
```

This method does not require a database update as does the previous example; however, depending on the number of records being ordered, there might be a performance impact.

## Syntax

```
void  
pin_mta_init_search(  
    pin_flist_t      *app_flistp,  
    pin_flist_t      **search_flistpp,  
    pin_errbuf_t     *ebufp);
```

## Parameters

### **app\_flistp**

A pointer to the flist containing application information from the global flist substruct **PIN\_FLD\_APPLICATION\_INFO**.

***search\_flistpp***

A pointer to a pointer to a search flist.

---

---

**Note:** The search flist allocated in this function is set to the PIN\_FLD\_SEARCH\_FLIST substruct in the global flist.

---

---

***ebufp***

A pointer to the error buffer.

## pin\_mta\_job\_done

This function performs functions required at application job completion.

This function is called after all worker threads have finished processing the jobs assigned to them. It is a hook for implementing functionality that is required, such as validation and logging.

### Syntax

```
void  
pin_mta_job_done(  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_main\_thread\_pcm\_context\_get

This function gets the main thread context. This context can be reused by the main thread callback functions only.

---

---

**Important:** This function is multithread unsafe and cannot be used with **pin\_mta\_worker** thread functions.

---

---

### Syntax

```
pcm_context_t *  
pin_mta_main_thread_pcm_context_get(  
    pin_errbuf_t    *ebufp);
```

### Parameters

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_config

This function performs post-configuration functions.

This function is called after application configuration. It is a hook to implement custom functions that are required after configuration, such as validation, providing results from the configuration policy opcode hook, and logging.

### Syntax

```
void  
pin_mta_post_config(  
    pin_flist_t      *param_flistp,  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***param\_flistp***

A pointer to the flist containing information about the command-line parameters.

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

---

## pin\_mta\_post\_exit

This function performs functions required before the application shuts down.

This is the last function called when the application is about to exit. It is a hook for implementing functions that are required, such as validation of results from the application exit policy opcode hook and logging.

### Syntax

```
void
pin_mta_post_exit(
    pin_flist_t      *app_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_init\_app

This function performs post-application initialization functions.

This function is a hook for implementing functionality that is required after initialization, such as validation of results from the initialization policy opcode hook and logging.

### Syntax

```
void  
pin_mta_post_init_app(  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.



---

## pin\_mta\_post\_init\_search

This function performs post-search flist preparation functions.

This function is a hook for implementing functionality that is required after the search flist is prepared, such as validation of results from the search initialization policy opcode hook and logging.

### Syntax

```
void
pin_mta_post_init_search(
    pin_flist_t    *app_flistp,
    pin_flist_t    *search_flistp,
    pin_errbuf_t   *ebufp);
```

### Parameters

**app\_flistp**

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

**search\_flistp**

A pointer to the flist containing the search flist from global flist substruct PIN\_FLD\_SEARCH\_FLIST.

**ebufp**

A pointer to the error buffer.

## pin\_mta\_post\_job\_done

This function performs post-application job-completion functions.

This function is called after all worker threads have finished processing the jobs assigned to them. It is a hook for implementing functionality that is required, such as validation of results from the application job-completion policy opcode hook and logging.

### Syntax

```
void  
pin_mta_post_job_done(  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_tune

This function performs post-search functions for preprocessing search results.

This function is a hook for implementing functions that are required after the search results have been preprocessed, such as validation of the results from search results tuning policy opcode hook and logging.

### Syntax

```
void
pin_mta_post_tune(
    pin_flist_t    *app_flistp,
    pin_flist_t    *srch_res_flistp,
    pin_errbuf_t   *ebufp);
```

### Parameters

#### ***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

#### ***srch\_res\_flistp***

A pointer to the flist containing the search results flist received from the global flist substruct PIN\_FLD\_SEARCH\_RESULTS.

#### ***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_usage

This function displays the help text prepared by `pin_mta_usage` and the usage policy opcode hook.

### Syntax

```
void  
pin_mta_post_usage(  
    pin_flist_t      *param_flistp,  
    pin_flist_t      *app_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***param\_flistp***

A pointer to the flist containing information about the command-line parameters.

***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct `PIN_FLD_APPLICATION_INFO`.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_worker\_exit

This function exits all worker threads.

This function is called when the application is about to exit and all worker threads must exit. This function is a hook for implementing functions that are required, such as logging.

### Syntax

```
void
pin_mta_post_worker_exit(
    pcm_context_t    *ctxp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_worker\_init

This function performs post-worker thread initialization functions.

This function is called for each thread at thread startup. It is a hook for implementing functions that are required after worker thread initialization, such as validation of results from the worker thread initialization policy opcode hook and logging.

### Syntax

```
void  
pin_mta_post_worker_init(  
    pcm_context_t    *ctxp,  
    pin_flist_t      *ti_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

---

## pin\_mta\_post\_worker\_job

This function performs post-worker thread job preparation functions.

This function is a hook for implementing functions that are required, such as validation of results from the worker thread policy opcode hook and logging.

### Syntax

```
void
pin_mta_post_worker_job(
    pcm_context_t    *ctxp,
    pin_flist_t      *srch_res_flistp,
    pin_flist_t      *op_in_flistp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***srch\_res\_flistp***

A pointer to the flist containing a subset of the global search results assigned to a worker thread.

***op\_in\_flistp***

A pointer to the flist containing the main opcode input flist.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_post\_worker\_job\_done

This function performs post-worker job completion functions.

This function is a hook for implementing functions that are required, such as validation or processing of results from the worker thread policy opcode hook.

### Syntax

```
void
pin_mta_post_worker_job_done(
    pcm_context_t      *ctxp,
    pin_flist_t        *srch_res_flistp,
    pin_flist_t        *op_in_flistp,
    pin_flist_t        *op_out_flistp,
    pin_flist_t        *ti_flistp,
    pin_errbuf_t       *ebufp);
```

### Parameters

**ctxp**

A pointer to the PCM context.

**srch\_res\_flistp**

A pointer to the flist containing a subset of the global search results assigned to a worker thread.

**op\_in\_flistp**

A pointer to the flist containing the main opcode input flist.

**op\_out\_flistp**

A pointer to the flist containing the main opcode output flist.

**ti\_flistp**

A pointer to the flist containing thread information.

**ebufp**

A pointer to the error buffer.



---

## pin\_mta\_tune

This function preprocesses search results.

This function is called after the main search execution for preprocessing the search results. The search results can be modified before the results are distributed to the worker threads.

### Syntax

```
void
pin_mta_tune(
    pin_flist_t    *app_flistp,
    pin_flist_t    *srch_res_flistp,
    pin_errbuf_t   *ebufp);
```

### Parameters

#### ***app\_flistp***

A pointer to the flist containing application information received from the global flist substruct PIN\_FLD\_APPLICATION\_INFO.

#### ***srch\_res\_flistp***

A pointer to the flist containing the search results flist received from the global flist substruct PIN\_FLD\_SEARCH\_RESULTS.

#### ***ebufp***

A pointer to the error buffer.

## pin\_mta\_usage

This function creates a help text message.

This function is called when the user requests help using the **-help** parameter or when an error occurs during application configuration. This function is a hook to prepare help text messages.

---

---

**Important:** You must set the PIN\_FLD\_DESCR field in PIN\_FLD\_EXTENDED\_INFO substruct in the global flist to the help text so that it can be accessed by the usage policy opcode for customization and by **pin\_mta\_post\_usage** for displaying the message.

---

---

### Syntax

```
void  
pin_mta_usage(  
    char    * prog);
```

### Parameters

***prog***  
The application name.

---

## pin\_mta\_worker\_exit

This function exits all worker threads.

This function is called when the application is about to exit and all worker threads must exit. This function is a hook for implementing functions that are required, such as logging.

### Syntax

```
void
pin_mta_worker_exit(
    pcm_context_t    *ctxp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_worker\_init

This function performs thread initialization.

This function is called for each worker thread at thread startup. It is a hook for implementing functions that are required at worker thread initialization.

### Syntax

```
void  
pin_mta_worker_init(  
    pcm_context_t    *ctxp,  
    pin_flist_t      *ti_flistp,  
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

---

## pin\_mta\_worker\_job

This function performs functions required at worker thread job preparation.

This function is called every time a worker thread receives work for any preprocessing of the search results before the results are passed to the main opcode to be processed.

---

**Tip:** This function provides the same functionality as **pin\_mta\_tune**. Because of parallel processing, preprocessing search results in the worker threads is more efficient when BRM is installed on a multiple-CPU host machine.

---

### Syntax

```
void
pin_mta_worker_job(
    pcm_context_t    *ctxp,
    pin_flist_t      *srch_res_flistp,
    pin_flist_t      **op_in_flistpp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***srch\_res\_flistp***

A pointer to the flist containing a subset of the global search results assigned to a worker thread.

***op\_in\_flistpp***

A pointer to a pointer to the main opcode input flist.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

## pin\_mta\_worker\_job\_done

This function performs functions that are required after the main opcode has processed the batch of search results.

This function is a hook to implementing functions that are required, such as the validation of main opcode results.

### Syntax

```
void
pin_mta_worker_job_done(
    pcm_context_t    *ctxp,
    pin_flist_t      *srch_res_flistp,
    pin_flist_t      *op_in_flistp,
    pin_flist_t      *op_out_flistp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***srch\_res\_flistp***

A pointer to the flist containing a subset of the global search results assigned to a worker thread.

***op\_in\_flistp***

A pointer to the flist containing the main opcode input flist.

***op\_out\_flistp***

A pointer to the flist containing the main opcode output flist.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.

---

## pin\_mta\_worker\_opcode

This function executes the main opcode.

This function is called by the worker threads to execute the main opcode to process the search results. Worker threads call this function for every batch of work they receive.

### Syntax

```
void
pin_mta_worker_opcode(
    pcm_context_t    *ctxp,
    pin_flist_t      *srch_res_flistp,
    pin_flist_t      *op_in_flistp,
    pin_flist_t      **op_out_flistpp,
    pin_flist_t      *ti_flistp,
    pin_errbuf_t     *ebufp);
```

### Parameters

***ctxp***

A pointer to the PCM context.

***srch\_res\_flistp***

A pointer to the flist containing a subset of the global search results assigned to a worker thread.

***op\_in\_flistp***

A pointer to the flist containing the main opcode input flist.

***op\_out\_flistpp***

A pointer to a pointer to the flist containing the main opcode output flist.

***ti\_flistp***

A pointer to the flist containing thread information.

***ebufp***

A pointer to the error buffer.





---

---

## Adding or Changing Login Options

This chapter describes how to create a login and password for custom applications to access Oracle Communications Billing and Revenue Management (BRM). It also includes a section about modifying the customer login policy to avoid duplicate login/service combinations in branding environments.

For general information about permissions and passwords, see "Implementing system security" in *BRM System Administrator's Guide*.

### About Customizing the Login Account for Your Application

You can use the default root account to login. However, to properly manage access and permissions to BRM, you must create a BRM account for each custom application that you create.

To change the default login for your application, perform the following tasks:

1. Use Customer Center to create a BRM account with **pcm\_client** service for your application.

See ["Creating an Account for Your Application"](#).

You can create an account for each instance of the application to manage permissions to a fine detail of control.

2. Provide the login and password to the application at runtime. See ["Providing Login and Password to Your Custom Application"](#) for instructions.

### Creating an Account for Your Application

To prevent unwanted billing, the account that owns your custom **/service/pcm\_client** and **/service/admin\_client services** must be nonbilling. You create a nonbilling account by specifying the billing type to **PIN\_BILL\_TYPE\_UNDEFINED**.

For a complete list of billing types, see the *BRM\_Home/include/pin\_cust.h* file, where *BRM\_Home* is the directory in which you installed BRM components.

To set up a nonbilling account:

1. Create an **/account** storable object.

For information on creating objects, see ["Creating Custom Fields and Storable Classes"](#).

2. Change its **PIN\_FLD\_BILL\_TYPE** value to **PIN\_BILL\_TYPE\_UNDEFINED**.
3. Use Customer Center to create an account with **service/pcm\_client** for your custom application.

## Providing Login and Password to Your Custom Application

You can use one of the following methods to pass the login and password to your application:

- You can have the application user enter the login and password at runtime. This is the most secure way because there are no configuration files to be read.

To use this method, call `PCM_CONTEXT_OPEN` in your application and build a login flist.

- You can get the login name and password from the application configuration file. This method allows the application to start automatically and reconnect. However, you must secure the configuration file to prevent unauthorized access.

To use this method, call `PCM_CONNECT` in your application to open a PCM context.

This routine reads the login type, name and password entries from your application configuration file. It then calls `PCM_CONTEXT_OPEN` with an input flist containing values for login type, name, and password from the configuration file.

For an example of how to use this routine, see `sample_app.c` located in `BRM_SDK_Home/source/samples/apps/c`.

## Configuring System Passwords

After you create the new service and account for your application, edit the `userid` entry in your application configuration file to point to the new service you created.

You can specify that your application requires a login name and password to connect to BRM by setting the login type to 1 in the login information section of your applications's configuration file.

In your application's configuration file, include entries for login type, name, and password using this syntax:

```
- nap login_type login_type
- nap login_name login_name
- nap login_pw password
```

Example:

```
- nap login_type 1
- nap login_name Portal_user
- nap login_pw
```

## Creating Several admin\_client Services with Different Permissions

You can create several `admin_client` services with different permissions to manage access and permissions to BRM components. Permissions are stored in the `/service/admin_client` storable object in the `PIN_FLD_PERMITTEDS` array.

1. Create the `/service/admin_client` storable objects that are owned by several accounts.

For information on creating storable objects, see "[Creating Custom Fields and Storable Classes](#)".

2. Add as many permissions to the service permissions array (`PIN_FLD_PERMITTEDS`) as you want.

For information about the array's format, see the `/service/admin_client` storable class specification.

## Setting Up Customer Verification for Your Applications

You can use the optional RADIUS Manager to require a login and password for all access to BRM. You can configure RADIUS Manager to do login and password checking for any custom situation, such as Web access. To enable this feature:

1. Modify your application to intercept request for access to BRM from all applications.
2. Make verification function calls to verify the request before allowing access to BRM.

See the descriptions of the following opcodes for more information:

- PCM\_OP\_ACT\_POL\_SPEC\_VERIFY
- PCM\_OP\_ACT\_FIND\_VERIFY
- PCM\_OP\_CUST\_POL\_PREP\_LOGIN
- PCM\_OP\_CUST\_POL\_PREP\_PASSWD
- PCM\_OP\_CUST\_POL\_VALID\_LOGIN
- PCM\_OP\_CUST\_POL\_VALID\_PASSWD
- PCM\_OP\_MAIL\_LOGIN\_VERIFY
- PCM\_OP\_MAIL\_DELIV\_VERIFY

## Establishing Unique Service Logins

If your BRM environment uses branding, you may need to ensure that only one brand contains a particular login/service combination. You can modify the customer login policy to extract the brand's domain name from the brand account's uniform resource locator (URL) field, and append it to the customer's login. The domain used for the customer's login is the domain defined for the brand in Configuration Center. For example, if the URL for the brand "East Coast Enterprises" is **www.ecoastent.com**, and a user has the login **jmcgee**, the login policy changes the login to **jmcgee@ecoastent.com**.

## Appending a Domain Name to a Customer's Login ID

By default, the login policy retrieves the domain name for a customer login ID from the CM `pin.conf` file. If you have a branded BRM system, you can customize this policy to retrieve the domain name from the brand account's URL field, and append it to a customer's login ID.

To retrieve the domain name for a customer's email address, follow the example below.

1. Open the `fm_cust_pol_prep_login.c` source file.
2. Define the `GetDomain()` function:

```
static char *
GetDomain
    pcm_context_t      *ctxp,
    poid_t             *o_pdp,
    pin_errbuf_t       *ebufp,
    int32              *err);
```

3. Locate the following lines of code that look up the **pin.conf** file for the default domain name:

```
/* If conf'ed force default domain */
pin_conf("fm_cust_pol", "domain", PIN_FLDT_STR,
        (caddr_t *)&(domain), &(err));
if (domain != (char *)NULL) {
```

4. Replace this code with the following lines:

```
if (!strcmp(type, "/service/email", 14)) {
    /* force brand-specific domain */
    domain = GetDomain(ctxp, o_pdp, ebufp, &err);
    if (domain != (char *)NULL) {
```

This causes BRM to use the brand domain for customers' email service.

5. Add the following lines to the **fm\_cust\_pol\_prep\_login.c** source file:

```
/* *****
 * Begin Customization
 * ***** */
static char *
GetDomain(
    pcm_context_t    *ctxp,
    poid_t           *o_pdp,
    pin_errbuf_t     *ebufp,
    int32            *err)
{
    char              *domain = NULL, *tmp = NULL;
    char              buf[80];
    pin_flist_t       *i_flistp = NULL;
    pin_flist_t       *r_flistp = NULL;
    poid_t            *a_pdp = NULL;
    poid_t            *b_pdp = NULL;

    //Get Account POID
    i_flistp = PIN_FLIST_CREATE(ebufp);
    PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_POID, o_pdp, ebufp);
    PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_ACCOUNT_OBJ, NULL, ebufp);

    PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Account POID input", i_
flistp);

    PCM_OP(ctxp, PCM_OP_READ_FLDS, 0, i_flistp, &r_flistp, ebufp);

    PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Account POID output", r_
flistp);

    if (PIN_ERR_IS_ERR(ebufp))
    {
        if (i_flistp) PIN_FLIST_DESTROY(i_flistp, ebufp);
        if (r_flistp) PIN_FLIST_DESTROY(r_flistp, ebufp);
        return NULL;
    }

    a_pdp = PIN_FLIST_FLD_TAKE(r_flistp, PIN_FLD_ACCOUNT_OBJ, 0, ebufp);
    //Now you have the account POID in a_pdp

    PIN_FLIST_DESTROY(i_flistp, ebufp);
    PIN_FLIST_DESTROY(r_flistp, ebufp);
```

```

i_flistp = r_flistp = NULL;

//Get the account type
i_flistp = PIN_FLIST_CREATE(obufp);
PIN_FLIST_FLD_PUT(i_flistp, PIN_FLD_POID, a_pdp, obufp);
PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_ACCOUNT_TYPE, NULL, obufp);
PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_BRAND_OBJ, NULL, obufp);

PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Account type input", i_
flistp);

PCM_OP(ctxp, PCM_OP_READ_FLDS, 0, i_flistp, &r_flistp, obufp);

PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Account type output", r_
flistp);

if (PIN_ERR_IS_ERR(obufp))
{
    if (i_flistp) PIN_FLIST_DESTROY(i_flistp, obufp);
    if (r_flistp) PIN_FLIST_DESTROY(r_flistp, obufp);
    return NULL;
}

//Get the brand object
b_pdp = PIN_FLIST_FLD_TAKE(r_flistp, PIN_FLD_BRAND_OBJ, 0, obufp);

PIN_FLIST_DESTROY(i_flistp, obufp);
PIN_FLIST_DESTROY(r_flistp, obufp);
i_flistp = r_flistp = NULL;

//if a brand exists
if (PIN_POID_GET_ID(b_pdp) != 1)
{
    //Get the brand URL
    i_flistp = PIN_FLIST_CREATE(obufp);
    PIN_FLIST_FLD_PUT(i_flistp, PIN_FLD_POID, b_pdp, obufp);
    PIN_FLIST_FLD_SET(i_flistp, PIN_FLD_AAC_SOURCE, NULL, obufp);

    PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Brand POID input", i_
flistp);

    PCM_OP(ctxp, PCM_OP_READ_FLDS, 0, i_flistp, &r_flistp, obufp);

    PIN_ERR_LOG_FLIST(PIN_ERR_LEVEL_DEBUG, "Get Brand POID output", r_
flistp);

    if (PIN_ERR_IS_ERR(obufp))
    {
        PIN_FLIST_DESTROY_EX(&i_flistp, obufp);
        PIN_FLIST_DESTROY_EX(&r_flistp, obufp);
        if (b_pdp) PIN_POID_DESTROY(b_pdp, obufp);
        return NULL;
    }

    tmp = PIN_FLIST_FLD_GET(r_flistp, PIN_FLD_AAC_SOURCE, 1, obufp);
    // if we get the URL
    if (tmp)

```

```
{
domain = (char *) malloc(255);

//You have the URL; now extract the domain name from it
if(strchr(tmp, '.'))
{
strcpy(domain, (strchr(tmp, '.')+1));
}
else
{
strcpy(domain, tmp);
}
}
else
// else use system default
{
pin_conf("fm_cust_pol", "domain", PIN_FLDT_STR,
(caddr_t *)&(domain), err);
}

PIN_FLIST_DESTROY_EX(&i_flistp, ebufp);
PIN_FLIST_DESTROY_EX(&r_flistp, ebufp);
i_flistp = r_flistp = NULL;
}
else
{
PIN_POID_DESTROY(b_pdp, ebufp);
pin_conf("fm_cust_pol", "domain", PIN_FLDT_STR,
(caddr_t *)&(domain), err);
}

return domain;
}
/*****
* End Customization
*****/
```

---

---

# Creating Custom Search Templates for Event Browser

This chapter explains how to add custom search templates to Oracle Communications Billing and Revenue Management (BRM) Event Browser.

## About Search Templates

A *search template* is an Event Browser component that you use to find events. Each template contains a group of related fields for one or more related classes. These fields define the results expected from the search and how the results are displayed in the results table. The templates are passed to the search bean in a Java Properties class.

## About Custom Search Templates

The Event Browser search tool contains a default set of search templates. You can enhance the search capability by creating custom templates.

You can create search templates that perform complex searches on up to four classes. Each search template can find multiple event types and define multiple search conditions. You can define which classes to search, and you can specify which fields from the first class are displayed in the results table.

Each custom search template you create appears on the list of templates in the Search dialog box. You can also optionally add custom templates to the list of templates on the **Browse** menu.

## Adding Custom Search Templates to Event Browser

You define custom search templates by using the specified syntax, in a file that you create with a specific name and save in a specific location.

To create custom search templates:

1. Create a text file.

In this file, you do the following:

- Define as many templates as you need, as described in "[Template Definition](#)".
- Optionally include entries that make the custom templates appear on the **Browse** menu, as described in "[Browse Menu Definition](#)".

2. Save the file with this file name:

**EventBrowserSearch.templates**

3. Save the file in this folder:

**Program Files\Portal Software\CustomerCenter\lib**

## Template Definition

A template definition in the **EventBrowserSearch.templates** file consists of several lines of text. Each line contains key/value pair properties that define:

- The template name.
- The classes to search.
- The results to search for.
- The labels to display in the Search dialog box.
- The column labels for the results table.

Each property that you define in your template uses the following basic syntax:

```
search.template.templateName.property=value
```

where:

- **search.template** identifies the beginning of an entry.
- *templateName* is the unique name that identifies the template.
- *property* is the key you are defining, for example, a class to search or a label to apply.
- *value* is the value you assign to the property, such as the template name and the class name.

For a list of the available search template entries and their syntax, see "[Search Template Properties](#)".

## Annotated Example Template

Table 30–1 shows the simple template named **Testing**, which searches the event and account classes for the account number and event description:

**Table 30–1 Annotated Example Template**

| Property and Value  | Meaning  |
|---|--|
| <code>search.template.test.name=Testing</code>  | The name of the template is Testing.   |
| <code>search.template.test.class.1=/event</code><br><code>search.template.test.class.2=/account</code>              | The classes that will be searched are the event and account classes, numbered 1 and 2 for reference.                                     |
| <code>search.template.text.results=</code><br><code>R1:1.FldSysDescr,R2:2.FldAccountObj.FldAccountNo</code>         | From class 1 (event), get the field description.<br>From class 2 (account), get the account number, which is found in the FldAccountObj. |
| <code>search.template.test.V1.label=Description</code><br><code>search.template.test.V2.label=Account Object</code> | In the Search dialog box, label the fields <b>Description</b> and <b>Account Object</b> .  |
| <code>search.template.test.R1.label=Desc</code><br><code>search template.test.R2.label=AcctObject</code>            | In the results table, label the columns <b>Desc</b> and <b>Acct Object</b> .   |



---

---

**Important:**

- For event searches, the first class must be `/event` or a subclass of `/event`.
  - Do not use spaces in the results property.
- 
- 

**Note:** The sort order defaults to the first item in the results table.

---

---

## Browse Menu Definition

Custom template names are always included on the list of templates in the Search dialog box. To optionally add a custom template to the **Browse** menu, you include two specific lines of text in the `EventBrowserSearch.templates` file. These entries identify the template and define its position on the menu.

These entries use the following syntax:

```
app.template.name.#=name
app.template.description.#=name...
```

where:

- **app.template.name.#** is the template name and menu position.
- **app.template.description.#** is the string that will appear in the **Browse** menu and specifies the menu position. If this string is omitted or blank, the template name is used.

In the following example, the template named **test** will be the fifth selection on the **Browse** menu, where **Testing...** will be the menu command.

```
app.template.name.5=test
app.template.description.5=Testing...
```

---

---

**Important:** Do not use template numbers 1 through 4 for the `.#` value or you will overwrite default **Browse** menu items.

---

---

## Default BRM Search Templates

The following list shows the names of the default search templates.

---

---

**Important:** Do not use these names for your templates.

---

---

- **account**
- **account&bill**
- **acct&usage**
- **araccount&bill**
- **balance**
- **bitem**
- **cashpay**

- charge
- checkpay
- creditpay
- customer
- date
- deal
- discount
- dispute
- generic
- group
- groupar
- item
- product
- prod&date
- registration
- session
- speccharge

## Search Template Properties

A search template property is the key to which you associate a value when you define a custom template.

Table 30–2 lists the properties in a search template:

**Table 30–2 Search Template Properties**

| Property                | Description   | Example   |
|-------------------------|---|---|
| <code>.class.n</code>   | Defines the class being searched. <i>n</i> indicates the class number, which you assign.<br>This number specifies the field to retrieve from the class during the search.<br>The maximum number of classes allowed is four. | <code>search.template.customer.class.1 = /event</code><br><code>search.template.customer.class.2 = /item</code><br><code>search.template.customer.class.3 = /account</code> |
| <code>.spec</code>      | Search specification string.<br>The number represents the class to which the field belongs and must precede the field name.   | <code>search.template.customer.spec =</code><br><code>3.FldAccountNo like V1 and 2.FldItemNo =</code><br><code>V2</code>  |
| <code>.Vn.label</code>  | The label for an entry field in the Search dialog box. <i>Vn</i> (value <i>n</i> ) corresponds to <b>V<i>n</i></b> in the search string.  | <code>search.template.customer.V1.label = Last</code><br><code>Name</code>  |
| <code>.mergespec</code> | Defines the join relationship among the classes searched. The example shows the association between the <code>/event</code> , <code>/item</code> , and <code>/account</code> classes.                                       | <code>search.template.customer.mergespec=1.Fld</code><br><code>AccountObject=3.FldPoid and</code><br><code>1.FldItemObj=2.FldPoid</code>                                    |

**Table 30–2 (Cont.) Search Template Properties**

| Property         | Description  | Example   |
|------------------|--|---|
| <b>.results</b>  | Defines the different fields returned from the different classes specified in the search. You can use variables to specify which column displays the fields. | <b>search.template.customer.results=R1:1.FldSysDesc, R2:2.FldAccountNo</b><br><b>R1</b> indicates the first column in the results table, <b>R2</b> the second column. <b>1.FldSysDescr</b> specifies that the field description is from the class defined as 1 and the account number is from the class defined as 2. |
| <b>.caption</b>  | Help information describing the purpose of the template. This text is displayed in the Search dialog box.  | <b>search.template.customer.caption = Find Events associated with customers</b>   |
| <b>.enum</b>     | List of entry fields as tag/value pairs. Each tag is displayed as a radio button in the Search dialog box. The value is entered as a value when searching.   | <b>search.template.purchase.enum = Item:1 Ongoing_item:2</b>  |
| <b>.name</b>     | Specifies the template name in the drop-down list of templates in the Search dialog box.   | <b>search.template.customer.name = Customer</b>   |
| <b>.Vn.value</b> | Defines a static value to use as a reference.  | <b>search.template.customer.V1.value=0</b>  |
| <b>.Rn.label</b> | Defines a label for a result in the results table.   | <b>search.template.customer.results=R1.label=Account Number</b>   |
| <b>.sort</b>     | Specifies a sort order different from the default sort order, which is the first item in the results table.  | <b>search.template.customer.sort=1.FldAccountNo</b>   |

## Example Search Template File

This example is the default template named Customer. You can compare it to the Search dialog box and results table for that template to see how the template definition is rendered.

```
search.template.customer.name=Customer
search.template.customer.class.1=/event
search.template.customer.class.2=/account
```

```
search.template.customer.spec=2.FldNameinfo[ANY].FldLastCanon like V1 and
2.FldNameinfo[ANY].FldFirstCanon like V2 and 2.FldNameinfo[ANY].FldPhones[ANY].FldPhone like V3 and
2.FldAccessCode1 like V4 and 2.FldAccessCode2 like V5 and 2.FldAccountNo = V6
```

```
search.template.customer.mergespec=2.FldPoid = 1.FldAccountObj
search.template.customer.caption=Find Events associated with customer(s).
```

```
search.template.customer.V1.label=Last Name:
search.template.customer.V2.label=First Name:
search.template.customer.V3.label=Phone Number:
search.template.customer.V4.label=Access Code 1:
search.template.customer.V5.label=Access Code 2:
search.template.customer.V6.label=Account Number:
```

```
search.template.customer.results=R1:1.FldAccountObj.FldAccountNo, R2:1.FldSysDescr, R3:1.FldEndT
```

```
search.template.customer.R1.label=Account Number
search.template.customer.R2.label=Event Description
search.template.customer.R3.label=Date
```



# Part IV

---

## Customizing Customer Center and Self-Care Manager

Part IV describes how to customize Oracle Communications Billing and Revenue Management Customer Center and Self-Care Manager. It contains the following chapters:

- [Using Customer Center SDK](#)
- [Customizing the Self-Care Manager Interface](#)
- [Customizing the Customer Center Help System](#)
- [Customizing the Customer Center Interface](#)
- [Using Configurator to Configure Customer Center](#)
- [Adding Custom Fields to Customer Center](#)
- [Setting Up JBuilder to Customize the Customer Center Interface](#)
- [Creating a New Customer Center Profile Panel](#)
- [Creating a New Customer Center Service Panel](#)
- [Sample Customer Center Customizations](#)



---

---

## Using Customer Center SDK

This chapter provides information on using the Oracle Communications Billing and Revenue Management (BRM) Customer Center Software Development Kit (SDK) for customizing the Customer Center and Self-Care Manager client applications. While Customer Center and Self-Care Manager share many of the controllers for communicating with BRM, their client interfaces differ. See "[Customizing the Customer Center Interface](#)" and "[Customizing the Self-Care Manager Interface](#)".

---

---

**Note:** To install Customer Center SDK, see "Installing Customer Center SDK on Windows" in *BRM Installation Guide*.

---

---

### About Customer Center SDK

Customer Center SDK provides the framework and toolkit you need to customize and configure the default implementations of Customer Center and Self-Care Manager.

### About Using Customer Center SDK to Customize Customer Center

Customer Center SDK allows you to modify the appearance and behavior of Customer Center to meet your business needs. You make these changes by using the customization APIs available for each screen of Customer Center.

Customer Center SDK includes a client application called Configurator that provides a graphical user interface for making modifications and additions to the default Customer Center properties and resources. Configurator allows you to:

- Change Customer Center tab order or tab contents
- Remove certain Customer Center fields
- Change Customer Center behavior
- Change the fields displayed in account search results

For information on using Configurator to make these changes to Customer Center, see "[Customizing the Customer Center Interface](#)".

---

---

**Important:** Because of interdependencies between fields that reside on multiple panels, certain fields cannot be removed from the Customer Center interface. Additionally, existing fields cannot be rearranged.

---

---

The SDK also includes scripts, customized properties files, source code examples, and a utility for exploring and copying field definitions that you can use for extending or customizing Customer Center functionality.

For customizing or modifying the Customer Center Help, the SDK provides the online help in a compressed file. Scripts are provided for unpacking the file and creating a new custom help file for deployment from your Customer Center deployment servers.

For information on deploying Customer Center changes you make using Customer Center SDK, see "[About Compiling and Packaging Your Customizations](#)".

## About Using Customer Center SDK to Customize Self-Care Manager

Self-Care Manager allows your customers to log into their accounts and view their account and product information by using a Web browser. Customer Center SDK allows you to modify the appearance and behavior of Self-Care Manager to meet your business needs.

Customer Center SDK includes the following components for customizing Self-Care Manager:

- HTML code you can edit to change the appearance of the web pages.
- Java Server pages (JSPs) for changing the layout of the Self-Care Manager interface, removing elements included in the default JSPs, or using a different set of components.
- Examples of modified JSPs and custom controllers for extending Self-Care Manager functionality.
- Scripts that build and package a custom Self-Care Manager Web Application Archive (WAR) file for deploying your customized files. See "Modifying the Self-Care Manager WAR File" in *BRM Managing Customers* for information about deploying an updated WAR file.

## Contents of Customer Center SDK

Customer Center SDK includes these components.

For modifying Customer Center and Self-Care Manager:

- **buildall**, a batch file for building your customized Customer Center and Self-Care Manager code. See "[About Compiling and Packaging Your Customizations](#)".
- "[Customer Care API Reference](#)", a set of JavaDocs describing the Customer Center SDK classes.

For modifying Customer Center only:

- **Configurator**, a graphical utility for implementing many common GUI modifications
- **Scripts**, for testing your code.

## Customer Care API Reference

See *Customer Care API reference* for JavaDocs describing Customer Care classes.

*Customer Care API reference* is also available in your `CCSDK_Home\CustomerCareSDK\docs` directory. To view the documentation, use a Web browser to open the `index.html` file in this directory.



## Coding Your Customizations

To design and code your customizations, see ["Customizing the Customer Center Interface"](#) or ["Customizing the Self-Care Manager Interface"](#).

## About Compiling and Packaging Your Customizations

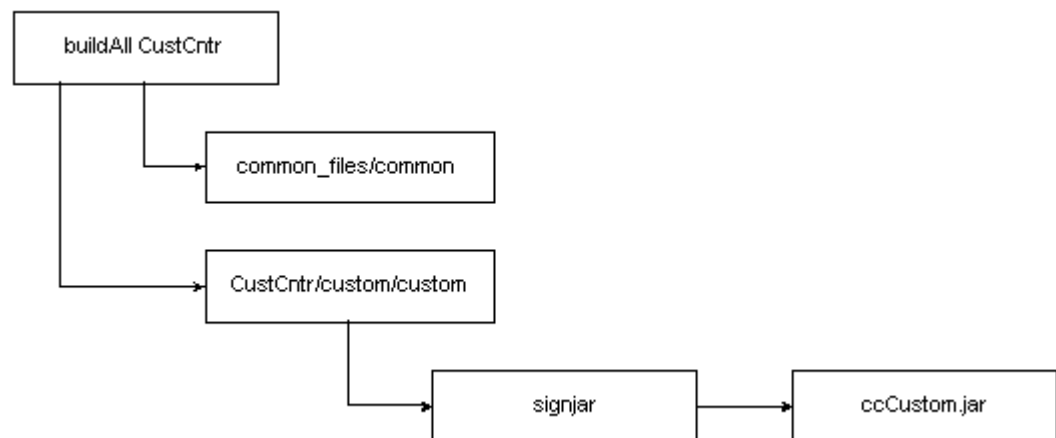
You compile your customizations to Customer Center and Self-Care Manager by using the **buildall** script in the `CCSDK_Home\CustomerCareSDK` directory, where `CCSDK_Home` is the directory in which you installed Customer Center SDK components. This script calls other scripts to accomplish the following tasks:

- For Customer Center:
  - Compiles any Java source code files encountered in the `CCSDK_Home\CustomerCareSDK\CustCntr\custom` directory.
  - Repackages the newly compiled class files and the **WizardCustomizations** and **Customized** properties files into a `CCSDK_Home\CustomerCareSDK\CustCntr\custom\ccCustom.jar` file.
  - Signs the new **ccCustom.jar** file with a Java Security Certificate.
- For Self-Care Manager:
  - Compiles any Java source code files encountered in the subdirectories under the `CCSDK_Home\CustomerCareSDK\WebKit\custom` directory.
  - Repackages the newly compiled class files into a **webkit\_en.war** file.
  - Builds a new `CCSDK_Home\CustomerCareSDK\WebKit\custom\webkit_en.war` file.

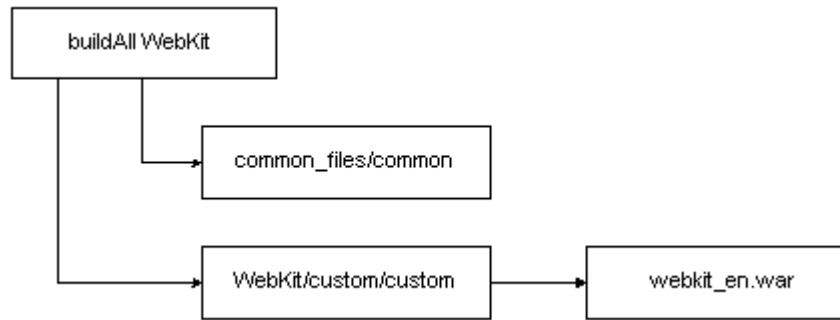
[Figure 31–1](#) and [Figure 31–2](#) show the relationships between the **buildall** script and the scripts it calls to accomplish these tasks:

- For building a **ccCustom.jar** file for Customer Center:

**Figure 31–1 Building Customer Center**



- For building a **webkit\_en.war** file for Self-Care Manager:

**Figure 31–2 Building Self-Care Manager**

This script calls the following scripts to process your files:

- **custom** compiles any **.java** files found in the **CustCntr\custom** or **WebKit\custom** directories.
- **signjar** (Customer Center only) signs the new **ccCustom.jar** distribution file with a security certificate, either a valid one obtained from an authorized provider or a self-signed certificate created with the **makecertificate** script. Before running the **buildAll** script, be sure to edit **signjar** to add values to the **KEYPASSWORD** and **STOREPASSWORD** entries.
- **common** compiles any **.java** files for controllers used by both Customer Center and Self-Care Manager found in the **common\_files** directory.

---

**Important:** Do not run the **custom**, **signjar**, or **common** scripts directly. They are designed to be called by **buildAll** only.

---

## Coding, Building, and Deploying Customizations

To code, build, and deploy your customizations, see:

- For Customer Center, "[Building Your Customer Center Customizations](#)".
- For Self-Care Manager, "[Building the Self-Care Manager Components](#)".

---

**Note:** To develop and deploy customized Customer Center Help, see "[Customizing the Customer Center Help System](#)".

---

## Syntax for the buildAll Script

The **buildAll** script is used to build the customized **jar** files for your Customer Center and Self-Care Manager customizations.

This section describes the syntax for the **buildAll** script. For general information on how to use the **buildAll** script for the client applications, see:

- For Customer Center, "[Building Your Customer Center Customizations](#)".
- For Self-Care Manager, "[Building the Self-Care Manager Components](#)".

### Syntax

```
buildAll CustCntr|WebKit [clean]
```

## File Location

`CCSDK_Home\CustomerCareSDK`

## Parameters

Table 31–1 lists the parameters for the **buildAll** script.

**Table 31–1** *buildAll Script Parameters*

| Parameter       | Description   |
|-----------------|---|
| <b>CustCntr</b> | Use this parameter to compile any new source code you put in the <code>CCSDK_Home\CustomerCareSDK\common_files</code> and <code>CustCntr\custom</code> directories.<br><br>The <code>ccCustom1.jar</code> file is created and signed.   |
| <b>WebKit</b>   | Use this parameter to compile any new source code you put in the <code>CCSDK_Home\CustomerCareSDK\common_files</code> and <code>WebKit\custom</code> directories.<br><br>The <code>webkit_en.war</code> file is created.  |
| <b>clean</b>    | Use the <b>clean</b> parameter with the <b>CustCntr</b> or <b>WebKit</b> parameters to verify that class files left from a previous build are removed before running <b>buildAll</b> again to rebuild the custom <b>jar</b> or <b>war</b> file.<br><br>You must specify the <b>CustCntr</b> or <b>WebKit</b> parameters, not both, when you use the <b>clean</b> parameter. |

## Testing Your Customizations for Customer Center

To test the customizations you made to Customer Center:

1. Run the **runCustomerCenter** script, in the `CCSDK_Home\CustomerCareSDK\CustCntr\bin` directory.
2. When the Login dialog box appears, enter your login information, and then click **OK**.

A local version of the Customer Center application starts. Any customizations you made are represented in this local version of Customer Center.

## Understanding the BRM Business Application SDK Framework

Customer Center and Self-Care Manager use the Business Application SDK (BAS) framework. The BAS framework supports the construction of a set of distributed objects and mutually independent BRM Infranet-aware (PIA) components.

### The Model-View-Controller Architecture

The BRM business applications framework is based on the model-view-controller (MVC) paradigm. In this paradigm, a component's control logic is separated from its display:

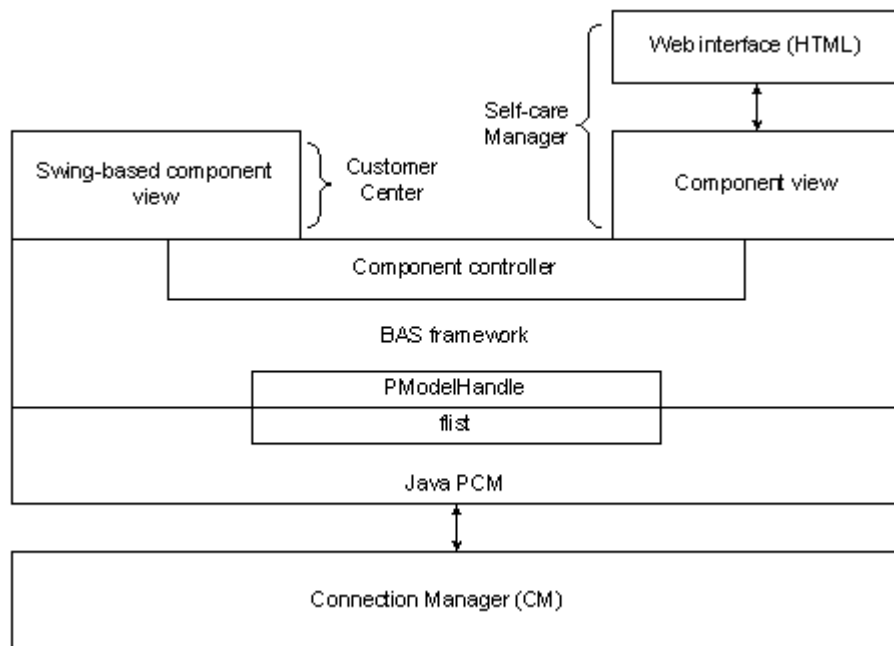
- The **model** component is the data. BRM data and BRM data types exist only in the controllers.
- The **view** component is the display of the data in the user interface. The view component handles only the Java data.

- The **controller** component is the logic on the server that determines the behavior of the data and how the data is displayed. The controllers convert the BRM data into Java data such as **Vector**, **int**, **Date**, and **String**.

In Customer Center and Self-Care Manager, the controller and view components are combined.

Figure 31–3 shows the Customer Care architecture:

**Figure 31–3 Customer Care Architecture**



## How the Controllers Work

This section describes the basic controller process:

1. When users interact with a component, the component calls **setModelHandle**, which sets the appropriate property for the field and sends the model handle to the controller.
2. The component calls the controller's **update** method.
3. The controller communicates with BRM by calling the necessary opcodes.
4. The opcodes get the fields specified in the field specification or they get data after performing calculations or other functions, depending on the component.

### Example Data Flow between a Simple Field and BRM

This example shows the data flow between the view component of a simple text field in the Account Maintenance panel, its controller, and BRM:

1. An external action, such as selecting an account in the Search Results panel, initiates a call to **setModelHandle** on a text field.
2. The text field view component calls its controller to get the data that corresponds to its **displayFieldDescription**.
3. The controller communicates with BRM by calling opcodes or reading objects.

4. The controller reads the **/account** object in the database and gets the fields specified by the display field specification.
5. The controller computes a new value and saves it in a property, for example, **mField=val**.
6. The view component calls a **get** method, for example, **getField()**, to get the previous property, and then sets this value in its display with **setText(getField())**.

## About Field Components

Field components have model handles and the Customer Center SDK components contain references to field subclasses in the BRM database. These components have several properties, for example:

- **Model field description**

Specifies the data that a field contains. For example, the first name field has this specification for model field: **FldNameInfo[1].FldFirstName**.

- **Display field description**

Specifies the data to display. For example, the read-only field of an **account** object might have this specification for the display field:  
**FldNameInfo[1].FldFirstName,FldNameInfo[1].FldLastName, FldAccountNo.**

- **Display field format**

Specifies the display format for the data specified in the display field. An **/account** object might have this specification for the display field format: **{0}{1} - {2}** to display the account information in the "First name Last name - Account number" format or **{1}{0} - {2}** to display "Last name First name - Account number" format. The field numbers, such as **{0}**, **{1}**, correspond to the order in which they are specified in the display field specification.

Every field component must have a specification for its **modelFieldDescription**, its **displayFieldDescription**, or both. The properties of the field depend on the type of the field. For example, a read-only field does not have a **modelFieldDescription** property, but it does have **displayFieldDescription** and **displayFieldFormat** properties.

---

**Note:** Field component names follow the Java class-naming conventions and use mixed case without the underscores. The Java field classes in the Java Portal Communication Module (PCM) package included in Customer Center SDK use the C **#define** name without the **PIN\_** prefix. For example, **PIN\_FLD\_NAME\_INFO** in C becomes **FldNameInfo** in Java. See "[Creating Client Applications by Using Java PCM](#)" for information about Java PCM. See *Customer Care API reference* for the **com.portal.pcm.fields** package for information about the supported field subclasses.

---

## Displaying Versus Saving Data in Fields

You use fields in a panel to display data as well as to allow users to change data. When users change data, their changes must be saved in the database. To implement reading from and writing to the object field in the database, you need to understand the read and write functions in BRM.

For information on BRM read and write fields functions, see "[Base Opcodes](#)".

For most fields that you create, you use the **modelFieldDescription** property to display and save changes to the data. For example, to display as well as save changes to the first name in the **FldNameinfo** field for the billing contact, you can use the following property for both **modelFieldDescription** and **displayFieldDescription**:

```
FldNameinfo[1].FldFirstName
```

However, not all fields have the same string for their model and display field descriptors.

In cases where reading the data is different from writing the data, such as the **FldPayinfo** data:

- For reading the data, set the description in **displayFieldDescription**.
- For writing the data, set the description in **modelFieldDescription**.

For example, use the following **displayFieldDescription** to read the credit card number field:

```
FldPayinfoObj.FldccInfo[0].FldDebitNum
```

And use the following **modelFieldDescription** to write the credit card number field:

```
FldPayinfo[1].FldInheritedInfo[0].FldccInfo[0].FldDebitNum
```

See *Customer Care API reference* for **PCreditCardPanel.java** for examples of setting the description in this manner.

BRM Infranet-aware (PIA) components:

- Are Swing compatible.
- Have references to specific storable class fields.
- Contain APIs that allow you to map them to specific fields in BRM storable classes, such as **account**.
- Have both client and server implementations, which allow individual components to encapsulate data retrieval and user interface (UI) display.

## Display Fields and Controllers

You can use properties, such as a **modelFieldDescription** and a **displayFieldDescription**, when there is a one-to-one correspondence between the fields in the Customer Center interface and the fields in the BRM object. For example, fields such as first name and last name have fields of type **String** in the **/account** object that map exactly to the display. Therefore, you can specify their data by specifying values for the **modelFieldDescription** and **displayFieldDescription** properties in a graphical IDE, such as JBuilder.

To display fields that do not have one-to-one mapping in the object, you need to extend an existing controller or create a new one. For example, the currency field is an integer type in the **/account** object. To display it as a string such as "US Dollar" in the user interface, you need to write a controller that:

- Takes the integer.
- Looks it up in the balance element ID (BEID) table.
- Gets the appropriate string description or name of the currency represented by the integer.

You can write controllers that perform any number of functions. For example, a controller can:

- Perform simple tasks, such as simple translations. For example, you can map an integer type to a string description and send it to the view component.
- Call opcodes and process information.
  - For example, to display the available payment methods, you can write a controller that calls the appropriate opcode, retrieves the data in a vector, and sends the vector to the view component.
  - You can initialize data (flists) for payment information.

---



---

**Important:**

- If you create a new Infranet-aware field, you must create a controller for the field.
  - (Self-Care Manager only) If you add a field component to a JSP that has a controller, you might need to add code to the JSP controller for any special processing of the new field. This code is necessary, for example, when you add custom fields to BRM and use Self-Care Manager to access them. For example, **com.portal.app.comp.PIAPhoneTableBeanImpl** handles the special processing for the phone fields for account creation. If you create a new Infranet-aware field, you need to create a controller for the field.
- 
- 

## About PModelHandle

A **PModelHandle** is an object that passes a reference to a BRM data object. Because the view code does not have access to the PCM library, the BAS API creates this object for client applications to use.

The data referenced by a **PModelHandle** is converted from its specified **modelFieldDescription** to an flist or a storable class, such as **/account**, for the BRM opcodes to use.

When data is returned from BRM, the BAS API converts it into the format specified by the **displayFieldDescription** for that object and the results are displayed in the associated Customer Center field.

## About Lightweight Components (Self-Care Manager Only)

Lightweight components such as text field components are only view components. They are used for storing and displaying data. They do not contain control logic. The encapsulating parent component or the page controller handles the lightweight components. They do not each need a controller.

Use lightweight components to map a UI field to a specific field in a BRM storable class, such as **/account**. The lightweight component used in Self-Care Manager is **PLightComponentHelper**. It is a wrapper for a field component (**PFieldBean**), which allows data to be retrieved from and passed to BRM.

For example, the credit card number UI field does not have a controller because it does not need information from the database; the "Choose service" UI field needs a controller to call the opcode to retrieve the list of available plans. So the credit card number is created as a lightweight component, but "Choose service" is not.

## Source Code Examples

Customer Center SDK provides scripts and applications for customizing Customer Center and Self-Care Manager. When you use Configurator or make entries or changes to the editable properties files, the **buildAll** script creates a new custom distribution file you copy to the appropriate directory to deploy your changes in a production environment. For Customer Center, the script creates a new **jar** file signed with a digital certificate. For Self-Care Manager, the script creates a new **war** file.

Source code examples are provided with Customer Center SDK to show how to use some of the more useful public API available to you.

For more information, see "[Customer Center Customization Examples](#)" and "[Self-Care Manager Customization Examples](#)".



---

## Customizing the Self-Care Manager Interface

This chapter introduces the Oracle Communications Billing and Revenue Management (BRM) Self-Care Manager architecture and provides information on how to customize Self-Care Manager.

For basic information about Self-Care Manager, including configuration, see "About Self-Care Manager" in *BRM Managing Customers*.

To customize Self-Care Manager using Customer Center SDK, you should have:

- Knowledge of the BRM architecture, Portal Communication Module (PCM) opcodes, flists (field lists), and storable classes. For more information, see:
  - BRM System Architecture
  - [Understanding the PCM API and the PIN Library](#)
  - [Understanding Flists and Storable Classes](#)
- Knowledge of the Java PCM Application Programming Interface (API)  
See "[Creating Client Applications by Using Java PCM](#)".
- Knowledge of the model-view-controller (MVC) architecture  
See "[Understanding the BRM Business Application SDK Framework](#)".
- Knowledge of how Customer Self-Care is set up and used with Self-Care Manager  
See "Setting up Customer Self Care With Self-Care Manager" in *BRM Managing Customers*.
- Experience in building Java applications and servlets
- Experience writing HTML

For installation instructions and for information on the contents of Customer Center SDK, see "[Contents of Customer Center SDK](#)".

### About Customizing Self-Care Manager

You can customize Self-Care Manager:

- By editing the HTML code in the Java Server pages (JSPs) or the **Infranet\_general.css** file to change the appearance of the page.  
See "Changing Web Pages" in *BRM Managing Customers*.
- By editing the Java Server pages (JSPs) to change the layout of the interface and to remove elements included in the JSPs.  
See "Editing JSPs" in *BRM Managing Customers*.

- By editing the JSPs to use a different set of components or by adding new JSPs. See ["Extending the Functionality of Self-Care Manager"](#).
- By creating new components and modifying existing components to extend the functionality of Self-Care Manager. See ["Extending the Functionality of Self-Care Manager"](#).

---

---

**Important:** Self-Care Manager files must be used for reference only. When you customize Self-Care Manager, you must implement security that prevents unauthorized access to the BRM system.

---

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## Hardware and Software

You require the following hardware and software to develop and test components for Self-Care Manager:

- Customer Center SDK  
For information on installing Customer Center SDK, see ["Contents of Customer Center SDK"](#).
- Java Development Kit.
- An application server that supports Servlet API and JSP.

## About the BAS Architecture

Self-Care Manager uses the Business Application SDK (BAS) framework. This architecture supports the model view controller (MVC) paradigm. See ["Understanding the BRM Business Application SDK Framework"](#).

## Understanding Self-Care Manager Components

This section describes the components and objects used by Self-Care Manager and how you use them to customize the Self-Care Manager interface.

### Self-Care Manager Components

Self-Care Manager consists of:

- JSPs and servlets, which act as view components.
- Business logic (BAS) beans that act as controller components.
- The BAS framework, which handles connections to BRM and caches BRM data accessed by multiple components. See ["Understanding the BRM Business Application SDK Framework"](#).

### About PInfranetServlet

**PInfranetServlet** is the main servlet which initializes BAS. It is a generic servlet that loads **WebKit.properties** and sets **PPooledConnectionClientServices** as the BAS client service. The BAS Connection Pooling Service tracks the connections in the pool. (These connections are shared by all Self-Care Manager users.) It also sets the start directories and the start page based on its configuration with the servlet engine.

**PInfranetServlet** servlet:

- Sets up a new connection to Connection Manager (CM) for new sessions by performing an explicit login on the BAS client service based on the properties defined in the **WebKit.properties** file. The connection is saved and used throughout the session and is only removed when the session is invalidated.

Most components that the user interacts with use this connection. The exceptions are **CreateFormPage1.jsp** and **CreateFormPage2.jsp**. These components set up their own connections.

---



---

**Note:** The **CreateFormPage1.jsp** and **CreateFormPage2.jsp**. These jsps are used to create an account and account creation is not supported in this release. It continues to be supported in the previous releases.

---



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- Handles the user login component, validates the user, and saves this user's account model handle.

The account model handle and connection are used by the other components that display account and product information, allow account modification, and so on. For more information on the account model handle, see "[About PModelHandle](#)".

## Using PInfranetServlet to Process Requests

To process requests using **PInfranetServlet**, you might need to specify the following in the HTML/JSP pages:

1. Specify "**page=<page\_to\_be\_loaded\_next>**" to forward the request to the page after creating the controller.
2. Specify **Component=<Class>** to:
  - Call BAS to create the controller.
  - Call the setters to set input data.
  - Call the public methods with either **HttpSession** or **PModelHandle** and **ResourceBundle** as arguments.

---



---

**Important:** The **ResourceBundle** is a deprecated parameter and should *not* be used in the business logic of the controller.

---



---

3. (Optional) Specify **sessionstate=start** to create a new session:
  - It creates a data structure to be passed to BAS with the character set and pricing plan information. The character set is based on the browser and is used to display invoices. The pricing plan is defined in **WebKit.properties** to retrieve the plans list.
  - It calls **registerApp** with the program name, locale, and the data structure created in the earlier step.
4. (Optional) Specify **sessionState=end** to invalidate the session.

---



---

**Note:** You can use either **sessionState=start** or **sessionState=end**.

---



---

5. (Optional) Specify **validateBean=<Class>** to create the class and call the setters and the validate method for validation before calling the controller. If the

validation fails, a **RemoteException** is thrown; otherwise, it sets the input data of the controller and calls the public methods. For example, specify the following in `invoice_selection.jsp` to use `DateValidator` to validate the user entered dates:

```
<INPUT Type="hidden" Name="validateBean"
Value="com.portal.web.fmt.DateValidator">
```

### Example Data Flow Designs

This section describes three example designs for communication between the servlet and controller that you can implement in your Self-Care Manager customizations. Information on how to choose the appropriate design from the samples is described in ["Designing a Component"](#).

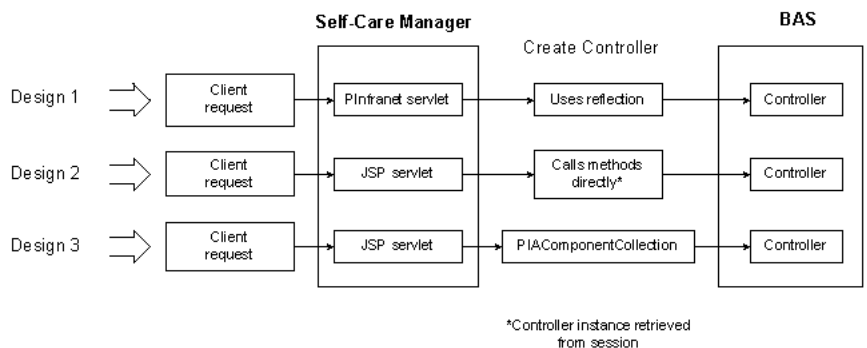
---

**Note:** These designs are examples. You can implement other designs according to your business needs.

---

Figure 32–1 summarizes the three example design architectures:

**Figure 32–1 Example Design Architectures Summary**



1. When a client requests information, an HTTP request is sent to the application server and is processed by a servlet engine.
2. The servlet engine sends a request to the appropriate JSP servlet as specified in the request.

For example, this request is sent to the `change_acct_form` JSP servlet:

```
<FORM Action="change_acct_form.jsp" Method="post">
```

This request is sent to `PInfranetServlet`:

```
response.encodeURL ("PInfranetServlet?page=change_status_
form&Component=com.portal.web.comp.PServicesBeanImpl&loadBean=yes")
```

---

**Note:** Do not include the servlet path in the request.

---

The HTTP request arrives at the application server and is dispatched to the appropriate servlet. Then one of three possible designs is followed:

## Design 1

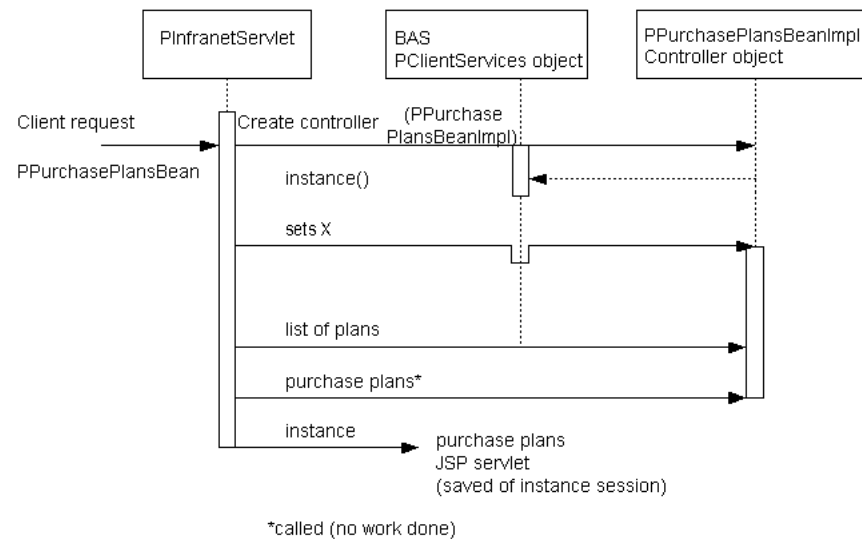
In Design 1, communication between the servlet and the controller occurs using introspection:

1. The request is received by the main servlet, **PInfranetServlet**.  
This is a generic servlet that performs some common Self-Care Manager tasks.
2. **PInfranetServlet** collects all the input data and creates the BAS controller beans specified in the "component" hidden variable.
3. The servlet uses introspection to call all the setters to set the input data properties for this bean (if any) and to call all public methods.
4. The JSP servlet then forwards this bean instance to the JSP specified in the page hidden variable.
5. The JSP servlet loads the data from the bean and returns the HTML output to the browser.

In some cases, this bean is saved in the session for use in later requests.

This Design 1 example UML sequence diagram in [Figure 32–2](#) shows the data flow for displaying the plans available for purchase:

**Figure 32–2 Design 1 Example**



## Design 2

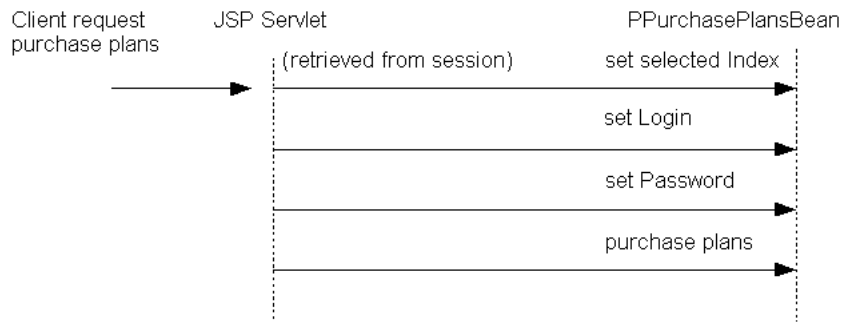
In Design 2, communication between the servlet and the controller occurs by calling methods directly:

1. The request is received by a specific JSP servlet.
  - If the controller bean associated with this JSP servlet does not exist, one is created to perform the necessary operation(s).
  - If the bean exists, the servlet uses the bean saved in session.
2. The servlet:
  - a. Collects all the input data.
  - b. Uses the bean saved in the session to set the input data properties of this bean.

- c. Calls the methods directly to perform the necessary operation for data.
- d. Returns the HTML output to the browser.

This Design 2 example UML sequence diagram in [Figure 32-3](#) shows the data flow for purchasing the plan that the user selected:

**Figure 32-3 Design 2 Example**



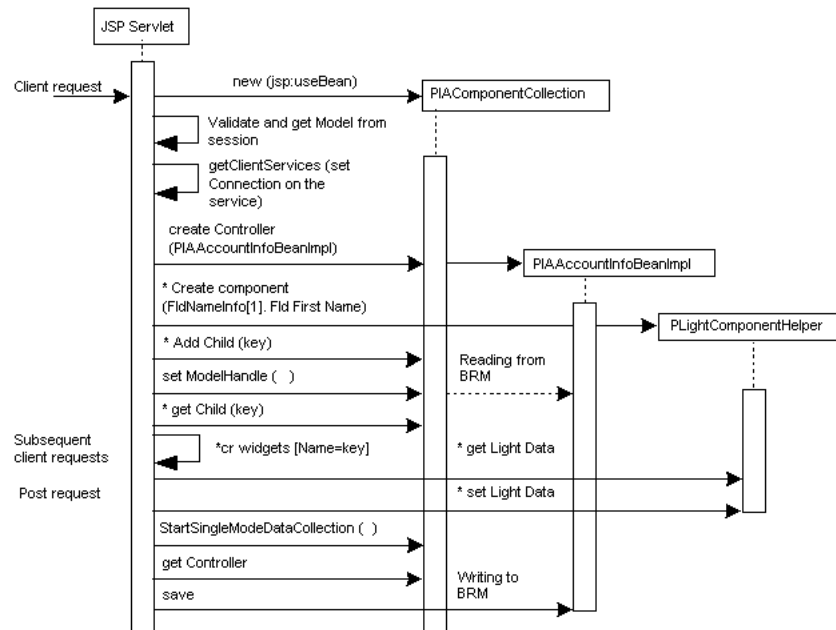
### Design 3

In Design 3, communication between the servlet and the controller occurs through **PIAComponentCollection**:

1. The request is received by a specific JSP servlet.  
In this design, the bean is not the controller, but is a component collection bean, that is, an instance of **PIAComponentCollection**.
2. The **createController()** method is called on the component collection bean to specify the controller bean that should be delegated to perform the necessary operation.
3. The lightweight components are added to the collection to specify the fields that should be retrieved from the database.  
For more information on lightweight components, see "[About Lightweight Components \(Self-Care Manager Only\)](#)".
4. It calls **setModelHandle()** on the component collection bean instance to retrieve the data of the model from the database.  
Data can be displayed using the **getLightData()** method.
5. This JSP servlet collects any data needed and calls the **setLightData()** method on each of the lightweight components to set the input data properties.
6. To save data to the database, the servlet calls the methods of the controller bean directly to perform the necessary operation and then returns the HTML output to the browser.

This Design 3 example UML sequence diagram in [Figure 32-4](#) shows the data flow for displaying account information. It is an example of a customizable JSP, where you can add or remove new account fields to be displayed to the user:

Figure 32–4 Design 3 Example



## Extending the Functionality of Self-Care Manager

All Self-Care Manager components follow the model view controller (MVC) paradigm. A component in Self-Care Manager includes the controller, which contains the logic of the component, and the view, which handles the display of data on the UI. The view in Self-Care Manager is HTML/JSP. When you create a component for a Customer Care application by using the SDK, you need to create the view of the data and the controller that determines the behavior and display of the data.

Self-Care Manager includes a set of components that provide the basic functionality for customer self-care. All the properties that the default beans support are included in the JSPs.

You can extend the functionality of Self-Care Manager to collect additional information from customer accounts or to provide customers with additional options. For more information, see:

- [Adding Fields](#)
- [Removing Fields](#)
- [Creating a New Component](#)

---

**Note:** The controllers used in Self-Care Manager have getters and setters; that is, they are true beans.

---

### Adding Fields

You add fields by adding to the component collection using the `ServletUtil.addComponent(...)`, which is a wrapper for the BAS API to add a lightweight component to the collection. In addition to the collection bean object, this method requires the name of this lightweight component, the model field description, and the display field description for updating and retrieving the data to and from BRM.

The name of the lightweight component is the same as specified for the UI field; that is, for **firstname** if the UI field specification is:

```
<INPUT Name="firstname" Value="<%=fname%>" Size="21" Tabindex="2">
```

Then the name passed to **addComponent** is the value of **NAME**, that is, **firstname**.

The model field description is **FldNameinfo[1].FldFirstName**. In this case, the display field description is the same "**FldNameinfo[1].FldFirstName**". However, for the credit card number, the model field description is

**FldPayinfo[1].FldInheritedInfo[0].FldCcInfo[0].FldDebitNum** and the display field description is **FldPayinfoObj.FldCcInfo[0].FldDebitNum**.

---

**Note:** When the collection is saved in the session, you can retrieve the lightweight components from the collection by using **getChild()**.

---

1. Retrieve the lightweight component data by using **getLightData()**.
2. When a customer enters data, **ServletUtil.gatherFormInput()** retrieves the user data. It then calls **setLightData()** of **PLightComponentHelper** to update the data of the component.

---

**Note:** **ServletUtil.setLightDataForAll()** is a wrapper function that calls **PLightComponentHelper.setLightData()** for every input field that has a lightweight component in the collection. However, if the input data needs massaging or there is no mapping between the UI field and the lightweight component, then you need to explicitly call **setLightData()**.

---

3. The return flists are parsed by calling **ServletUtil.parseErrorData**, which identifies lightweight components that are in error. You can mark the lightweight components that are in error by checking if the field is in the error flist. To check the error flist, call **ServletUtil.checkError(...)**.

## Removing Fields

To remove a field that is not required, for example, the middle name field, you remove all references to it.

---

**Important:** Before you remove a field, make sure that no opcode requires it by checking opcode input flist specifications.

---

1. Remove the **ServletUtil.addComponent(...)** of that field so it is no longer added to the collection.

For example, to remove the middle name field, delete:

```
ServletUtil.addComponent(<BEAN>, MIDDLENAME,
    "FldNameinfo[1].FldMiddleName"); and <BEAN>.
getChild(MIDDLENAME) .
```

2. Remove the calls to **checkError** and **getLightData()**.

For the middle name field, remove the following:

```
<% if (ServletUtil.checkError(errorMap, cbMname)) { %>
```



```

        <TH Align="right" Class="optional">__MiddleName__*</TH>
    <% } else { %>
        <TH Align="right" Class="optional">__MiddleName__</TH>
    <% } %>
    <TD Colspan="3" Align="left"><INPUT Name="middlename"
    Value="<%=cbMname.getLightData()%>" Size="21" Tabindex="3"></TD>2.

```

3. If `setLightData()` is called explicitly on this lightweight component, remove that line.

## Creating a New Component

When adding a component to Self-Care Manager, you create the view component of the data, and if necessary, the controller component that determines the behavior of the data.

1. Create a link in the existing JSPs or HTML pages for loading the next or new JSPs. See ["Creating a Link for the JSP Pages for a Get Request"](#).

2. Create the component.

For a view component, subclass either an existing controller from `app/ccare/comp` or `web/comp`, or design a new one.

See ["Designing a Component"](#).

3. Develop the customizable component.

See ["Developing the Customizable Component"](#).

4. Develop the non-customizable component.

See ["Developing a Noncustomizable Component"](#).

### Creating a Link for the JSP Pages for a Get Request

If you are using `PInfranetServlet` and the HTTP request is a get request, add the `page_to_load_next` and `component_to_be_created` values in the `response.encodeURL` parameter entry in the appropriate JSP:

```

A HREF="<%=response.encodeURL("PInfranetServlet?page=
    page_to_load_next&Component=component_to_be_created")%>"

```

For example:

```

A HREF="<%=response.encodeURL("PInfranetServlet?page=
    change_login_form&Component=com.portal.web.comp.PServicesBeanImpl")%>"

```

### Creating a Link for the JSP Pages for a Post Request

If you are using `PInfranetServlet` and the HTTP request is a post request, add the following entry, specify the page to load next, the Component to be created and a submit button:

```

<FORM Action="PInfranetServlet"
    Method="post"><INPUT Type="hidden" Name="page"
    Value=page_to_load_next>
    <INPUT Type="hidden" Name="Component" Value=Component_to_be_created>

```

For example:

```

<FORM Action="PInfranetServlet"
    Method="post"><INPUT Type="hidden" Name="page" Value="view_invoice"><INPUT

```

```
Type="hidden" Name="Component "
Value="com.portal.web.comp.PInvoiceBeanImpl">
```

If you are *not* using **PIInfranetServlet**, use the same link you would for HTML pages.

## Designing a Component

To design a component:

1. Plan the UI and functionality.
2. Determine if the component UI involves updating as well as displaying of data.
  - a. If the UI displays the data, then [Design 1](#) or [Design 3](#) is appropriate. See [Choosing Design 3](#) to determine if you need to use it; if not, use Design 1.
  - b. If the UI displays and updates data, use one of the following:
    - A combination of Design 1 to retrieve data and [Design 2](#) to update it.
    - Design 3. To determine if you need to use Design 3, see [Choosing Design 3](#); if you do not, use a combination of Design 1 and Design 2.
3. Determine the design that the data flow of your component resembles:
  - a. See [Choosing Design 3](#), to determine if you need to use it to build a customizable component.
  - b. Choose Design 1 if you want most of the work to be done by **PIInfranetServlet**; otherwise, choose Design 2.
  - c. To share the same controller bean instance between multiple HTTP requests, choose the combination of Design 1 to retrieve data and Design 2 to update data.

### Choosing Design 1 and Design 2

You can use Design 1 and Design 2 to display data and update it on user interaction. For example, you can display all the plans available for purchase. When the user selects a plan, the controller bean updates the user information. Use Design 1 to display all the plans. The bean is saved in session. When the user selects a plan, the same bean that has the model handle to the data is called with the index of the plan. When the **save** method is called, the plan list of the plan at the selected index is retrieved from the model.

### Choosing Design 3

Use Design 3 when you have a one-to-one correspondence between the fields in the view and fields in the object. Each of these fields can be a lightweight component. For example, fields such as **First Name** and **Last Name** in the **View Balance** page have object fields that map exactly to the display, so you have a light component for first name and last name. To display **FldBalances**, there is a specific controller which you specify by using the **createController()** method in **PIAComponentCollection**. This allows you to override the **update** method, which takes an integer reason code and object as parameters to do special processing, such as retrieving the balance information. For more information, see ["Display Fields and Controllers"](#).

---



---

**Important:** When you override an update you have to call **super.update()** so that any **FieldBeans** that are part of the collection also get updated; that is, their **update** method is called, so the opcode to retrieve data is executed.

---



---

## Developing the Customizable Component

This component has a view component and one or more controllers. For example, `CreateFormPage2.jsp` servlet has a few controllers.

---



---

**Note:** To extend Self-Care Manager functionality, you must subclass the controllers provided in Customer Center SDK.

---



---

## Developing the View Component

The view component displays the data and provides user interaction with the system.

To develop the view component, create a new HTML page and then follow these steps to edit it to build the JSP.

1. Add a page directive that sets the value for `errorPage` to `error.jsp`:

```
<%@ page errorPage="error.jsp" %>
```

This redirects all exception handling to the defined page. For information about handling exceptions, see ["Error Handling"](#).

2. Add a `jsp:useBean` statement, with the following values shown for `scope` and `class`:

```
<jsp:useBean id="myBeanInstanceName" type="InterfaceName" class="concrete
Implementation of the interface" scope="request"/>
```

---



---

**Note:** You are saving the collection bean instance in session, not the data.

---



---

3. Follow the steps in Account creation or Account maintenance:
  - If you're adding functionality that is independent of an individual user logging in, such as account creation, follow the steps in Account creation.
  - If you're building functionality that is dependent on the user logging in, for example, account maintenance, follow the steps in Account maintenance.

---



---

**Note:** Account creation and maintenance is not supported in this release. It continues to be supported in the previous releases.

---



---

## Account Creation

---



---

**Important:** This is an example for developing a customizable component. Account creation is not supported in this release.

---



---

Follow these steps for account creation:

1. If a client service exists for the session, retrieve it:

```
PPooledConnectionClientServices pcs =
(PPooledConnectionClient)session.getAttribute
(CREATE_CONNECTION);
```

2. For a first-time access, that is, the collection bean was just created and the controller was not set:
  - a. Create a new instance of **PPooledConnectionClientServices**:
 

```
pCS = new PPooledConnectionClientServices((PClientServices)
application.getAttribute(ServletUtil.PARENT_SERVICE));
>
```
  - b. Call **setServices** with the new instance of **PPooledConnectionClientServices** on the collection bean:
 

```
accountCreationBean.setServices(pCS);
>
```
  - c. Create a **ConnectionListener** and save it in the session:
 

```
ConnectionListener listener = new
ConnectionListener(session.getCreationTime(), pCS);
```
  - d. Call **ServletUtil.saveLocaleInfo** and **registerApp**.
  - e. Specify the controller associated with this component.
  - f. Create the lightweight components. See "[Creating a New Component](#)".
3. If the collection bean was created by a previous HTTP request, retrieve the lightweight components in the collection by calling **getChild** on the collection bean saved in the session.
4. Call **getLightData** on the lightweight component to display the data.
5. If the data can be updated by the user, use a POST request to handle the update. In the JSP code, check for POST requests, as follows:
  - a. Call **ServletUtil.gatherFormInput**.
  - b. To set data, call **ServletUtil.setLightDataForAll**.
 

This function loops through the components. If there is a mapping between the component and user input, **setLightDataForAll** calls **setLightData** on the component.
  - c. For user input for which where there is no mapping, such as a billing address, you can explicitly call **setLightData** on the component.
  - d. After setting the user input values on all the components in the collection, collect the data for storing:
 

```
accountInfoBean.startSingleModelDataCollection
(PCollectDataEvent.FOR_STORING, <model>);
```

The value for *model* is either null or the model handle previously created with some data. In the case of payment method, for example, create an untyped model but modify it with the payment info flist.
6. Call **session.invalidate** to release the connection.

### Account Maintenance

---

**Important:** This is an example for developing a customizable component. Account maintenance is not supported in this release.

---

Follow these steps for account maintenance:

1. Retrieve the model handle.

```
PModelHandle mH = ServletUtil.getModelFromSession(session);
```

2. Use `ServletUtil.CONNECTION` as the key to retrieve the `PPooledConnectionClientServices` instance from the session.

---



---

**Note:** A `PPooledConnectionClientServices` instance is created and saved in a session using `ServletUtil.CONNECTION` when a user logs in. Additional functionality provided for the user, such as account maintenance, can use `ServletUtil.CONNECTION` to retrieve the `PPooledConnectionClientServices` instance from the session.

---



---

3. Call `setServices` with the retrieved instance on the collection bean:

```
accountInfoBean.setServices(pCS);
```

4. If this is a first-time access; that is, the collection bean was just created and the controller was not set:
  - a. Specify the controller associated with this component.
  - b. Create the lightweight components. See "[Creating a New Component](#)".
  - c. Call `setModelHandle` to retrieve data from the database.
5. If the collection bean was created in a previous HTTP request, you can retrieve the lightweight components in the collection by calling `getChild` on the collection bean saved in the session.
6. Call `getLightData` on the lightweight component to display the data.
7. If data can be updated by the user, use a POST request to handle the update. In the JSP code, check for POST requests:
  - a. Call `ServletUtil.gatherFormInput`.
  - b. To set data, call `ServletUtil.setLightDataForAll`.

This function loops through the components. If there is a mapping between the component and user input, it calls `setLightData` on the component.

- c. For user input where there is no mapping, such as a billing address, you can explicitly call `setLightData` on the component.
- d. After setting the user input values on all the components in the collection, collect the data for storing:

```
accountInfoBean.startSingleModelDataCollection
(PCollectDataEvent.FOR_STORING, <model>);
```

The value for *model* is either null or the model handle previously created with some data. In the case of payment method, for example, create an untyped model but modify it with the payment info flist.

### Developing the Controller Component

You must create a controller for each view element. The controller component performs the functions, for example, reading fields from the database.

To create the component controller:

1. Declare the controller's API in the interface:
  - a. Declare all the setters to set input data.
  - b. Declare all the getters to retrieve the output data.
  - c. Declare all the public methods.
2. Define a class derived from **com.portal.bas.comp.PIAComponentCollectionBean**, which implements the interface.  
Implement all the public methods, setters and getters.

### Developing a Noncustomizable Component

This component has a view component and one controller.

#### Developing a View Component

The view component displays the data and provides user interaction with the system.

To develop the view component, create the HTML page and then build the JSP as follows:

1. Add the page declarative which has the errorpage set to **error.jsp**.  
This redirects all exception handling to this page.
2. Add the **jsp:useBean** statement whose type is the controller interface and scope is request or session.  
If the bean was already created through the main servlet and placed in the request object, you can load the bean using the **jsp:useBean** clause and use the getters to get the data.
3. Call the getters to get any data.
4. If data can be updated by the user, it requires special handling. Use a POST request to handle the update. So in the JSP code, check if POST.
  - a. Gets the model from the session, if it exists.
  - b. Calls **ServletUtil.gatherFormInput**.
  - c. Calls the setters of the light components to update them with user inputs.
  - d. Calls the method to save the data into the database.

For information about error handling, see "[Error Handling](#)".

#### Developing the Controller Component

You must create a controller for each view element. The controller component performs the functions, for example, reading fields from the database.

To create the component controller:

1. Declare the controller's API in the interface, for example, in **PCAAccountInfoBean**:
  - a. Declare all the setters to set input data.
  - b. Declare all the getters to retrieve the output data.
  - c. Declare all the public methods.
2. Define a class derived from **com.portal.bas.PControllerImpl**, which implements the interface defined in the previous step. Note these rules:

- Implement all the public methods, setters and getters.
- Use the connection pool to connect to BRM.
- For error handling, see "[Error Handling](#)".

### Using the Connection Pool

When developing a noncustomizable component, you must use connections from the connection pool to connect to BRM.

For more information on connection pooling, see "[About PInfranetServlet](#)".

---



---

**Important:** The Self-Care Manager Connection pool implementation is expected to change in a future release of BRM.

---



---

When using the connection pool, note these rules:

- Use `getConnection` to get a connection from the connection pool.
- Use `releaseConnection` to release the connection back to the connection pool.

---



---

**Important:**

- You must use `releaseConnection` to release connections.
  - You must pair a `getConnection` with a `releaseConnection`.
- 
- 

- Adjust the values of the `infranet.bas.connectionpool.size` and `infranet.bas.connectionpool.timeout` parameters in the `Self-Care_Manager_install_dir/WebKit.properties` file.

---



---

**Tip:** If you add noncustomizable components to your Self-Care Manager implementation, Self-Care Manager performance may improve if you increase the value for the `infranet.bas.connectionpool.size` parameter from the default value 4.

---



---

For more information on these parameters, see "Optimizing Self-Care Manager Connection Pool Performance" in *BRM Managing Customers*.

### Error Handling

The controller handles exceptions and errors shown in [Table 32-1](#):

**Table 32-1 Exceptions, Errors, and Responses**

| Exception/Error                      | Response  |
|--------------------------------------|---|
| <code>EbufException</code>           | Calls <code>PControllerImpl.createClientException()</code> in the BAS API |
| Other exception                      | Throws <code>RemoteException</code> with the resource string              |
| Error returned in <code>flist</code> | Returns <code>CustomerValErrorData</code>                                 |

If the exception is received in `PInfranetServlet`, it redirects to `error.jsp`

If the exception is received by a JSP Servlet with the error attribute in `<page >` directive, set to `error.jsp`, which redirects the exception to `error.jsp`.

If you return `CustomerValErrorData`, call `ServletUtil.parseErrorData(...)` to gather the lightweight components in error, and call `ServletUtil.checkError(...)` to mark any data in error.

## Using Branding in Your Custom Beans

This section explains how Self-Care Manager handles branding in your custom JSPs and beans that connect to a BRM system with Branded service management.

Self-Care Manager uses connection pooling to communicate with BRM. In a branding environment, you need to establish credentials on these anonymous connections from the pool before executing an opcode. When you get a BRM connection from BAS, you establish credentials using the `setUserCredtials (...)` in `PBrandBeanImpl`.

---



---

**Note:** Once the user logs in, Self-Care Manager retains the user credentials throughout the client session. So any JSP servlets or custom beans that execute after the user logs in are not required to handle branding.

---



---

To handle branding in your JSPs or custom beans:

1. Specify the brand properties in the `WebKit.properties` file.

This includes brand manager login, brand manager password, and the service object for each brand manager.

```
brand_name = brand_login, brand_password, service_object
```

2. Specify the brand name in an `href` link or as a hidden variable.

For example, to get all the plans associated with a brand in the create account page, specify the brand name in the `index.html` file:

```
a href = "createFormPage1.jsp"?brand=brand_name
```

3. Create the brand bean, `com.portal.web.comp.PBrandBeanImpl`.

4. Get the brand name from the input parameters.

5. If you are developing branding in a custom bean, you have to provide a set method for setting the brand name. Retrieve the brand properties by using `PClientContext.getServices().getDefaultProperties()`.

The brand properties are in `WebKit.properties`:

- Brand service
- Brand login
- Brand password

6. Create `com.portal.web.comp.PLoginBeanImpl`:

- a. Set the login, service, and password.
- b. Get the account model handle that corresponds to the above data by using `PLoginBeanImpl.login_verify`.

## Formatting Your Data

You can customize the display format of your data by using one of these methods:



- [Method 1: Add Java Code to Your JSP Pages](#)
- [Method 2: Use a Formatting Bean that Contains the Presentation Logic for the Data.](#)

### Method 1: Add Java Code to Your JSP Pages

You can specify the date in month-day-year format by using the following Java code in a JSP page:

```
<%Date lastBill = accountBean.getLastBillT();%>
<%=lastBill.getMonth()%>/<%=lastBill.getDate()%>/ <%=lastBill.getYear()%>
```

See the `view_balance.jsp` file included with Customer Center SDK in `CCSDK_Home/CustomerCareSDK/WebKit/html/en`.

You can edit the entry to change the format to day-month-year by changing the order:

```
<%Date lastBill = accountBean.getLastBillT();%>
<%=lastBill.getDate()%>/<%=lastBill.getMonth()%>/ <%=lastBill.getYear()%>
```

### Method 2: Use a Formatting Bean that Contains the Presentation Logic for the Data.

The JSP calls the formatting bean to obtain the instructions on how to display the data. By using a formatting bean, you reduce the amount of Java code in the JSP, such as localizing the data for your environment.

To use a bean to format data:

1. Create a Java class with setters and getters to set the data and get the formatted data.
2. Compile the file and save the class file in a directory included in the CLASSPATH.
3. Add entries in your JSP page to do the following:
  - Point to the formatting bean.
  - Set the property of the data.
  - Get the property of the formatted data from the formatting bean.

#### **Example 32–1** *Formulating the Date in the view\_balance.jsp*

This example shows the entries for formatting the date in the `view_balance.jsp`.

1. Define a class, such as `PSampleFmt`, with a `setDate()` and `getFormattedDate()` method. The `getFormattedDate()` method retrieves the date set and returns the formatted date.
2. In the `view_balance.jsp` file, replace the Java code for formatting the date with these lines:

```
<jsp:useBean id="fmtBean" class="com.portal.web.fmt.PSampleFmt"
scope="request" />
<jsp:setProperty name="fmtBean" property="date"
value=<%=accountBean.getLastBillT()%>
</jsp:useBean>
<jsp:getProperty name="fmtBean" property="formattedDate" />
```

#### **Example 32–2** *Creating Multiple Pages with a NEXT Button*

You can use `PPartialListFmt` (in `com/portal/web/fmt`) to break down the display of events list into multiple pages with a NEXT button.

## Building the Self-Care Manager Components

To build or rebuild the `webkit_en.war` file for Self-Care Manager, follow these steps:

1. If you created custom source to extend Self-Care Manager, copy it to the `CCSDK_Home/CustomCareSDK/WebKit/custom` directory.
2. Copy any HTML or JSP pages you modified for the HTML version of Self-Care Manager to `CCSDK_Home/CustomCareSDK/WebKit/htmlui_en`.
3. Make the appropriate entries in the `WebKit.properties` file as required to accompany your source.
4. Open a command shell and enter the `buildAll` command with the appropriate syntax for the application you're customizing. See "[Syntax for the buildAll Script](#)".

For example, to clean and rebuild the `webkit_en.war` file for Self-Care Manager, enter the following:

```
buildAll WebKit clean
buildAll WebKit
```

---

**Note:** For more information on the `buildAll` script, see "[About Compiling and Packaging Your Customizations](#)".

---

## Self-Care Manager Customization Examples

Customer Center SDK includes Self-Care Manager customization example code in `CCSDK_Home/CustomCareSDK/WebKitExamples`.

When you install Customer Center SDK, separate folders with the appropriate source and support files provide examples for extending Customer Center and Self-Care Manager. Many of the example folders include `Readme.txt` files that explain the purpose of each example.

You can execute many of the examples in place by using the `testExamples.bat` script.

[Table 32–2](#) describes the Self-Care Manager extension examples in the `SDK_Home/CustomCenterSDK/WebKitExamples` directory. Read the `readme.txt` files and the comments in the source files of each example for further information on their functionality and how to use them for creating your own customizations.

**Table 32–2 Self-Care Manager Extension Examples**

| Directory Under <i>SDK_Home/</i><br><i>CustomerCareSDK/WebKitExamples</i> | Contents  |
|---|---|
| Controllers   | <code>PIAWKCreateAccountBeanImpl.java</code> , an example of subclassing <code>PIACreateAccountBeanImpl</code> to override its <code>validatePage</code> and <code>validate</code> methods. This example can also be used for learning how to subclass controllers for Customer Center. |
| Currency  | <code>CreateFormPage1.java</code> and <code>CreateFormPage2.java</code> , examples that demonstrate how to include the currency field as input for account creation.<br><br><b>Note:</b> Account creation is not supported in this release.   |
| Profile   | <code>CreateFormPage1.jsp</code> and <code>CreateFormPage2.jsp</code> , examples that demonstrate how to add support for a profile object to Self-Care Manager. The profile object used for this example is <code>/profile/customertype</code> .  |

---

---

## Customizing the Customer Center Help System

This chapter describes how to modify the Help in Oracle Communications Billing and Revenue Management (BRM) Customer Center. You can add, remove, or modify topics in the Customer Center Help. To do this, you work with HTML and simple XML files.

Customer Center Help uses Oracle Help for Java (OHJ). You do not need advanced knowledge of OHJ; you can use the information in this chapter, supplemented by the Oracle Help documentation.

For more information about customizing Customer Center, see ["Using Customer Center SDK"](#) and ["Customizing the Customer Center Interface"](#).

### About Customizing Customer Center Help

Customer Center Help includes procedures, reference information, and context-sensitive Help topics for the version of Customer Center you receive with BRM.

You might want to customize Help for one or more of these reasons:

- You customized the Customer Center application and want the Help to reflect your modifications.
- You want to include information specific to your business.
- You want to remove information not relevant to your customer service representatives (CSRs).
- You use a BRM service integration component and want to add Help for additional fields and procedures for that service. See ["About Help for Service Integration Components"](#).

Before customizing Help, you need to install the following software:

- Customer Center SDK. See "Installing Customer Center SDK on Windows" in *BRM Installation Guide*.
- Java Development Kit (JDK). See ["Downloading and Installing Java"](#).
- Oracle Help for Java. See ["Downloading and Installing Oracle Help for Java"](#).

---

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**Note:**

- Only the English version of Customer Center Help is packaged with the Customer Center SDK. But you can also use the procedures in this chapter to customize a localized version of Customer Center Help that you obtain from a localized version of the application or from the Localization SDK (see "[About the Localization SDK](#)").
  - Help for the Event Browser, a separate application you can open from Customer Center, is also available in the Customer Center SDK. However, the SDK is not configured for customizing Event Browser Help, so that Help system is not covered in this chapter.
- 
- 

## About Help for Service Integration Components

Customer Center Help does not include procedures and information about fields added to Customer Center by optional BRM features. For example, GSM Manager adds a **Promotion** tab to your version of Customer Center, and you also enter data specific to the GSM service when you create an account. You can add your own Help topics to cover information for any service integration components you use.

## About Oracle Help for Java

Customer Center uses Oracle Help for Java (OHJ). For OHJ, you provide Help in a single JAR file named **Customer\_Center\_Help\_locale.jar**, where *locale* is the Java locale. The English version is **Customer\_Center\_Help\_en.jar**.

This chapter provides basic information on working with OHJ. For additional information, see *Oracle Help Guide*. This is available both as part of the OHJ installation and on the Oracle Technology Network at <http://www.oracle.com/technetwork/indexes/documentation/index.html>.

## About Types of Help Files

The following list shows the type of files that the Help system contains:

- **HTML files:** Each Help topic has its own HTML file. Most topics are procedures, but there are also overview topics, reference topics, glossary definitions, and context-sensitive topics connected to a specific dialog box or wizard page.
- **CSS file:** A style sheet referenced by each Help topic.
- **GIF files:** Graphics referenced by the HTML files are GIF files located in the **images** subdirectory.
- **HelpSet (.hs) file:** The file that describes your Help system. This is the file Customer Center looks for to start Help.

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**Important:** You do not need to edit the helpset file as long as you keep the names of the index, table of contents, and map files the same. The procedures in this chapter assume you do not edit this file.

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- **Index file:** An XML file that contains the index located in the left pane of the Oracle Help window.

- **Table of Contents (TOC) file:** An XML file that contains the Table of Contents located in the left pane of the Oracle Help window.
- **Map file:** An XML file that associates Help IDs with HTML file names. The TOC and index use the IDs to link entries to Help topics. Customer Center dialog boxes and wizard pages use the IDs to provide context-sensitive Help. The IDs also support popup windows.

The Help also includes a full-text search database that you create with a command-line Java utility at the end of the customization process.

More information about the Oracle Help files is provided within the procedures for customizing Help in this chapter.

## Installing Oracle Help for Java

To install the JDK and OHJ software, follow these procedures:

- [Downloading and Installing Java](#)
- [Downloading and Installing Oracle Help for Java](#)

### Downloading and Installing Java

1. Download the JDK (also known as Java 2 SDK) from [java.sun.com](http://java.sun.com).

For the version compatible with this BRM release, see "BRM Software Compatibility" in *BRM Installation Guide*.

2. Install the JDK by following the instructions at [java.sun.com](http://java.sun.com).

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**Note:** During the installation, you select components in the Select Components dialog box. The components you need for working with OHJ are Program Files and Java 2 Runtime Environment.

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3. Add the path to the **java** command to your Path environment variable.

Environment variables are available on the **Advanced** tab of the System control panel. You can use either the system or user Path variable, whichever works best in your environment.

Add this location to the beginning of the Path variable:

```
Java_install_dir\bin
```

where *Java\_install\_dir* is the JDK installation directory; for example:

```
C:\jdk1.5.0_09\bin
```

4. Open a new command window and enter:

```
java -version
```

The output should be something like this (the version number should be the version you installed):

```
java version "1.5.0_09"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.5.0_09-b03)
Java HotSpot(TM) Client VM (build 1.5.0_09-b03, mixed mode)
```

## Downloading and Installing Oracle Help for Java

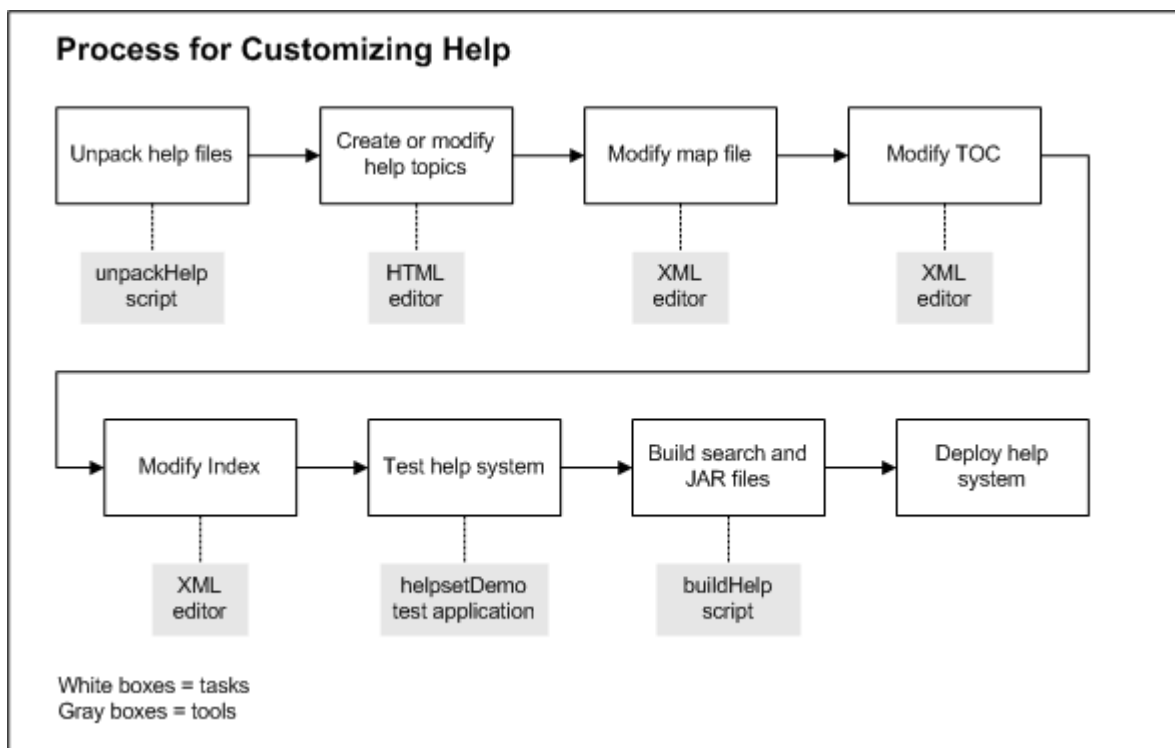
1. If you have a previous version of OHJ on your system, uninstall it.
2. Download the Oracle Help for Java Windows executable from:  
<http://www.oracle.com/technetwork/topics/utilsoft-085729.html>  
 For the version compatible with this BRM release, see "BRM Software Compatibility" in *BRM Installation Guide*.
3. Run the installer and follow the prompts.

## Customizing Help

You use the Customer Center SDK and the instructions in this chapter to customize Help.

Figure 33–1 provides an overview of the process for customizing Customer Center Help.

Figure 33–1 Customizing Customer Center Process



For details on each step, see:

- [Unpacking the Help Files](#)
- [Creating or Modifying Help Topics](#)
- [Modifying the Map File](#)
- [Modifying the Table of Contents](#)
- [Modifying the Index](#)
- [Testing the Help System](#)

- [Creating the Search Database and JAR File](#)
- [Deploying the Help System](#)

## About Tools for Customizing Help

The procedures in this chapter require using basic tools, including:

- Scripts from the Customer Center SDK.
- An HTML editor.
- An XML editor.
- The helpsetDemo test application from OHJ.

These tools should be adequate if your customizations are fairly limited.

For more extensive customizations, consider using a full-fledged Help authoring tool that can create OHJ systems. One good list of Help authoring tools is available in the WritersUA Online Help Resource Directory at:

<http://www.welinske.com/resources/>

Some of the tools listed on this page support OHJ. You can follow links to each vendor's Web site for more information.

## Unpacking the Help Files

You use the Help system packaged with Customer Center as the starting point for your customizations. All Customer Center Help files are in the file **Customer\_Center\_Help\_en.jar**, which is part of the Customer Center SDK.

To extract the files from the Customer Center Help JAR file:

1. Go to *CustomerCareSDK\_Home/CustCntr/CustomHelp*.
2. Run the **unpackHelp** script:

```
unpackHelp
```

The script copies the file *CustomerCareSDK\_Home/lib/Customer\_Center\_Help\_en.jar* and extracts the files from that JAR file into the directory *CustomerCareSDK\_Home/CustCntr/CustomHelp/cchfiles*.

---



---

**Important:** If you already have a **cchfiles** directory, **unpackHelp** deletes any files in that directory before extracting files from the JAR file.

---



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**Note:** If you have a Customer Center Help system in a JAR file with a different name, the JAR file must be in *CustomerCareSDK\_Home/lib*, and you must specify its name on the command line: **unpackHelp filename.jar**

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## Creating or Modifying Help Topics

You can now add, remove, or modify HTML files. The changes you make need to appear in the **cchfiles** directory because that directory is the source for the script you run to compile the customized Help system at the end of the process.

To modify an HTML file, open and revise it in the HTML editor of your choice. To create a new HTML file, you might want to open an existing file and save it under a new name as a starting point.

---

---

**Note:** If you remove a file, you will break any links to that file. You can use a link-checking program or other method to identify files with broken links.

---

---

## Working with Pop-Up Windows

A pop-up window is a separate window without a title bar that appears over the Help topic and goes away when you click outside the popup. Customer Center Help uses pop-up windows mainly for definitions of terms.

The text related to the pop-up window appears the same as any other link. If the link text is a term instead of a topic title, then it generally opens a popup.

To include a link to a pop-up window in an HTML file, you use the popup protocol in the link. Following is an example:

```
<a href="popup:account_html_wp538547">account</a>
```

In this example:

- **popup** is the popup protocol, which identifies the link as a popup.
- **account\_html\_wp538547** is the ID of the topic to be displayed in the popup window. This ID is in the map file for the Help system and is associated with the HTML file for the topic. For more information on the map file, see "[Modifying the Map File](#)".
- **account:** The hyperlinked text.

## Naming Files

The Customer Center Help system uses certain file naming rules and conventions. You should follow the rules to avoid problems using your customized Help system. Following the conventions is optional, but knowing them might help you identify and work with the Customer Center files.

### HTML files

Follow these rules in naming HTML files:

- Use only letters, numbers, and underscores in file names.
- Do not use spaces in file names.

Optional naming conventions for HTML files:

- All HTML files except glossary items start with **cc\_**.
- Except for the underscores in the prefix **cc\_**, and other prefixes listed below, the names use only uppercase and lowercase letters.
- The names are usually based on the title of the topic.
- Context-sensitive Help topics are named based on the Java name for the dialog box or wizard page they are linked to.
- HTML files that are glossary items do not have a special prefix. They are based on the name of the term they define. These files are part of the glossary and appear in pop-up windows, unless you access them from the index or the Search.



- HTML files that appear in pop-up windows but not definitions start with **cc\_popup\_**.
- HTML files that start with **cc\_sec\_** were originally designed to appear in separate secondary windows. Customer Center Help no longer uses secondary windows, but the naming convention still exists for some files.

### Graphics files

Follow the same rules for naming graphics files as for HTML files.

The only convention for graphic names is that they typically start with the name of the section of the Help in which they appear as shown in [Table 33–1](#).

**Table 33–1** File Name Prefix

| File Name Prefix | Section                                      |
|------------------|--|
| CC_Accounts_     | Creating and Finding Accounts                |
| CC_AcctGroups_   | Creating and Managing Account Groups         |
| CC_AcctInfo_     | Working with Account Information             |
| CC_ARinfo_       | Working with Accounts Receivable Information |
| CC_GetStart_     | Getting Started with Customer Center         |
| CC_PDS_          | Working with Products, Deals, and Services   |

CS\_ is added to the prefix if the image is part of a context-sensitive Help topic.

### Using the Style Sheet

Customer Center Help uses a cascading style sheet (CSS), **brm\_help.css**.

If you want to change styles, you might want to use **brm\_help.css** as a starting point. If you remove the style sheet, you will see changes in the font, spacing, and other formatting.

The Customer Center Help style sheet uses a small number of style classes, usually to control spacing. The style sheet uses the following classes:

- li.nospace
- p.graphic
- table.dialog
- table.noborderindent
- table.note
- table.noteindent
- ul.indentnospace
- ul.nospace

You can see examples of these classes by searching for them in the HTML files.

For information about both CSS and HTML support in OHJ, see *Oracle Help Guide* and the Release Notes.

## Modifying the Map File

The map file associates an ID with each file. OHJ uses the IDs rather than the file names for the table of contents, the index, and context-sensitive Help. The map file is in XML and has a **.xml** extension.

The map file for Customer Center is **Customer\_Center\_Help Map.xml**. You need to edit this file if you add or remove Help topics.

To add a new Help topic to the map file:

1. Open **Customer\_Center\_Help.xml** in an XML editor or text editor.
2. Add an ID in the following format anywhere between the **<map>** and **</map>** elements:

```
<mapID target="ID" url="filename" /> <!-- topic_title -->
```

The mapID element includes the following attributes:

- *ID* is a string that identifies the Help topic. Every HTML file in Customer Center Help has an ID based on the file name. **.html** is replaced by **\_html\_anchor**, where *anchor* is an anchor in the HTML file.

Context-sensitive Help topics have another entry in this file using an ID that corresponds to their Help IDs, which Customer Center uses to launch the correct topic when a user clicks a **Help** button.

There are also extra sets of IDs, one based on the filename but without the anchor and one that starts with **Customer\_Center\_Help**, but these are not used.

Any file you add needs only one ID. IDs that you create do not need to follow the conventions used in Customer Center Help. You can use your own scheme for creating new IDs.

- *filename* is the name of the HTML file.
- *topic\_title* is the title of the topic. This is optional and is included as a comment.

For example:

```
<mapID target="cc_GetStarted_html_wp477160" url="cc_GetStarted.html" /> <!--  
Getting Started with Customer Center -->
```

If you remove a Help file, search for the Help file name in the map file and remove the **<mapID>** element or elements for that file.

---

---

**Note:** The IDs can be in any order, as long as they are inside the **<map>** element.

---

---

## Modifying the Table of Contents

The OHJ TOC file defines the content and structure of the TOC that appears in the Help Navigator. The TOC file for Customer Center is **toc.xml**. You need to edit this file if:

- You add Help topics that you want to include in the TOC.
- You remove or change the title of topics that are already in the TOC.

Help topics do not have to be in the TOC. Most, but not all, Customer Center Help topics are in the TOC. Topics in pop-up windows and context-sensitive topics are among those that do not appear.

To edit the TOC, open **toc.xml** in an XML editor or text editor. The entire TOC is between the **<toc>** and **</toc>** elements. Each TOC item is a separate **<tocitem>** element.

Following is the syntax of a **<tocitem>** element:

```
<tocitem target="ID" text="topic_title">
```

where:

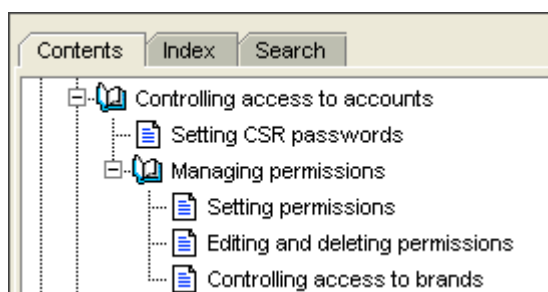
- *ID* is the topic's ID in the **map.xml** file.
  - You can add a TOC item with no target, which means there is no Help topic associated with it. An item without a target can be used to help organize the TOC.
- *topic\_title* is the heading in the topic.

The **<tocitem>** elements are nested to create a multi-level TOC. Following is an excerpt from a Customer Center TOC file:

```
<tocitem target="cc_ControlAcctAccess_html_wp454423" text="Controlling access to
accounts">
<tocitem target="cc_SetCSRPasswd_html_wp461812" text="Setting CSR passwords" />
<tocitem target="cc_Permissions_html_wp448861" text="Managing permissions">
  <tocitem target="cc_SetPermissions_html_wp448684" text="Setting permissions" />
  <tocitem target="cc_EditPermissions_html_wp448881" text="Editing and deleting
permissions" />
  <tocitem target="cc_ControlAccessToBrands_html_wp455236" text="Controlling access
to brands" />
</tocitem>
</tocitem>
```

Figure 33–2 depicts how the excerpt looks in OHJ:

**Figure 33–2 Contents Tab**



Each **<tocitem>** element starts a new level. A **</tocitem>** element closes the current level and returns to the next level up.

## Modifying the Index

The Oracle Help index file defines the content and structure of the index that appears in the Help Navigator. The index file is in XML and has a **.xml** extension.

The index file for Customer Center is **index.xml**. You need to edit this file:

- To add index entries for new, revised, or existing Help topics.

- To remove index entries associated with a Help topic you are removing.
- To change or remove index entries for any other reason.

To edit the index, open **index.xml** in an XML editor or text editor.

To edit the TOC, open **toc.xml** in an XML editor or text editor. The entire TOC is between the **<toc>** and **</toc>** elements. Each TOC item is a separate **<tocitem>** element.

Following is the syntax of a **<tocitem>** element:

```
<tocitem target="ID" text="topic_title">
```

where:

- *ID* is the topic's ID in the **map.xml** file.  
You can add a TOC item with no target, which means there is no Help topic associated with it. An item without a target can be used to help organize the TOC.
- *topic\_title* is the heading in the topic.

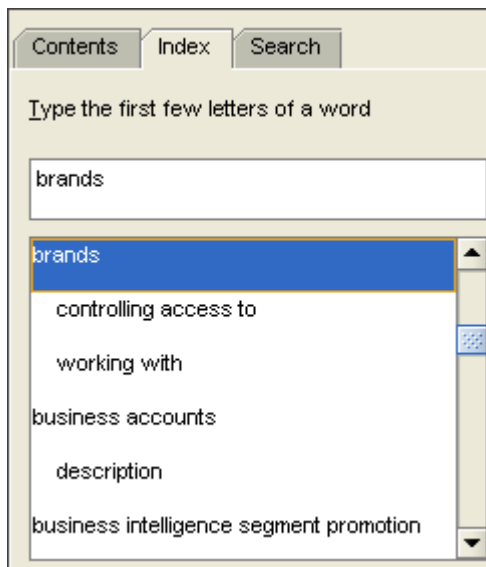
The **<tocitem>** elements are nested to create a multi-level TOC. Following is an excerpt from a Customer Center TOC file:

This is an excerpt from a Customer Center index file:

```
<indexitem text="brands">
  <indexitem target="cc_ControlAccessToBrands_html_wp455236" text="controlling
access to" />
  <indexitem text="controlling access to" target="cc_Brands_html_wp454964"
text="controlling access to" />
  <indexitem text="working with" target="cc_Brands_html_wp454964" />
</indexitem>
<indexitem target="cc_CreateFindAcct_html_wp465886" text="business accounts,
description" />
<indexitem target="cc_BusIntelSegPromo_html_wp446805" text="business intelligence
segment promotion" />
```

Figure 33–3 depicts how the excerpt looks in OHJ:

**Figure 33–3 Index Tab**



Each `<indexitem>` element starts a new level. An `</indexitem>` element closes the current level and returns to the next level up.

You can have an index entry without a target. In Customer Center Help, parent index entries do not have targets.

In the previous example, "brands" is a parent index entry, because there is a second level of entries below it, and "brands" does not link to a topic. But "business intelligence segment promotion" is a standalone entry that does link to a topic.

Entries without targets look the same as entries with targets, but when you click them the displayed topic does not change.

---

---

**Note:** The **target** and **text** attributes are in reverse order in the Customer Center Help index. The index works regardless of the order of the attributes, but the Oracle Help syntax is for **target** to come first.

---

---

## Testing the Help System

You can test your Help system with the OHJ test application helpsetDemo.

---

---

**Note:** This application does not work if your Help files are inside a JAR file.

---

---

To test your Help system:

1. Run this batch script from either the command line or Windows Explorer:

```
OHJ_Install_Dir\bin\helpsetDemo.bat
```

where *OHJ\_Install\_Dir* is the path to your OHJ installation. The default installation directory is `C:\ohelp`.

The Oracle Help for Java HelpBook Previewer appears.

2. Enter the full path to your helpset file or click the **Browse** button to find the file.
3. (Optional) Select a look and feel.
4. Click **OK**.

The Help Navigator for your Help system opens. A separate Oracle Help for Java HelpBook Previewer window enables you to enter a Help ID to display a specific topic.

Include the following when testing your Customer Center Help:

- Navigate to the topics you added or changed and make sure they display correctly. The display might not be what you expect from a standard browser, but you should verify that the appearance is acceptable.
- Test the links within Help topics.
- Test the links from the TOC and index to make sure they open the correct Help topics.
- Open a topic not included in the TOC or index by entering the topic ID in the Oracle Help for Java HelpBook Previewer window.

---

**Note:**

- This round of testing takes place before you create the search database. You should test again after creating the search database.
  - If you cannot get a Help topic to appear, make sure it is in the map file. See "[Modifying the Map File](#)".
- 

## Creating the Search Database and JAR File

When your Help topics are final, you run the **buildHelp** script to create the search database and place all the Help files in a Java Archive (JAR) file.

After you finish customizing Customer Center Help files, all your changes should be in the *CustomerCareSDK\_Home/CustCntr/CustomHelp/cchfiles* directory.

1. Create a certificate to sign the new Customer Center Help JAR file, using the **makecertificate** command. See "[Creating a Self-Signed Java Security Certificate](#)" for details.

---

**Important:** The self-signed test certificate should be used only for testing or deployment where security is not a concern.

For enhanced security, obtain Java code signing certificates from a Certificate Authority such as:

- VeriSign (<http://www.verisign.com>)
  - Thawte (<http://www.thawte.com>)
- 

2. In a shell, go to the *CustomerCareSDK\_Home/CustCntr/CustomHelp* directory.
3. Enter the following command:

```
buildHelp
```

---

**Caution:** If a JAR file with the same name as the one **buildHelp** is creating already exists in the *CustomerCareSDK\_Home/CustCntr/custom* directory, **buildHelp** overwrites the existing file. If you want to save the existing file, copy it to another location before running **buildHelp**.

---

The **buildHelp** command does the following:

- Runs the Oracle Help search indexer to create the search database.
  - Creates the **ccCustomHelp\_en.jar** file containing all the Help files and places it in the *CustomerCareSDK\_Home/CustCntr/custom* directory.  
You can use a name other than **ccCustomHelp\_en.jar** by specifying the name on the command line. But you cannot use the same name as the Help JAR file that ships with Customer Center-**Customer\_Center\_Help\_en.jar**.
  - Runs the **signjar** script to sign the JAR file with your own certificate.
4. Test the Help system again, now with searching available. To do this, copy the JAR file to a different location and extract all the files. Then test using the instructions in "[Testing the Help System](#)".

5. If you find problems, fix them in the files in the **cchfiles** directory. Then run **buildHelp** again to create a new JAR file to test.

## Deploying the Help System

Use the following procedures to deploy your customized Customer Center Help. For the full procedure you follow to deploy any Customer Center customization, see ["Building Your Customer Center Customizations"](#).

To deploy your customized Help with your version of Customer Center, follow these procedures:

- [Editing JNLP Files](#)
- [Copying Customized Files to Customer Center](#)

### Editing JNLP Files

A Java Network Launch Protocol (JNLP) file describes how to launch an application with Java WebStart. This is the technology that Customer Center uses to distribute updates to Customer Center users through a Web page.

You need to edit two JNLP files so that your custom Help is distributed with WebStart:

1. Open the **custom.jnlp** file in the *CustomerCareSDK\_Home/CustCntr/custom* directory.

2. In **custom.jnlp**, remove the comments around the following line:

```
<!-- <jar href="custom/ccCustomHelp.jar"/> -->
```

3. If you are *not* customizing the Customer Center application, add comments around the following line:

```
<!-- <jar href="custom/ccCustom.jar"/> -->
```

4. Save and close **custom.jnlp**.

5. Open the **CustomerCenter\_en.jnlp** file in *CustomerCareSDK\_Home/CustCntr/custom*.

6. Remove the comments around the following line:

```
<!-- <extension name="Customized" href="custom/custom.jnlp"/> -->
```

7. To remove the reference to the original Customer Center Help file, add comments around the following line:

```
<!-- <jar href="lib/Customer_Center_Help_en.jar"/> -->
```

8. Save and close **CustomerCenter\_en.jnlp**.

### Copying Customized Files to Customer Center

You need to copy the modified JNLP files and your custom Help JAR file to your Customer Center installation.

1. Make a backup copy of the **CustomerCenter\_en.jnlp** file in *Customer\_Center\_Home*, the directory where you installed Customer Center on your Web server.
2. Create a new subdirectory named **custom** in *Customer\_Center\_Home*.
3. Copy the revised **custom.jnlp** files from *CCSDK\_Home/CustCntr/custom* to *Customer\_Center\_Home/custom*.

4. Copy the revised `CustomerCenter_en.jnlp` from `CCSDK_Home/CustCntr/custom` to `Customer_Center_Home`.
5. Copy `ccCustomHelp.jar`, or whatever you named your customized Help file, from `CCSDK_Home/lib` to `Customer_Center_Home/custom`.

The next time a CSR opens their local version of Customer Center, Java WebStart installs the updated Help file to their system.

---

---

**Important:** If you previously deployed the original Help JAR file, or any other Help JAR file with a different name, to client systems, verify that Customer Center brings up your customized Help. If it does not, follow the procedure [Clearing the WebStart cache](#) for each client system.

---

---

### Clearing the WebStart cache

If client systems are not accessing your customized Help system after you deployed it, each client system should clear its WebStart cache:

1. Open Java WebStart.
2. Choose **File - Preferences**.
3. Click the **Advanced** tab.
4. Click **Clear Folder**.  
A new dialog box appears.
5. Deselect the **Also remove downloaded applications and certificates** option.
6. Click **Yes**.
7. Click **OK** in the Preferences dialog box.

The next time a CSR starts Customer Center, either from WebStart or from your Web site, WebStart downloads the full application.

---

---

**Note:** As an alternative to clearing the cache, you can also remove the Customer Center application from WebStart. In this case, the CSR must go to the Web site to download the latest version of Customer Center.

---

---

## Working with Context-Sensitive Help

Customer Center includes context-sensitive Help for dialog boxes and wizard pages. The user clicks this button to get a Help topic about the current dialog box or wizard page:



The Help topic typically describes each field on the dialog box or page.

Customer Center does not support field-level context-sensitive Help, where you click a field to get a brief description of that field.

If you create a custom page or dialog box, use the following code to add a **Help** button:

```
JButton helpB = new JButton(CCCompatibilityUtility.loadImage(
```



```
"com/portal/app/cc/HelpDefault.gif"));  
helpB.addActionListener(new PDefaultHelpIDAction("ID"))
```

where *ID* is the ID of the Help topic you want to appear for that page or dialog box. The ID must be mapped to a filename in the map file. For more information, see ["Modifying the Map File"](#).



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## Customizing the Customer Center Interface

This chapter provides the following information on customizing Oracle Communications Billing and Revenue Management (BRM) Customer Center:

- The requirements for customizing Customer Center
- Using the Configurator application
- Adding entries to customized properties files
- Extending the Customer Center architecture and framework to add customized panels
- The Customer Center architecture and framework

Before you read this chapter, you should be familiar with these concepts:

- [Understanding the PCM API and the PIN Library](#)
- [Understanding Flists and Storable Classes](#)
- [About Customer Center](#)
- [Understanding the BRM Business Application SDK Framework](#)

For information about Java classes used in Customer Center SDK, see the *Customer Care API Reference*.

---

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**Note:** Customer Center Software Development Kit (SDK) uses the Portal Communication Module (PCM) Java Application Programming Interface (API) to communicate with BRM database objects. While the PCM API uses the format `PIN_FLD_SUBCLASS` to represent an flist field to BRM, the PCM Java API uses the format `FldSubClass` to represent an flist to BRM. See the *API Reference for PCM Java* for information about the Java equivalents for the PCM API field subclasses.

---

---

Related documentation:

- To customize Self-Care Manager, see "[Customizing the Self-Care Manager Interface](#)".
- To use the Java PCM API to create Java client applications that interface with BRM, see "[Creating Client Applications by Using Java PCM](#)".
- To customize Customer Center online help, see "[Customizing the Customer Center Help System](#)".

- To customize localized versions of Customer Center using Customer Center SDK and the Localization SDK, see "[Modifying Localized Versions of Customer Center](#)".

## Customizing and Configuring Customer Center

This section describes the "[Tools and Techniques for Customizing Customer Center](#)" and a "[Customization Procedure Overview](#)" describing which tools and techniques to use for various types of customizations.

### Tools and Techniques for Customizing Customer Center

To customize and configure the Customer Center interface, perform the following tasks.:

1. Code your customizations by:
  - Using the graphical Configurator application to configure the most commonly modified interface features. See "[Using Configurator to Configure Customer Center](#)".
  - Modifying Customer Center customized properties files. See "[Modifying the Customer Center Properties Files](#)".
  - Creating custom fields and panels with PIA (Portal Infranet Aware) widgets by using an IDE tool such as JBuilder. See "[Setting Up JBuilder to Customize the Customer Center Interface](#)".
  - Using scripts, such as the one that starts a local version of Customer Center, for testing your customizations. See "[Using Customer Center SDK Scripts for Customer Center](#)".
2. Build and test your customizations by using scripts such as:
  - **buildAll** to build your **jar** files. See "[Building Your Customer Center Customizations](#)".
  - **runCustomerCenter** to launch a local version of Customer Center to test your customizations before deployment. See "[Testing Your Customizations](#)".
3. Deploy your customizations. See "[Deploying Your Customer Center Customizations](#)".

### Customization Procedure Overview

This section describes which "[Tools and Techniques for Customizing Customer Center](#)" to use for various types of customizations.

#### Coding Your Customizations

- If you are making basic changes to the Customer Center interface, such as changing page field attributes, page order, or search fields, you use Configurator.  
For a complete description of the customizations you can make with Configurator and how to make them, see "[Using Configurator to Configure Customer Center](#)".
- If you are making minor customizations not handled by Configurator, such as changing the list of services available in the search panel, edit the Customer Center customized properties files.  
See "[Modifying the Customer Center Properties Files](#)".
- If you are adding new fields to Customer Center, use:

- Developer Center
- JBuilder
- Configurator

See ["Setting Up JBuilder to Customize the Customer Center Interface"](#) and ["Adding Custom Fields to Customer Center"](#).

- If you are adding a new profile or service panel, you use JBuilder and Configurator. See:
  - [Setting Up JBuilder to Customize the Customer Center Interface](#)
  - [Adding New Pages to the Customer Center Interface](#)
  - [Creating a New Customer Center Profile Panel](#)
  - [Creating a New Customer Center Service Panel](#)
  - The sample profile and service panel code in the `/Profile` and `/Service` directories in the `CCSDK_Home/CustomerCareSDK/CustCntrExamples` directory.
- If you are adding new account maintenance tabs or pages to the new accounts wizard, see ["Adding New Pages to the Customer Center Interface"](#)  
See also sample code in the `CCSDK_Home/CustomerCareSDK/CustCntrExamples` directory.
- If you are doing advanced customizations, see ["Understanding the BRM Business Application SDK Framework"](#) and ["Advanced Customer Center Concepts"](#).

### Building and Deploying Your Customizations

All customizations are built and deployed using the same procedures no matter which tools and techniques are used to do the customizations. See ["Building Your Customer Center Customizations"](#) and ["Deploying Your Customer Center Customizations"](#)

## Modifying the Customer Center Properties Files

This section describes the properties files used to define Customer Center behavior and how to modify those behaviors.

### About the Default Customer Center properties Files

Default Customer Center settings are defined with parameter-value pairs in the following files in the `CCSDK_Home/CustomerCareSDK/CustCntr/Settings` directory:

- `CustomerCenter.properties`
- `CustomerCenterResources.properties`

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**Caution:** Do not delete or modify the default properties files.

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For information on the parameters in the default properties files, see the comments in the files.

### Modifying Behaviors Defined by the Default Properties Files

To change the behaviors in the default properties files:

- Add or modify parameters in the **Customized.properties** and **CustomizedResources.properties** files, which are located in the `CCSDK_Home/CustomerCareSDK/CustCntr/custom` directory. Parameters and values specified in the **Customized\*.properties** files take precedence over values for identical parameters in the respective default properties files.

For examples of changing Customer Center behavior by modifying the **Customized.properties** file, see:

- [Displaying Event Timestamps with Seconds Precision](#)
  - [Adding Inactive Product Status Indicators](#)
  - [Changing the List of Services Available in the Search Panel](#)
  - [Improving Account Search Performance](#)
  - [Changing Number Searches for GSM Services](#)
  - [Modifying the Shortcut Key Sequences](#)
  - [Specifying the Number of Bills Displayed in the Balances Tab](#)
  - [Suppressing the "Missing Login/ID" Message for Custom Service Panels](#)
  - [Changing the Maximum Number of Security Code Characters](#)
  - [Updating Notes Before Saving](#)
  - [Reminding CSRs to Customize Deals Before Completing a Purchase](#)
  - [Identifying Services by Device ID Rather than Login ID](#)
  - [Adding a Tax Exemption Type](#)
  - [Customizing Event Searches](#)
  - [Customizing Balance Group Searches](#)
  - [Customizing Product/Discount Searches](#)
  - [Customizing Service Searches](#)
  - [Hiding the Password Fields in Customer Center](#)
  - [Disabling the Child Amounts Check Box](#)
  - [Adding a Custom Service as a Login to Customer Center](#)
  - [Enabling Copy and Paste of Service ID for Read-Only Access](#)
- Add or modify parameters in the **WizardCustomizations.properties** and **WizardCustomizationsResources.properties** files, which are located in the `CCSDK_Home/CustomerCareSDK/CustCntr/bin` directory. Parameters and values specified in the **WizardCustomizations\*.properties** files:
    - Supersede values for identical parameters in the respective default properties files.
    - *Are superseded by* values for identical parameters in the respective **Customized\*.properties** files.

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**Note:** Values in the **WizardCustomizations\*.properties** files are also modified by the Configurator utility.

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To modify one of these properties files:

1. Open the file with a text editor.
2. Add appropriate parameter-value pairs.
3. Save the file.

After you modify the properties files and make any other customizations, see ["Building Your Customer Center Customizations"](#) and ["Deploying Your Customer Center Customizations"](#).

## Displaying Event Timestamps with Seconds Precision

By default, Customer Center displays event timestamps with hours and minutes precision, such as, 4:30 p.m. You can configure Customer Center to display event timestamps with seconds precision, such as 4:30:55 p.m., by enabling the `customercenter.datetime.showseconds` entry in the `Customized.properties` file.

To display event timestamps with seconds precision:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor.
2. Add the following line after the comment statements:
 

```
customercenter.datetime.showseconds=true
```
3. Save and close the file.
4. Restart Customer Center.

## Adding Inactive Product Status Indicators

To add inactive product status indicators:

1. Open the `Customized.properties` file in the `CCSDK_Home/CustCntr/custom` directory.
2. After the comment statements, add the following lines:
 

```
product.details.status.flags.waiting=Waiting for installation
product.details.status.flags.network=Network configured
product.details.status.flags.maintenance=Maintenance
```
3. Save your changes.

## Changing the List of Services Available in the Search Panel

To change the list of services available in the Search panel:

1. Open the `Customized.properties` file in the `CCSDK_Home/CustCntr/custom` directory.
2. Add the following line after the comment statements, changing the value to match the total number of service types to display in the Search panel:
 

```
searchpanel.service.num=3
```
3. Add entries for each service type to display, for example:
 

```
searchpanel.service.type.0=admin_client
searchpanel.service.type.1=broadband
searchpanel.service.type.2=email
```

---



---

**Important:** If you add a new service type to BRM, add a **searchpanel.service.type** entry for it in the **Customized.properties** file and be sure to increment the value for **searchpanel.service.num** accordingly.

---



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4. Save your changes.

## Improving Account Search Performance

You can improve Customer Center account search performance by reducing the maximum number of search results displayed. The default is **1000**.

To reduce the maximum number of search results displayed:

1. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
2. Add the following line after the comment statements:

```
search.accountsresults.displaylimit=<new value>
```

3. Save your changes.

## Changing Number Searches for GSM Services

You search for telephone numbers when assigning numbers for a GSM service in Customer Center. Numbers are assigned when customizing services in the New Account or Purchase wizards or when changing the number for an existing service.

One of the search criteria on the Search Number dialog box is **Status**. By default, the **Status** list has these options-**<Not Specified>**, **New**, and **Unassigned**. If you choose **<Not Specified>**, Customer Center searches for numbers with a status of either **New** or **Unassigned**. It does not search for numbers with a status of **Assigned** or **Quarantined**.

If you have customized the list to include other status options, **<Not Specified>** also searches for the custom options.

You can change this default so that Customer Center adds **Assigned** and **Quarantined** to the **Status** list and searches numbers with **Assigned** or **Quarantined** status when you choose **<Not Specified>**:

1. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
2. After the comment statements, add the following line:

```
device.num.search.entry.panel.status.availability=false
```

3. Save the file.

By default, **device.num.search.entry.panel.status.availability** is set to **true**. When you set this property to **false**, the following takes place:

- The default **Status** list will also display **Assigned** and **Quarantined**.
- When you choose **<Not Specified>**, Customer Center searches for numbers of any status.



## Modifying the Shortcut Key Sequences

Customer Center provides shortcut key sequences for many of the actions in the UI. You can customize the mnemonics by adding an updated property statement for each custom shortcut in the **Customized.properties** file.

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**Important:** Make sure you do not assign the same mnemonic to different shortcuts.

---



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To customize the shortcut key sequences:

1. Open the **CustomerCenter.properties** file in the *CCSDK\_Home/CustCntr/Settings* directory.
2. Copy the line containing the mnemonic property you want to change. For example:

```
search.startsearch.mnemonic=S
```

3. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
4. Paste in the line you copied.
5. Change the value assigned to the property, for example:

```
search.startsearch.mnemonic=X
```

6. Save your changes.

## Specifying the Number of Bills Displayed in the Balances Tab

In Customer Center, you can view detailed information about the bills associated with an account in the **Bills** section of the **Balances** tab. By default, the **Balances** tab displays a maximum of six bills for each account. You can customize the maximum number of bills displayed by adding a property to the **Customized.properties** file.

To customize the maximum number of bills Customer Center displays on the **Balances** tab:

1. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
2. After the comment statements, add the following line:

```
balance.default.bills.count =Count
```

Replace *Count* with the number of bills you want Customer Center to display for each account on the **Balances** tab.

3. Save your changes.

## Suppressing the "Missing Login/ID" Message for Custom Service Panels

You can create custom service panels that do not request users to enter their login IDs and passwords. However, when users exit the custom service panel, Customer Center generates a "Missing Login/ID. Do you want to fix the error now?" message.

To suppress the login error message in custom service panels, perform the following tasks.

1. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
2. Set the **extended.ServiceType.required** entry to **false**:  
`extended.ServiceType.required=false`
3. Save and close the file.

## Changing the Maximum Number of Security Code Characters

When you create an account in Customer Center, you can enter security codes on the **General** tab of the Account Creation wizard.

You can also modify security codes in the **Account Summary** section of the **Summary** tab.

The BRM database is set up to store a maximum of 30 characters for a security code. You can change the number of allowed characters by modifying the database and adding a property to the **Customized.properties** file.

To change the maximum number of security code characters:

1. In the Storable Class Editor, change the length of the `PIN_FLD_ACCESS_CODE1` and `PIN_FLD_ACCESS_CODE2` fields in the `/account` storable class.
2. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
3. After the comment statements, add the following line:

```
summary.securitycode.length=length
```

Replace *length* with the number of characters you want to allow. The number cannot exceed the size of the `PIN_FLD_ACCESS_CODE1` and `PIN_FLD_ACCESS_CODE2` fields in the `ACCOUNT_T` database table.

4. Save the file.

## Updating Notes Before Saving

By default, when you open an account in Customer Center, existing notes are cached. If two or more users have an account open at the same time and add notes, only one user's notes will be saved.

To prevent this from happening, you can add a property that directs Customer Center to refresh notes from the database before saving an account. This can slow the performance, but it ensures that notes entered by different users to the same account are not overwritten.

To have Customer Center refresh notes from the database:

1. Open the **Customized.properties** file in the *CCSDK\_Home/CustCntr/custom* directory.
2. After the comment statements, add the following line:  
`notes.management.option=refresh`
3. Save the file.

## Reminding CSRs to Customize Deals Before Completing a Purchase

If you create deals with a **Deal Customization** setting of **Required**, you will probably want to ensure that CSRs go to the Customer Center **Customize Product** page to offer your customizations. Customer Center automatically reminds CSRs to customize deals with a **Required** deal customization setting when they first select the deal for purchase. You can also remind CSRs to visit the **Customize Product** page before *completing* the sale by using the `customize.deal.enforce` setting.

You turn this option on and off by changing the `customize.deal.enforce` setting in the **Customized.properties** file.

This example turns this option on:

```
customize.deal.enforce = true
```

The default is **false**.

## Identifying Services by Device ID Rather than Login ID

By default, Customer Center identifies a service owned by an account by using the service login ID, allowing you to find email or IP services owned by the account. You can configure Customer Center to identify services by using device IDs rather than login IDs by using a **Customized.properties** entry. You might do this, for example, if you offer mostly telco services.

To configure Customer Center to identify services by using device IDs rather than login IDs:

1. Open the **Customized.properties** file in the `CCSDK_Home/CustCntr/custom` directory.
2. After the comment statements, add the following line:  
`service.alias.display=true`
3. Save and close the file.

## Adding a Tax Exemption Type

If a tax exemption type does not exist, you can include it by overriding an existing property in the **WizardCustomizationsResources.Properties** file:

1. Make a copy of the **WizardCustomizationsResources.Properties** file.
2. Add the following property:

```
exemptionType.format={0,choice,0#Federal|1#State|2#County|3#City|4#Secondary County|5#Secondary City|8#District}
```

3. Place the customized file in the directory where you start Customer Center.

## Customizing Event Searches

Customer Center has the following criteria to event searches for wholesale customers. Customer Center allows you to:

- Narrow your filters for event searches by providing search criteria in the Event Search dialog box. For more information, see the Customer Center Help.
- Customize the case sensitivity of the searches for events. See "[Customizing the Case Sensitivity of Event Searches](#)"

- Customize event searches by adding custom settings for the following search components:
  - Service types. See ["Customizing the Selections for Service Type in Event Searches"](#)
  - Service status. See ["Customizing the Selections for Service Status in Event Searches"](#)
  - Device types. See ["Customizing the Selections for Device Type in Event Searches"](#)

### Customizing the Case Sensitivity of Event Searches

The **Match case** check box in the Event Search dialog box is selected, indicating that, by default, event searches are case-sensitive in Customer Center.

To change the default case sensitivity of event searches:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor, where `CCSDK_Home` is the directory in which you installed the Customer Center software development kit (CCSDK).

2. Add the following entry:

```
par.eventsearch.default.matchcase=false
```

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

When you deploy this customization, event searches are not case-sensitive, by default. The **Match case** check box in the Event Search dialog box is not selected.

### Customizing the Selections for Service Type in Event Searches

The **Service Type** field in the Event Search dialog box displays the possible selections for service types that can be used in event searches.

To customize the selection for service types in event searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `par.eventsearch.servicetypes.format` entry. For example:

```
par.eventsearch.servicetypes.format={0,choice,1#/service/ip|2#/service/email|3#/service/fax|1,default,2}
```

In this example,

- The service types you want to include are numbered **1# 2#** and so on, delimited by `|`.
- The default service type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **2**; that is, **/service/email**.

---



---

**Note:** The default setting for the **Service Type** field is defined by the following statement. (The default service type is **/Not Specified**.)

```
par.eventsearch.servicetypes.format={0,choice, 0#(Not Specified)|1#/service|2#/service/ip|3#/service/email|4#/service/telco|5#/service/telco/gsm|6#/service/telco/gsm/sms|7#/service/telco/gsm/telephony|1,default,0}
```

---



---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

### Customizing the Selections for Service Status in Event Searches

The **Service Status** field in the Event Search dialog box displays the possible selections for service status that can be used in event searches.

To customize the selection for service status in event searches:

1. Open the *CCSDK\_Home/CustCntr/custom/CustomizedResources.properties* file in a text editor.
2. Add the custom setting for the **par.eventsearch.servicestatus.format** entry. For example:

```
par.eventsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|1,default,0}
```

In this example,

- The service status entries you want to include are numbered **0# 10100#** and so on, delimited by **|**.
- The default service status that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **0**; that is, **All**.

---



---

**Note:** The default setting for the **Service Status** field is defined by the following statement. (The default service status is **All**.)

```
par.eventsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|10103#Closed|1,default,0}
```

---



---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

### Customizing the Selections for Device Type in Event Searches

The **Device Type** field in the Event Search dialog box displays the possible selections for device types that can be used in event searches.

To customize the selection for device types in event searches:

1. Open the *CCSDK\_Home/CustCntr/custom/CustomizedResources.properties* file in a text editor.
2. Add the custom setting for the **eventsearch.devicetypes.format** entry. For example:

```
par.eventsearch.devicetypes.format={0,choice,1#/device/num|2#/device/sim|1,default,1}
```

In this example,

- The device types you want to include are numbered **1# 2#** and so on, delimited by |.
- The default device type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **1**; that is, **/device/num**.

---



---

**Note:** The default setting for the **Device Type** field is defined by the following statement. (The default device type is **Not Specified**.)

```
par.eventsearch.devicetypes.format={0,choice,0#(Not Specified)|1#/device|2#/device/num|3#/device/sim|1,default,0}
```

---



---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

## Customizing Balance Group Searches

Customer Center has the following criteria to balance group searches for wholesale customers. Customer Center allows you to:

- Set the threshold for the number of available balance groups to display in Customer Center. For more information, see Customer Center Help.
- Customize the case sensitivity of searches for balance groups. See "[Customizing the Case Sensitivity of Balance Group Searches](#)"
- Customize searches for balance groups by adding custom settings for the following search components:
  - Service types. See "[Customizing the Selections for Service Type in Balance Group Searches](#)"
  - Service status. See "[Customizing the Selections for Service Status in Balance Group Searches](#)"
  - Device types. See "[Customizing the Selections for Device Type in Balance Group Searches](#)"

### Customizing the Case Sensitivity of Balance Group Searches

The **Match case** check box in the Balance Group Search dialog box is selected, indicating that, by default, balance group searches are case-sensitive in Customer Center.

To change the default case sensitivity of balance group searches:

1. Open the *CCSDK\_Home/CustCntr/custom/Customized.properties* file in a text editor, where *CCSDK\_Home* is the directory in which you installed the Customer Center software development kit (CCSDK).
2. Add the following entry:
 

```
balancegroupsearch.default.matchcase=false
```
3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

When you deploy this customization, balance group searches are not case-sensitive, by default. The **Match case** check box in the Balance Group Search dialog box is not selected.

### Customizing the Selections for Service Type in Balance Group Searches

The **Service Type** field in the Balance Group Search dialog box displays the possible selections for service types that can be used in balance group searches.

To customize the selection for service types in balance group searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `balancegroupsearch.servicetypes.format` entry. For example:

```
balancegroupsearch.servicetypes.format={0,choice,1#/service/ip|2#/service/email|3#/service/fax|1,default,2}
```

In this example,

- The service types you want to include are numbered **1# 2#** and so on, delimited by `|`.
- The default service type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **2**; that is, `/service/email`.

---

**Note:** The default setting for the **Service Type** field is defined by the following statement. (The default service type is `/service`.)

```
balancegroupsearch.servicetypes.format={0,choice, 0#(Not Specified)|1#/service|2#/service/ip|3#/service/email|4#/service/telco|5#/service/telco/gsm|6#/service/telco/gsm/sms|7#/service/telco/gsm/telephony|1,default,1}
```

---

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

### Customizing the Selections for Service Status in Balance Group Searches

The **Service Status** field in the Balance Group Search dialog box displays the possible selections for service status that can be used in balance group searches.

To customize the selection for service status in balance group searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `balancegroupsearch.servicestatus.format` entry. For example:

```
balancegroupsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|1,default,0}
```

In this example,

- The service status entries you want to include are numbered **0# 10100#** and so on, delimited by `|`.
- The default service status that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **0**; that is, `All`.

---



---

**Note:** The default setting for the **Service Status** field is defined by the following statement. (The default service status is **Active**.)

```
balancegroupsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|10103#Closed|1,default,10100}
```

---



---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

### Customizing the Selections for Device Type in Balance Group Searches

The **Device Type** field in the Balance Group Search dialog box displays the possible selections for device types that can be used in balance group searches.

To customize the selection for device types in balance group searches:

1. Open the *CCSDK\_Home/CustCntr/custom/CustomizedResources.properties* file in a text editor.
2. Add the custom setting for the **balancegroupsearch.devicetypes.format** entry. For example:

```
balancegroupsearch.devicetypes.format={0,choice,1#/device/num|2#/device/sim|1,default,1}
```

In this example,

- The device types you want to include are numbered **1# 2#** and so on, delimited by **|**.
- The default device type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **1**; that is, **/device/num**.

---



---

**Note:** The default setting for the **Device Type** field is defined by the following statement. (The default device type is **Not Specified**.)

```
balancegroupsearch.devicetypes.format={0,choice,0#(Not Specified)|1#/device|2#/device/num|3#/device/sim|1,default,0}
```

---



---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

### Customizing Product/Discount Searches

Customer Center has the following criteria to product/discount searches for wholesale customers. Customer Center allows you to:

- Set the number of available products/discounts to display in Customer Center. For more information, see *Customer Center Help*.
- Customize the case sensitivity of searches for products/discounts. See ["Customizing the Case Sensitivity of Product/Discount Searches"](#)
- Customize searches for products/discounts by adding custom settings for the following search components:
  - Service types. See ["Customizing the Selections for Service Type in Product/Discount Searches"](#)



- Service status. See ["Customizing the Selections for Service Status in Product/Discount Searches"](#)
- Device types. See ["Customizing the Selections for Device Type in Product/Discount Searches"](#)

### Customizing the Case Sensitivity of Product/Discount Searches

The **Match case** check box in the Product/Discount Search dialog box is selected, indicating that, by default, product/discount searches are case-sensitive in Customer Center.

To change the default case sensitivity of product/discount searches:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor, where `CCSDK_Home` is the directory in which you installed the Customer Center software development kit (CCSDK).

2. Add the following entry:

```
proddiscsearch.default.matchcase=false
```

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

When you deploy this customization, product/discount searches are not case-sensitive, by default. The **Match case** check box in the Product/Discount Search dialog box is not selected.

### Customizing the Selections for Service Type in Product/Discount Searches

The **Service Type** field in the Product/Discount Search dialog box displays the possible selections for service types that can be used in product/discount searches.

To customize the selection for service types in product/discount searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `proddiscsearch.servicetypes.format` entry. For example:

```
proddiscsearch.servicetypes.format={0,choice,1#/service/ip|2#/service/email|3#/service/fax|1,default,2}
```

In this example,

- The service types you want to include are numbered **1# 2#** and so on, delimited by `|`.
- The default service type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **2**; that is, **/service/email**.

---

**Note:** The default setting for the **Service Type** field is defined by the following statement. (The default service type is **/service**.)

```
proddiscsearch.servicetypes.format={0,choice,1#/account|2#/service|3#/service/ip|4#/service/email|5#/service/telco|6#/service/telco/gsm|7#/service/telco/gsm/sms|8#/service/telco/gsm/telephony|1,default,2}
```

---

3. Save the file.

4. Build the custom `.jar` file and deploy this customization.

### Customizing the Selections for Service Status in Product/Discount Searches

The **Service Status** field in the Product/Discount Search dialog box displays the possible selections for service status that can be used in product/discount searches.

To customize the selection for service status in product/discount searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `proddiscsearch.servicestatus.format` entry. For example:

```
proddiscsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|1,default,0}
```

In this example,

- The service status entries you want to include are numbered **0# 10100#** and so on, delimited by `|`.
- The default service status that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **0**; that is, **All**.

---



---

**Note:** The default setting for the **Service Status** field is defined by the following statement. (The default service status is **Active**.)

```
proddiscsearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|10103#Closed|1,default,10100}
```

---



---

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

### Customizing the Selections for Device Type in Product/Discount Searches

The **Device Type** field in the Product/Discount Search dialog box displays the possible selections for device types that can be used in product/discount searches.

To customize the selection for device types in product/discount searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `proddiscsearch.devicetypes.format` entry. For example:

```
proddiscsearch.devicetypes.format={0,choice,1#/device/num|2#/device/sim|1,default,1}
```

In this example,

- The device types you want to include are numbered **1# 2#** and so on, delimited by `|`.
- The default device type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **1**; that is, **/device/num**.

---



---

**Note:** The default setting for the **Device Type** field is defined by the following statement. (The default device type is **Not Specified**.)

```
proddiscsearch.devicetypes.format={0,choice,0#(Not Specified)|1#/device|2#/device/num|3#/device/sim|1,default,0}
```

---



---

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

## Customizing Service Searches

Customer Center has the following criteria to service searches. Customer Center allows you to:

- Set the threshold for the number of available services to display in Customer Center. For more information, see the Customer Center Help.
- Customize the case sensitivity of searches for services. See ["Customizing the Case Sensitivity of Service Searches"](#)
- Set the step size for the searches. See ["Customizing the Step Search Size"](#)
- Customize service searches by adding custom settings for the following search components:
  - Service types. See ["Customizing the Selections for Service Type in Service Searches"](#)
  - Service status. See ["Customizing the Selections for Service Status in Service Searches"](#)
  - Device types. See ["Customizing the Selections for Device Type in Service Searches"](#)

### Customizing the Case Sensitivity of Service Searches

The **Match case** check box in the Service Search dialog box is selected, indicating that, by default, service searches are case-sensitive in Customer Center.

To change the default case sensitivity of service searches:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor, where `CCSDK_Home` is the directory in which you installed the Customer Center software development kit (CCSDK).
2. Add the following entry:
 

```
servicesearch.default.matchcase=false
```
3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

When you deploy this customization, service searches are not case-sensitive, by default. The **Match case** check box in the Service Search dialog box is not selected.

### Customizing the Step Search Size

You can customize the step search size for retrieving services.

To customize the step search size:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor, where `CCSDK_Home` is the directory in which you installed the Customer Center software development kit (CCSDK).
2. Set the `servicesearch.stepsize` entry to the appropriate value for your server (memory) configuration. The default is `100`.
3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

### Customizing the Selections for Service Type in Service Searches

The **Service Type** field in the Service Search dialog box displays the possible selections for service types that can be used in service searches.

To customize the selection for service types in service searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `servicesearch.servicetypes.format` entry. For example:

```
servicesearch.servicetypes.format={0,choice,1#/service/ip|2#/service/email|3#/service/fax|1,default,2}
```

In this example,

- The service types you want to include are numbered **1# 2#** and so on, delimited by `|`.
- The default service type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **2**; that is, **/service/email**.

---



---

**Note:** The default setting for the **Service Type** field is defined by the following statement. (The default service type is **/service**.)

```
proddiscsearch.servicetypes.format={0,choice,1#/service|2#/service/ip|3#/service/email|4#/service/telco|5#/service/telco/gsm|6#/service/telco/gsm/sms|7#/service/telco/gsm/telephony|1,default,1}
```

---



---

3. Save the file.
4. Build the custom `.jar` file and deploy this customization.

### Customizing the Selections for Service Status in Service Searches

The **Service Status** field in the Service Search dialog box displays the possible selections for service status that can be used in service searches.

To customize the selection for service status in service searches:

1. Open the `CCSDK_Home/CustCntr/custom/CustomizedResources.properties` file in a text editor.
2. Add the custom setting for the `servicesearch.servicestatus.format` entry. For example:

```
servicesearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|1,default,0}
```

In this example,

- The service status entries you want to include are numbered **0# 10100#** and so on, delimited by |.
- The default service status that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **0**; that is, **All**.

---

**Note:** The default setting for the **Service Status** field is defined by the following statement. (The default service status is **Active**.)

```
servicesearch.servicestatus.format={0,choice,0#All|10100#Active|10102#Inactive|10103#Closed|1,default,10100}
```

---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

### Customizing the Selections for Device Type in Service Searches

The **Device Type** field in the Service Search dialog box displays the possible selections for device types that can be used in service searches.

To customize the selection for device types in service searches:

1. Open the *CCSDK\_Home/CustCntr/custom/CustomizedResources.properties* file in a text editor.
2. Add the custom setting for the **servicesearch.devicetypes.format** entry. For example:

```
servicesearch.devicetypes.format={0,choice,1#/device/num|2#/device/sim|1,default,1}
```

In this example,

- The device types you want to include are numbered **1# 2#** and so on, delimited by |.
- The default device type that is displayed when you access the dialog box is specified as **1,default,n**. In this example, the default is **1**; that is, **/device/num**.

---

**Note:** The default setting for the **Device Type** field is defined by the following statement. (The default device type is **Not Specified**.)

```
servicesearch.devicetypes.format={0,choice,0#(Not Specified)|1#/device|2#/device/num|3#/device/sim|1,default,0}
```

---

3. Save the file.
4. Build the custom **.jar** file and deploy this customization.

## Hiding the Password Fields in Customer Center

Hiding the password fields for services in Customer Center (in the **Customize Services** page and the **Services** tab) enhances security. When the password fields are hidden, the BRM server generates the password for services. You cannot hide the password fields for the **/service/admin\_client** and **/service/pcm\_client** service types.

To hide the password fields for services in Customer Center:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor.
2. Add the following line after the comment statements:

```
nonCSRservices.hide.passwordfields=value
```

where *value* is:

- **true** to hide the password fields for service types other than `/service/admin_client` and `/service/pcm_client`.
  - **false** to display the password fields. This is the default.
3. Save and close the file.
  4. Build the custom `.jar` file and deploy this customization.
  5. Restart Customer Center.

## Disabling the Child Amounts Check Box

To disable the include **Child Amounts** check box in Customer Center:

1. Open the `Customized.properties` file in the `CCSDK_Home/CustCntr/custom` directory.
2. After the comment statements, add the following line:
 

```
Customized.ReadOnlyIncludeChild=true
```
3. Save and close the file.

## Adding a Custom Service as a Login to Customer Center

As an alternative to `/service/admin_client`, you can add a custom service as a login.

To add a custom service as a login to Customer Center:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor.

Alternatively, you can add the line to `WizardCustomizations.properties`.

2. Add the following line after the comment statements:
 

```
customercenter.loginType=/service/CustomService
```
3. Save and close the file.
4. Build the custom `.jar` file and deploy this customization.
5. Restart Customer Center.

## Enabling Copy and Paste of Service ID for Read-Only Access

By default, the users with read-only access cannot copy any fields in Customer Center. You can customize the Service tab in Customer Center to enable these users to copy service IDs.

To enable users with read-only access to copy service ID:

1. Create the `com.custom.cc.ServiceIdSelectable` class that contains the following:

```
package com.portal.app.cc;
```

```

import java.rmi.RemoteException;
import com.portal.bas.PModelHandle;

public class ServiceIdSelectable extends PServiceDefault {

    @Override
    public void setModelHandle(PModelHandle pm) throws RemoteException {
        super.setModelHandle(pm);
        idTF.setEnabled(true);
        idTF.setEditable(false);
    }
}

```

This extends the **com.portal.app.cc.PServiceDefault** class and allows the user with read-only access to copy the service ID.

2. Open the *CCSDK\_Home/CustCntr/custom/Customized.properties* file in a text editor.
3. Add the following in the file:
 

```
com.portal.app.cc.PServiceDefault.subclass=com.custom.cc.ServiceIdSelectable
```
4. Save and close the file.
5. Build the custom **.jar** file and deploy this customization. See "[Building Your Customer Center Customizations](#)" and "[Deploying Your Customer Center Customizations](#)".
6. Restart Customer Center.

## Using Customer Center SDK Scripts for Customer Center

[Table 34–1](#) contains the scripts provided with Customer Center SDK to automate many of the processes for preparing and building your customizations:

**Table 34–1** Customer Center SDK Scripts

| Script                   | Purpose   |
|--------------------------|---|
| <b>runConfigurator</b>   | Runs the Configurator client.<br>See " <a href="#">Using Configurator</a> ".  |
| <b>runFldSpecWidget</b>  | Runs a read-only Storable Class Editor widget for reading BRM field definitions to copy and use for <b>modelFieldDescription</b> , <b>displayFieldDescription</b> , and <b>displayFieldFormat</b> entries for new fields. You can use these field definitions when you write code to add functionality to the Customer Center and Self-Care Manager applications. |
| <b>makecertificate</b>   | Creates a self-signed certificate for deploying your customizations.<br>See " <a href="#">Creating a Self-Signed Java Security Certificate</a> ".   |
| <b>runCustomerCenter</b> | Runs a standalone version of Customer Center for local testing of your customizations. This script requires a connection to a CM, but doesn't require a Web server.<br>See " <a href="#">Testing Your Customizations</a> ".   |

**Table 34–1 (Cont.) Customer Center SDK Scripts**

| Script             | Purpose  |
|--------------------|--|
| <b>compile</b>     | Recompiles the example source files in all subdirectories under the <code>/CustCntrExamples</code> directory.<br>Use this script before you run the example source files.<br><b>Tip:</b> To see how the <b>buildAll</b> script compiles, packages, and signs custom source code, copy <b>Customized.properties</b> and <b>CustomizedResources.properties</b> files from the example's folder to the <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory. |
| <b>testExample</b> | Tests the compiled Customer Center examples in the following directories under the <code>/CustCntrExamples</code> directory: <ul style="list-style-type: none"> <li>■ <b>AccountCreation</b></li> <li>■ <b>General</b></li> <li>■ <b>Notes</b></li> <li>■ <b>Service</b></li> <li>■ <b>Summary</b></li> <li>■ <b>Profile</b></li> <li>■ <b>Events</b></li> </ul>   |
| <b>unpackHelp</b>  | Unpacks the Customer Center Help file, <code>Customer_Center_Help_en.jar</code> .  |
| <b>buildHelp</b>   | Builds the <code>ccCustomHelp_en.jar</code> file for distributing your customized online help.   |

## Adding New Pages to the Customer Center Interface

This section describes the concepts and components you need to add pages for account maintenance or for the new account wizard.

To add new pages to Customer Center, you need:

- Experience with a Java graphical user interface (GUI) builder, such as JBuilder
- Experience in building Java applications
- Familiarity with "[Understanding the BRM Business Application SDK Framework](#)" and "[Advanced Customer Center Concepts](#)"

This section includes these topics:

- [About Portal Infranet Aware Widgets](#)
- [Adding Account Maintenance Pages](#)
- [Adding New Account Wizard Pages](#)

### About Portal Infranet Aware Widgets

Custom Center uses the Portal Infranet Aware (PIA) widget set when building a custom page. These widgets include extra APIs that know about BRM; they are capable of automatically toggling currency data, some are capable of exporting their data to HTML, and others contain bug fixes that you need when using the normal Swing widgets. These widgets are in the `com.portal.bas.comp` Java package in `basacAll.jar`. The most important mappings from PIA widgets to Swing widgets include:

- `PIACustomizablePanel == JPanel`



- `PIAScrollPane == JScrollPane`
- `PIATextField == JTextField`
- `PIAReadOnlyField == JLabel`
- `PIASpecSpreadSheet == JTable`

When constructing a custom page, always try to use the PIA widget set for the reasons described above.

For more information on PIA widgets, see:

- [Components Used in Customer Center](#)
- [Advanced Customer Center Concepts](#)
- Customer Care API reference

## Adding Account Maintenance Pages

This section provides information and implementation tips on adding account maintenance pages.

- [Overview of Account Maintenance Components](#)
- [Saving Changes](#)
- [Refreshing Data in the UI](#)
- [Currency Toggling](#)
- [Drill-Down Links](#)
- [Advanced Drill-Down Techniques](#)
- [Modifying the Customer Center Permissions](#)
- [Adding Your Page to the Customer Center Toolbar](#)

### Overview of Account Maintenance Components

When working with an existing account, the Customer Center framework uses the **PCustomerCenterContext** class. This class contains APIs for accessing the current account and for accessing global data managers. Each open account contains a further set of APIs encapsulated in the **PAccountViewContext** class. This class contains APIs for implementing drill-downs and accessing the refresh manager for the account.

Every page in the account maintenance view, including tabs and drill-down panels, must implement the **PAccountViewPage** interface. This interface contains methods required by the Customer Center framework to interact with the various pages in the tabbed pane. If you are creating a new page from scratch, it is highly recommended that you start with **PMaintenancePage**. This base class implements the **PAccountViewPage** interface and provides a basic implementation in many of the methods.

If you choose to override a particular method in **PMaintenancePage**, simply call the superclass method first to take advantage of the default implementation.

If you start with **PMaintenancePage**, you should be aware of these methods:

- **save()**: Saves data in a page. Provide code in this method to save the data in your page.

This method is called automatically by the framework.

- **hasUnsavedChanges()**: This method is called automatically by the framework to determine if your page needs to be saved.
- **getLabel()** – If your page contains links allowing the user to drill down within your custom tab, you provide a string in this method that describes your page. This string appears as the initial tag in the breadcrumb trail.
- **refresh()**: This method is called when the user clicks the **Refresh** toolbar button. You should refresh the data on your page in this method, going to BRM as required.
- **recycle()**: Pages in the tabbed pane are reused between accounts. In this method, clear out all data you set manually so data from one account doesn't accidentally appear when displaying the next account.

If you are using the BAS PIA widgets on your screen, you might want to use the **collectData()** method when gathering data for saving. For example:

```
PModelHandle mod1 = PClientContext.getServices().
    createNewModel(PModelHandle.UNTYPED);
PCollectDataEvent evt = new PCollectDataEvent(
    this, PCollectDataEvent.FOR_DIRTY, mod1);
collectData(evt);
```

After this code is invoked, the **mod1** variable represents data that was modified on your page. You can now convert this data from a **PModelHandle** into an **flist** and pass it off to your appropriate opcode. The conversion is performed as shown in this example:

```
PCachedContext conn = (PCachedContext)
    CCCompatibilityUtility.getConnection();

//This is how you turn a PModelHandle into an FList
FList flist = (FList)conn.lookupModel(mod1);
```

## Saving Changes

When a user leaves a Customer Center page, the page saves its own data.

---

---

**Note:** Customer Center users leave a page by changing tabs, drilling down to another page, or using the **Back** button.

---

---

The act of leaving a page invokes code that gathers the data and calls the opcode used for saving the data. Each page formats the appropriate input **flist** and calls the correct opcode. If a data entry error occurs, a page can use the global **PSaveManager** methods to notify the user of the error and locate the field causing the error. The global **SaveManager** contains convenience methods that the pages can use for alerting the user and locating the UI field causing the error.

To save changed data from a page, the framework calls the **hasUnsavedChanges()** method on the **PAccountViewPage** interface. If the class returns **true**, the **save()** method is called on the page. If the page signals a save failure, a **PSaveException** is returned.

Customer Center uses wrapper opcodes to group editable data together so that all changes can be saved with a single opcode call. For example, the **CUST\_UPDATE\_CUSTOMER** opcode is a wrapper opcode that calls **CUST\_MODIFY\_PROFILE**. This feature allows you to embed a panel for a **/profile** object into a panel that displays

regular account data, such as contact or payment data, and save any changes using a single opcode call. Profile panels do not have to be contained within separate tabs.

---



---

**Important:** Avoid calling multiple opcodes when saving page data. If you call more than one opcode, you might need to roll back a set of changes if a subsequent page save attempt fails.

---



---

If your page is constructed using the BAS Portal Infranet-aware (PIA) widgets, you probably do not need to override this method.

The base implementation in **PMaintenancePage** returns the appropriate value. However, if you are using standard Swing widgets in your page, you probably need to determine if your page must be saved or not:

- If your page requires saving, return **true**.
- If your page doesn't require saving, return **false**. The method is not be called.

If you are subclassing (directly or indirectly) a **PIACustomizablePanel** in your custom page, call the **setInputTracking(true)** method after constructing the UI for your page. This is especially important if you are using **collectData()** to gather the data for saving. Input tracking tells the system that every PIA widget should track changes made by a user. (This feature displays the colored widgets when a user makes a change). When **collectData()** is called, it asks each widget if it has been modified. If it has been modified, it retrieves the modified data.

---



---

**Important:** If input tracking turned is turned off, the widgets won't know that they have been changed.

---



---

### Refreshing Data in the UI

When components use one of the **PRefreshManager** listener methods to register for event notification, they are notified whenever a data type of interest changes.

**PRefreshManager** tracks the following types of data changes:

- Balance impacts
- Contact information
- Changes to credit limits
- Deferred actions
- Hierarchy changes
- Holdings changes (product and deal purchases and cancellations)
- Payment type changes
- Service changes (login, status, password, and deferred action count)
- Status changes

There is a separate refresh manager instance created for each open account in Customer Center so that changes in one account do not accidentally impact an unrelated account. The **PRefreshManager** instance associated with an open account can be retrieved from the account's view context by using the **getRefreshManager()** method in **PAccountViewContext**.

Each **PAccountViewPage** instance also contains a **refresh()** method that is called when the user clicks the **Refresh** toolbar button. The **refresh()** method is invoked for a page if the page is currently active. Each page should update its data when this method is invoked.

Use the **PRefreshManager** component's refresh mechanism if you are:

- Adding a page that displays data found in other pages.
- Adding a page that displays data that is directly impacted by changes elsewhere in the interface.

If you change a data type, call one of the **PRefreshManager** process methods so that other registered components are also updated as required. See for **PRefreshManager** for details about the various listener and process methods supported by the default implementation.

You can implement the **refresh()** method by resetting the **PModelHandle** on the page as follows:

```
setModelHandle(getModelHandle());
```

### Currency Toggling

If you use multiple currencies in an account, you can implement currency toggling. When you implement currency toggling on your panel, use the Portal Infranet-aware (PIA) widget set when building a new page. The PIA widget set is part of the **com.portal.bas.comp** package.

The PIA widgets are wrappers for common **Swing** widgets. When setting the data for any PIA widget, use the **setLightData** API instead of the standard **Swing** methods such as **setText**. For example, if you have a screen that displays balance information, such as **Balance: \$15.99**, you could make the **Balance** widget a **JLabel** and the **\$15.99** widget a **PIAReadOnlyField**.

---



---

**Note:** If you are specifying **displayFieldDescription** for your widgets, this happens automatically.

---



---

Call **setCurrencyDisplay(true)** on each widget displaying currency data.

---



---

**Note:** This API is available for the PIA widgets that are capable of displaying currency data. For more information, see *Customer Care API Reference*.

---



---

### Drill-Down Links

The Customer Center interface allows users to *drill down* from one page to another. The **PCCLink** class provides the drill down functionality, including the visual element to display your link. You create a new **PCCLink** as follows:

```
new PCCLink("text", pageClass, "trailTag", null|"parent");
```

Table 34–2 describes the input parameters for a new **PCCLink**:

**Table 34–2** Input Parameters for **PCCLink**

| Input Parameter | Description  |
|-----------------|--|
| text            | The text you want to appear in the link widget itself. Include the quotes. |

**Table 34–2 (Cont.) Input Parameters for PCCLink**

| Input Parameter  | Description   |
|------------------|---|
| <b>pageClass</b> | A quoted string that contains the name of the class you want the link to drill down to.   |
| <b>trailTag</b>  | The text label, in quotes, that you want to appear in the bread crumb trail above the tabbed panel.   |
| <b>parent</b>    | The name of the destination tab. This tag is the same tag specified in <b>CustomerCenter.properties</b> . Leave the value as <b>null</b> if you do not want to drill down to a different page. Include quotes if the value is not <b>null</b> .<br>Use this parameter to drill down from one page tab to another. |

**Drill-down example 1**

To create a **PCCLink** that drills down from the Summary page to the status change screen, include the following link on the Summary page:

```
new PCCLink("Status", com.portal.app.cc.PChangeStatusPage, "Change Status", null);
```

The **PCCLink** automatically calls the framework API required for drilling down a link selected by the user. You do not need to call any APIs or hook up event handlers.

**Drill-down example 2**

To make a drill down that appears as if a user had drilled down directly from the **Service** tab, include the following link on the Summary page:

```
new PCCLink("Status", com.portal.app.cc.PChangeStatusPage, "Change Status", "service");
```

When this link is selected, the **Service** tab moves to the front and the bread crumb trail on the displayed page reads **Service -> Change Status**.

See the **DrillDownTest.java** sample code in **CCSDK\_Home/CustomerCareSDK/CustCntrExamples** for a detailed example.

**Invoking the drill-down API directly**

You can gain further control over drill-down behavior by invoking the drill-down API directly rather than using the **PCCLink** class.

To invoke drill downs directly:

1. Retrieve the context for the current account view. The context is a reference to the tabbed pane for the currently active account.

You can access the **PAccountViewContext** through the **PCustomerCenterContext**:

```
CCCompatibilityUtility.getCustomerCenterContext().getAccountViewContext();
```

2. From the **PAccountViewContext**, call one of the four **switchToPage** API variants.

You can either pass in a pre-existing **PAccountViewPage** instance or a reference to the **Class** instance of the page. If a reference is passed, the framework first attempts to find an instance of this class within the current view. If one is found, it is reused and a handle to the existing **PAccountViewPage** is returned. If no instance is found, a new one is created and a handle to the new **PAccountViewPage** instance is returned.

---

---

**Tip:** If possible, use the **switchToPage** method that takes a **Class** instance. If you pass a **Class** instance, the framework tracks the page instance for you. If you do need to call any specific API on the page you are drilling down to, an instance is returned to you from the **switchToPage** method to enable the drill-down. For more information, see *Customer Care API Reference* for information on this version of the **switchToPage** method.

---

---

### Drill-down simulation

You can simulate two types of drill downs:

- You can drill down within the current tab.
- You can switch to a different tab and simulate a drill down from the top-level page in that tab.

Two of the **switchToPage()** methods take three parameters that allow you to drill down within the current tab or switch to a different tab and simulate a drill down from the new top-level tab. Pass in the tag reference for the tab you want to drill down to, and the framework automatically switches the active tab before performing the drill down.

---

---

**Note:** The tag reference for each tab is the same tag specified in the **custinfo.tabs** property in **CustomerCenter.properties**.

---

---

For more information on using the **switchToPage()**, see "[Advanced Drill-Down Techniques](#)".

### Drill-down implementation procedure

To implement a drill down:

1. Pass in the following:
  - The label to display in the breadcrumb trail for the new top-level tab.
  - The **Class** name of the parent page to display as a drill-down. If an instance of that class exists, it becomes the current drill-down. Otherwise, the class is instantiated and added as a drill-down.
  - A **String** with the name of the parent component to drill down from.

The framework automatically switches the active tab before performing a drill-down. The label text used for each tab is the same as specified in the **custinfo.tabs** property in **CustomerCenter.properties**.

2. Provide a graphical element to invoke the **switchToPage** method. Normally you would use the **Link** widget and hook up an **ActionListener** to it. Within the **ActionListener** callback method, **actionPerformed**, retrieve the context for the current account and invoke the **switchToPage** method.

To embed a link within a table cell, use the framework API but create a renderer for your table column instead of using the **PCCLink** or **Link** widgets directly. Instead, use **PLinkRenderer**. For an example, see the **DrillDownTest.java** sample code in the **General** directory under *CCSDK\_Home/CustomerCareSDK/CustCntrExamples*.

## Advanced Drill-Down Techniques

To gain more control over drill downs, you can invoke the drill down API yourself instead of using `PCCLink()`.

1. Retrieve the context for the current account view.

The context is a reference to the tabbed pane for the currently active account. You can access the `PAccountViewContext` through the `CustomerCenterContext`:

```
CCCompatibilityUtility.getCustomerCenterContext().getAccountViewContext();
```

2. From the `PAccountViewContext`, call one of the four variants of the `switchToPage()` API. You can either pass in a pre-existing `PAccountViewPage` instance or a reference to the class instance of the page.

If you pass in a class instance, the framework first attempts to find an instance of this class within the current view. If one is found, the framework re-uses it and return a handle to it. If no instance is found, a new one is created and a handle is returned.

---

**Tip:** If you use the `switchToPage()` method that takes a class instance, the framework keeps track of the page instance for you. Also, if you do need to call any specific API on the page you are drilling down to, an instance is returned to you from the `switchToPage()` method to accomplish this.

---

You must provide a graphical element to invoke the `switchToPage()` method. You typically use the `com.portal.ctrl.Link` widget, and hook up an `ActionListener` to it. Within the `ActionListener` callback method (`actionPerformed`), retrieve the context for the current account and invoke the `switchToPage()` method.

To embed a link within a table cell, you use the framework API above. However, instead of using a `PCCLink` or `Link` widget directly, you create a renderer for your table column. You can use the `com.portal.app.comp.PLinkRenderer` for this purpose. There is a sample of how to use this renderer in the SDK examples directory.

## Modifying the Customer Center Permissions

Customer Center SDK includes the `PRestriction` class that defines server-side permissions for the user or the client application to perform certain functions.

## Adding Your Page to the Customer Center Toolbar

You can add your page to the account maintenance toolbar button instead of as a separate tab. This section includes information on how to present your data in a floating dialog box, such as for notes, that the user can keep up at all times.

Write your toolbar button code as you do when writing tab code. You can extend `PMaintenancePage`, but that is not required, and you can start with any base class. However, if you plan on using BAS PIA widgets you must start with a `PIACustomizablePanel`. Once you have your page, you create an action class for the toolbar. Your class should extend the BAS action class as follows:

```
public class WorkflowAction extends PBASAction {
    public WorkflowAction(PClientComponent comp) {
        super(comp, "workflow");
    }
}
```

Note the **workflow** tag highlighted above. This is a mapping into the property file indicating attributes of your toolbar button such as label, icon, and so forth. Override the **actionPerformed()** method and display your dialog when this method is invoked:

```
public void actionPerformed(ActionEvent ae) {  
}
```

To add your custom toolbar button to Customer Center, modify **Customized.properties** and **CustomizedResources.properties**. For example, if you identify your additional button by the **workflow** tag, your property file changes is as follows:

#### **Customized.properties**

```
customercenter.toolbar=back home SEP VSEP save refresh SEP VSEP SEP newaccounts  
SEP VSEP  
    search notes workflow  
customercenter.tb.class.workflow=WorkFlowAction
```

#### **CustomizedResources.properties**

```
customercenter.workflow.label=  
customercenter.workflow.icon=myWorkFlow.gif  
customercenter.workflow.desc=Launches the workflow dialog  
customercenter.workflow.accel=  
customercenter.workflow.mnemonic=
```

---

---

**Tip:** You can optionally fill in values for parameters that have none. For example, if you fill in the **label** property, a label appears next to your toolbar button.

---

---

## **Adding New Account Wizard Pages**

This section includes concepts and guidelines for adding pages to the new accounts wizard:

- [Understanding the New Accounts Wizard](#)
- [Base Classes for Account Creation Pages](#)
- [Methods Used in New Account Creation Pages](#)

### **Understanding the New Accounts Wizard**

This section describes how the new account wizard works.

#### **PWizardPage**

Every page in the new account wizard must implement the **PWizardPage** interface. This interface contains methods required by the wizard framework. For more information on the **PWizardPage** interface, see the *Customer Care API Reference*.

---

---

**Tip:** If you add a new account wizard page to using Configurator, all entries are written out for you automatically.

---

---



### Data sharing

The new account wizard in Customer Center uses *shared data*. Shared data allows one page to access data from another page, or for one page to broadcast data changes to other pages by using data registration.

Pages in the wizard can use the shared data in a request-based or broadcast-based manner:

- **Request-based shared data.** When a user switches to a page, the page can retrieve the shared data.
- **broadcast-based data sharing.** If a page must be notified when a piece of data (such as the primary and secondary currency) changes, it can register for notification with the shared data manager.

Each wizard has a context that can be retrieved from the main

**CustomerCenterContext**. Only one wizard can be active at any given time so the **getWizardContext()** method can be used to access the active wizard. If it is null, a wizard is not currently active. From the wizard context, you can access the **SharedDataManager**. Use this class if you are interested in registering for notification of data changes, or simply to access the shared data object itself.

You do not need to write a page if you want to tap into the shared data mechanism. See the **AcctCreationTapNonGUI.java** example in the **CCSDK\_Home/CustomerCareSDK/CustCntrExamples/AccountCreation** directory. This example demonstrates how to retrieve shared data when starting the wizard.

### Partial validation

The New Account wizard performs partial validation on all pages contained within it. Data is sent to BRM on a per-page basis as the user moves between pages. This mechanism catches CSR data entry errors. Each page within the wizard validates its own data and identifies any errors encountered while validating and saving the data in BRM.

When the user attempts to leave a page, the page's **validateWizardPage()** method is called. This signals the page to gather its data and send it to BRM for validation. A number of convenience methods that assist in performing validation are available in the **WizardValidationManager**.

---



---

**Note:** The **WizardValidationManager** is available through the wizard context.

---



---

For example, if a page doesn't have any special validation needs of its own, it can immediately call the **validatePage API** on the **WizardValidationManager**. This method performs default data collection on the wizard page, invokes the **CUST\_VALIDATE\_CUSTOMER** opcode in BRM, and performs default error handling when if validation fails. Alternatively, the page can collect its own data and, perhaps after examining it, call the convenience method **validateModel** on the **WizardValidationManager**. This method invokes the **CUST\_VALIDATE\_CUSTOMER** opcode and, if validation failed, hands an error data structure back to the page. The page can then pass the error information to an API in the **SaveManager** that attempts to identify the field(s) that caused the error.

Pages can be coded to perform data validation and any error determination itself without using the **WizardValidationManager**, the **SaveManager**, or even without calling an **opcode**.

If an error results when the user clicks **Finish** to create a new account based upon the entered data, the wizard can call the **handleWizardCommitError** method on each wizard page successively until a page reports back that it wants to handle the error. That page is then made visible. To handle the error, the page could then:

- Call a convenience method on the **WizardValidationManager** to get the default commit-time error handling behavior.
- Use the **SaveManager** method mentioned above to try and identify any fields that were responsible for the error.
- Perform its own analysis of the error data.

### Base Classes for Account Creation Pages

You can start with any base class you want when creating your account creation page.

---

---

**Tip:** Customer Center SDK does not include a base class for adding account creation pages. However, you can optionally use **PMaintenancePage** class described in "[Adding Account Maintenance Pages](#)", especially if you want to use the same page as a tab during account maintenance.

---

---

### Methods Used in New Account Creation Pages

These methods are used for account creation panels:

- **getWizardHelpID():** Use this method to add custom help to your page. Include the empty string ("") if you are not including customized help.
- **recycle():** Pages in the new accounts wizard are reused between accounts. In this method, clear out all data you set manually so data from one account doesn't accidentally appear when displaying the next account.
- **validateWizardPage():** This method is called as the user leaves your page in the New Account wizard. It includes a hook to validate any data the user has entered. Since your page is custom, determine if BRM can validate your page or if you must validate it manually.

If you have modified BRM policy code to validate your page, the following code may be useful:

```
CustomerCenterContext ctx = CCompatibilityUtility.getCustomerCenterContext();
if (ctx.getWizardContext() instanceof PAccountCreationWizardContext) {
    PAccountCreationWizardContext wizContext =
        PAccountCreationWizardContext) ctx.getWizardContext();
    WizardValidationManager wizValidation =
        wizContext.getWizardValidationManager();
    wizValidation.validatePage();
}
```

This code utilizes the convenience class **WizardValidationManager** to handle validation. However, your page must use the BAS PIA widget set to take full advantage of this mechanism.

- **handleWizardCommitError():** This method is called when the user attempts to create the account and an error occurs. A data structure is passed in containing a description of the error. Return **true** if the error actually occurs on your page. If the error is not yours, return **false**. When you return **true**, the wizard framework automatically takes the user to your page.

---



---

**Tip:** Visually indicate to the user which field is causing the error. If you are using the BAS PIA widgets, the following code might be useful:

---



---

```
public boolean handleWizardCommitError(CustomerError error) {
    CustomerCenterContext ctx = CCCompatibilityUtility.getCustomerCenterContext();
    if (ctx.getWizardContext() instanceof PAccountCreationWizardContext) {
        PAccountCreationWizardContext wizContext = (PAccountCreationWizardContext)
            ctx.getWizardContext();
        WizardValidationManager wizValidation =
            wizContext.getWizardValidationManager();
        return wizValidation.handleCommitError(error, this);
    } else {
        return false;
    }
}
```

## Removing a Payment Method from Customer Center

Removing a payment method prevents it from appearing in the Account Creation wizard, the **Payments** section, the **Hierarchy** section, the **Purchase** wizard, and dialog boxes.

---



---

**Note:** Testing and maintaining customized code is your responsibility.

---



---

To remove a payment method from Customer Center:

1. Open the `CCSDK_Home/CustCntr/custom/Customized.properties` file in a text editor.
2. Add the following after the comment statements:

```
custinfo.payment.class=com.portal.custom.PCustomPaymentPage
Customized.hierarchyMoveDlg.class=com.portal.custom.PCustomHierarchyMoveDlg
com.portal.app.ccare.comp.PPaymentPanelBeanImpl.subclass=com.portal.custom.PCus
tomPaymentPanelBeanImpl
Customized.BillUnitHierarchyPage.class=com.portal.custom.PCustomBillUnitHierpag
e.
```

3. Create a `com.portal.custom.PCustomPaymentPage` that contains the following:

```
package com.portal.custom;
.
import com.portal.app.cc.PPaymentPage;
import java.util.Vector;
.
public class PCustomPaymentPage extends PPaymentPage{
    public PCustomPaymentPage(){
        super();
    }
    public Vector getPayMethods () {
        Vector vec = super.getPayMethods();

        //Remove the entry for bad payment method from the vector and return

        return vec;
    }
}
```

```
    }  
}
```

4. Create a `com.portal.custom.CustomHierarchyMoveDlg` page that contains the following:

```
package com.portal.custom;  
.  
import com.portal.app.cc.PHierarchyMoveConfirmDlg  
import java.util.Vector;  
.  
import javax.swing.JFrame;  
.  
public class PCustomHierarchyMoveDlg extends PHierarchyMoveConfirmDlg {  
.  
    public PCustomHierarchyMoveDlg(JFrame frame, String title, boolean modal)  
{  
        super(frame, title, modal);  
        // TODO Auto-generated constructor stub  
    }  
.  
    public Vector getPayMethods() {  
        Vector vec = super.getPayMethods();  
        //Remove the entry for the bad payment method from the vector  
        //and return  
        return vec;  
    }  
}
```

5. Create a `com.portal.custom.PCustomPaymentPanelBeanImpl` page that contains the following:

```
package com.portal.custom;  
.  
import com.portal.app.cc.BalanceGroupTreeTable;  
import com.portal.app.cc.PPayType;  
import com.portal.app.ccare.comp.PPaymentPanelBeanImpl;  
import java.util.Iterator;  
import java.util.Vector;  
.  
public class PCustomPaymentPanelBeanImpl extends PPaymentPanelBeanImpl {  
.  
    public PCustomPaymentPanelBeanImpl() {  
        super();  
    }  
.  
    public void refreshPaymentMethodModel(BalanceGroupTreeTable  
balanceTreeTable) {  
        super.refreshPaymentMethodModel(balanceTreeTable);  
        Vector payMethod = getPayMethod();  
        //Remove the entry for the bad payment method from the vector  
        //and return  
.  
        setPayMethod(payMethod);  
.  
    }  
.  
    public Vector getPayTypes() {  
        Vector list = super.getPayTypes();  
        int i = 0;  
        int index = -1;
```

```

//Remove the entry for the bad payment method from the vector
//and return
.
for (Iterator iterator = list.iterator(); iterator.hasNext();) {
    PPayType str = (PPayType) iterator.next();
    if (str.getPayTypeName().equals("BadPaymentMethod")) {
        index = i;
    }
    i++;
}
if (index != -1) {
    list.remove(index);
}
return list;
}
}

```

6. Build the custom .jar file and deploy this customization.
7. Restart Customer Center.

## Advanced Customer Center Concepts

This section describes these Customer Center concepts:

- [Components Used in Customer Center](#)
- [About the BAS Data Flow with a Swing-Compatible UI](#)
- [About Field Specifications](#)
- [About Controller Processing](#)
- [Creating a Self-Signed Java Security Certificate](#)

For information on the Business Application SDK (BAS) framework used by Customer Center and Self-Care Manager, see "[Understanding the BRM Business Application SDK Framework](#)".

## Components Used in Customer Center

This section describes the main Portal Infranet-aware (PIA) components used in Customer Center, including "[Graphical Components](#)", "[Nongraphical Components](#)", and "[Data Manager Components](#)".

### Portal Infranet-Aware Components

The Customer Center framework includes Portal Infranet-aware (PIA) components. These components, or widgets, are extensions to their corresponding Swing components and have references to specific storable class fields. They contain APIs that allow you to map them to specific fields in BRM storable classes, such as `/account`. PIA components have implementations that allow individual components to encapsulate data retrieval and user interface (UI) display.

---

**Note:** Customer Center SDK also includes basic components, such as links, headers, and dates that are useful in accounting and billing applications.

---

Customer Center consists of panels that display PIA components. These components can be made aware of specific BRM storable class fields. They can perform all the tasks required to retrieve, display, and save BRM data; so when you add a field or change the properties of a panel, you do not have to implement server functionality to communicate with BRM.

The Customer Center framework includes classes for graphical and nongraphical components as well as classes for managing changes made to the components during a login session.

The following sections describe the main components in the framework. For detailed information about the methods and API used, see *Customer Care API Reference*.

## Graphical Components

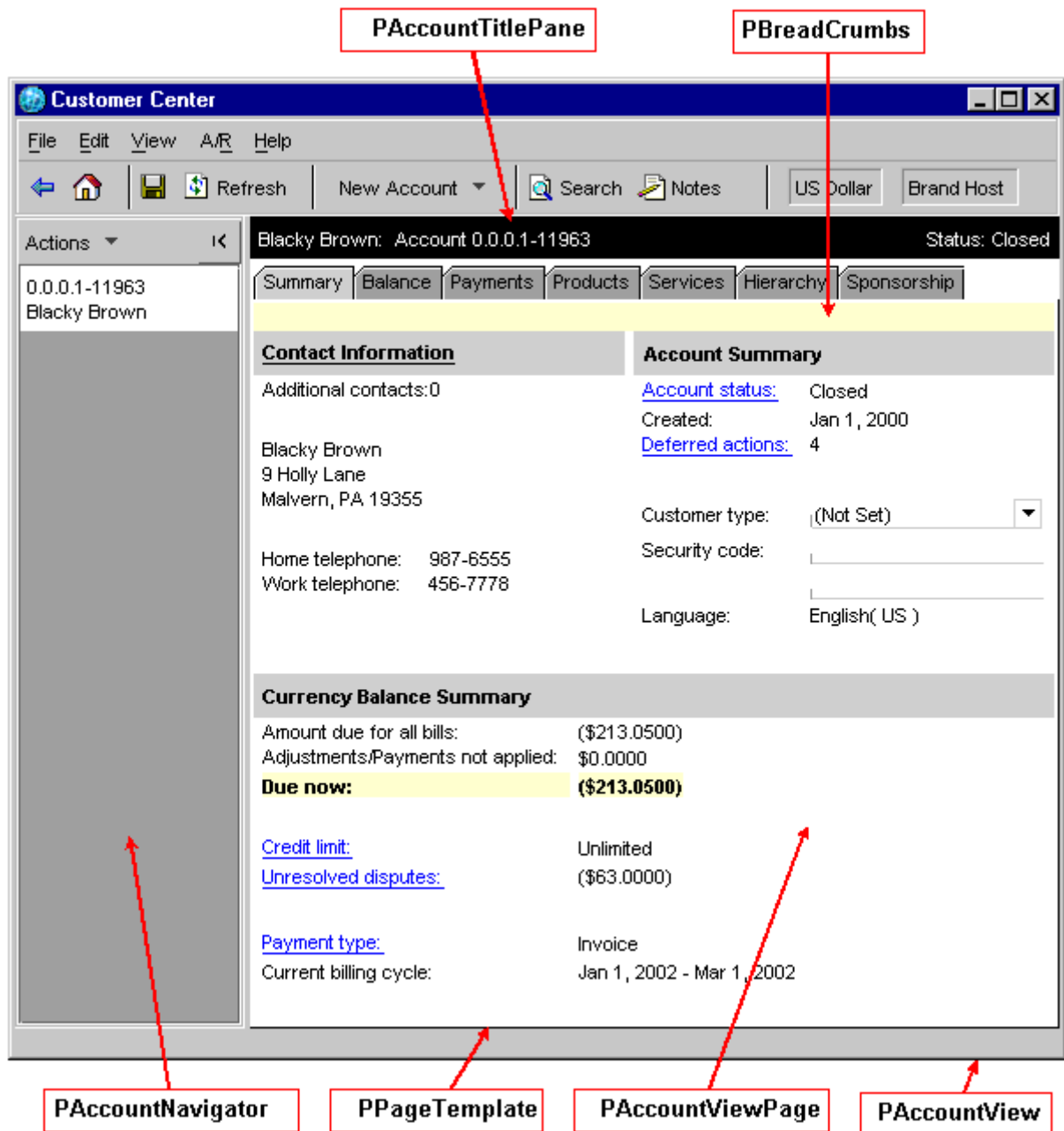
The Java classes in [Table 34–3](#) comprise the main Customer Center graphical components:

**Table 34–3 Customer Center Graphical Components**

| Component                    | Description  |
|------------------------------|--|
| <b>PAccountNavigator</b>     | A columnar component that displays a list of open accounts. As the CSR opens accounts, they are added to this graphical list with the most recently opened account at the top. This component also provides the capability of closing accounts and removing them from view in Customer Center.   |
| <b>PBreadCrumbs</b>          | Displays a visual history of the various data screens the CSR has visited within a single tab. The history is presented as selectable links.<br><b>Note:</b> Each account is displayed in a tabbed pane component, and each tab can have any number of virtual screens. This means it is possible to stay within the same visual tab and view many different screens.  |
| <b>PPageTemplate</b>         | The main component found on each tab in the account view. It contains the <b>PBreadCrumbs</b> component along the top, and a Business Application SDK (BAS) <b>PIAPanelGroup</b> component below that. The <b>PIAPanelGroup</b> enables the virtual tabs feature of the client by providing a mechanism for embedding a number of screens on top of each other while displaying only a single screen at any one time. The <b>PPageTemplate</b> hooks the <b>PBreadCrumbs</b> and <b>PIAPanelGroup</b> components together. This allows the <b>PBreadCrumbs</b> component to determine which screen is displayed in the <b>PIAPanelGroup</b> . The <b>PMaintenancePage</b> subclass you create exists within the <b>PPageTemplate</b> on a given tab.   |
| <b>PAccountView</b>          | Provides the concrete implementation of <b>PAccountViewContext</b> in Customer Center. This is implemented as a tabbed pane component, with each tab containing a <b>PPageTemplate</b> component.  |
| <b>PActiveAccountManager</b> | Responsible for managing the components that display account data. Like the <b>PPageTemplate</b> component, it uses a <b>PIAPanelGroup</b> to manage the display of <b>PAccountView</b> components. Each time a new account is opened in Customer Center, <b>PActiveAccountManager</b> delivers a <b>PAccountView</b> component that can be used to display the account's data. As the user switches between open accounts, the <b>PActiveAccountManager</b> tracks those changes and displays the appropriate <b>PAccountView</b> . As accounts are closed in the client, the associated <b>PAccountView</b> component is removed from the panel group.<br><br>Essentially, this component manages a stack of tabbed panes with only the active one visible. It takes up all the space to the right of the <b>PAccountNavigator</b> . |

[Figure 34–1](#) shows the areas of the interface that some graphical components control:

Figure 34–1 Customer Center Graphical Components



### Nongraphical Components

The Java classes in Table 34–4 comprise the main Customer Center nongraphical components:

**Table 34–4 Nongraphical Components**

| Component                     | Description  |
|-------------------------------|--|
| <b>PCustomerCenterContext</b> | <p>Provides a context for standalone Javabeen components within Customer Center.</p> <p>Components can use this context to:</p> <ul style="list-style-type: none"> <li>▪ Open and close accounts</li> <li>▪ Register for notification when accounts are opened or closed</li> <li>▪ Access the global data managers: <b>PBrandManager</b>, <b>PCurrencyManager</b>, <b>PSaveManager</b>, and <b>PrintManager</b></li> <li>▪ Retrieve a model handle to the currently active account or its context. Each open account contains a further set of API encapsulated in <b>PAccountViewContext</b>.</li> </ul> |
| <b>PAccountViewContext</b>    | <p>A context which abstracts the mechanism used to display existing account data.</p> <p>This context encapsulates the API for enabling drill-downs in the client and accessing the account's <b>PRefreshManager</b>.</p> <p>By default, Customer Center uses a tabbed pane component. You can implement the <b>PAccountViewContext</b> API to use a different type of component.</p>  |
| <b>PMaintenancePage</b>       | <p>A concrete implementation of the base page interfaces used for account maintenance.</p> <p>This component implements <b>PAccountViewPage</b> which extends <b>PCCPage</b>. If you are building a new page, you should subclass <b>PMaintenancePage</b>.</p>   |
| <b>PAccountInfo</b>           | <p>A data class instance that exists for every open account in Customer Center. The data can be retrieved from the <b>PCustomerCenterContext</b>. This data class contains information about an account. When an account is opened, this data is retrieved and made available for all components. It can be marked for refresh if data contained in the class has been modified and then refreshed from BRM using an API call.</p>   |

### Data Manager Components

The Java classes in [Table 34–5](#) comprise the main Customer Center data manager components:

**Table 34–5 Data Manager Components**

| Component            | Description   |
|----------------------|---|
| <b>PBrandManager</b> | <p>Encapsulates the management of and access to the current BRM scope. Used to determine what the current scope is or when the scope changes.</p> <p>This class also contains an API for determining account scope.</p> |



**Table 34–5 (Cont.) Data Manager Components**

| Component               | Description   |
|-------------------------|---|
| <b>PCurrencyManager</b> | Encapsulates management and notification for currency changes. This is useful if the accounts in the system use multiple currencies. Most pages do not need to use this class. If you follow the suggestions for currency toggling described in " <a href="#">Currency Toggling</a> ", the framework handles currency toggling automatically.   |
| <b>PSaveManager</b>     | Encapsulates functionality for saving data and identifying errors in a page. It also contains the logic for determining whether the CSR should be prompted before data is saved.  |
| <b>PRefreshManager</b>  | Encapsulates data synchronization across an account view. Use this class to register for notification of data changes or to broadcast data changes to other registered pages.<br><br><b>Note:</b> Each account view is recycled when it is closed and a new refresh manager is created each time an account is opened. This means that a page must register or unregister with the refresh manager each time. See the <a href="#">RefreshTest.java</a> example and look specifically at the <code>addNotify()</code> and <code>removeNotify()</code> methods. |

## About the BAS Data Flow with a Swing-Compatible UI

**PModelHandle** is a client-side representation of an flist. Because UI code typically does not directly access the PCM library, BAS creates this object for client use.

**PModelHandle** is turned into a real flist on the server for use in opcodes. A

**PModelHandle**, like an flist, can also represent storable classes. So it is possible to have a **PModelHandle** that represents an account or an event.

Every BAS widget (the PIA widgets) has a `setModelHandle` method. This is how data is passed in to the component. For the container PIA widgets (panel, scroll pane, and tabbed pane) the `setModelHandle` method automatically propagates the **PModelHandle** to all child components. For example, if you have a **PIACustomizablePanel** with ten **PIATextField** components on the panel, one call to `setModelHandle` on the panel is enough to set the **PModelHandle** for all ten **PIATextField** components.

To get data out of the PIA widgets, BAS uses the `collectData` method. Essentially, you create an **UNYPED PModelHandle** from scratch and hand that to a new **PCollectDataEvent**. This event is passed into `collectData`, which is available on every PIA widget.

Regardless of the type of data collection (you can create many different types of **PCollectDataEvent**), each PIA widget properly updates the **PModelHandle** passed in with the event. For example, to gather all data modified by a user you could issue a **PCollectDataEvent** of type **FOR\_DIRTY**. Only the modified PIA widgets would append their data to the **PModelHandle** that is passed in. This would happen automatically by calling `collectData` on the encompassing panel.

## About Field Specifications

Each PIA widget contains two methods that bind the widget to a specific field in BRM. These widgets enable the `setModelHandle` and `collectData` methods to work.

- **setDisplayFieldDescription:** This method is a read data mechanism. When `setModelHandle` is called on a widget, the widget internally attempts to extract the BRM field identified by the `setDisplayFieldDescription` specification from the associated **PModelHandle**.

For example, if a widget is passed a **PModelHandle** that represents an account object and a text field has a display field description of **FldNameinfo[1].FldLastName**, the text field can automatically extract the value of **FldLastName** from the **PModelHandle** and display it.

- **setModelFieldDescription**: This method is a write data mechanism. It performs the reverse function provided by **setDisplayFieldDescription**. This specification indicates how to write a particular piece of data to BRM. It is a **String** representation of what the input flist to an opcode looks like.

In the last name example above, the model field description for storing the last name is identical to the display field description. However, that is a rare case, since most fields in BRM are read from an flist in one format, but passed in an input flist to an opcode in a different format.

## About Controller Processing

The previous sections describe how data goes into a panel, and how it is extracted from that panel. If you need to perform additional data processing before your panel receives the data, use the controller for the panel. Each PIA widget contains the method **getControllerClassName**. This identifies the class name of the server-side component (controller) for your panel.

When **setModelHandle** is called on the panel, the **update** method is invoked remotely on the controller. This happens before any widget contained in the panel receives the data. If any type of conversion, lookup, or translation of data needs to occur before passing the data along, this is how to do it.

## Building Your Customer Center Customizations

To build your Customer Center customizations, follow these steps:

1. [Creating a Self-Signed Java Security Certificate](#)
2. [Building Your Customization Files](#)
3. [Testing Your Customizations](#)

### Creating a Self-Signed Java Security Certificate

If you do not have an authenticated security certificate or do not want to use it for testing your customizations, use the **makecertificate** script to create a self-signed certificate.

---

---

**Important:** The certificate created by the **makecertificate** script is not a validated, secure certificate. It is not an appropriate certificate to copy to the Web server you use to deploy Customer Center to your CSRs. Its use is limited to internal testing environments.

---

---

1. Run the **makecertificate** script, located in the *CCSDK\_Home/CustCntr/bin* directory.
2. Answer the following prompts as they appear, or press ENTER to accept the default entries displayed in brackets:

```
Enter keystore password: yourPassword
What is your first and last name?
[Unknown]: yourFirstName yourLastName
```

What is the name of your organizational unit?  
 [Unknown]: *yourUnitName*  
 What is the name of your organization?  
 [Unknown]: *yourOrganizationName*  
 What is the name of your City or Locality?  
 [Unknown]: *yourCity\_or\_Locality*  
 What is the name of your State or Province?  
 [Unknown]: *yourState\_or\_Province*  
 What is the two-letter country code for this unit?  
 [Unknown]: *yourCountryCode*

3. When prompted to verify whether the entries you made are correct, type **yes** or press ENTER to verify or change the entries you made after the keystore password.

If you accept the default answer, **no**, the script redisplay each of the prompts with your answers listed as the default entry in brackets. You can enter a new value or press ENTER to keep the current values.

4. After you verify that your entries are correct, the script composes a certificate and then prompts you to enter a key password for the test certificate's alias, **customcert**. Enter a different password or press ENTER to reuse the keystore's password.
5. The certificate is stored in a keystore file named **certificate\_keystore** in the *CCSDK\_Home/bin* directory.

### Modifying the signjar Script

Before running the **buildAll** script to build and sign the **ccCustom.jar** file for Customer Center, first edit the *CCSDK\_Home/CustomCareSDK/CustCntr/custom/signjar* script to add your entries for the following values:

- set **KEYPASSWORD**=*yourPassword*
- set **STOREPASSWORD**=*yourPassword*

If you created a self-signed certificate with the **makecertificate** script, use the password values you entered to create that certificate.

If you have an authentic Java Security Certificate, use the password values associated with that certificate. Copy your certificate keystore file to the **custom** directory.

## Building Your Customization Files

You use the **buildAll** script in the *CCSDK\_Home/CustomCareSDK* directory to build your customized files.

### Requirements

Before using the **buildAll** script, verify that:

- The appropriate entries are in the **.properties** files. See:
  - [Using Configurator](#)
  - [Modifying the Customer Center Properties Files](#).
- If you have customized help, the **ccCustomHelp\_en.jar** file is generated and in the *CCSDK\_Home/CustCntr/custom* directory.  
 See "[Customizing the Customer Center Help System](#)".

- If you created custom source to extend Customer Center, the source files are in the `CCSDK_Home/CustomCareSDK/CustCntr/custom` directory.
- Your `certificate_keystore` file is in the `CCSDK_Home/CustomCareSDK/CustCntr/custom` directory.  
See ["Creating a Self-Signed Java Security Certificate"](#).

### Using the `buildAll` Script

To build the `ccCustom.jar` file for Customer Center:

1. Open a command shell and go to `CCSDK_Home/CustomCareSDK/lib`.
2. Run the `buildAll` script:
  - a. To remove class files from any previous custom builds:  

```
buildAll CustCntr clean
```
  - b. To build a new copy of the `ccCustom.jar` file:  

```
buildAll CustCntr
```

---

---

**Note:** For more information on the `buildAll` script, see ["About Compiling and Packaging Your Customizations"](#) and ["Syntax for the buildAll Script"](#).

---

---

When the `buildAll` script finishes, you can deploy your Customer Center customizations. See ["Deploying Your Customer Center Customizations"](#).

## Testing Your Customizations

You can test your customizations before you deploy them by running your local version of Customer Center (the `runCustomerCenter` batch file) in the `CCSDK_Home/CustomCareSDK/CustCntr/bin` directory.

---

---

**Note:** The local version of Customer Center does not require access to the Customer Center Web Start server, but it does require access to a CM.

---

---

1. If you are adding custom fields, add `ccCustomFields.jar` to the CLASSPATH as in this example:  

```
set CLASSPATH=f:/CCSDK_Home/CustCntr/custom/ccCustomFields.jar;%CLASSPATH%
```
2. If you are adding customized help, add the `ccCustomHelp_en.jar` to the CLASSPATH.  
See ["Customizing the Customer Center Help System"](#).
3. Go to the `CCSDK_Home/CustomCareSDK/CustCntr/bin` directory.
4. Double-click the `runCustomerCenter` batch file.  
Your local version of Customer Center starts.
5. Log in to Customer Center when prompted.

---



---

**Note:** You must specify the host and port of a working BRM system when logging in.

---



---

6. Verify that your customizations appear and work properly in the Customer Center.
7. Close Customer Center.

---



---

**Note:** In the "[Building Your Customization Files](#)" procedure, you can use `runCustomerCenter` to test your customizations without building `jar` files if:

- You are making customizations with Configurator or by editing the customizes properties files, *and*
  - You are *not* adding new fields, panels, or customized help.
- 
- 

## Deploying Your Customer Center Customizations

This section describes how to deploy your Customer Center customizations.

### Deploying Customer Center Customizations on UNIX

This section describes how to deploy your customizations to the Web Start server.

1. Create a new subdirectory named `custom` in the directory where you installed Customer Center on your Web server.
2. Make a backup copy of the `CustomerCenter_en.jnlp` file on your Web server.
3. Edit the `CustomerCenter_en.jnlp` file in the directory where you installed Customer Center and remove the comments around the following line if they are present:

```
<!-- <extension name="Customized" href="custom/custom.jnlp"/> -->
```

4. Copy the `custom.jnlp` and, if present, `ccCustomFields.jar` files from the `CCSDK_Home/custom` directory to the directory where you installed Customer Center on your Web server.
5. Copy the `ccCustom.jar` and, if present, the `ccCustomHelp.jar` files from the `CCSDK_Home/custom` directory to the `custom` directory where you installed Customer Center on your Web server.

The next time a CSR accesses the link that opens the `CustomerCenter_en.jnlp` file from your Web server, Web Start installs the updated application to their system.

For more information on Web Start, see "Installing Java Web Start and Downloading Customer Center" in *BRM Installation Guide*.

## About the Customer Center Properties Files

Customer Center SDK includes three sets of properties files that define the Customer Center interface:

- [Default Properties Files](#)
- [Configurator Properties Files](#)

- [Customized Properties Files](#)

Parameters in the Configurator properties files take precedence over like parameters in the default properties files. Parameters in the customized properties files take precedence over like parameters in the default and Configurator properties files.

## Default Properties Files

The *CCSDK\_Home/CustomerCareSDK/CustCntr/Settings* directory contains copies of properties files shipped with Customer Center. The two files that define the default interface are:

- **CustomerCenter.properties** defines several non-text features of the Customer Center UI, for example:
  - The order of panes in the New Account wizard
  - The Account Maintenance view
  - Which threshold settings to use
  - The home page to use when no accounts are open
  - The search entry page to use
  - The color and font used by the fields
  - The number and sequence of panels in a window or wizard
- **CustomerCenterResources.properties** contains the names of images and the localizable text for the panels, fields, and messages that appear in the UI.

These properties files are shipped in signed **jar** files that are installed with Customer Center and can't be directly modified.

---

---

**Important:** Do not modify these or any other properties files under the **CustCntr/Settings** directory. Customer Center uses these in **jar** files that are signed with an authentic security certificate from BRM. If you directly modify these files and attempt to include them in a custom **jar** file signed with a different certificate, Web Start returns an error. To change a property or string, copy it to the **Customized.properties** or **CustomizedResources.properties** files.

---

---

## Configurator Properties Files

When you save changes you make in Configurator, the parameters are saved in the **WizardCustomizations.properties** and **WizardCustomizationsResources.properties** properties files in the *BRM\_Home/CustomerCareSDK/CustCntr/bin* directory, where *BRM\_Home* is the directory in which you installed BRM components.

Parameters in the Configurator properties files take precedence over like parameters in the default properties files.

---

---

**Important:** Do not directly modify or add entries to the **WizardCustomizations** files. These files are rewritten every time you save Configurator changes.

---

---

## Customized Properties Files

The `CCSDK_Home/CustomCareSDK/CustCntr/custom` directory contains the following files for overriding the default properties defined in the installed Customer Center properties files:

- **Customized.properties** modifies the appearance of the UI components in Customer Center.
- **CustomizedResources.properties** modifies the names of images and localizable text that appear in Customer Center.

Use these properties files to make global changes that affect the whole application or several related fields in an application.

The parameter values in the customized properties files take precedence over like parameter values in the default and Configurator properties files.

For examples of customizations you can make by modifying the customized properties files, see ["Modifying the Customer Center Properties Files"](#).

For more information on the properties files parameters, see the comments in the ["Default Properties Files"](#).

---



---

**Tip:** You can copy and paste default parameters from the ["Default Properties Files"](#) into their ["Customized Properties Files"](#) counterparts and change the parameter values as required.

---



---

## Other Properties Files

Customer Center SDK includes these additional properties files in the `CCSDK_Home/CustomCareSDK/CustCntr/Settings` directory:

- **CCViewResources.properties** contains additional strings used in Customer Center, such as warning messages.
- **GSMManagerResources.properties** contains the names of images and the localizable text for GSM Manager panels that display extended service information. This property file is only valid when the GSM Manager Customer Center Extension is installed.

---



---

**Important:** Do not change entries directly in these resource files. Instead, copy the entry to the **CustomizedResources.properties** file and change the parameter as required. Parameters found in the **CustomizedResources.properties** file takes precedence over the value in the same parameter in the **CCViewResources.properties** and **GSMManagerResources.properties** files.

---



---

The `CCSDK_Home/CustomCareSDK/CustCntr/bin/Infranet.properties` file provides specific server settings for starting the Configurator application or for using the `runCustomerCenter` script to start a standalone Customer Center session.

## Deploying Customer Center Customizations on Windows

This section describes how to deploy your customizations to the Tomcat server.

1. Copy the certificate keystore file (by default at `CCSDK_Home/CustomCareSDK/CustCntr/bin`) to `Tomcat_`

*home\webapps\ROOT\customercenter*, where *Tomcat\_home* is the directory in which you installed the Apache Tomcat software.

2. Copy the **signjar.bat** file from *CCSDK\_Home\CustomerCareSDK\CustCntr/custom* to *Tomcat\_home\webapps\ROOT\customercenter\lib*.
3. Edit the **signjar.bat** file and enter the password:

```
set KEYPASSWORD= password
set STOREPASSWORD= password
where password refers to the keystore password
```
4. Go to *Tomcat\_home\webapps\ROOT\customercenter\lib*.
5. Using an application such as WinZip, open all the **.jar** files and remove the **Business.sf** and **Business.rsa** files from the archive.
6. Copy the **ccCustomjar** file from *CCSDK\_Home\CustomerCareSDK\lib* to *Tomcat\_home\Webapps\ROOT\customercenter\lib*.
7. Go to *Tomcat\_home\webapps\ROOT\customercenter\lib*.
8. Run the following command, which signs all the JAR files:

```
signjarbat jarFileName
```
9. Open the *CCSDK\_Home\CustCntr/custom\CustomerCenter\_en.jnlp* file and add the path to the **ccCustomjar** file in the **Resources** area. Replace **<-NEWJAR- />** with the following:

```
<jar href="lib/ccCustomjar.jar" />
```

## Customer Center Customization Examples

When you install Customer Center SDK, separate folders with the appropriate source and support files provide examples for extending Customer Center and Self-Care Manager. Many of the example folders include brief README files to explain the purpose of each example.

You can execute many of the examples in place by using the **testExamples.bat** script.

[Table 34–6](#) describes the Customer Center extension examples in the *CCSDK\_home\CustomerCenterSDK\CustCntrExcamples* directory. Read the **readme.txt** files and the comments in the source files of each example for further information on their functionality and how to use them for creating your own customizations.



Table 34–6 Customer Center Extension Examples

| Directory              | Contents  |
|------------------------|---|
| <b>AccountCreation</b> | <p><b>AccountCreation.ipl</b>, a BRM price list file used by the examples in this directory. To see the contents of this file, open it in Pricing Center.</p> <p><b>AcctCreationTapNonGUI.java</b>, an example that demonstrates how you might use the New Account wizard without adding a panel to the UI.</p> <p><b>CredScoreProfile.java</b>, an example of tapping into the New Account wizard with a custom page. A panel for a new profile subclass is added, which simulates the retrieval of a credit score that determines which plans are available for purchase.</p> <p><b>CreditScoreProfile.sce</b>, a BRM storable class definition file, which defines a sample object used by the examples in this directory. To see the contents of this file, use Storable Class Editor.</p> <p><b>Customized.properties</b>, a collection of properties required for implementing these examples in the Customer Center UI. To implement customizations, you copy and paste these entries into the <b>Customized.properties</b> file in <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory.</p> <p><b>CustomizedResources.properties</b>, a collection of resource properties required for implementing these examples in the Customer Center UI. To implement customizations, you copy and paste these entries into the <b>CustomizedResources.properties</b> file in <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory.</p> <p><b>DepositSimulator.java</b> provides a simulated deposit requirement, represented as a set of checkboxes for a CSR to select.</p> <p><b>ManageFinishButton.java</b>, an example that demonstrates how you can control the <b>Finish</b> button in the New Account wizard.</p> |
| <b>Controllers</b>     | <p><b>ControllerTest.java</b>, an example of invoking methods on your controller. The controller for this class contains two methods that retrieve the number of service objects and profile objects associated with the current account.</p> <p><b>ControllerTestBeanImpl</b>, an example of a controller that can be used in Customer Center.</p>   |
| <b>General</b>         | <p><b>Customized.properties</b>, a collection of properties required for implementing these examples in the Customer Center UI. To implement customizations, you copy and paste these entries into the <b>Customized.properties</b> file in <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory.</p> <p><b>CustomizedResources.properties</b>, a collection of resource properties required for implementing these examples in the Customer Center UI. To implement customizations, you copy and paste these entries into the <b>CustomizedResources.properties</b> file in <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory.</p> <p><b>DrillDownTest.java</b> contains a number of examples demonstrating how to perform drill downs using the Customer Center framework.</p> <p><b>PermissionTest.java</b> contains examples of how to retrieve CSR permissions.</p> <p><b>RefreshTest.java</b> contains examples of registering for refresh events.</p> <p><b>SaveTest.java</b> contains an example of saving data to BRM. It also demonstrates how to use the PIA widget API and invoke a controller other than the default controller created for this panel.</p>   |
| <b>HomePage</b>        | <p><b>CustomHomePage</b>, an example of a branded Customer Center home page.</p> <p><b>Customized.properties</b>, a collection of properties required for implementing this example in the Customer Center UI. To implement customizations, you copy and paste these entries into the <b>Customized.properties</b> file in <code>CCSDK_Home/CustomCareSDK/CustCntr/custom</code> directory.</p> <p><b>LaunchBrowserPage</b>, a sample home page that demonstrates using the JNLP API to invoke the system browser.</p>  |

**Table 34–6 (Cont.) Customer Center Extension Examples**

| Directory | Contents   |
|-----------|--|
| Notes     | <p><b>Customized.properties</b>, a collection of properties required for implementing this example in the Customer Center UI. You copy and paste these entries into the <b>Customized.properties</b> file in <i>CCSDK_Home/CustomCareSDK/CustCntr/custom</i> directory before running the <b>buildAll</b> script.</p> <p><b>HTMLNotes.java</b> is an example of an alternate notes display.</p>  |
| Profile   | <p><b>CDProf.java</b>, a profile panel example that can be used during account creation and account maintenance. A very simple example that captures the birthday and gender of the account holder.</p> <p><b>CDProf.sce</b>, a BRM storable class definition file, which defines a sample object. This sample object is used by the CDprof example in this directory. To see the contents of this file, use Storable Class Editor.</p> <p><b>CombinedProfPage.java</b>, an example of profile panels for multiple <b>/profile</b> subclasses that are incorporated into one UI panel.</p> <p><b>CSPProf.java</b>, a profile panel example that can be used during account creation and account maintenance. This example captures the credit score.</p> <p><b>CSPProf.sce</b>, a BRM storable class definition file, which defines a sample object. This sample object is used by the CSPProf example in this directory. To see the contents of this file, use Storable Class Editor.</p> <p><b>ProfileTemplate.txt</b>, a template for an empty Profile panel. Use this template as a starting point for creating a profile panel for use with the New Account wizard and for account maintenance.</p> |
| Events    | <p>An example event displayer. You can use this generic code to retrieve and display most BRM events. This code also demonstrates how to export the displayed date to HTML.</p>  |
| Service   | <p><b>Customized.properties</b>, a collection of properties required for implementing this example in the Customer Center UI. You copy and paste these entries into the <b>Customized.properties</b> file in the <i>CCSDK_Home/CustomCareSDK/CustCntr/custom</i> directory before running the <b>buildAll</b> script.</p> <p><b>PEmailPanel.java</b>, an example of a service panel. The service object used for this example is <i>/service/email</i>.</p> <p><b>ServiceTemplate.txt</b>, a template for an empty extended-service panel. Use this template as a starting point for creating a panel for an extended service.</p> <p>The <b>PGPRSPanel</b>, <b>PGSMPanel</b>, <b>PMSEExchangeOrgPanel</b>, and <b>PMSEExchangeUserPanel</b> classes are additional examples of extended service panels.</p>   |
| Summary   | <p><b>AddToSummaryPage.java</b>, an example of embedding panels directly into the summary page.</p> <p><b>Customized.properties</b>, a collection of properties required for implementing these examples in the Customer Center UI. You copy and paste these entries into the <b>Customized.properties</b> file in the <i>CCSDK_Home/CustomCareSDK/CustCntr/custom</i> directory before running the <b>buildAll</b> script.</p> <p><b>CustomizedResources.properties</b>, a collection of resource properties required for implementing these examples in the Customer Center UI. You copy and paste these entries into the <b>CustomizedResources.properties</b> file in the <i>CCSDK_Home/CustomCareSDK/CustCntr/custom</i> directory before running the <b>buildAll</b> script.</p> <p><b>WrappedSummaryPage.java</b>, an example of wrapping the existing Customer Center summary page with additional information or fields at the bottom of the page.</p>  |

---

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# Using Configurator to Configure Customer Center

This section describes the Oracle Communications Billing and Revenue Management (BRM) Configurator application included with Customer Center Software Development Kit (SDK).

## About Configurator

You use Configurator to configure the most commonly modified features of Customer Center. The Configurator interface mimics the tab organization of the Customer Center interface, so you can easily locate the features you want to modify.

When you choose **File - Save** in Configurator, Configurator saves the changes to the **WizardCustomizations.properties** and **WizardCustomizationsResources.properties** configuration files in the *BRM\_Home/CustomCareSDK/CustCntr/bin* directory, where *BRM\_Home* is the directory in which you installed BRM components.

For an overview of all Customer Center properties files, see "[Modifying the Customer Center Properties Files](#)".

## Using Configurator

To use Configurator to configure Customer Center:

1. Go to the *CCSDK\_Home/CustomCareSDK/CustCntr/bin* directory.
2. Double-click the **runConfigurator** executable script.  
The Login dialog box appears.
3. Enter your login and password.

---

---

**Important:** To verify that you have full access to make changes across all brands, use either your BRM **root** account or another account that is allowed to change permissions. See "About Granting Access to Brands" in *BRM Managing Customers*.

---

---

4. Click the **Connection Info** button to display and, if needed, change the values for **Host** and **Port**. These entries are automatically filled in with the values you provided when you installed Customer Center SDK.

---



---

**Note:** You can enter values that point to a different BRM server or database after installing Customer Center SDK.

---



---

5. Click **OK**.

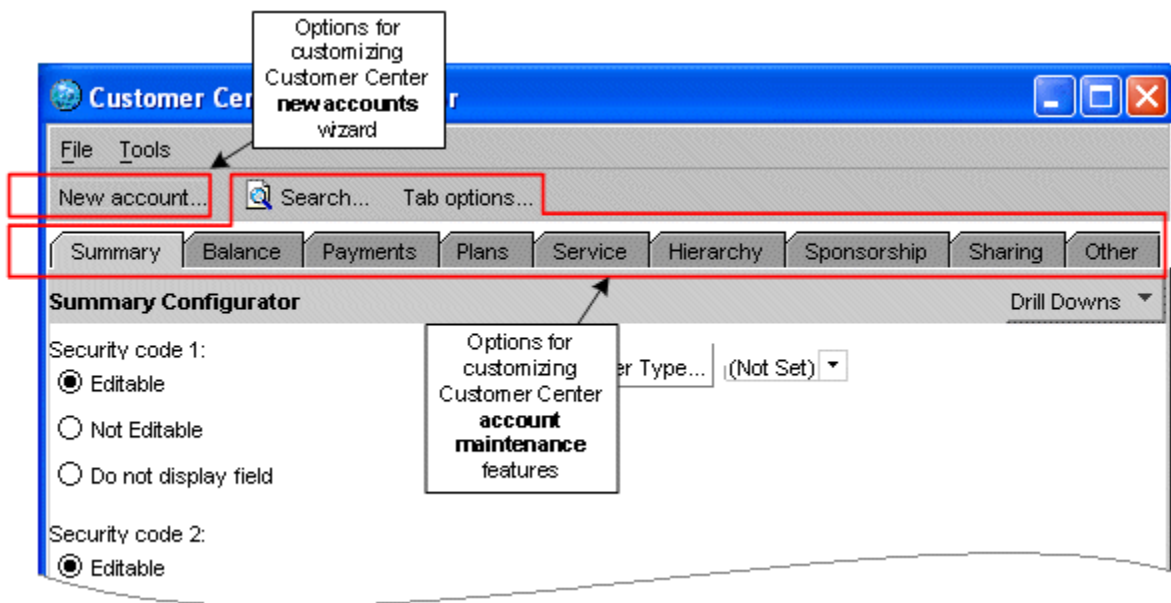
The Configurator application opens with the **Summary Configurator** tab on top.

6. Make your configurations:

- To configure Customer Center panels that handle changes to existing accounts, see "[Configuring Customer Center Account Maintenance Pages](#)".
- To configure Customer Center panels in the New accounts wizard, see "[Configuring the Customer Center New Accounts Wizard](#)".

Figure 35-1 shows where to find these options in the initial Configurator panel:

**Figure 35-1 Customer Center Configurator Panel**



7. Save your changes.

## What's Next?

Continue coding your configurations using other methods described in "[Customizing and Configuring Customer Center](#)", or proceed to "[Building Your Customer Center Customizations](#)".

## Configuring Customer Center Account Maintenance Pages

This section describes how to configure fields and pages used in Customer Center to display information about existing accounts.

### Using the Account Maintenance Configurator Tabs

The tabs and toolbar selections in Configurator mirror the ones found in Customer Center.

Table 35–1 lists the Configurator tab selection options for configuring the corresponding account maintenance items in Customer Center.

**Table 35–1 Configurator Account Maintenance Configurator Tab Selections**

| Configurator Account Maintenance Tab     | Tab Description  |
|--|--|
| <a href="#">Summary Configurator</a>     | Configures options in the <b>Customer Center Summary</b> tab                                 |
| <a href="#">Contacts Configurator</a>    | Configures options in the Customer Center Contacts drill-down area of the <b>Summary</b> tab |
| <a href="#">Balance Configurator</a>     | Configures options in the <b>Customer Center Balance</b> tab                                 |
| <a href="#">Payment Configurator</a>     | Configures options in the <b>Customer Center Payment</b> tab                                 |
| <a href="#">Plan Configurator</a>        | Configures options in the <b>Customer Center Plans</b> tab                                   |
| <a href="#">Service Configurator</a>     | Configures options in the <b>Customer Center Services</b> tab                                |
| <a href="#">Hierarchy Configurator</a>   | Configures options in the <b>Customer Center Hierarchy</b> tab                               |
| <a href="#">Sponsorship Configurator</a> | Configures options in the <b>Customer Center Sponsorship</b> tab                             |
| <a href="#">Sharing Configurator</a>     | Configures options in the <b>Customer Center Sharing</b> tab                                 |
| <a href="#">Other Settings</a>           | Handles configuration options that are not specific to a particular account maintenance tab  |

Table 35–2 shows the Configurator toolbar selection options for configuring the corresponding account maintenance items in Customer Center.

**Table 35–2 Configurator Account Maintenance Toolbar Selections**

| Account Maintenance Toolbar Selection               | Tab Description                                     |
|---|---|
| <a href="#">Account Search Results Configurator</a> | Configures the Customer Center account Search panel |
| <a href="#">Tab Options</a>                         | Configures the Customer Center tabbed pages         |

## Summary Configurator

Click the **Summary** tab to configure the fields and choices displayed on the Customer Center Summary page.

The **Drill Downs** menu on this tab displays two choices:

- Summary
- Contacts

Choose **Summary** to open the Summary Configurator, which displays the choices listed in [Table 35–3](#):

**Table 35–3 Summary Tab Items**

| Item                               | Summary Page Action   | Default   |
|------------------------------------|---|---|
| Security code 1                    | Select an option to set permissions for the first <b>Security code</b> field. <ul style="list-style-type: none"> <li>■ Editable</li> <li>■ Not editable</li> <li>■ Do not display field</li> </ul>  | Editable  |
| Security code 2                    | Select an option to set permissions for the second <b>Security code</b> field. <ul style="list-style-type: none"> <li>■ Editable</li> <li>■ Not editable</li> <li>■ Do not display field</li> </ul>   | Editable  |
| Deferred actions                   | Select or clear the option to display the <b>Deferred actions</b> field.  | Displayed   |
| Language (locale)                  | Select or clear the option to display the <b>Language</b> field.  | Displayed   |
| Dispute                            | Select or clear the option to display these dispute options: <ul style="list-style-type: none"> <li>■ <b>Unresolved Dispute</b> link on the Summary and Balance pages</li> <li>■ <b>Dispute</b> option in the <b>Type</b> drop-down list in the Search dialog box on the A/R Actions On All Bills page</li> <li>■ <b>Open Dispute</b> and <b>Settle Dispute</b> options on the Bill Details page</li> <li>■ <b>Open Dispute</b> and <b>Settle Dispute</b> options on the <b>Item Changes Action</b> menu</li> </ul> | Displayed   |
| Balance summary section            | Select or clear the option to display: <ul style="list-style-type: none"> <li>■ The Currency Balance Summary pane on the Summary page</li> <li>■ The Balance Summary pane on the Balance page.</li> </ul>   | Displayed   |
| Payment type                       | Select or clear the option to display the Billing Payment Method section of the <b>Payments</b> tab. <p><b>Note:</b> This option only affects the Payment page. It does not affect the Summary page.</p>  | Displayed   |
| Show service in change status list | Select or clear the option to display or hide the services in the <b>Account/service</b> drop-down list in the Change Account/Service Status panel in the <b>Summary</b> tab.   | Displayed   |
| Modify Customer Type               | Click Modify Customer Type to change the list of customer type options. See " <a href="#">Modifying the Customer Type List</a> ".   | <b>Default list:</b> <ul style="list-style-type: none"> <li>■ Bronze</li> <li>■ Silver</li> <li>■ Gold</li> <li>■ Platinum</li> </ul> |

## Modifying the Customer Type List

The **Summary** tab in Customer Center Configurator includes a **Modify Customer Type** button that allows you to modify the customer type pull-down list.

### Adding a customer type

To add a customer type to the selector pull-down list:

1. In the **Summary** tab, click **Modify Customer Type**.

The Modify Customer Type window appears:

2. Type a BRM value in the **Map the Infranet value** field.
3. Type a string to associate with the BRM value in the **To the string** field.

---

**Note:** The text in the **To the string** field will appear in the **Customer Type selector** pull-down list.

---

4. Click **Add**.

### Deleting a customer type

1. In the **Summary** tab, click **Modify Customer Type**.
2. Click the customer type you want to delete.
3. Click **Delete**.

## Contacts Configurator

Choose **Contacts** from the **Drill Downs** menu to open the Contacts Configurator.

The Contacts Configurator options shown in the following table affect the text entry fields displayed in the **Contact Information** drill down on the **Summary** page. If you remove a field from the display, the fields that follow it are moved up on the displayed pages.

To change only the fields displayed in the New Account wizard, click the **New account** toolbar button and access the Contact Configurator for the "[Configuring the Customer Center New Accounts Wizard](#)". Set the values for the items listed in [Table 35-4](#).

---

**Note:** The **Last name**, **Address**, and **Phone** fields cannot be removed.

---

**Table 35-4** *Contacts Configurator Items*

| Item        | Action   | Default   |
|-------------|--|-----------|
| Company     | Select or clear the option to display the <b>Company</b> field.        | Displayed |
| Job Title   | Select or clear the option to display the <b>Job title</b> field.      | Displayed |
| Salutation  | Select or clear the option to display the <b>Salutation</b> field.     | Displayed |
| First Name  | Select or clear the option to display the <b>First name</b> field.     | Displayed |
| Middle Name | Select or clear the option to display the <b>Middle name</b> field.    | Displayed |
| City        | Select or clear the option to display the <b>City</b> field.           | Displayed |
| State       | Select or clear the option to display the <b>State/Province</b> field. | Displayed |

**Table 35–4 (Cont.) Contacts Configurator Items**

| Item    | Action   | Default   |
|---------|--|-----------|
| Zip     | Select or clear the option to display the <b>ZIP/Postal</b> field. | Displayed |
| Country | Select or clear the option to display the <b>Country</b> field.    | Displayed |
| E-mail  | Select or clear the option to display the <b>Email</b> field.      | Displayed |

## Balance Configurator

Click the **Balance** tab to open the Balance Configurator. Use the Balance Configurator to configure the options (shown in [Table 35–5](#)) in the **Balance** tab of Customer Center:

**Table 35–5 Balance Configurator**

| Item   | Balance Panel Action   | Default  |
|--|--|--|
| Event browser                                  | Select or clear the option to display the <b>Event Browser</b> menu choice on the <b>Edit</b> menu.<br><b>Note:</b> This choice doesn't affect the <b>Event Adjustment</b> action.   | Displayed  |
| Refund   | Select or clear the option to display all of the following: <ul style="list-style-type: none"> <li>▪ <b>Refund Account</b> item on the <b>A/R</b> menu</li> <li>▪ <b>Refund Bill</b> item on the <b>Bills - Action</b> menu</li> </ul>   | Displayed  |
| Dispute  | Select or clear the option to display all of the following: <ul style="list-style-type: none"> <li>▪ <b>Unresolved Disputes</b> link on the Summary and Balance pages.</li> <li>▪ <b>Dispute</b> choice in the <b>Type</b> drop-down list in the <b>Search – A/R Actions</b> dialog box on the <b>A/R Actions On All Bills</b> page.</li> <li>▪ <b>Open Dispute</b> and <b>Settle Dispute Action</b> menu selections in the <b>Item Charges</b> panel on the <b>Bill Details</b> drill-down page.</li> </ul> | Displayed  |
| Write-off                                      | Select or clear the option to display the of the following: <ul style="list-style-type: none"> <li>▪ <b>Write Off Account</b> menu option on the <b>A/R</b> menu.</li> <li>▪ <b>Write Off Bill</b> item in the <b>Bills</b> section on the <b>Balance</b> page</li> <li>▪ <b>Write Off Bill</b> item in the <b>Item Charges - Action</b> menu on the <b>Bill Details</b> drill-down page.</li> </ul>   | Displayed  |
| Make "Include Child Amount" checkbox read only | Click the checkbox to enable or disable changing the selection of the <b>Include Child Accounts</b> checkbox.  | The <b>Include Child Accounts</b> checkbox choice can be modified. |
| Balance summary section                        | Select or clear the option to display the Balance Summary pane on the Balance page and the Currency Balance Summary pane on the Summary page.  | Displayed  |
| Noncurrency section                            | Select or clear the option to display the Noncurrency panel.   | Displayed  |



**Table 35–5 (Cont.) Balance Configurator**

| Item   | Balance Panel Action  | Default   |
|--|---|-----------|
| Account adjustment                               | Select or clear the option to display the <b>Account Adjustment</b> link on the Balance and Bill Details pages.   | Displayed |
| Item adjustment                                  | Select or clear the option to display the <b>Item Adjustment</b> choice in the <b>Action</b> menu in the Item Charges panel on the Bill Details drill-down page.  | Displayed |
| Event adjustment                                 | Select or clear the option to display the <b>Event Adjustment</b> choice in the <b>Action</b> menu in the following: <ul style="list-style-type: none"> <li>■ Bills panel on the Balance page</li> <li>■ Item Charges panel on the Bill Details page</li> </ul>   | Displayed |
| Disable View Invoice Button in Bill Details page | Select or clear the option to disable the <b>View Invoice</b> button in the <b>Bills</b> panel of the <b>Balance</b> tab.<br>By default, this option is not selected.   | Enabled   |
| Tax treatment                                    | Select the option to control whether the customer center representative (CSR) can choose the <b>Tax treatment</b> on the adjustment, dispute, and settlement dialog boxes: <ul style="list-style-type: none"> <li>■ <b>Include tax:</b> Always perform a tax reversal for the adjustment, dispute, or settlement. If you select this option, the Customer Center dialog boxes do not include tax treatment check boxes.</li> <li>■ <b>Exclude tax:</b> Never perform a tax reversal for the adjustment, dispute, or settlement. If you select this option, the Customer Center dialog boxes do not include tax treatment check boxes.</li> <li>■ <b>None:</b> Allow the CSR to choose whether to include taxes. If you select this option, the Customer Center dialog boxes include tax treatment check boxes.</li> <li>■ This is the default setting for Customer Center. While it provides flexibility by letting the CSR make decisions based on the circumstances surrounding the adjustment, dispute, or settlement, it can result in inconsistent application of tax reversals for disputes and settlements.</li> </ul> <p>For more information on tax treatment, see "Configuring the Default Tax Treatment for Customer Center" in <i>BRM Managing Accounts Receivable</i>.</p> | None      |

### Payment Configurator

Click the **Payments** tab to open the Payment Configurator. Use the Payment Configurator to configure the options (shown in [Table 35–6](#)) in the **Payment** tab of Customer Center:

**Table 35–6 Payment Configurator Items**

| Item  | Payments Panel Action   | Default        |
|---|---|----------------|
| Payment section                             | Select or clear the option to display the Payment Setup panel.  | Displayed      |
| Tax setup section                           | Select or clear the option to display the Tax Setup panel.  | Displayed      |
| Credit Card Number - maximum digits allowed | Enter an integer to indicate the maximum number of digits allowed for the <b>Credit Card Number</b> field.  | 16             |
| CVV2 Number - maximum digits allowed        | Enter an integer to indicate the maximum number of digits allowed for the <b>CVV2</b> field.<br><br><b>Important:</b> If you change the default value, you must also customize the PCM_OP_CUST_POL_VALID_PAYINFO policy opcode to validate the number of CVV2 digits entered. See "Specifying the Maximum Number of Digits Allowed for CVV2 Verification" in <i>BRM Configuring and Collecting Payments</i> . | 3              |
| Account Number - maximum digits allowed     | Enter an integer to indicate the maximum number of digits allowed for the <b>Account Number</b> field for direct debit accounts.  | 26             |
| Bank Number - maximum digits allowed        | Enter an integer to indicate the maximum number of digits allowed for the <b>Bank Number</b> field for direct debit accounts.   | 26             |
| Custom billing cycle/tax setup class        | Enter the custom <b>PBillingCycleAndTaxSetupPage</b> class name.<br><br>For more information, see " <a href="#">Configuring Values in the Billing Day of Month Combo Box</a> ".   | Not customized |

## Plan Configurator

Click the **Plans** tab to open the Plan Configurator. Use Plan Configurator to configure the options (listed in [Table 35–7](#)) in the **Plans** tab of Customer Center:

**Table 35–7 Plan Configurator Items**

| Item            | Plan Panel Action   | Default                    |
|-----------------|---|----------------------------|
| Product History | Select or clear the option to display the <b>Product History</b> option in the <b>Actions</b> menu on the Plans page.   | Displayed                  |
| Deal History    | Select or clear the option to display the <b>Deal History</b> option in the <b>Actions</b> menu on the Plans page.  | Displayed                  |
| Service History | Select or clear the option to display the <b>Service History</b> option in the <b>Actions</b> menu on the Plans page.   | Displayed                  |
| Product status  | Globally modifies <i>all</i> Customer Center user permissions for altering Product Status settings.<br><br><b>Note:</b> To modify a <i>specific</i> user's permissions for altering Product Status settings, see the permission strings displayed when you click <b>Additional note</b> under the field. The permission string is entered in the Customer Center Permission dialog box. | Read and write permissions |

## Service Configurator

Click the **Service** tab to open the Service Configurator.

The **Drill Downs** menu on this tab displays two choices:

- **Service**
- **Deferred Actions**

Choose **Drill Downs - Service** to open the Service Configurator. Use Service Configurator to configure the options (shown in [Table 35–8](#)) on the **Services** tab of Customer Center:

**Table 35–8 Service Configurator**

| Item                            | Service Panel Action   | Default        |
|---------------------------------|--|----------------|
| Allow purchase products         | Select or clear the option to display the <b>Purchase</b> option.  | Displayed      |
| Service History                 | Select or clear the option to display the <b>Service History</b> option.   | Displayed      |
| Status column                   | Select an option to set permissions for entries in the <b>Status</b> column: <ul style="list-style-type: none"> <li>■ <b>Editable</b></li> <li>■ <b>Not editable</b></li> <li>■ <b>Do not display field</b></li> </ul>       | Editable       |
| Defer action column             | Select an option to set permissions for entries in the <b>Defer Action</b> column: <ul style="list-style-type: none"> <li>■ <b>Editable</b></li> <li>■ <b>Not editable</b></li> <li>■ <b>Do not display field</b></li> </ul> | Editable       |
| Custom SIM Panel Class          | Enter the subclass of the <b>SIMPanel.java</b> class that you created for charging for Subscriber Identity Module (SIM) changes.<br>For more information, see " <a href="#">Adding Charges for SIM and MSISDN Changes</a> ". | Not customized |
| Custom Number Panel Class       | Enter the subclass of the <b>NUMPanel.java</b> that you created for charging for MSISDN changes.<br>For more information, see " <a href="#">Adding Charges for SIM and MSISDN Changes</a> ".                                 | Not customized |
| Disable change in MSISDN number | Select or clear the option to disable changes to the Mobile Station International Subscriber Directory Number (MSISDN) number.   | Enabled        |

Choose **Drill Downs - Deferred Actions** to open the Deferred Actions Configurator. Set the items shown in [Table 35–9](#).

**Table 35–9 Deferred Actions Configurator**

| Item                     | Action   | Default   |
|--------------------------|--|-----------|
| Delete deferred actions  | Select or clear the option to display the <b>Delete</b> button.      | Displayed |
| Execute deferred actions | Select or clear the option to display the <b>Execute Now</b> button. | Displayed |

## Hierarchy Configurator

Click the **Hierarchy** tab to open the Hierarchy Configurator. Use Hierarchy Configurator to configure the options (shown in [Table 35-10](#)) on the **Hierarchy** tab in Customer Center:

**Table 35-10 Hierarchy Configurator**

| Item  | Hierarchy Panel Action  | Default   |
|---|---|---|
| Allow accounts to be moved                                    | Select or clear the option to display the <b>Move</b> button.   | Displayed   |
| Allow moves to be deferred                                    | Select or clear the option to display the <b>Defer the action until</b> field in the Move – Options dialog box.   | Displayed   |
| Custom Hierarchy Move Page Class                              | Enter the name of your extended <code>com.portal.app.cc.PHierarchyMovePage.java</code> class for your custom search dialog box.<br><br>For more information, see " <a href="#">Creating Customized Search Dialogs and Disabling the To Field</a> ".   | Not customized  |
| Allow accounts to be removed                                  | Select or clear the option to display the <b>Actions – Remove from Hierarchy</b> option.  | Displayed   |
| Allow removal to be deferred                                  | Select or clear the option to display the <b>Action – Remove from Hierarchy – Effective Move Date</b> option.   | Displayed   |
| Allow the bill in progress to be transferred or carried along | Select or clear the option to display the: <ul style="list-style-type: none"> <li>Transfer the current bill in progress to this account option in the <b>Actions – Remove from Hierarchy – Bill in Progress Options</b> menu</li> <li>Transfer the bill in progress to the new parent option in the <b>Move – Options – Bill in Progress Options</b> menu</li> </ul> Click the option under Default to set <b>Transfer the (current) bill in progress</b> as the default choice for both menus. | Allowed   |
| Allow the bill in progress to be billed immediately           | Select or clear the option to display the <b>Bill now</b> option in the: <ul style="list-style-type: none"> <li><b>Actions – Remove from Hierarchy – Bill in Progress Options</b> menu</li> <li><b>Move – Options – Bill in Progress Options</b> menu</li> </ul> Click the option under Default to set <b>Bill now</b> as the default choice for both menus.  | Not allowed   |
| The confirmation dialog's default button is                   | Select one of these options as the default confirmation button: <ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>   | Yes<br><b>Note:</b> A CSR can still click the <b>Cancel</b> button. |
| Custom NoHierarchy Page Class                                 | Enter your custom NoHierarchy page class.<br><br>For more information, see " <a href="#">Adding a Custom NoHierarchy Page</a> ".  | Not customized  |
| Double click account opens the account                        | Select or clear the option to enable opening any account in a hierarchy by double-clicking it.<br><br><b>Note:</b> If this feature is disabled, double clicking an account expands or collapses it.   | Enabled   |

**Table 35–10 (Cont.) Hierarchy Configurator**

| Item  | Hierarchy Panel Action  | Default  |
|---|---|--|
| <b>Show expand/collapse control</b>                                       | Select or clear to display the expand and collapse controls (+ and - icons) in an account hierarchy.  | <b>Not shown</b>   |
| <b>Expand entire hierarchy by default</b>                                 | If the <b>Show expand/collapse control option</b> is selected, select or clear to specify whether the default tree display mode is expanded or collapsed.   | <b>Not expanded</b>  |
| <b>Expand by default only when total number of accounts are less than</b> | <p>If the <b>Expand entire hierarchy by default</b>, enter the threshold number of accounts above which the default display is collapsed.</p> <p>To show the entire hierarchy for any size tree, set the field to <b>0</b>.</p> <p><b>Important:</b> Customer Center performance might be affected if this field is set to <b>0</b> or a high number.</p> <p>If the number of accounts in the hierarchy is more than the expansion threshold, the account hierarchy is displayed as a collapsed tree and a message window indicates the complete hierarchy cannot be shown.</p> | <b>Not specified</b> (a default value of <b>25</b> is assumed) |

## Sponsorship Configurator

Click the **Sponsorship** tab to open the Sponsorship Configurator. Click the **Include sponsorship functionality** checkbox to display or hide sponsorship information from all areas of Customer Center. The default behavior is to display sponsorship information.

## Sharing Configurator

Click the **Sharing** tab to open the Sharing Configurator. Use Sharing Configurator to control how Customer Center adds members to resource sharing groups and to configure the options (shown in [Table 35–11](#)) on the **Sharing** tab in Customer Center:

**Table 35–11 Sharing Configurator**

| Item  | Sharing Panel Action   | Default   |
|---|--|---|
| <p><b>Automatically participate in the membership</b></p> | <p>Select the option to control whether members can automatically participate in group sharing:</p> <ul style="list-style-type: none"> <li>■ <b>Accept</b></li> <li>■ <b>Decline</b></li> </ul> <p>Selecting <b>Accept</b> lets members benefit from resource sharing groups without having to explicitly join the group by clicking <b>Participate in Membership</b>. BRM automatically adds ordered balance groups to the data base for all members selected on the Add Members dialog box.</p> <p>For more information, see "Creating and Modifying Multiple Ordered Balance Groups Simultaneously" in <i>BRM Managing Accounts Receivable</i>.</p>   | <p><b>Decline</b></p>                               |
| <p><b>Accepting the membership as</b></p>                 | <p>Select the option to determine whether new resources sharing groups are added at the beginning or end of the ordered balance group list for participating services:</p> <ul style="list-style-type: none"> <li>■ <b>First Priority</b></li> <li>■ <b>Last Priority</b></li> </ul> <p>This setting controls the sequence in which BRM applies discount and charge sharing for a service. This setting also controls how the sharing groups for a service are arranged on the <b>Sharing</b> tab and Participate in Membership dialog box.</p> <p>For information on ordered balance groups, see "About Ordered Balance Groups" in <i>BRM Managing Accounts Receivable</i>.</p>                                   | <p><b>Last Priority</b></p>                         |
| <p><b>Bill unit for group owner</b></p>                   | <p>Select the option to display or hide <b>Bill to put charges in</b> and <b>Payment method</b> fields:</p> <ul style="list-style-type: none"> <li>■ <b>Show it</b></li> <li>■ <b>Hide it</b></li> </ul> <p>The <b>Bill to put charges in</b> field appears on the Charge Sharing Group and Discount Sharing Group dialog boxes. The <b>Payment method</b> field appears only on the Charge Sharing Group dialog box.</p>  | <p><b>Show it</b></p>                               |
| <p><b>Ordering the Sharing combo box</b></p>              | <p>Change the order of the sharing groups in the <b>View</b> drop-down on the <b>Sharing</b> tab. To do so, select a group and click:</p> <ul style="list-style-type: none"> <li>■ <b>Raise Order</b></li> <li>■ <b>Lower Order</b></li> </ul> <p>The list of groups always include <b>PDiscount</b> and <b>PCharge</b>. It also includes any new sharing group types you create and add to Customer Center.</p> <p>For information on adding new panels to Customer Center, see "<a href="#">Customizing the Customer Center Interface</a>". For information on adding new sharing types to the <b>View</b> drop-down on the <b>Sharing</b> tab, see "<a href="#">Customizing Fields in the Sharing Tab</a>".</p> | <p>Discount sharing (<b>PDiscount</b>) is first</p> |

## Other Settings

Click the **Other** tab to configure default behavior for the items in [Table 35–12](#):

Table 35–12 Other Items

| Item   | Other Action   | Default  |
|--|--|--|
| Alert user when opening accounts in different brands               | Select or clear the option to display an alert message to a CSR who opens two or more accounts in different brands.  | <b>Not displayed</b><br><b>Note:</b> See "About Granting Access to Brands" in <i>BRM Managing Customers</i> .    |
| Display the connection info in the login dialog                    | Select or clear the option to display the <b>Connection Info</b> button in the Login dialog box.   | <b>Displayed</b><br><b>Tip:</b> If you are working in a single BRM environment, hide the Connection Info button. |
| Background image in home page                                      | Enter the package path and name for an alternate image to display in the Customer Center home page.  | <b>com/portal/app/cc/homebg.jpg</b>  |
| Allow an account to have only one plan                             | Select or clear this option to restrict accounts to have only one plan.<br><br>When this option is selected, a CSR doesn't have the standard set of options in the <b>Purchase Options</b> field in the <b>Plans - Purchase</b> window. Instead, the CSR can only select the <b>Upgrade from</b> option to transfer the account to a new plan. | <b>Not restricted</b> (accounts can have two or more plans)  |
| Enable plan options page when using plans with only optional deals | Enable or disable the <b>Plan Options</b> tab in the Account purchase wizard when the plan being purchased has no required deals.  | <b>Not enabled</b>   |
| Class name for loading the Custom Properties                       | Enter the class name that implements the <b>LoadCustomProperties</b> interface.<br><br><b>Important:</b> You must define the fully qualified class name, for example, <b>com.helloworld.MyInterface</b> .<br><br>For more information, see " <a href="#">Configuring Dynamic Drop-Down Lists</a> ".  | <b>Not customized</b>  |
| Maximum number of contacts allowed for an account                  | Enter the maximum number of contacts allowed for an account.   | <b>-1</b> (No limit to the number of contacts in an account)   |
| Enforce deal customization   | Select or clear this option.<br><br>When selected, Customer Center automatically reminds CSRs to visit the <b>Customize Products</b> page if they select a deal with required customization.   | Not selected   |

## Account Search Results Configurator

The Account Search Configurator wizard in the Customer Center SDK Configurator includes a Search Criteria section. You use this area to add, change, and delete custom search fields that CSRs use to search for accounts in Customer Center.

---

**Note:** The Customer Center SDK includes sample configurations.

---

To change Customer Search criteria field options in Customer Center by using the Account Search Configurator, follow these steps:

1. [Starting Account Search Configurator](#)

2. [Adding a New Search Criteria field](#)
3. [Modifying a Search Criteria Field](#)
4. [Deleting a Custom Search Criteria Field](#)

### Starting Account Search Configurator

1. Start Configurator.
2. Click the **Search** toolbar button to open the Account Search Configurator dialog box. Use this dialog box to:
  - View and modify the list of fields available in the Customer Center Search dialog by default.
  - Add more fields.

### Adding a New Search Criteria field

To add a new search criteria field:

1. In the Search Criteria section of the Account Search Configurator Wizard, click **Add New**.
2. In the Attributes window, type the values for the basic attributes fields:
  - a. **Property file identifier:** Type a keyword that is unique to the field.

---

**Tip:** For easy identification, use a value that resembles the label name. For example, if you use **Payment type** for the label, you could use **Payment\_type** for the **Property file identifier**.

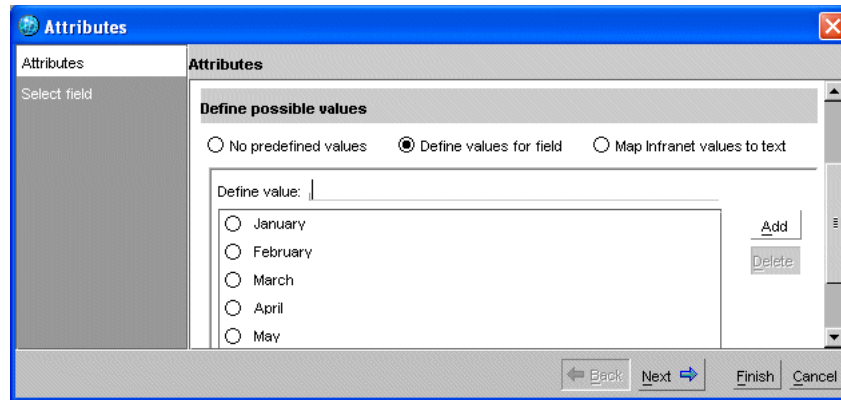
---

This key is stored in the **Customized.properties** file when you exit Configurator.

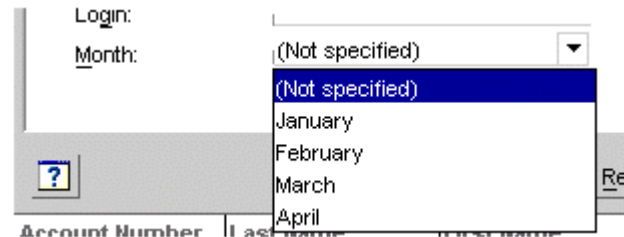
- b. **Label:** The label that appears in the Search dialog box for this field.
  - c. (Optional) **Mnemonic:** A single letter that allows the customer service representative (CSR) to access this field quickly.  
 For example, if you specify **t** as the mnemonic for the Payment Type field, the CSR can access this field by typing **Ctrl+t**.
3. (Optional) To require CSRs to select from a set of specific values for the field:
  - a. Click the **Define values for field** option.
  - b. Type a selectable value in the **Define value** field.
  - c. Click **Add**.
  - d. Repeat steps 3b and 3c until all predefined options are added.
  - e. (Optional) To specify a default value for the field, select the button to the left of the field.
  - f. To delete a field value option, select its row and click **Delete**.

Figure 35–2 shows the **Month** field added with selectable values:



**Figure 35–2 Month Field Attribute Configuration**

When a CSR searches on the **Month** field, the pull-down list of months is presented (as shown in [Figure 35–3](#)):

**Figure 35–3 Customer Center Month Pull-Down List**


---

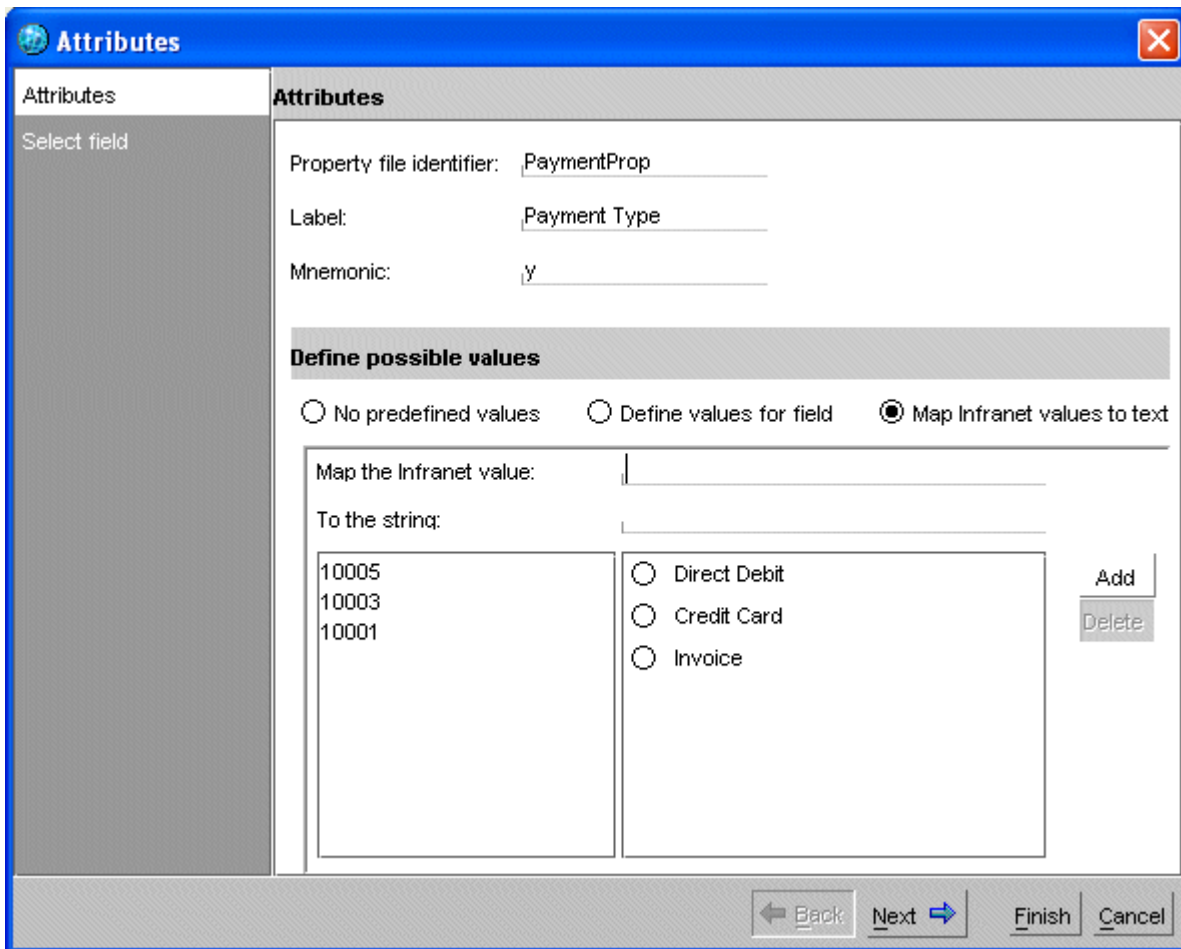
**Note:** If no default value is specified and the CSR selects it (the **Not specified** option) the search ignores the field.

---

4. (Optional) To require CSRs to select from a set of predefined values that map to BRM values:
  - a. Click the **Map Infranet values to text** option.
  - b. Type value pairs for the **Mapped the Infranet value** and **To the string** fields.
  - c. Click **Add**.
  - d. Repeat steps 4b and 4c until all options are added.
  - e. (Optional) To specify a default value for the field, select the button to the left of the **String** field value.
  - f. To delete a field value option, select its row and click **Delete**.

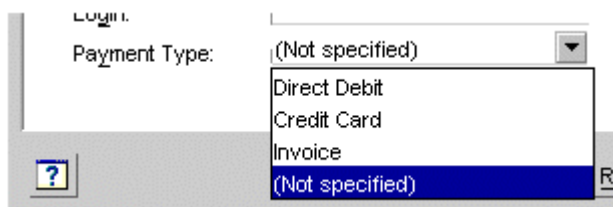
[Figure 35–4](#) shows how to add a **Payment Type** field with selectable values:

**Figure 35–4 Adding a Payment Type in Configurator**



When a CSR searches on the **Payment Type** field, the pull-down list of payment methods is presented as shown in [Figure 35–5](#):

**Figure 35–5 Customer Center Payment Type Pull-Down List**



5. Click **Next**.  
The Select field window displays storable classes and their fields in tree format.
6. Select a field from the appropriate storable class.
7. Click **Finish**. The new field appears at the bottom of the list in the Search Criteria section of the main Account Search Configurator window.

### Modifying a Search Criteria Field

To modify an existing Search Criteria field:

1. In the Search Criteria area of the Account Search Configurator window, click the field to modify.
2. Click **Modify**.
3. In the Modify wizard, change the displayed attributes of the search field.

---

**Note:** The Modify wizard is similar to the Add wizard. See "[Adding a New Search Criteria field](#)". The Modify wizard doesn't include a **Property file identifier** field in the Attributes window. You can't change the **Property file identifier** for a field after you add the field.

---

### Deleting a Custom Search Criteria Field

To delete a custom Search Criteria field:

1. In the Search Criteria area of the Account Search Configurator window, select the custom field to delete.
2. Click **Delete**.

---

**Note:** You cannot delete a default Search Criteria field. However, you can prevent it from displaying in Customer Center by clearing the check box next to the field. You can disable the display of custom Search Criteria in the same way.

---

## Tab Options

This section describes how to reorder, modify, or add a page to the Customer Center account maintenance interface.

1. Start Configurator.
2. Click the **Tab options** button.  
The Configure Page Maintenance wizard appears.
3. Make your configurations. See:
  - [Reordering Pages](#)
  - [Modifying Attributes of an Existing Page](#)
  - [Hiding an Existing Page](#)
  - [Adding a New Page](#)
  - [Removing a Custom Page](#)

### Reordering Pages

To reorder pages, highlight the page's name in the list and click one of the arrows to move its position on the page.

### Modifying Attributes of an Existing Page

1. Highlight an existing page in the list.
2. Click **Modify**.
3. Modify the page's name, the tool tip text, or the name of the Java class that creates the page, as required.

## Hiding an Existing Page

To hide an existing page, clear its checkbox in the list.

---

**Important:** You cannot delete the default pages included with Customer Center. However, you can prevent their display.

---

## Adding a New Page

To add a new page, click the **Add New** button and enter information listed in [Table 35–13](#):

---

**Note:** To add a new page, first create the new page with an IDE tool such as JBuilder. See "[Setting Up JBuilder to Customize the Customer Center Interface](#)".

---

**Table 35–13** *New Page Information*

| Field                    | Description   |
|--------------------------|---|
| Property file identifier | The property file key to attach your class values to.   |
| Name                     | The tab text to display for your new page's name.   |
| Tool tip                 | The tool tip text to display when the mouse hovers over the tab name.                               |
| Java class name          | The name of the source file for your new page, in the format <i>com.yourpackage.YourClassName</i> . |

## Removing a Custom Page

To remove a custom page, highlight the page and click the **Delete** button.

---

**Note:** You cannot delete the default pages included with Customer Center, however, you can prevent their display.

---

# Configuring the Customer Center New Accounts Wizard

To configure fields and panels used in the Customer Center new accounts wizard:

1. Click the **New account** toolbar button in Configurator.  
The new accounts configurator wizard appears.
2. Modify the configurator options as required.

---

**Important:** The selections on each tab in this configuration wizard only affect the fields and options displayed in the **New Account** wizard. They do not impact the **Contact Information** drill-down on the account maintenance **Summary** page.

---

[Table 35–14](#) describes the main new account configuration pages:

**Table 35–14 Contents of the New Account Configuration Page**

| New Account Wizard Panels      | Panel Description   |
|--------------------------------|---|
| <a href="#">Contacts Panel</a> | Configures options in the Customer Center New account <b>Contacts</b> panel |
| <a href="#">General Panel</a>  | Configures options in the Customer Center New account <b>General</b> panel  |
| <a href="#">Payment Panel</a>  | Configures options in the Customer Center New account <b>Payments</b> panel |
| <a href="#">Billing Panel</a>  | Configures options in the Customer Center New account <b>Billing</b> panel  |

To reorder, hide, or add New Account wizard panels, see "[New Account Page Options](#)".

## Contacts Panel

Select **Contacts** in the navigation bar to open the Contacts Configurator. Use Contacts Configurator to configure the options (shown in [Table 35–15](#)) in the **New accounts - Contacts** tab in Customer Center.

---



---

### Note:

- If you clear a checkbox to hide a field, the fields that follow it are moved up in the display.
  - The **Last name**, **Address**, and **Phone** fields cannot be removed.
- 
- 

**Table 35–15 Contacts Configurator Panel**

| Item                | New Account - Contacts Panel Action  | Default                                   |
|---------------------|--|---|
| <b>Company</b>      | Select or clear the option to display the <b>Company</b> field.  | <b>Displayed</b> (business accounts only) |
| <b>Job Title</b>    | Select or clear the option to display the <b>Job title</b> field.  | <b>Displayed</b> (business accounts only) |
| <b>Salutation</b>   | Select or clear the option to display the <b>Salutation</b> field.   | <b>Displayed</b>                          |
| <b>First Name</b>   | Select or clear the option to display the <b>First name</b> field.   | <b>Displayed</b>                          |
| <b>Middle Name</b>  | Select or clear the option to display the <b>Middle name</b> field.  | <b>Displayed</b>                          |
| <b>City</b>         | Select or clear the option to display the <b>City</b> field.   | <b>Displayed</b>                          |
| <b>State</b>        | Select or clear the option to display the <b>State/Province</b> field.   | <b>Displayed</b>                          |
| <b>Zip</b>          | Select or clear the option to display the <b>ZIP/Postal</b> field.   | <b>Displayed</b>                          |
| <b>Country</b>      | Select or clear the option to display the <b>Country</b> field.  | <b>Displayed</b>                          |
| <b>E-mail</b>       | Select or clear the option to display The <b>E-mail</b> field.   | <b>Displayed</b>                          |
| <b>Contact Type</b> | Enter the default value for the Customer Center <b>Contact Type</b> field.<br><b>Note:</b> The default value appears during account creation and account maintenance operations. | <b>Account holder</b>                     |

## General Panel

Click the **Next** button or select **General** in the navigation bar to open the General Configurator. Use General Configurator to configure the options (shown in [Table 35–16](#)) in the **New accounts - General** tab in Customer Center:

**Table 35–16** Items in General Panel for New Account

| Item                                   | New Account-General Panel Action  | Default   |
|--|---|---|
| Security Code 1                        | Select an option to set permissions for the first <b>Security code</b> field. <ul style="list-style-type: none"> <li>▪ Editable</li> <li>▪ Not editable</li> <li>▪ Do not display field</li> </ul>  | Editable  |
| Security Code 2                        | Select an option to set permissions for the second <b>Security code</b> field. <ul style="list-style-type: none"> <li>▪ Editable</li> <li>▪ Not editable</li> <li>▪ Do not display field</li> </ul>   | Editable  |
| Language (locale) field                | Select an option to set permissions for the <b>Language</b> field. <ul style="list-style-type: none"> <li>▪ Editable</li> <li>▪ Not editable</li> <li>▪ Do not display field</li> </ul> <p><b>Note:</b> If either the <b>Read only</b> or <b>Hide</b> options are selected, the user is given a choice at runtime to select the default locale to use.</p>  | Editable  |
| Currency field                         | Select an option to set permissions for the <b>Primary currency</b> and <b>Secondary currency</b> : <ul style="list-style-type: none"> <li>▪ Editable</li> <li>▪ Not editable</li> <li>▪ Do not display field</li> </ul> <p>Select a default entry to use for the <b>Primary currency</b> field.</p> <p>Select a default entry to use for the <b>Secondary currency</b> field.</p> <p><b>Note:</b> The <b>Secondary currency</b> is valid only if the <b>Primary currency</b> is <b>Euro</b>.</p> | Editable<br><br><b>Note:</b> The default currencies appropriate for the application's locale are displayed. |
| Hierarchy support                      | Select or clear the option to display the Hierarchy Setup panel.  | Displayed   |
| Hierarchy appears initially expanded   | Select or clear the option to display the hierarchies in expanded format.   | Displayed   |
| Sponsorship support                    | Select or clear the option to display the Sponsorship Setup panel.  | Displayed   |
| Sponsorship appears initially expanded | Select or clear the option to display the sponsorship in expanded format.   | Displayed   |

## Payment Panel

Click the **Next** button or select **Payment** in the navigation bar to open the Payment Configurator. Use Payment Configurator to configure the options (shown in

Table 35–17) in the **New accounts - Configurator** tab in Customer Center:

**Table 35–17 Payment Panel Settings**

| Item                            | New Account Wizard - Payment Panel Action                | Default |
|---------------------------------|--|---------|
| Default payment type - consumer | Select a default payment method from the drop-down menu. | Invoice |
| Default payment type - business | Select a default payment method from the drop-down menu. | Invoice |

## Billing Panel

Click the **Next** button or select **Billing** in the navigation bar to open the Billing Configurator. Use Billing Configurator to configure the options (shown in Table 35–18) in the **New accounts - Billing** tab in Customer Center:

**Table 35–18 Billing Panel**

| Item                  | New Account Wizard – Billing Panel Action  | Default         |
|-----------------------|--|-----------------|
| Accounting type field | Select one of these options to specify access to accounting type: <ul style="list-style-type: none"> <li>▪ Editable</li> <li>▪ Not Editable</li> <li>▪ Do not display field</li> </ul> | Editable        |
| Accounting type       | Select one of these options to specify access to accounting type: <ul style="list-style-type: none"> <li>▪ Balance forward</li> <li>▪ Open Item</li> </ul>                             | Balance forward |

## New Account Page Options

This section describes how to reorder, modify, or add a page, or add a profile panel to the Customer Center New Account wizard interface.

1. Start Configurator.
2. From any New account panel, select the **Page Options** button at the bottom of the panel.
3. Select either **Consumer account** or **Business account** depending on the account type you want to configure.
4. Make your configurations. See:
  - [Reordering New Account Pages](#)
  - [Modifying an Existing Page](#)
  - [Hiding an Existing Page](#)
  - [Adding a New Page](#)
  - [Removing a Custom Page](#)

### Reordering New Account Pages

To reorder pages, highlight the page's name in the list and click one of the arrows to change its position on the page.

### Modifying an Existing Page

1. Highlight an existing page in the list.
2. Click **Modify**.
3. Modify the page's name, or the Java class that creates the page, as required.

### Hiding an Existing Page

To hide an existing page, clear its checkbox in the list.

---



---

**Note:** You cannot delete the default pages included with Customer Center. However, you can prevent their display.

---



---

### Adding a New Page

To add a new page, click the **Add New** button and enter information in the fields shown in [Table 35-19](#):

---



---

**Note:** To add a new page, first create the new page with an IDE tool such as JBuilder. See "[Setting Up JBuilder to Customize the Customer Center Interface](#)".

---



---

**Table 35-19** Information Required for a New Page

| Field                    | Description   |
|--------------------------|---|
| Property file identifier | The property file key to attach your class values to.   |
| Name                     | The tab text to display for your new page's name.   |
| Java class name          | The name of the source file for your new page, in the format <i>com.yourpackage.YourClassName</i> . |

### Removing a Custom Page

To remove a custom page, highlight the page and click the **Delete** button.

---



---

**Note:** You cannot delete the default pages included with Customer Center, however, you can prevent their display.

---



---

## Using the Configurator Resource String Editor

Configurator includes a Resource String Editor. You use this feature to replace Customer Center field labels with your custom text values.

To use the Resource String Editor, follow these steps:

1. [Starting the Resource String Editor](#)
2. [Searching for Labels to Replace](#)
3. [Replacing Labels with New Strings](#)
4. [Undoing Label Changes](#)



## Starting the Resource String Editor

To start the Resource String Editor, choose **Tools - Resource String Editor** from the Configurator main menu. The Resource String Editor appears.

## Searching for Labels to Replace

To locate Customer Center field labels whose text you want to replace, type the label text you want to locate in the **Change text from** field and click **Search**. Any labels that contain matching text will appear in the results area.

### Resource String Editor String Search Rules

- Search matching is case sensitive.
- Search matching is performed against the whole value of the field. For example, if you search for the string **Balance**, the results include screen labels that consist of only the word **Balance**.
- You can use the wildcard symbol (\*) at the end or beginning of your search string to return all labels that *start* or *end* with the search string, respectively.

#### – Example 1

If you search for the string **Balance\***, you get the same matches as you do if you search for **Balance** plus longer labels that *start* with **Balance**, such as **Balance summary** and **Balance forward**.

#### – Example 2

If you search for **\*forward**, two items called **Balance forward** are returned.

## Replacing Labels with New Strings

To replace label text with new text:

1. Click one or more matching fields whose label text you want to replace.
2. In the **Change text to** field, type the replacement text.

---

**Important:** The *entire label string* of the selected labels is replaced with the replacement text in the **Change text to field**, not just the string you searched for.

---

3. Click **Apply**.

## Undoing Label Changes

To undo the last string replace operation during the current Configurator session:

1. If it is not already running, start Resource String Editor.
2. Click **Undo**.
3. When prompted to confirm, click **Yes**. Your changes are reversed.

## Additional Configured Profile Panel Examples

For more complete examples, see the code in *CCSDK\_Home/CustomerCareSDK/CustCntrExamples/Profile*:

- **CSProf.java** demonstrates how to extend this example to manipulate the list of plans available for sale.
- **CDProf.java** is an example similar to the one discussed above, but uses a different */profile* object and different BAS widgets.

---

## Adding Custom Fields to Customer Center

This section describes the procedures for adding custom fields to your Oracle Communications Billing and Revenue Management (BRM) Customer Center implementation.

Before you read this chapter, you should be familiar with these concepts:

- [Understanding the PCM API and the PIN Library.](#)
- [Understanding Flists and Storable Classes.](#)
- About Customer Center
- [Understanding the BRM Business Application SDK Framework.](#)
- [Customizing the Customer Center Interface.](#)
- Storable Class Editor in Developer Center. For more information, see [Storable Class Editor Help](#).

You should also have a working knowledge of JBuilder.

### Coding and Deploying Custom Fields for Customer Center

To code and deploy custom fields for Customer Center, perform these tasks in this order:

1. [Adding Custom Fields to Infranet.properties](#)
2. [Generating Your Custom Field Java Source Code](#)
3. [Compiling and Signing Your Custom Fields Java Source Code](#)
4. [Building and Deploying Your New Profile Panel](#)

### Adding Custom Fields to Infranet.properties

As with all BRM Java clients, the field numbers for Customer Center custom fields must be added to **Infranet.properties**. If you add custom fields to Customer Center:

1. Add your custom field numbers to the **Infranet.properties** file.
2. Before creating your **jar** file, copy the modified **Infranet.properties** file to the top level of the directory structure along with your other compiled source files.

---

---

**Note:** When Customer Center is deployed by using Web Start, an **Infranet.properties** file is normally not required since the BRM host and port information is read from the Web Start **.jnlp** file. However, if the **Infranet.properties** file exists in the CLASSPATH, it is recognized by Customer Center, or, more specifically, Portal Communication Module (PCM).

---

---

For example, if you are adding a custom credit score field and a custom panel for displaying that field, the file and directory structure might look like this:

- **./Infranet.properties**
- **./com/**
- **./com/mycompany/**
- **./com/mycompany/CustomPanel.class**
- **./customfields/**
- **./customfields/CreditScore.class**

Note that the **Infranet.properties** file is at the top level of this directory structure.

This **jar** command:

```
jar cvf ccCustomFields.jar .
```

Generates a **jar** file containing:

- 0 Mon Dec 10 09:03:40 PST 2002 META-INF/MANIFEST.MF
- 0 Mon Dec 10 08:58:28 PST 2002 **Infranet.properties**
- 0 Mon Dec 10 09:01:14 PST 2002 **com/**
- 0 Mon Dec 10 08:58:54 PST 2002 **com/mycompany/**
- 0 Mon Dec 10 08:58:54 PST 2002 **com/mycompany/CustomPanel.class**
- 0 Mon Dec 10 09:01:36 PST 2002 **customfields/**
- 0 Mon Dec 10 09:01:36 PST 2002 **customfields/CreditScore.class**

---

---

**Important:** Be sure to include the "." at the end of the **jar** command. This specifies the current directory.

---

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---

**Note:** This example assumes that you have only one **Infranet.properties** file packaged in a **jar** file per Customer Center deployment. The **jar** file is recognized and picked up when Customer Center is run.

---

---

For detailed custom field development procedures, see "[Adding Custom Fields to Customer Center](#)".

## Generating Your Custom Field Java Source Code

This section describes how to select the custom fields profile object that you want to add to Customer Center.

---



---

**Note:** This procedure uses the sample profile object `/profile/customfieldsprof`. Replace this object name with the one you create in Developer Center.

---



---

1. Start Storable Class Editor in Developer Center.
2. Create your custom fields in a profile object.  
For information, see the Storable Class Editor Help.
3. Create a directory in the `CustCntr/custom` directory for your custom field Java code, as in this example:

```
mkdir CustCntr\custom\custom_fields
```

4. Choose **File – Generate Custom Fields Source**.
5. Click **Browse** and select the `CustCntr/custom/custom_fields` directory.

---



---

**Note:** If you are deploying only in Java, you can deselect the option to export C code.

---



---

6. Click **OK**.  
The source Java code for your custom fields is generated in `CustCntr/custom/custom_fields`. In this example, these files are:
  - `InfranetPropertiesAdditions.properties`
  - `XCreditScore.java`
  - `XLICENSENum.java`
7. Click **OK** in the confirmation dialog box.

## Compiling and Signing Your Custom Fields Java Source Code

This section describes how to compile and sign the profile object that you created by using the Storable Class Editor.

1. Go to the `CustCntr/custom/custom_fields` directory.
2. Copy the contents of the custom fields file (`CCSDK_Home/CustomCareSDK/CustCntr/custom/custom_fields`) to the end of the `CCSDK_Home/CustomCareSDK/CustCntr/bin/Infranet.properties` file by using a text editor.

---



---

**Note:** The `InfranetPropertiesAdditions.properties` file contains information required when running code that references your custom fields.

---



---

3. Rename the `CCSDK_Home/CustomCareSDK/CustCntr/custom/custom_fields/InfranetPropertiesAdditions.properties` file to `Infranet.properties`.

You use this file for deploying your custom fields with WebStart. This file is similar to the one you created in step 2 except it doesn't contain the connection and login parameters.

4. If you have more than one set of custom fields, merge all associated **InfranetPropertiesAdditions.properties** files.

---

---

**Note:** If you are deploying multiple sets of custom fields (you used Developer Center to generate multiple custom source files), you have several copies of the **InfranetPropertiesAdditions.properties** file. You must merge all of these files into the *CCSDK\_Home/CustomCareSDK/CustCntr/bin/Infranet.properties* file.

---

---

5. Compile your custom fields.
  - a. Go to your custom field directory (*CCSDK\_Home/CustomCareSDK/CustCntr/custom/custom\_fields*).

- b. Compile your source code:

```
javac -classpath ../../../../lib/pcm.jar -d . *.java
```

A directory matching the Java package name of your custom fields (in this example, **customfields**) is created.

6. Package the compiled code and the revised **Infranet.properties** file, as in this example:

```
jar cf ../ccCustomFields.jar customfields Infranet.properties
```

The **jar** file is placed up one level in the *CCSDK\_Home/CustomCareSDK/CustCntr/custom* directory.

7. If you are deploying the **jar** file using Web Start, sign the **jar** file.
  - a. Go to *CCSDK\_Home/CustomCareSDK/CustCntr/custom* directory and find your **jar** file.

- b. Sign your **jar** file by using the **signjar** script, as in this example:

```
signjar.bat ccCustomFields.jar
```

- c. Verify that the signing process completed properly by using the **jarsigner** utility provided in the JDK:

```
jarsigner -verify ccCustomFields.jar
```

The expected output is:

```
jar verified.
```

## What's Next

See "[Configuring JBuilder to Add Custom Fields to Customer Center](#)".

## Configuring JBuilder to Add Custom Fields to Customer Center

This section describes how to configure your custom fields in JBuilder. This enables you to use the fields later when building a new panel or other customization.

Before you use JBuilder to configure your custom fields, set up a JBuilder project. See "[Setting Up JBuilder to Customize the Customer Center Interface](#)".

1. Start JBuilder.

2. Open your BRM project. See "[Creating a JBuilder Project for Customer Center SDK](#)".
3. Chose **Project – Project Properties**.
4. Click the **Required Libraries** tab.  
You should see a single library named CCSDK.
5. Select the **CCSDK** library and then click **Edit**.
6. In the Configure Libraries dialog box, click **Add**.
7. Go to your CCSDK install directory, select your custom fields **jar** file, and then click **OK**.
8. Click **OK** in each of the open dialog boxes.
9. Go to the `CCSDK_Home/CustomCareSDK/CustCntrExamples/Profile` directory.
10. Copy **ProfileTemplate.txt** to your custom fields file (**CustomFieldsProfile.java** in this example).
11. Choose **File - Open File** and open the **CustomFieldsProfile.java** file.
12. Replace the two instances of XXX with your Java Class name (**CustomFieldsProfile** in this case).
13. In **CustomFieldsProfile.java**, find this line:

```
setProfileType();
```

And specify the **customfieldsprof** subclass:

```
setProfileType(customfieldsprof);
```

This maps to the profile object created in Developer Center. This example shown in [Figure 36–1](#) references the `/profile/customfieldsprof` profile object.

Figure 36-1 CustomFieldsProfile Example

```

CustomFieldsProfile
import javax.swing.*;
import com.portal.app.cc.comp.PIACAProfilePanel;
import com.portal.bas.comp.PIACustomizablePanel;
import com.portal.bas.*;
import java.util.*;

/**
 * An empty Profile panel which can be used as a starting point for cr
 * a profile panel for use with an account creation wizard and for acc
 * maintenance. Each profile object should have its own profile panel
 *
 * @version %version: 2 % %date_modified: Wed Jan 23 09:21:26 2002 %
 */
public class CustomFieldsProfile extends PIACAProfilePanel {
    ResourceBundle bundle = PIACustomizablePanel.getBundle(
        "com.portal.ar

/**
 * Creates a new profile panel.
 */
public CustomFieldsProfile() {

    //First step, you must indicate what your /profile sub
    //If you create an subclass along the lines of /profil
    //should pass in "xxx" without the leading '/profile'.
    //would read:                setProfileType
    //
    setProfileType("customfieldsprof");

```

14. Click the **Design** tab at the bottom of the JBuilder window.
15. Verify that you can launch the Business Application SDK (BAS) widget Configurator and that it displays your custom profile object and custom fields.
  - a. In the widget palette at the top of the JBuilder window, click the **CCSDK Components** tab.
  - b. In the lower left pane, click the **PIATextfield** widget. This is typically the first widget in the list.
  - c. Drag the widget into your panel.
  - d. Right-click the widget instance on the left side of the window and click **Configurator**.
  - e. If prompted, log in to BRM.
  - f. Expand the node containing your custom field and select your profile object.

If your profile object is visible in the configurator, you have successfully made JBuilder aware of your custom fields. You can continue constructing your panel. If it is not visible verify that:



- Your JBuilder library path is correct.
  - There are no errors in the **Infranet.properties** file you modified in **CustCntr/bin** when you combined the existing file with the **InfranetPropertiesAdditions.properties** file that was generated by Developer Center.
  - Your **CustCntr/bin/Infranet.properties** file contains the entries for your custom fields. Choose **Project – Project Properties** in JBuilder, click the **Required libraries** tab select **CCSDKlib** in the list, and click **Edit**. Verify that **CustCntr/bin** and **ccCustomFields.jar** are in the list.
16. When you have completed your panel layout, save your changes.

## What's Next

See ["Building and Deploying Your New Profile Panel"](#).

## Building and Deploying Your New Profile Panel

This section describes how to build and deploy your custom fields in your custom profile panel:

1. Run Configurator to add your profile panel to Customer Center, and save your changes:
  - If you are adding your new panel to a Customer Center account maintenance page, see ["Tab Options"](#).
  - If you are adding your new panel to a Customer Center new accounts wizard page, see ["New Account Page Options"](#).
2. Run the build script (*CCSDK\_Home/CustomerCareSDK/buildAll.bat*). This script compiles and packages your new panel into the *CCSDK\_Home/CustomerCareSDK/CustCntr/custom/ccCustom.jar* file.
3. Add **ccCustomFields.jar** to the CLASSPATH in the *CCSDK\_Home/CustomerCareSDK/CustCntr/bin/runCustomerCenter*:
 

```
set CLASSPATH=f:/7.2sdk/CustCntr/custom/ccCustomFields.jar;%CLASSPATH%
```
4. Test your customizations. See ["Testing Your Customizations"](#).
5. To deploy your customizations with Customer Center WebStart:
  - a. Open the *CCSDK\_Home/CustomerCareSDK/CustCntr/custom/custom.jnlp* file with a text editor.
  - b. Add this entry for **ccCustomFields.jar**:
 

```
<jar href="custom/ccCustomFields.jar"/>
```
  - c. Continue with the standard deployment procedure. See ["Deploying Your Customer Center Customizations"](#).



---

---

## Setting Up JBuilder to Customize the Customer Center Interface

This chapter describes how to set up JBuilder to customize Oracle Communications Billing and Revenue Management (BRM) Customer Center functionality.

Before you read this chapter, you should be familiar with JBuilder and have read the following documents:

- [Understanding the PCM API and the PIN Library](#)
- [Understanding Flists and Storable Classes](#)
- [Using Customer Center SDK](#)
- [Customizing the Customer Center Interface](#)

### About Using JBuilder to Customize the Customer Center Interface

To set up your JBuilder development environment for customizing Customer Center:

1. Make sure you have installed the following on your system:
  - JDK. See "Installing the JDK" in *BRM Upgrade Guide*.
  - JBuilder 2008 Release 2

For more compatibility information, see "BRM Software Compatibility" in *BRM Installation Guide*.
2. Install Customer Center SDK. See "Installing Customer Center SDK on Windows" in *BRM Installation Guide*.
3. Add PIA widgets to the JBuilder palette. See "[Adding PIA Widgets to the JBuilder Palette](#)".
4. Create a JBuilder project. See "[Creating a JBuilder Project for Customer Center SDK](#)".

### Adding PIA Widgets to the JBuilder Palette

Customer Center SDK includes a JBuilder plug-in of Privacy Impact Assessment (PIA) widgets. You can use these widgets to add components to existing Customer Center panels or to custom panels you create by subclassing the controllers provided with the SDK.

To add PIA widgets to the JBuilder palette, copy the Customer Center SDK plug-in file (`CCSDK_Home/CustomerCenterSDK/CustCntr/bin/oracle.communications.brm.uicomponents_1.0.0.jar`) to your JBuilder directory.

## Creating a JBuilder Project for Customer Center SDK

To create a JBuilder project for Customer Center SDK:

1. Start JBuilder.
2. Choose **File – New – Java Project**.  
The New Java Project wizard starts.
3. In the **Project Name** field, enter a name for your project.
4. Select the appropriate JRE.
5. Set the remaining fields according to your system configuration.
6. Click **Next**.  
The Java Settings pane appears.
7. Click the **Libraries** tab and then click **Add Library**.  
The Add Library dialog box appears.
8. In the Add Library pane, select **User Library** and then click **Next**.  
The User Library pane appears.
9. Click **User Libraries**.  
The Preferences (Filtered) dialog box appears.
10. In the User Libraries pane, click **Import**.  
The Import User Libraries dialog box appears.
11. In the **File location** field, enter the path to the Customer Center SDK library file (*CCSDK\_Home/CustomerCenterSDK/CustCntr/bin/CCSDK\_lib.userlibraries*).
12. Click **OK**.  
The User Library dialog box appears.
13. Make sure **CCSDK\_lib** appears in the **User libraries** list.  

---

---

**Note:** If **CCSDK\_lib** is not in the **User libraries** list, the **CCSDK\_lib.userlibraries** file is not in a folder that JBuilder can access. See ["Adding PIA Widgets to the JBuilder Palette"](#) for information on where to copy the file.

---

---
14. Select **CCSDK\_lib** and then click **Finish**.  
Your project is now ready for adding Java source files.

---

---

## Creating a New Customer Center Profile Panel

This section uses an example to show how to create a new Oracle Communications Billing and Revenue Management (BRM) Customer Center profile panel using JBuilder.

---

---

**Note:** These instructions assumed you have already set up JBuilder.

---

---

Before you read this chapter, you should be familiar with these concepts:

- [Understanding the PCM API and the PIN Library](#)
- [Understanding Flists and Storable Classes](#)
- [About Customer Center](#)
- [Understanding the BRM Business Application SDK Framework](#)
- [Customizing the Customer Center Interface](#)

You should also have a working knowledge of JBuilder.

### Creating a New Profile Panel

Profile panels are extensions to the `PIACAProfilePanel` class. You use them to add data entry or display fields to the Customer Center Account Maintenance and New Accounts pages.

---

---

**Note:** You mostly work with the widgets in the CCSDK Components widget palette since they are BRM aware. Additional widgets are included under the PFC **Components** tab, but they are not BRM aware. They provide functionality beyond the normal Java widget set, such as links, section headers, and drop-down menus.

---

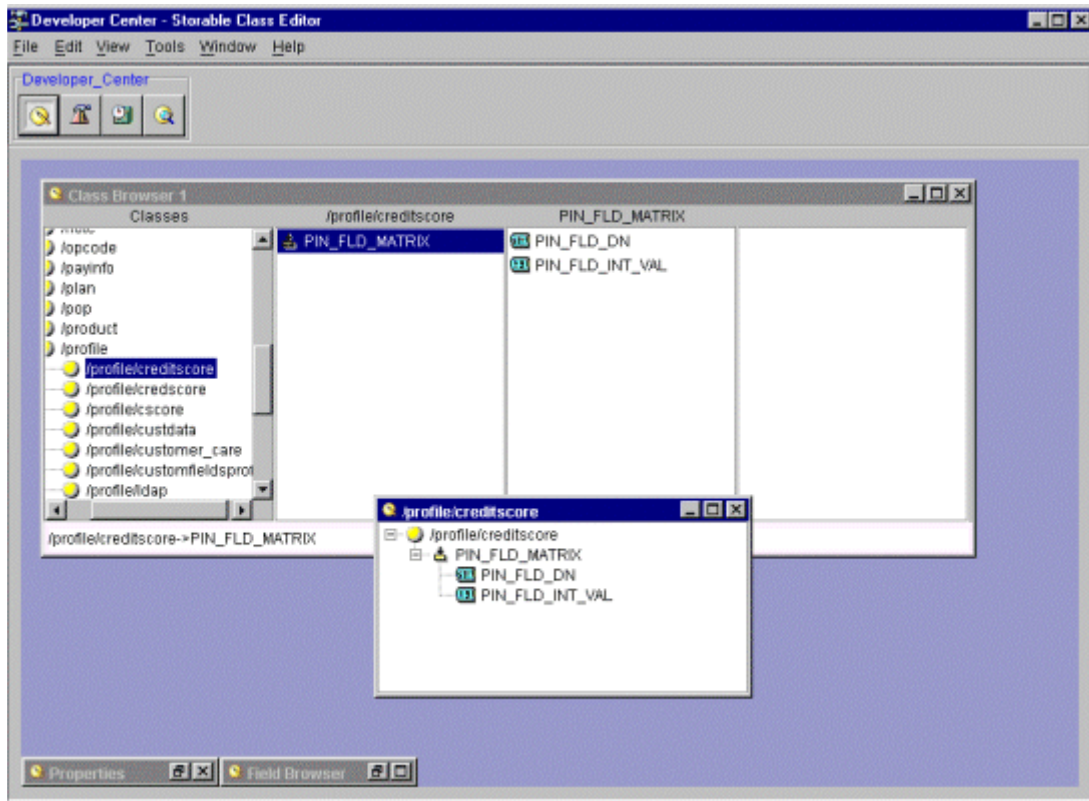
---

To create a new profile panel:

1. Be sure the `/profile/creditscore` profile object has been created in BRM.

[Figure 38-1](#) shows a sample window from Developer Center. The `CreditScoreProfile.sce` file is open.

Figure 38-1 Developer Center View of /profile/creditscore Object



2. Go to the `CCSDK_Home/CustomCenterSDK/CustCntrExamples/Profile` directory.
3. Copy `ProfileTemplate.txt` to `CustomProfile.java`. You can give the file any name.
4. Edit `CustomProfile.java` by changing all instances of `XXX` to `CustomProfile` (or whatever you have named your file) and move this file to the `CCSDK_Home/CustomCenterSDK/CustCntr/custom` directory.

---

**Important:** Always develop your deployment code in the `CCSDK_Home/CustomCenterSDK/CustCntr/custom` directory.

---

5. Find the following line of code:

```
setProfileType();
```

and modify this line to call out your profile subclass. For this example, change the line to:

```
setProfileType("creditscore");
```

---

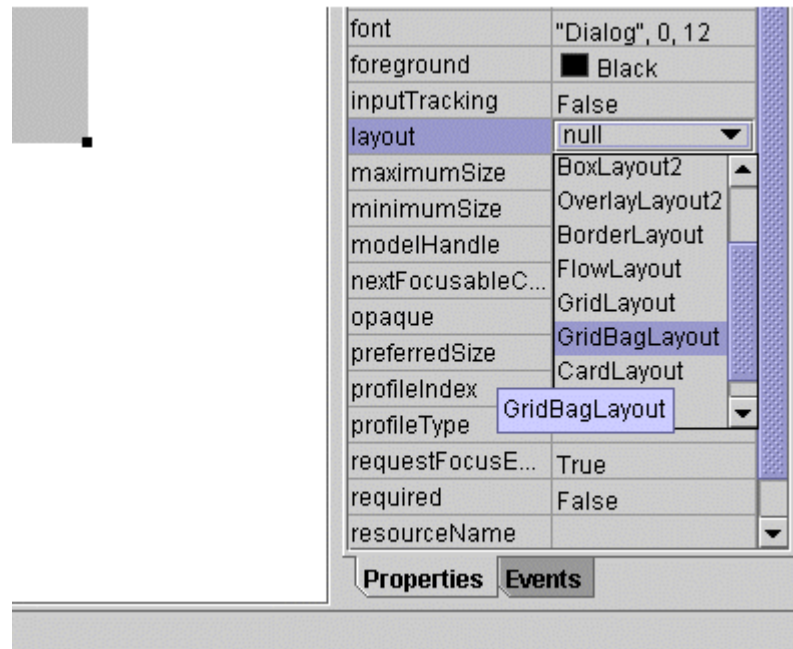
**Important:** Be sure to omit the `/profile`.

---

6. Start JBuilder and load the project you previously created.  
The example project is called `MyCustomizations`.

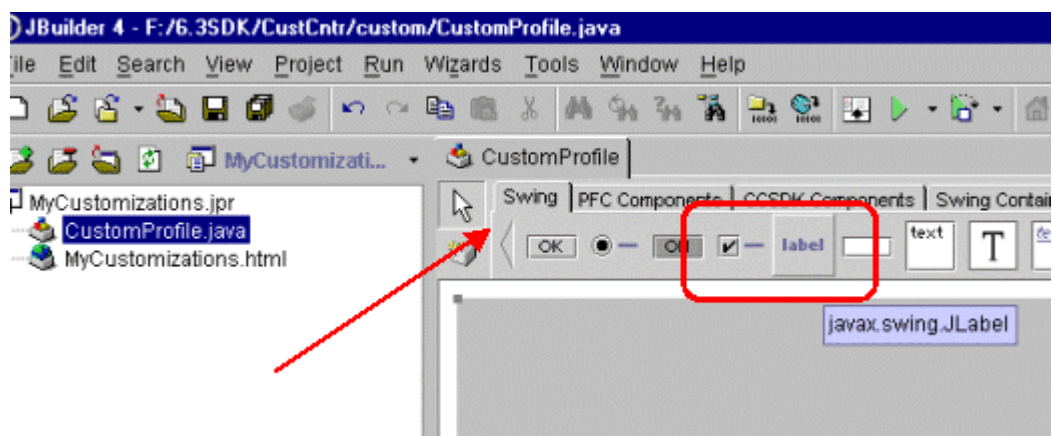
7. Choose **File – Open** to open the **CustomProfile.java** file, and then click the **Design** tab.
8. Select the gray panel in the center of the screen and make sure the layout is set to **GridBagLayout**.  
If not, choose **GridBagLayout** from the drop-down menu associated with the layout property as shown in [Figure 38-2](#).

**Figure 38-2** *Setting GridBagLayout*



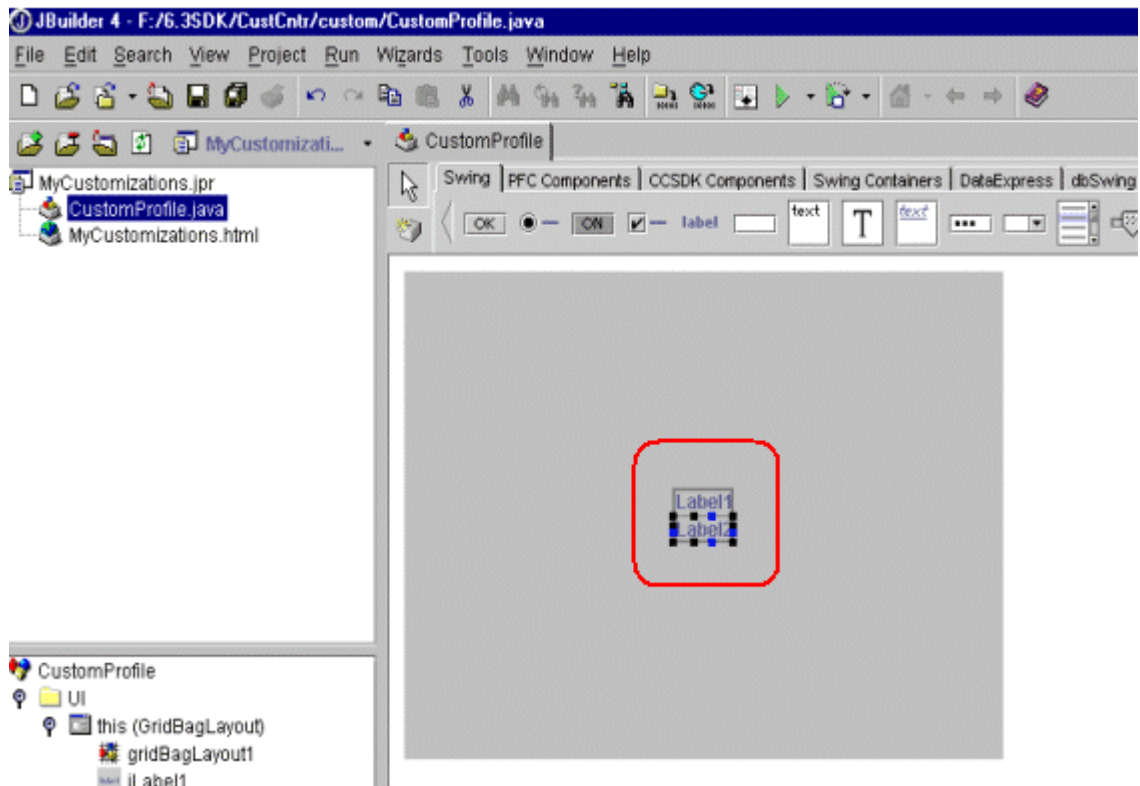
9. From the Swing widget palette, select the **Label** widget as shown in [Figure 38-3](#).

**Figure 38-3** *Selecting the Swing Label Widget*



10. Drag a label widget in the gray work area in the center of the screen.
11. Select the label widget again and drag it below the first one as shown in [Figure 38-4](#).

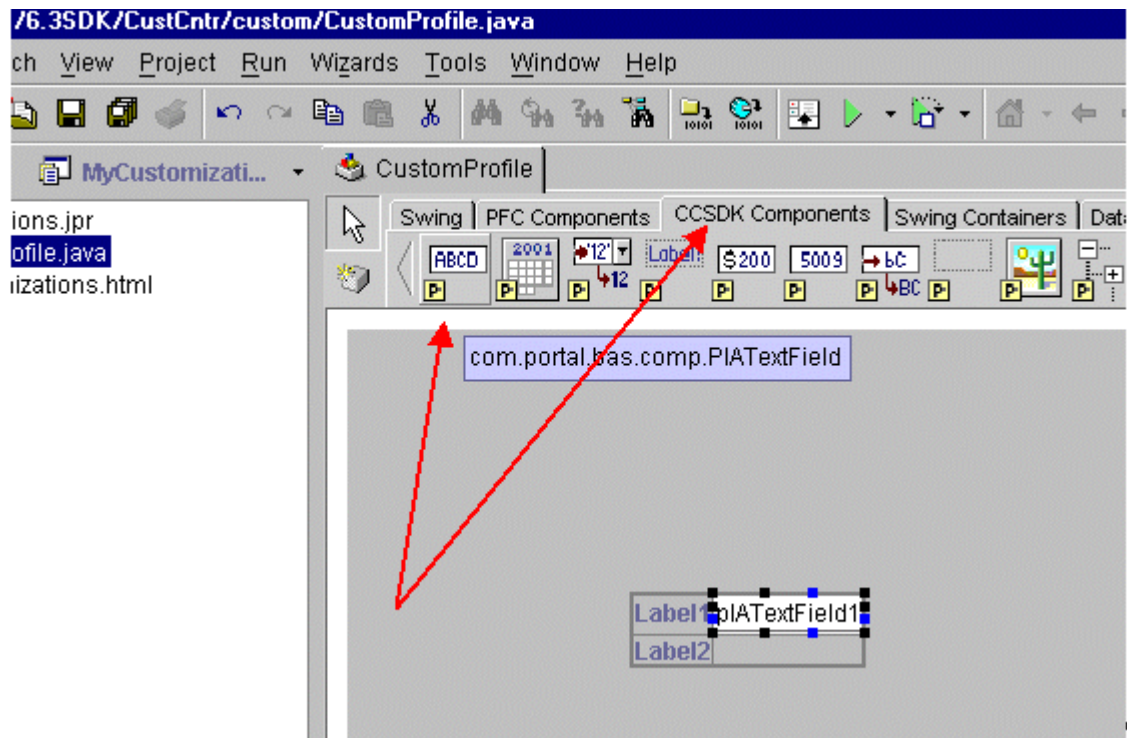
Figure 38–4 Adding a Second Label Widget



12. From the widget palette on the **CCSDK Components** tab, drag the `PIATextField` widget next to the first label widget as shown in [Figure 38–5](#).



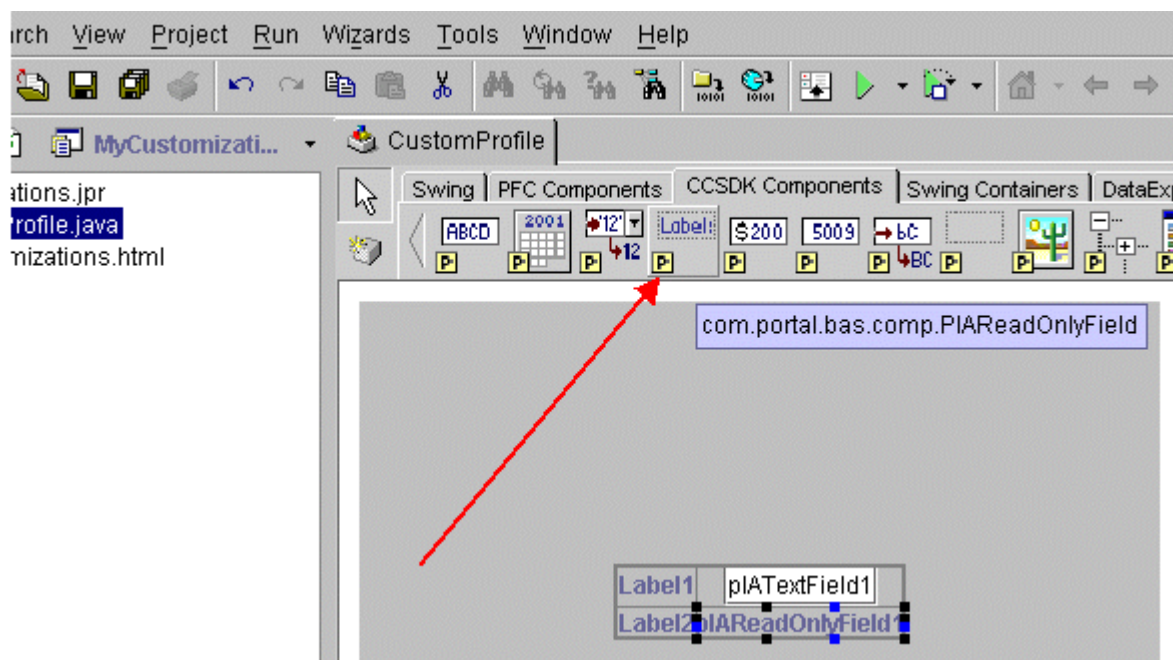
Figure 38–5 Adding a CCSDK PIATextField Widget



13. Drag a PIAReadOnlyField widget next to the second label widget.

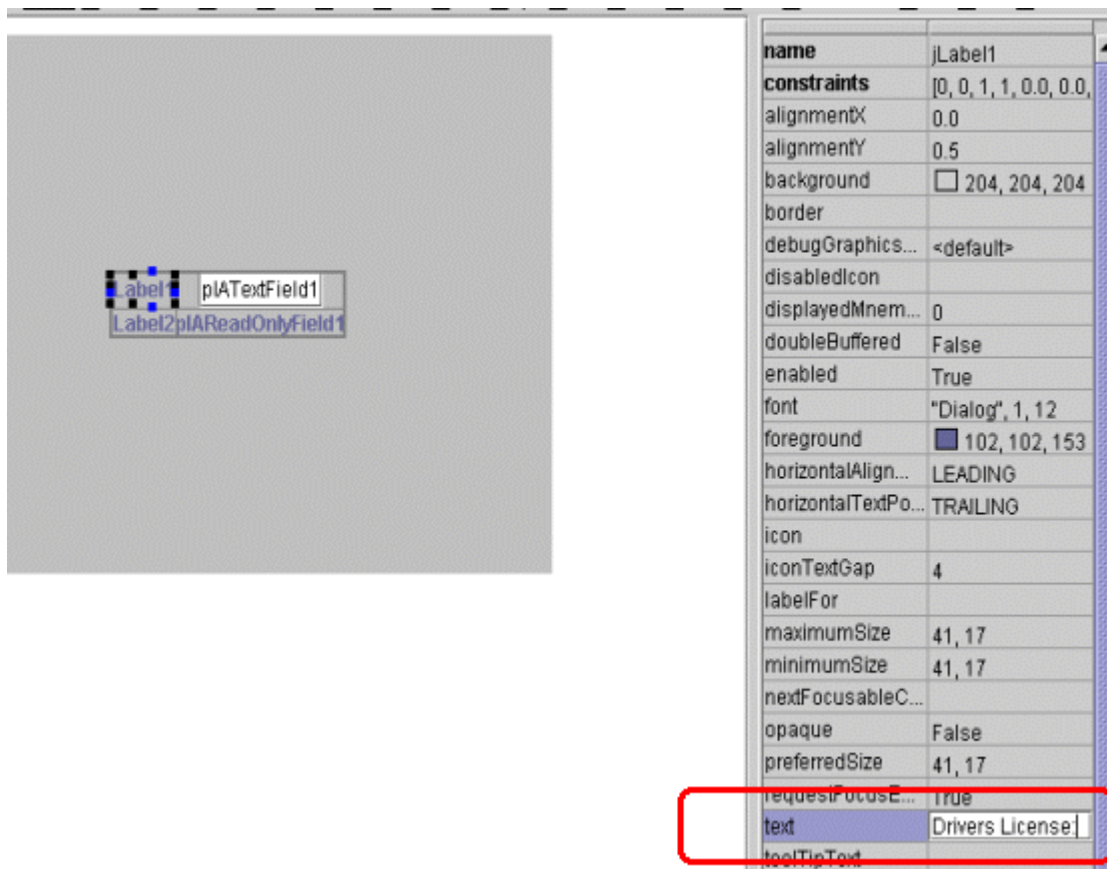
In Figure 38–6, the first field is editable and the second is read-only:

Figure 38–6 Adding a PIAReadOnly Widget



14. Select the first label, click the text widget property, and enter the text Drivers License as shown in Figure 38–7:

Figure 38-7 Adding Text to a PIATextField



15. Click the second label and enter Credit Score: as its text property.
16. Click the first textfield widget (the PIATextField).

In this example, you map this widget to the `/profile/creditscore` field that stores the drivers license data. With the widget selected, right-click the `pIATextField1` instance variable on the left panel and choose **Customizer**.

17. To connect to BRM, enter the login and password.

---

**Note:** You might need to expand the **Connection info** section and enter the host and port.

---

18. In the Customizer dialog box, scroll down and expand the **profile** section of the tree and select the `/profile/creditscore` storable class. This is the profile object you created in Developer Center.
19. Select `PIN_FLD_DN` in the right pane.

The information at the bottom of the Customizer is filled in. This is the mapping of BRM fields to Java field names, which maps your widget to a BRM field. The customizer automatically fills in the necessary information to enable BAS to read and write the data to and from BRM.

In this example, you can leave the `DisplayFieldFormat` as is, it is used only when you are working with a BRM field that contains data that does not make sense to a

person, such as the int values that represent an account's status. See the SDK documentation for more information on this field.

20. Click the **Apply** button, and then click **OK**.

The values are copied automatically from the Customizer to the appropriate widget properties.

21. Select the pIAReadOnlyField widget and display its customizer.

You are already connected to BRM, so you do not need to log in again.

22. Select PIN\_FLD\_INT\_VAL, click **Apply**, and then click **OK**.

23. Save your changes in JBuilder.

At this point, you are done. However, you can modify the layout by adding space between the widgets and renaming the widgets more appropriately. For example, to rename the textfield widget, select its name property and change it to driversLicenseTextField.

24. If required, modify the initial widget values.

For example, select the textfield widget, select the columns property on the right side, and enter a value of **10** as shown in [Figure 38–8](#).

**Figure 38–8** *Editing the Columns Property*

|                          |   |
|--------------------------|---|
| <b>constraints</b>       | [1, 0, 1, 1, 0.0, 0.0, 10, 0              |
| alignmentX               | 0.5                                       |
| alignmentY               | 0.5                                       |
| associatedClass          |   |
| background               | <input type="checkbox"/> White            |
| border                   | Compound Border                           |
| caretColor               | <input checked="" type="checkbox"/> Black |
| caretPosition            | 0   |
| <b>columns</b>           | <b>10</b>                                 |
| currencyDisplay          | False                                     |
| debugGraphicsOptio...    | <default>                                 |
| disabledTextColor        | <input type="checkbox"/> 153, 153, 153    |
| displayFieldDescripti... | FldMatrix[any],FldDn                      |
| displayFieldFormat       | ...                                       |

25. Select the textfield widget and on the right side of the JBuilder work area, click the text property. By default, it contains pIATextField. Delete the entire string.
26. If required, modify the read-only widget.
  - a. Right-click the widget and set its fill to Horizontal.
  - b. Select its text property value and delete it.

---

**Tip:** You can switch back to the source code window to see the generated JBuilder code.

---

27. Save your code.
28. Use Configurator to integrate your profile panel to Customer Center:

- If you are adding the profile panel to the account maintenance interface, see ["Tab Options"](#).
- If you are adding the profile panel to the new account interface, see ["New Account Page Options"](#).

## What's Next

If you have no further Customer Center customizations to code, see ["Building Your Customer Center Customizations"](#).

---

---

## Creating a New Customer Center Service Panel

This section uses an example to show how to create a new Oracle Communications Billing and Revenue Management (BRM) Customer Center service panel using JBuilder.

---

---

**Note:** These instructions assumed you have already set up JBuilder.

---

---

Before you read this chapter, you should be familiar with these concepts:

- [Understanding the PCM API and the PIN Library](#)
- [Understanding Flists and Storable Classes](#)
- [About Customer Center](#)
- [Understanding the BRM Business Application SDK Framework](#)
- [Customizing the Customer Center Interface](#)

You should also have a working knowledge of JBuilder.

### Creating a New Service Panel

Service panels are extensions to the `PIAExtendServiceBase` class. They are used to add data entry or display fields to the account maintenance service tab. The fields displayed are dependent on the type of service selected.

---

---

**Note:** You mostly work with the widgets in the CCSDK Components widget palette since they are BRM aware. Additional widgets are included under the PFC **Components** tab, but they are not BRM aware. They provide functionality beyond the normal Java widget set, such as links, section headers, and drop-down menus.

---

---

As an example, these instructions create a panel for the email service. This panel includes three fields:

- **Maximum message size**
- **Mailbox path**
- **Service status**

---



---

**Note:** Customer Center displays status information elsewhere in the UI. The service status field is added here as an example only.

---



---

Follow these steps to create a new service panel:

1. Go to the `CCSDK_Home/CustomCenterSDK/CustCntrExamples/Service` directory.
2. Copy `ServiceTemplate.txt` to `CustomService.java`. You can give the file any name.
3. Edit `CustomProfile.java` by changing all instances of `XXX` to `CustomService` (or whatever you have named your file) and move this file to the `CCSDK_Home/CustomCenterSDK/CustCntr/custom` directory.

---



---

**Important:** Always develop your deployment code in the `CCSDK_Home/CustomCenterSDK/CustCntr/custom` directory.

---



---

4. Start JBuilder and load the project you previously created.  
The example project is called `MyCustomizations`.
5. Choose **File – Open** to open the `CustomProfile.java` file.
6. (Optional) Include code to inform the base class that you are handling the login and password data entry elsewhere.

You might want full control over how the login and password data are entered. For example, some services store non-traditional information in the **login** and **password** fields, such as phone numbers and URLs. In these situations, you should change the UI field labels accordingly. If you fill in these fields automatically, you may also not want to display these fields at all.

To instruct the base class that you are handling login and password data entry elsewhere:

- a. In JBuilder, click the **Source** tab.
- b. Add the following code towards the bottom of your source file:

```
public boolean supportsLoginAndPassword() {
    return true;
}
```

- c. Save the file

---



---

**Important:** Your UI must accommodate these fields with fields you add to the UI and label yourself or by passing the appropriate data directly to the input list.

---



---



---



---

**Note:** This example assumes that login and password entry is done in the traditional sense. In this situation, you do not need to add these fields to your UI.

---



---

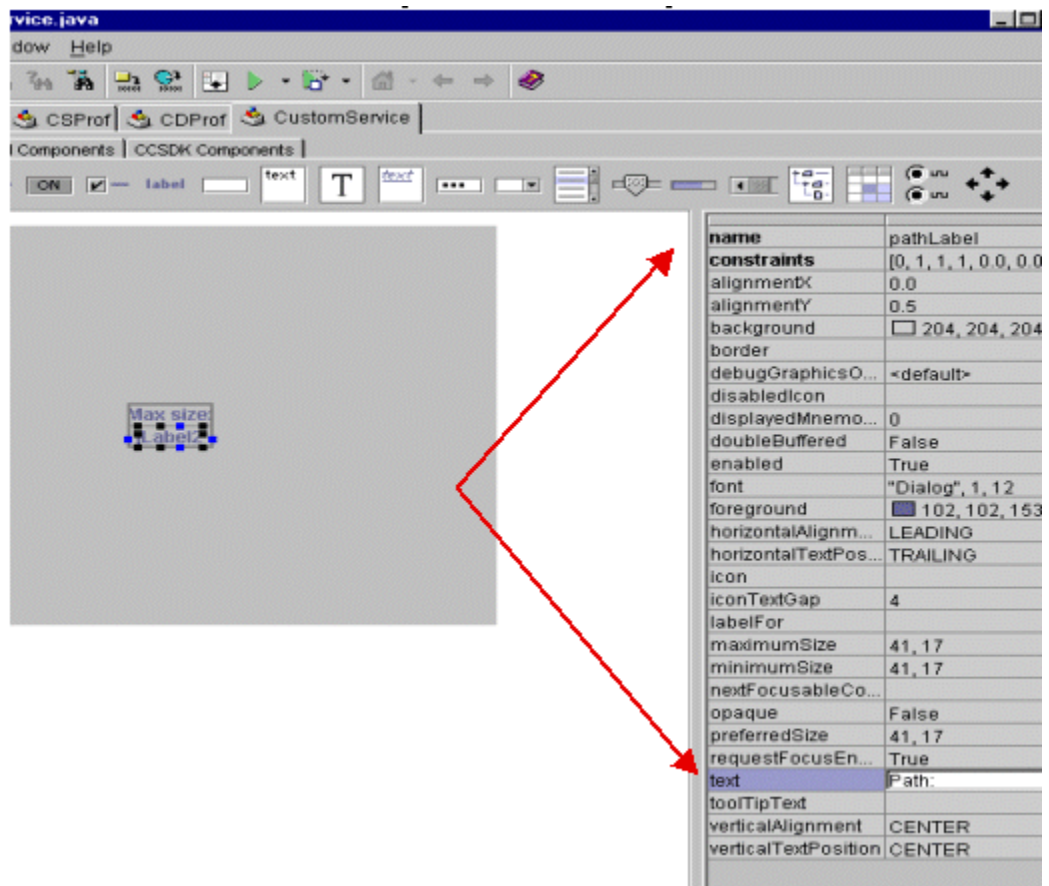
7. Click the **Design** tab.

8. Select the gray panel in the center of the screen and make sure the layout is set to GridBagLayout.
 

If not, choose GridBagLayout from the drop-down menu associated with the layout property.
9. From the Swing widget palette, select the Label widget.
10. Drag one label in the gray work area in the center of the screen.
11. Select the label widget again and drag it below the first one.
12. Select the first label, click the name attribute and change it to maxSizeLabel.
13. Click the text attribute and change it to Max size.
14. Select the second label, click the name attribute and change it to pathLabel.
15. Click the text attribute and change it to Path: as shown in [Figure 39-1](#).
 

This represents the mailbox path value.

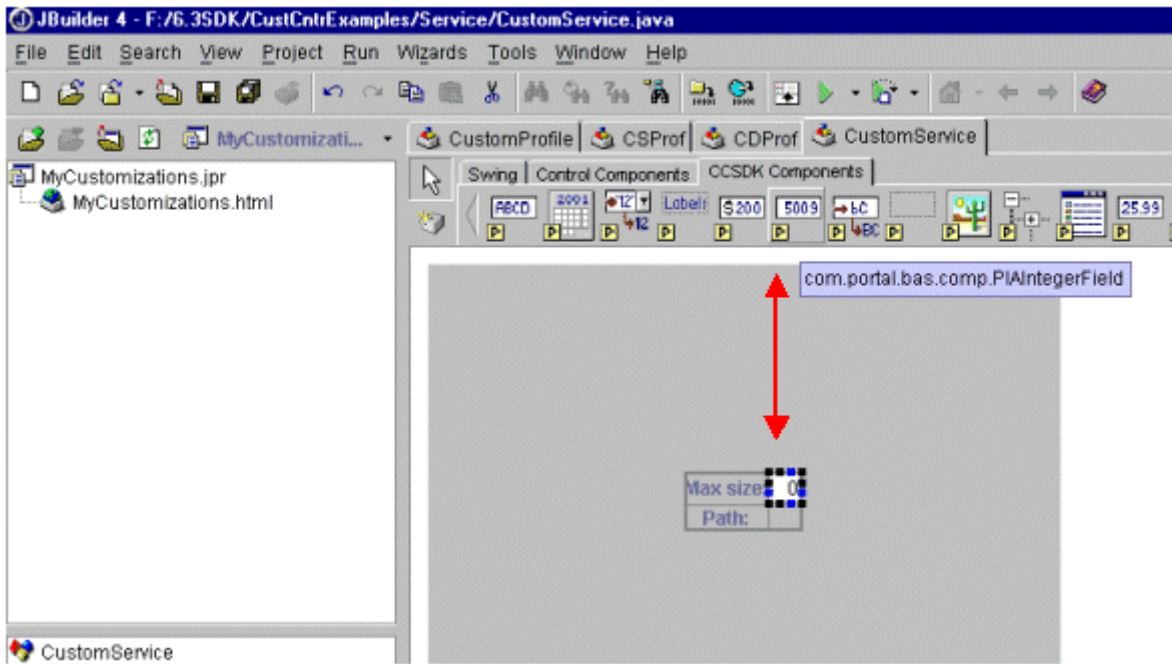
**Figure 39-1** Changing the Text Attribute



16. From the CCSDK Components widget palette, select the PIAIntegerTextField widget and drag it to the right of the Max size label widget as shown in [Figure 39-2](#).

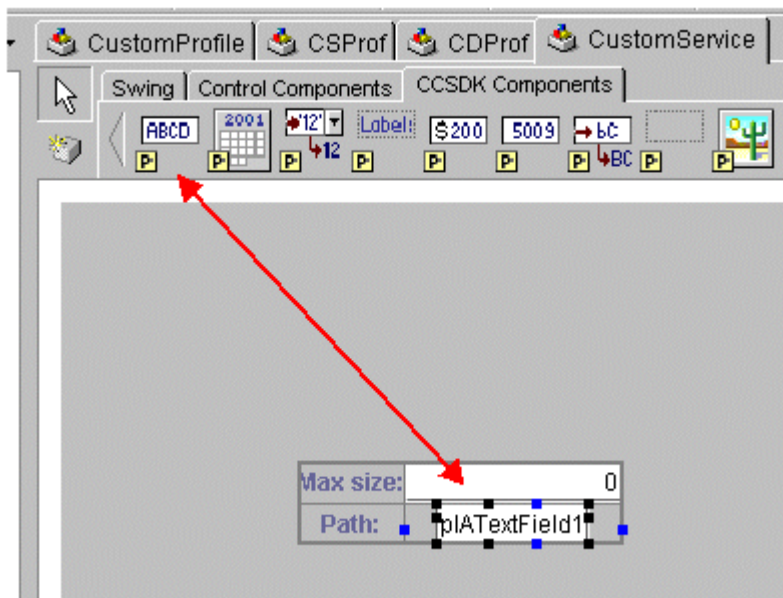
This configures the widget to capture the max size data in an integer-only text entry widget.

**Figure 39–2 Adding a PIAIntegerTextField Widget**



17. Select the PIAIntegerField widget and select the columns attribute.
18. Change the columns attribute to 10.  
This causes the widget width to expand.
19. Right-click the widget and from the menu and set its fill to Horizontal.
20. Select the PIATextField widget and drag it to the right of the Path widget as shown in Figure 39–3.

**Figure 39–3 Adding a PIATextField Widget**



21. Change the widget columns attribute to 10 and set its fill to Horizontal.

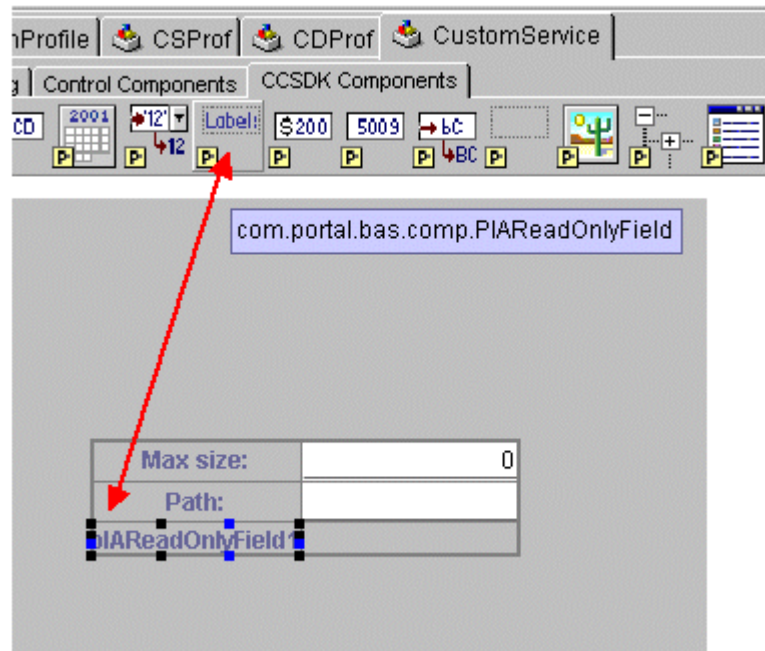


22. Select the existing text and delete it.

This clears the text attribute so it no longer reads `PIATextField`.

23. Click the `PIAReadOnly` widget from the CCSDK Components palette and drag it below the Path: label as shown in [Figure 39-4](#).

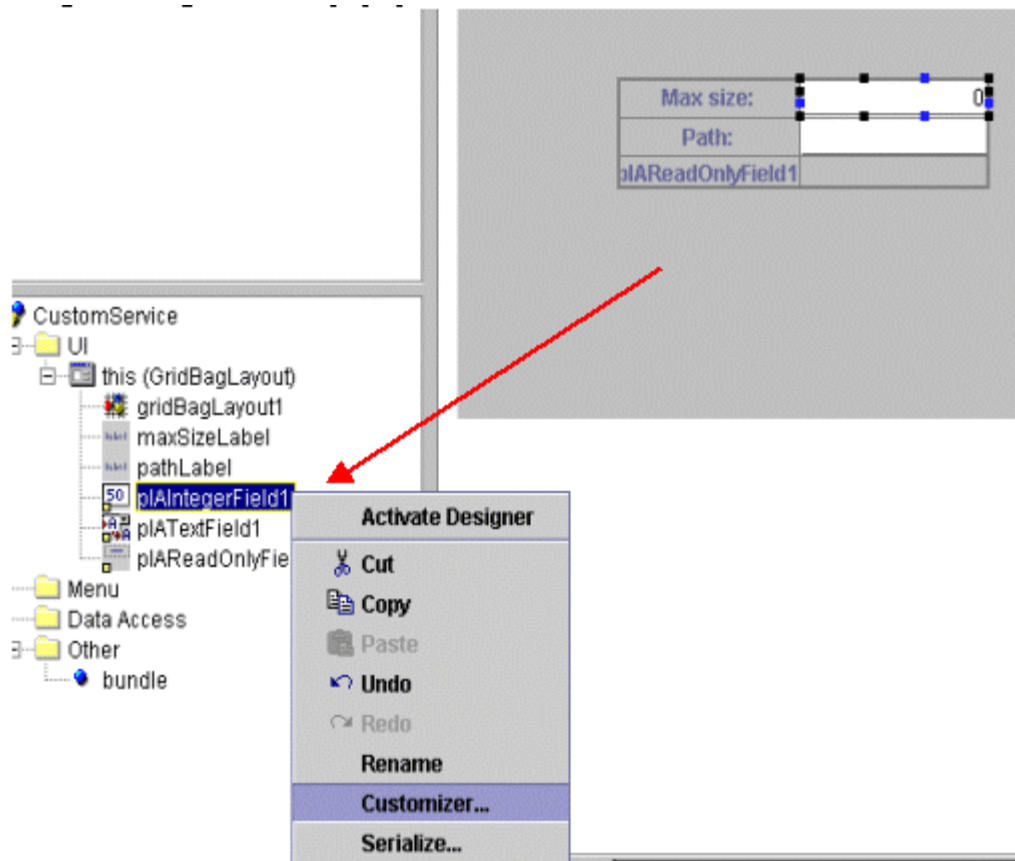
**Figure 39-4 Adding a `PIATextReadOnly` Widget**



24. Map the widgets to BRM fields:

- a. Click the `PIAIntegerTextField` representing "Max size" and bring up the Infranet-aware customizer.
- b. Select the variable instance for this widget and right click to popup the action menu.
- c. Select Customizer as shown in [Figure 39-5](#).

**Figure 39–5** *Selecting Customizer*




---

**Note:** Before the customizer appears, you must log in to BRM. Log in as you normally would.

---

- d. From within the customizer, locate the `/service/email` node in the tree and Click the `PIN_FLD_MAX_MSG_SIZE` field on the right.
  - e. Select **Apply**, and then **OK**.  
You have now mapped that widget to a field in BRM.
  - f. Follow the same procedure to map the Path textfield widget to `PIN_FLD_PATH`.
25. Map the read-only widget to a BRM field:
- a. Launch the read-only widget customizer.
  - b. Select that class and select `PIN_FLD_STATUS`.

---

**Tip:** Since the widget is read-only and its value cannot change, you do not need to work with the `ModelFieldDescription`. (`ModelFieldDescription` is what the Business Application SDK (BAS) turns into the input flist when it saves data). You can delete this value.

---

---



---

**Note:** The field is not in the `/service/email` class but instead in the base `/service` class.

---



---

**26. Click Display Field Format.**

The Display Field Format editor appears.

---



---

**Tip:** You change the display field format feature to make BRM values easier for the user to read.

---



---

**27. Enter the BRM data value and the string you want displayed in the UI.**

**28. When you are finished, click Done.**

This updates the BAS widget property with the correct mapping format.

**29. (Optional) Add the leading text **Status -** to the front of the display field format.**

**30. Save your file.**

Your basic service panel is now complete.

**31. Compile your panel using the **buildAll** script in the top-level SDK directory.**

See "[Building Your Customer Center Customizations](#)".

**32. Add this entry to the `CC_SDK/CustomCareSDK/CustCntr/custom/Customized.properties` file:**

```
extended.service.email=CustomService
```

Replace *CustomService* with the name of your Java Class.

This entry makes Customer Center aware of the new service panel.

**33. From the `CC_SDK/CustomCareSDK/CustCntr/bin` directory, start your local copy of Customer Center (run **CustomerCenter.bat**).**

**34. Locate an account containing an email service.**

**35. Switch to the **Services** tab and select the email service in the table.**

Your panel and the default widget set appear.

If the fields on your service panel need alignment, see "[Correcting Field Alignment](#)".

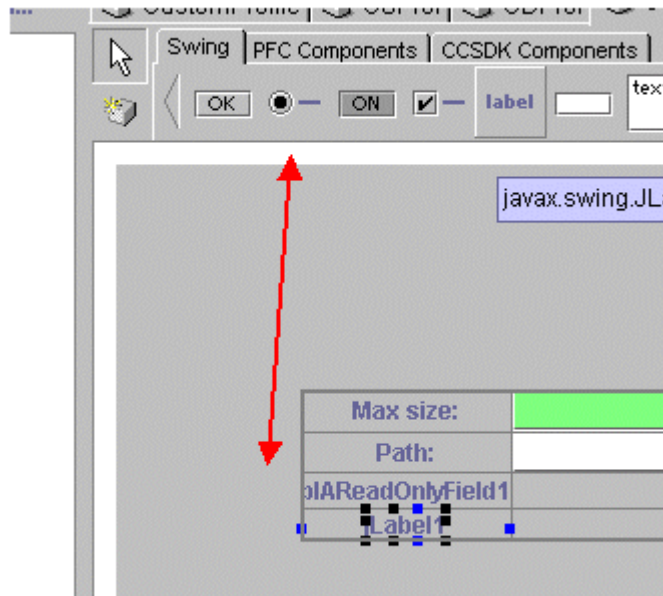
## Correcting Field Alignment

If your panel has alignment problems, you might need to work with the Java layout to correct them.

This section describes how to add a blank widget in your panel to fix alignment problems. The widget is invisible but takes up the extra space within the panel. (By default, widgets in a GridBagLayout tend to move towards the center.)

1. Exit Customer Center.
2. Open JBuilder and click the **Design** tab.
3. From the **Swing** widget palette, select the 'label' widget and drop it below your status read-only widget as seen in [Figure 39-6](#).

**Figure 39–6 Adding a Label Widget**



4. Click the constraints attribute.
5. Select the ... button to launch the editor.
6. Set the **Grid Position Width** to 2; set the **Weight X** and **Y** parameters to 1; set the **Fill** parameter to **BOTH** as seen in [Figure 39–7](#).

Figure 39-7 GridBagConstraints Editor

The first 3 rows of widgets should move toward the top of the panel.

You have just told the label in the fourth row to take up two columns of space, and all remaining space on the bottom.

7. Delete the value in this widget's 'text' attribute so it no longer reads 'label'. Select the 'text' attribute on the right side of JBuilder and delete the text.
8. Save your changes, compile, and re-launch Customer Center. When you revisit your service panel the layout should be improved.

## What's Next

If you have no further Customer Center customizations to code, see ["Building Your Customer Center Customizations"](#).



---

---

## Sample Customer Center Customizations

This chapter describes various kinds of customizations you can make to the Oracle Communications Billing and Revenue Management (BRM) Customer Center interface.

Before you read this chapter, you should read:

- [Using Customer Center SDK](#)
- [Customizing the Customer Center Interface](#)
- [Using Configurator to Configure Customer Center](#)

This chapter describes how you can customize various fields and behaviors in several Customer Center tabs and in the Search feature.

### Building and Deploying Customizations

To build and deploy the customizations described in this chapter, see "[Building Your Customer Center Customizations](#)" and "[Deploying Your Customer Center Customizations](#)".

### Customizing Contact Fields

This section describes how you can customize the Customer Center contact fields. The contact fields appear in the Contact page of the New Account wizard and in the **Summary** tab.

---

---

**Note:** For simplicity, this section uses **Contact** page to refer to both the Contact page in the New Account wizard and the contact fields in the summary tab.

---

---

### Customizing Contact Fields

This section describes how to customize some default contact fields within a contact record. For information on modifying contact field behavior when there is more than one contact, see "[Modifying Multiple Contact Behavior](#)". For information on replacing address and contact panels with your own custom panels, see "[Using Custom Address Panel and Contact Page](#)".

#### Adding Drop-Down Lists to the Contact Type and Salutation Fields

To replace the **Contact type** and **Salutation** text fields with drop-down lists:

1. Extend the `com.portal.app.cc.PContactPage` class.

- Call the following methods from the extended class:

- For the **Salutation** drop-down list:

```
protected final void setValidSalutations(String salutations[],String
defaultSalutation)
super.customizeNow();
```

- For the **Contact type** drop-down list:

```
protected final void setValidContactTypes(String contactTypes[],String
defaultContactType)
```

where:

- The first parameter contains the list of values displayed in the drop-down list.
- The second parameter specifies the default value for the field.

Example method call:

```
protected final void setValidSalutations(String
salutations["Mr.", "Ms.", "Mrs."],String "Mr.")
super.customizeNow();
```

See also "[Disabling Changes to the Contact Type for the First Contact](#)".

### Populating Drop-Down List Values from a Properties File

To populate drop-down list values from a properties file:

- Add the following line to the *CCSDK\_Home/CustomerCareSDK/CustCntr/custom/CustomizedResources.properties* file:

```
mycontactpage.contacttype=Billing,Mailing,Shipping
```

- Add a method to your customized class, such as the one extended from **PContactPage**, that reads the drop-down list values from the properties file, as in this example for the **Contact type** field:

```
private String[] getValidContactTypes() {
    try {
        final String delimiter = ",";
        String contactypestring = getResourceBundle().getString("mycontactpage.
contactype");
        return contactypestring.split(delimiter);
    } catch (MissingResourceException e) {
        //A customized error message can be added here to informing the end user of
the error
        String[] retval = {" "};
        return retval;
    }
}
```

When the list of valid data is read, you can set it by calling the base class method:

```
setValidContactTypes(getValidContactTypes(), "Billing");
```

### Adding Drop-Down Lists to Address Panel Fields

To replace the **City**, **State/Province**, **ZIP/Postal**, and **Country** text fields in the **Contact** page with a drop-down list:

- Extend the **com.portal.app.cc.PAddressPanel** class.
- Call the following methods:



- For the **City** drop-down list:
 

```
protected final void setValidCities(String[] cities,String defaultCity)
```
- For the **State/Province** drop-down list:
 

```
protected final void setValidStates(String[] states,String defaultState)
```
- For the **ZIP/Postal** drop-down list:
 

```
protected final void setValidZips(String[] zips,String defaultZip)
```
- For the **Country** drop-down list:
 

```
protected final void setValidCountries(String[] countries,String defaultCountry)
```

where:

- The first parameter is the list of values displayed in the drop-down list.
- The second parameter specifies the default value for the field.

### Populating drop-down list values from a properties file

To populate the drop-down list values from a properties file:

1. Add the **myaddresspanel** parameters to the *CCSDK\_Home/CustomCareSDK/CustCntr/custom/CustomizedResources.properties* file, as in this example for countries:

```
myaddresspanel.countries=US,UK,India
```

---



---

#### Note :

- This entry is for the country field. Follow the same procedure for the **City**, **State/Province**, and **ZIP/Postal** fields.
  - The list drop-down list values will be displayed in the order placed in the parameter.
- 
- 

2. Add a method to your customized class, such as the one extended from **AddressPanel**, that reads the drop-down list values from the properties file, as in this example:

```
private String[] getValidCountries() {
    try {
        final String delimiter = ",";
        String countrystring = "A,B,C,D";
        return countrystring.split(delimiter);
    } catch (MissingResourceException e) {
        String[] retval = { "" };
        return retval;
    }
}
```

Once you have the list of valid data then you can set it by calling the base class method:

```
String defaultCountry = "US";
setValidCountries(getValidCountries(),defaultCountry);
```

## Adding and Removing Item Listeners to Address Field Drop-Down Lists

You can add and remove item listeners to the **Address** drop-down fields that trigger actions depending on which value the CSR selects. For example, you can use listeners to dynamically populate drop-down list values for the **State/Province** field depending on the country that the customer service representative (CSR) selects for the **Country** field.

To add and remove item listeners to the address fields, use these methods:

- For the **Country** drop-down list:

```
protected final void addCountryListener(ItemListener l)
protected final void removeCountryListener(ItemListener l)
```

- For the **State/Province** drop-down list:

```
protected final void addStateListener(ItemListener l)
protected final void removeStateListener(ItemListener l)
```

- For the **City** drop-down list:

```
protected final void addCityListener(ItemListener l)
protected final void removeCityListener(ItemListener l)
```

- For the **ZIP/Postal** drop-down list:

```
protected final void addZipListener(ItemListener l)
protected final void removeZipListener(ItemListener l)
```

## Modifying Multiple Contact Behavior

This section describes how to customize **Contact** page fields and behavior for accounts with more than one contact.

### Specifying the Contact Type for Each Consecutive Contact

You can specify custom contact types by adding the following parameters to the **Customized.properties** file in the **CCSDK\_Home/CustomCareSDK/CustCntr/custom** directory:

- For the first (mandatory) contact panel, use this parameter:

```
custinfo.panel.billingcontact.1=<customcontacttype>
```

- For the second and consecutive panels, use this property:

```
custinfo.panel.newcontact.index=<customcontacttype>
```

where *index* is **2** for the second panel and increments by 1 for each subsequent panel. If a new contact has no corresponding type set, for example if you add a fourth contact and **custinfo.panel.newcontact indexes** are only available for contacts 1, 2, and 3, the contact type defaults to a blank field.

### Disabling Changes to the Contact Type for the First Contact

You can disable the custom **Contact type** drop-down list for the first contact and restrict the field value to a certain value, such as **Billing**.

To set a static **Contact type** value for the first contact, call the following method with the parameter **true** from the contact type subclass:

```
protected final void setDisableBillingContactType(boolean b)
```

## Configuring Duplicate Checking for the Contact Type Field

You can configure duplicate checking for the **Contact type** field by calling the following method with the parameter **true**:

```
protected final void setContactDuplicateCheckOn(boolean b)
```

By default, duplicate checking is turned off.

## Configuring the Contact Type Validation Error Messages

You can customize the error messages that Customer Center displays when contact type uniqueness validation is enabled. (That is, when **setContactDuplicateCheckOn** is set to **true**).

Customer Center displays contact type error messages:

- When the contact type has already been specified for a previous contact and the CSR specifies a contact type for a secondary contact.

By default, the error message displayed is **Contact type duplicate check is on, cannot be duplicated**. To change this message, add the following line to the *CCSDK\_Home/CustomerCareSDK/CustCntr/custom/CustomizedResources.properties* file:

```
custinfo.validate.duplicatecontacttypes=Error_Message
```

where *Error\_Message* is the error message string.

---



---

**Note:** Do not put the string in quotes.

---



---

- When the CSR attempts to add a new contact without selecting a valid contact type.

By default, the error message displayed is **Contact type duplicate check is on, inadequate contact types**. To change this message, add the following line to the *CCSDK\_Home/CustomerCareSDK/CustCntr/custom/CustomizedResources.properties* file:

```
custinfo.validate.inadequatecontacttypes=Error_Message
```

where *Error\_Message* is the error message string.

---



---

**Note:** Do not put the string in quotes.

---



---

## Using Custom Address Panel and Contact Page

This section describes how to replace the default Address panel and Contact page with your customized versions.

### Replacing the Address Panel with a Custom Panel

This section describes how to replace the **Address panel** with a custom Address panel.

---



---

**Note:** This procedure only customizes the **City**, **State/Province**, **ZIP/Postal**, and **Country** fields. The **Address** field isn't customized with this procedure.

---



---

To replace the **Address** panel of the **Contact** page with a custom **Address** panel:

1. Extend the `com.portal.app.cc.PAddressPanel` class.
2. Copy the Java source file of the custom class to the `CCSDK_Home/CustomerCareSDK/CustCntr/custom` directory.
3. Open the customized properties file (`CCSDK_Home/CustomerCareSDK/CustCntr/custom/Customized.properties`) and add this line after the comment statements:

```
com.portal.app.cc.PAddressPanel.subclass=MyAddressPanel
```

where `MyAddressPanel` is the name of your extended class.

4. Save the file.

### Replacing the Contact Page with a Custom Page

This section describes how to replace the **Contact** page with a custom **Contact** page.

1. Extend the `com.portal.app.cc.PContactPage` class.
2. Copy the Java source file of the custom class to the `CCSDK_Home/CustomerCareSDK/CustCntr/custom` directory.
3. Open the customized properties file (`CCSDK_Home/CustomerCareSDK/CustCntr/custom/Customized.properties`) and add these lines after the comment statements:

```
com.portal.app.cc.PContactPage.subclass=MyContactPage
contactspage.class=MyContactPage
helpid.acwizard.contactpage=MyContactPage
```

where `MyContactPage` is the name of your extended class.

4. Save the file.

## Customizing Fields in the Balance Tab

This section describes how to customize the **Action** drop-down list in the **Balance** tab.

### Setting the Correct JRadioButtonMenuItem Button

To indicate the balance page state, you can add `JRadioButtonMenuItem` to the **Action** drop-down list on the **Bills** panel of the **Balance** tab:

1. Extend `PARBalancePage` class and create a `JRadioButtonMenuItem` object.
2. Add the object by calling the `addRadioMenuToAction(JRadioButtonMenuItem)` method.

## Customizing Fields in the Payments Tab

This section describes how to customize various fields in the **Payments** tab.

## Disabling the Billing Cycle & Tax Setup Link in the Payments tab

You can enable or disable the **Billing Cycle & Tax Setup** link in the **Payments** tab and enable or disable the fields in the **Tax Setup** panel.

- To enable or disable the **Billing Cycle & Tax Setup** link in the **Payments** tab, call the methods in [Table 40–1](#):

**Table 40–1 Payments Tab Methods**

| <b>PPaymentPage methods</b>                        | <b>Description</b>                                     |
|--|--|
| <code>disableBillingCycleAndTaxSetupLink ()</code> | Disables the <code>BillingCycleAndTaxSetup</code> link |
| <code>enableBillingCycleAndTaxSetupLink ()</code>  | Enables the <code>BillingCycleAndTaxSetup</code> link  |

- To enable or disable the fields in the **Tax Setup** panel, use the new `setTaxSetupEnabled(boolean)` flag. Call this method from the extended `PbillingCycleAndTaxSetupPage` class. This method is provided in `PbillingCycleAndTaxSetupPage`. The default is enable.

## Configuring Values in the Billing Day of Month Combo Box

You can configure the list of available values in the **Billing day of month** spinner field in the **Payments - Billing Cycle & Tax Setup** panel. For example, you might want to offer a different billing day of month for each brand.

To configure the available values of the **Billing day of month** spinner field:

1. Extend the `PbillingCycleAndTaxSetupPage` class.
2. Create a custom controlled day of month widget by creating a `PIASpinnerField` object.
3. Assign a custom range of values to the object.
4. Call either the `setCustomDomFld(PIASpinnerField sf)` or the `setCustomDomComponent(Component sf)` method, where `sf` is the name of the custom widget.

---

### Note :

- The `setCustomDomFld(PIASpinnerField)` method replaces the **Billing Day of Month** field (`PIASpinnerField`) with another custom `PIASpinnerField`.
  - The `setCustomDomComponent(Component)` method replaces the **Billing Day of Month** field (`PIASpinnerField`) with another custom `Component`.
- 

5. In the Custom billing cycle/tax setup class field in the Configurator **Payments** tab, specify the custom `PbillingCycleAndTaxSetupPage` class name. See "[Payment Configurator](#)".

## Setting the Next Billing Cycle Field to Visible or Not Visible

You can specify whether the **Next billing cycle** read-only field is displayed in the **Payment tab - Billing Cycle & Tax Setup - Billing Cycle** panel by using the `showNextBillingCycle(boolean)` method in an extended `PbillingCycleAndTaxSetupPage` class.

The `showNextBillingCycle(boolean)` method is included in `PbillingCycleAndTaxSetupPage`. This method can be used in the extended payment page to set the **Next billing cycle** field to visible or not visible.

To set the next billing cycle field to visible or not visible:

1. Extend the `com.portal.app.cc.PPaymentPage` class.
2. Call the `showNextBillingCycle(boolean)` method. Pass in `true` (default) for visible and `false` for not visible.

## Customizing the Expiration Date Fields in the Credit Card Panel

You can replace the **Expiration date** field in the **Credit Card** panel of the **Payment Options** dialog box with a custom spinner field. To do this:

1. Open the customized properties file (`CCSDK_Home/CustomCareSDK/CustCntr/custom/CustomizedResources.properties`).
2. After the comment statements, add this line:

```
paymentsetup.creditcard.expirationdate.usespinnerfields=true
```

3. (Optional) Set the year limits for the spinner field by adding these lines:

```
paymentsetup.creditcard.expirationdate.spinnerfield.yearmax=Max_Limit  
paymentsetup.creditcard.expirationdate.spinnerfield.yearmin=Min_Limit
```

where *Max\_Limit* and *Min\_Limit* are the upper and lower bounds for the year value.

---

---

**Note :**

- *Max\_Limit* must be greater than or equal to the *Min\_Limit*. By default range for the year spinner field is **00** to **99**.
  - If *Min\_Limit* is not in the range of **00** to **99**, the system uses **00** for **yearmin**.
  - If *Max\_Limit* is not in the range of **00** and **99**, the system uses **99** for **yearmax**.
  - The month spinner field is hard-coded with the range **00** to **12**. If the CSR selects the default **00**, an error is thrown and the CSR is prompted to select a correct month value.
- 
- 

4. Save the file.

## Creating a Custom Payment Method

You can add a custom payment method to the **New Payment Method** drop-down list. This list appears on the **Payment Options** dialog box, which you can access from the **Payments** tab and the **Account Creation** wizard.

---

---

**Important:** To implement custom payment methods, you must also add them to the BRM system so that your custom methods can be saved and retrieved. See "Customizing Payment Methods" in *BRM Managing Customers*.

---

---

To create a custom payment method:

1. Create a custom panel that extends the BRM class **com.portal.app.cc.comp.PIAPaymentTypePanel**.

The following sample code uses the name **NewPayPanel** for the custom panel:

```
public class NewPayPanel extends com.portal.app.cc.comp.PIAPaymentTypePanel {

    //used while acct creation
    public void shareInData() { }

    //used while acct maintenance
    public void shareInData(PModelHandle model) { }

}
```

2. Create an interface that extends **com.portal.app.ccare.comp.PIAPaymentTypePanelBean**.

The following sample code uses the name **NewPayBean** for the interface:

```
public interface NewPayBean extends PIAPaymentTypePanelBean {
    // NewPayBean is a blank interface
    //PIAPaymentTypePanelBean interface abstract methods are getting implemented in
    the controller class
}
```

3. Create a controller class that extends **PIAComponentCollectionBean** and implements the interface you created in the previous step.

The abstract methods in the **NewPayBean** interface need to be implemented in the new controller class for the custom payment method to work.

In the following sample code, **NewPayBeanImpl** is the name of the new controller class:

```
public class NewPayBeanImpl extends PIAComponentCollectionBean
    implements NewPayBean {

    //Appends additional create-time information onto the model passed in
    public void defaultsForStoring(PModelHandle model)
        throws RemoteException { }

    //Appends additional update-time information onto the model passed in
    public boolean defaultsForUpdate(PModelHandle model)
        throws RemoteException { }

    //Appends additional validate-time information onto the model passed in
    public boolean defaultsForValidation(PModelHandle model)
        throws RemoteException { }

    //Gets the contact Name and Address Info current account model
    public NameAddressData getNameAddressData(PModelHandle modelHandle)
        throws RemoteException { }

}
```

4. Add the following lines to the **CCSDK\_Home/CustomCareSDK/CustCntr/custom/Customized.properties** file:

```
consumerpayment.options=invoice creditcard ddebit new_pay
businesspayment.options=invoice creditcard ddebit new_pay
```

```

maintenance.options=invoice creditcard ddebit new_pay
new_pay.selector=id
id.class=NewPayPanel

```

where:

- *new\_pay* is a text string that identifies your custom payment method internally. It is not the text that will be displayed in Customer Center.
- *id* is the ID for the new payment method. The ID must be a 5-digit number starting with 100. 10000 to 10016 are already used in the default version of Customer Center. Do not use the same number for more than one payment method.
- *NewPayPanel* is the name of the customized panel class for the new payment method.

---

**Note:** The **invoice**, **creditcard**, and **ddebit** strings represent the default payment methods.

---

5. Save and close **Customized.properties**.
6. Add the following line to the `CCSDK_Home/CustomerCareSDK/CustCntr/custom/CustomizedResources.properties` file:

```

payType.format={0,choice,0#Unknown|10000#Prepaid|10001#Invoice|10002#Debit|10003#Credit Card|10004#Direct Debit (Fr)|10005#Direct Debit|10006#Smart Card|10007#Nonpaying child|10008#Unknown|10009#Undefined|10010#Guest|10011#Cash|10012#Check|10013#Wire-Transer|10014#Inter Bank Payment order|10015#Postal order|10016#Voucher|id#New_Pay_Label}
methodofpayment.id=New_Pay_Label

```

where:

- *id* is the 5-digit number you entered in **Customized.properties**.
  - *New\_Pay\_Label* is the name displayed in Customer Center for the new payment method.
7. Save and close **CustomizedResources.properties**.

## Customizing Fields in the Services Tab

This section describes how to customize various fields in the **Services** tab.

### Adding Charges for SIM and MSISDN Changes

To charge for Subscriber Identity Module (SIM) changes and Mobile Station International Subscriber Directory Number (MSISDN) changes:

1. Do one or both of the following:
  - To charge for SIM changes, subclass the **SIMPanel.java** class.
  - To charge for MSISDN changes, subclass **NUMPanel.java**.
2. Create a customized panel with the necessary fields and pass them to the **setCustomData(PIACustomizablePanel)** method as an argument.



The new panel appears at the end of the existing SIM or Number panels in the **Services** tab.

3. In the Configurator **Service** tab, specify the custom class names in the Custom SIM Panel Class and Custom Number Panel Class fields. See "[Service Configurator](#)".

## Adding a Secondary MSISDN for Supplementary Services

To add a secondary MSISDN for supplementary services:

1. Create a custom **PPurchaseOfferingAction** class by extending it.
2. Specify the class path and key in the **customized.properties** file, as in this example:

```
customized.PurchaseOfferingAction.class=<com.portal.app.cc.TestOfferingAction>
```

3. Create a custom **PPurchaseOfferingWizard** class by extending it.
4. Specify the class path and key in the **customized.properties** file, as in this example:

```
customized.PurchaseOfferingWizard.class=<com.portal.app.cc.TestOfferingWizard>
```

5. Create a custom search entry panel class (**PTelcoNumberEntryPanel**) by extending it.

6. Specify the class path and key in the **customized.properties** file, as in this example:

```
device.num.search.entry.panel.class=<com.portal.app.cc.tcf.TestNumberEntryPanel>
```

7. Create a custom search results panel class (**PTelcoNumberResultPanel**) by extending it.
8. Specify the class path and key in the **customized.properties** file, as in this example:

```
device.num.search.results.panel.class=<com.portal.app.cc.tcf.TestNumberResultsPanel>
```

9. Create a custom purchase offering wizard by extending the **PPurchaseOfferingWizard** class.
10. In the extended class, override the **protected Object commitData(PModelHandle model) throws RemoteException** method.
11. (Optional) Create a search popup dialog box for the secondary MSISDN number based on the services that are purchased in the current **MdelHandle**.

To call the custom opcode in **commitData**, call your own method. If you do not want to call the custom opcode, call **super.commitData(model)**.

To retrieve the default value in the **Number Category combo** field, use the **public void setDefaultToNumCategory(String defaultStr)** method in the **PTelcoNumberEntryPanel** class. This can be called with a string (the default value) as a parameter for setting default values in that field.

## Customizing Fields in the Hierarchy Tab

This section describes how to customize various fields in the **Hierarchy** tab.

## Adding a Custom Popup Component to the No Hierarchy Page

You can use the `addAdditionalActions(AbstractAction[] actions)` method in `PAcctNoHierarchyPage` to add a custom popup component to the title panel. When this method is called from the `PAcctNoHierarchyPage` subclass, a new action drop-down is displayed the first time the method is called. If the method has been previously called, the action is added to the existing drop-down list.

To set a label for the action:

1. Define the `public String getMenuLabel()` method with a return string as the label value.
2. Implement the action event by defining the `public void actionPerformed(ActionEvent)` method.

This sample code describes a `PAcctNoHierarchyPage` subclass:

```
public class MyHierarchyPage extends PAcctNoHierarchyPage {
    public MyHierarchyPage() {
        PAddOnAction[] actions = new PAddOnAction[1];
        actions[0] = new MyActionA();
        addAdditionalActions(actions);
    }
}
class MyActionA extends PAddOnAction {
    public MyActionA() {
    }
    public String getMenuLabel() {
        return "Action A";
    }
}
public void actionPerformed(ActionEvent e){
    //Custom Action
    //JOptionPane.showMessageDialog(null, "My Action A");
}
}
```

## Adding a Custom NoHierarchy Page

To replace the default NoHierarchy page with a custom NoHierarchy page by using Configurator:

1. Create a custom NoHierarchy page class.
2. Start Configurator.
3. Go to the Custom NoHierarchy Page Class field on the Configurator **Hierarchy** tab. See "[Hierarchy Configurator](#)".
4. Type the full path of your customized page class name in this field to replace the default No-Hierarchy-Page, as in this example:

```
com.myComp.app.CustomNoHierarchyPage
```

## Creating Customized Search Dialogs and Disabling the To Field

You can create your own search dialog box and disable the **To** field in the **Move account** panel in the **Hierarchy** tab.

1. Extend the `com.portal.app.cc.PhierarchyMovePage.java` class and override the `search_actionPerformed(ActionEvent e)` method to launch a custom action to call a custom Search dialog box.

---



---

**Tip:** See the sample code `MyHierarchyMovePage.java`.

---



---

2. Disable or enable the **To** field in the **Move account** panel by setting the `setEnabledToField(boolean) boolean` method.
3. In the Custom Hierarchy Move Page Class field in the Configurator **Payments** tab, specify the custom payment setup class name. See "[Hierarchy Configurator](#)".

## Adding Custom Options to the Actions Drop-Down Lists

The Customer Center SDK includes the methods in [Table 40–2](#) for adding custom options to **Action** drop-down lists in a hierarchy page:

**Table 40–2 Custom Options Methods**

| Method  | Description  |
|---|--|
| <code>public void treeValueChanged(TreeSelectionEvent)</code>   | Triggers events when items are selected in a hierarchy tree.               |
| <code>public void addAdditionalActions(AbstractAction[])</code> | Accepts the <b>PBASAction</b> and <b>PAddOnAction</b> arrays as arguments. |

To add custom options to the Action drop-down lists:

1. Create a custom action class by extending the **PAddOnAction** class and overriding these methods:
  - `public String getMenuLabel()`
  - `public void actionPerformed(ActionEvent e)`
  - `public void treeValueChanged(TreeSelectionEvent e)`

---



---

**Note:** Override this method to generate an event whenever a new item is selected in the hierarchy.

---



---

2. Write a custom Account Hierarchy page by extending the **PAcctHierarchyPage** class and using the `addAdditionalActions` method to add your action to the **Action** drop-down menu.

See the sample code in `MyHierarchyPage.java`.

## Customizing Fields in the Sharing Tab

This section describes how to customize fields in the **Sharing** tab.

### Adding a New Sharing Type to the View Drop-Down List

You can create your own resource sharing types and create supporting dialog boxes. To create a new resource sharing type, you must define the sharing type, its **Sharing** panel and all other dialog boxes, its controller class, a unique ID, and a unique label. See "[Customizing the Customer Center Interface](#)".

You then add the new sharing type to the **View** drop-down on the **Sharing** tab. To do this, you modify the `Customized.properties` file to add the new **Sharing** panel class, controller, and option name used internally. You also modify the

**CustomizedResources.properties** file to add the label you want displayed in the drop-down. You then package these files in the **ccCustom.jar** file, which should be added to the file you use to run customer center (**runCC.bat**, for example).

To modify the **Customized.properties** file and **CustomizedResources.properties** files:

---

---

**Note:** These files are located in the *CustomerCareSDK\_Home/CustomCareSDK/CustCntr/custom* directory.

---

---

1. Open the **Customized.properties** file in a text editor and add these lines for each new sharing type:

```
customercenter.sharing.NewSharingType.class = ClassName
customercenter.sharing.NewSharingType.controller = ControllerName
```

---

---

**Note:** Be sure to use fully qualified class and controller names. If there are multiple sharing options in the last line, delimit them with commas.

---

---

2. Add the following line:

```
customercenter.sharing.options = PCharge, PDiscount, NewSharingType
```

This line appears only once in the **Customized.properties** file and should include the option names of the standard BRM resource sharing types (PCharge and PDiscount) as well as the option name of each new sharing type you include in the file. The order of the list determines the order of the options in the **View** box on the Customer Center **Sharing** tab.

3. Save the file.
4. Open the **CustomizedResources.properties** file in a text editor and add this line:

```
customercenter.sharing.NewSharingType.label = StringName
```

The string name is the sharing type name you want to appear in the **View** drop-down.

5. Save the file.
6. (Optional) On the Customer Center SDK **Sharing** tab, select the new group on the **Order the Sharing combo box** list and click **Raise Order** or **Lower Order** to rearrange the drop-down list.

For information on the Customer Center SDK **Sharing** tab, see "[Sharing Configurator](#)".

The following samples show a customization that adds a new resource sharing group for free Megabytes:

#### **Customized.properties file**

```
customercenter.sharing.PMbyte.class = com.portal.app.cc.sharing.PMbyteSharingPanel
customercenter.sharing.PMbyte.controller =
com.portal.app.cc.sharing.PMbyteSharingController
```

```
customercenter.sharing.options = PCharge, PDiscount, PMbyte
```

**CustomizedResources.properties file**

customercenter.sharing.PMbytes.label = Megabyte Sharing

## Configuring Dynamic Drop-Down Lists

To configure a dynamic drop-down list whose labels and values are based on data stored in BRM:

1. Create a custom properties object by creating a new class that implements the new **LoadCustomProperties** interface and providing the implementation for the **public Properties loadCustomProperties()** method. You must override this method with your custom code that accumulates properties (name/value pairs).
2. In the Class name for loading the Custom Properties field in the **Other** tab in Configurator, specify the class name that implements the **LoadCustomProperties** interface. See "[Other Settings](#)".

---

---

**Important:** You must define the fully qualified class name, for example, **com.helloworld.MyInterface**.

---

---

See the sample code in the **TestInterface.java** file.



# Part V

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## Localizing BRM

Part V describes how to localize Oracle Communications Billing and Revenue Management (BRM). It contains the following chapters:

- [Using BRM in International Markets](#)
- [BRM Internationalization and Localization](#)
- [Creating a Localized Version of BRM](#)
- [Handling Non-ASCII Code on the BRM Server](#)





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## Using BRM in International Markets

This chapter describes how Oracle Communications Billing and Revenue Management (BRM) supports customer management and billing for international markets.

For information on localizing BRM applications, see "[BRM Internationalization and Localization](#)".

### Supporting Multiple Currencies

If you have customers in more than one country, there are two currency issues that you might need to work with:

- Customers who use a currency different from the currency you use in your business. For example, if your business is in the United States, you run your business with US dollars. However, your Canadian customers pay their bills with Canadian dollars. To handle multiple currencies, BRM uses a *system currency* for your business, and *account currencies* for your customers. See "Managing System and Account Currencies" in *BRM Managing Customers*.
- Customers in EMU countries who recently joined the EMU, and are still in the currency crossover period. They can still pay their bills in euros or in their native EMU country currency. BRM allows you to use both EMU currencies and the euro. See "Euro Support in BRM Client Tools" in *BRM Managing Customers*.

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**Important:** For countries that joined the EMU before February, 2002, the euro is the only legal currency.

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### Accepting Credit Card Payments in Multiple Currencies

The ability to accept credit card payments in multiple currencies depends on your credit card processor. For information, see "Paymentech and International Transactions" in *BRM Configuring and Collecting Payments*.

### Supporting Multiple Languages

You need to handle the following situations when you have customers that use multiple languages:

- Your customers need to receive messages and invoices from you in their language. To do so, you specify the customer's language when creating the account. See "How BRM Uses the Customer's Language Setting" in *BRM Configuring and Collecting Payments*.

- Your customers might need to access Web pages in their native languages. You can create multiple sets of Web pages, each in a localized language. When a customer logs in, the customer's language setting automatically opens the Web page in the correct language. See "[Localizing Self-Care Manager](#)".
- Your BRM system, including your BRM database, needs to handle multiple types of characters, for example, Japanese and Chinese characters and characters with accent marks.

## Using Localized Client Applications

Localized versions of BRM client applications are available in the following languages:

- Chinese Simplified
- Chinese Traditional
- French
- Italian
- Japanese
- Korean
- Portuguese Brazilian
- Russian
- Spanish

You can use localized versions of many BRM client applications:

- All language versions of the Java applications use Unicode characters.
- Payment Tool, an MFC application, is available in a native encoding or Unicode.
  - The native encoding version is translated, but is not suitable for a multiple language installation.
  - The Unicode version of Payment Tool is not translated, but supports displaying multiple languages and storing them in the database.

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**Note:** For the Unicode version of Payment Tool, you must install a Unicode font, for example, Bitstream's Cyberbit font.

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All BRM client applications are internationalized and handle most locale formats for time, date, number, and so on by using the Windows Regional Settings. To keep currency symbols constant whatever the locale, they are not handled by Windows Regional Settings.

For client platforms supported, see "BRM Software Compatibility" in *BRM Installation Guide*.

## Localizing BRM

You can localize BRM in these ways:

- If a localized version of a BRM application does not already exist, you can create localized versions in additional languages using the Localization SDK. See the following topics:

- For a list of applications you can localize, see "[Localization SDK Contents](#)".
- For details on how to localize BRM applications, see "[Creating a Localized Version of BRM](#)".
- You can localize some system files, such as reason codes, by using the Localization SDK. See the following topics:
  - [Localizing Object Initialization Files](#)
  - [Localizing and Customizing Strings](#)
- You can create localized versions of your custom client applications. See "[Creating a Localized Version of BRM](#)".

The Localization SDK supports localization into any language that is both non-complex text and single-direction (left-to-right), including languages written with the Roman alphabet and multi-byte or East Asian languages.

BRM does not support localization into complex text languages, including Thai, Indic languages, and languages that use bi-directional writing systems, such as Arabic and Hebrew.

## About BRM Reports

To use the BRM Reports templates with languages other than English, see "[Localizing BRM Reports](#)".



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## BRM Internationalization and Localization

This chapter gives an overview of internationalization and localization issues for Oracle Communications Billing and Revenue Management (BRM) developers.

For information about using BRM internationally, see "[Using BRM in International Markets](#)".

### About Localizing and Internationalizing

Localization and internationalization are related but not identical:

- **Localization (L10N)** is adapting a software product for a specific market (locale). This requires the following procedures:
  - Translating the product interface and help files into the locale language
  - Supporting the date, time, number, currency formats, and collation order of the locale
  - Supporting the input methods of the language
  - Possibly changing the content of the application, depending on the product and market
- **Internationalization (I18N)** is a process of developing software products that are independent from cultural, language, or other specific attributes of a market and can be easily localized.

This includes designing user interfaces to handle languages that need more space, placing text strings in a resource file instead of hard-coding them, and using icons that have meaning across cultures.

### About Internationalization of BRM Client Applications

BRM client applications are internationalized to work with languages using text that is both non-complex and single-direction (left-to-right), including most languages of Western European and East Asian origin.

For European languages, the client applications support any Windows Regional setting locale that uses code page 1252. These are languages of Western European origin or languages that use a very similar alphabet including Afrikaans, Basque, Catalan, Dutch (standard), and Dutch (Belgian).

For East Asian multibyte locales, the client applications support Japanese (code page 932) Korean (949), Simplified Chinese (936), and Traditional Chinese (950).

For more information on languages BRM does and does not support, see ["Localizations Supported"](#).

For information about localizing client applications, see ["Creating a Localized Version of BRM"](#). For information about using localized client applications, see ["Using Localized Client Applications"](#).

## Writing Localized MFC Client Applications

To use the Windows Regional Settings for a locale, you must follow the Microsoft Developer Network standards. Some of the most important APIs are those for:

- String manipulation
- Locale-related APIs such as **GetLocaleInfo** and **enum**, as well as **LC\_\*** types for currency, date, and so on
- Code pages

## About Internationalized Development on BRM

For international development, text strings must be isolated from other parts of the software. For information about:

- Using the proper conventions for storing text strings, see ["String Manipulation Functions"](#) in *BRM Developer's Reference*.
- Storing non-ASCII text, see ["Handling Non-ASCII Code on the BRM Server"](#).
- Loading your strings into the database, see ["load\\_localized\\_strings"](#).

## About Canonicalization

Canonicalization is a process of presenting text in a standard way, called canonical form. For example, two strings such as "àbc" and "abc" are equivalent, but the second one is in canonical form because it is written in the most common way. Strings in canonical form are easier to compare for searches and sorts.

Canonicalization is based on the account's locale. To add canonicalization for a non-Latin 1 locale, you must customize the **PCM\_OP\_CUST\_CANONICALIZE** opcode. If you use a multibyte code set or Unicode, you need to convert it to UTF8. For more information, see ["Handling Non-ASCII Code on the BRM Server"](#).

BRM supports canonicalization for some of the Latin 1 languages and locales in ISO 8859. For a list of supported languages, see ["Locale Names"](#).

In these languages Event Browser ignores capital letters, accents, and diacritical marks when searching by name or company name.

With localized versions of BRM, the sort order returned from searches is byte order.

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## Creating a Localized Version of BRM

This chapter describes the Oracle Communications Billing and Revenue Management (BRM) Localization Software Developers Kit (SDK) and how to use it to create localized versions of BRM client applications and Self-Care Manager.

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**Important:** To install the Localization SDK, see "Installing the Localization SDK on Windows" in *BRM Installation Guide*.

---

---

### About the Localization SDK

The Localization SDK is for:

- Localization agencies who make the localized versions of BRM.
- Customers who develop localized versions of BRM client applications for languages that are not supported by BRM.

You can use the SDK to:

- Translate menus, dialog boxes, and online Help for BRM clients, including those written using Microsoft Foundation Class (MFC) and those written in Java.
- Make minor customizations of Customer Center that do not involve translation. For example, you can change text in the user interface or replace a bitmap image. See "[Modifying Localized Versions of Customer Center](#)" for more information.

The Localization SDK is available in the same language versions as BRM client applications, so you can make these types of customizations to Customer Center in all available languages. For a list of supported languages, see "[Localizations Supported](#)".

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**Note:** You cannot translate the installation screens for an application. When you create an application with the SDK, the application's installation screens use the same language as the version of the SDK you used.

For example, if you use the English SDK to translate an application into another language, the installation for the translated application is in English. If you use the French SDK to modify a French version of an application, the installation is in French.

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---

### Localization SDK Contents

This section describes localization SDK contents.

## Java Client Applications

The Localization SDK contains all the Java properties files, Help files, and installation files that need to be translated for the following BRM applications:

- Business Configuration Center, which includes Field Validation Editor
- Brand Manager, which includes Access Privileges

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**Important:** Brand Manager is an optional feature that requires a separate license.

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- Customer Center, which includes Event Browser
- GSM Customer Center Extension
- Number Administration Center
- Payment Center
- Permissioning Center
- Pricing Center, which includes Resource Editor and Zone Mapper
- Revenue Assurance Center
- SIM Administration Center
- Suspense Management Center
- Voucher Administration Center

## Payment Tool

The Localization SDK contains all the MFC Resource DLL projects, Help files, installation files, and other files that need to be translated for Payment Tool.

In addition, the application includes the client uninstall tool (PinUninstall).

## Self-Care Manager Server Application

The Localization SDK contains all the Java properties files, Java server pages, and installation files that need to be translated for Self-Care Manager, the browser-based self-care application.

For information about localizing Self-Care Manager, see "[Localizing Self-Care Manager](#)".

## BRM Server Files

The Localization SDK also contains these BRM server files:

- Object initialization files. See "[Localizing Object Initialization Files](#)".
- Other server files containing text used by client applications. See "[Localizing and Customizing Strings](#)".

## Localizations Supported

BRM supports localization into any language that is both non-complex text and single-direction (left-to-right), including:

- Languages written with the Roman alphabet, including Western European languages.



- Other European languages, including Russian and Greek.
- Multi-byte or East Asian languages, such as Korean, Japanese, Traditional Chinese, and Simplified Chinese.

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**Note:** Creating localized tools can represent a significant customization effort, especially for certain languages, including Norwegian, Danish, Russian, and Greek.

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BRM does not support localization into complex text languages, including:

- Complex text languages that use bi-directional writing systems, such as Arabic and Hebrew.
- Other complex text languages, such as Thai and Indic languages.

## System Requirements for the Localization SDK

To use the SDK, you need the following minimum requirements:

- System hardware:
  - 256 MB RAM
  - 500 MB of disk space for your build tree and zip files, preferably on one dedicated drive
- The client application you want to localize.
- Tools

You need some or all of these tools, depending on the files you are localizing. For many of these tools, you can find the version compatible with the current BRM release in "BRM Software Compatibility" in *BRM Installation Guide*.

- Microsoft Visual C++ plus the special files for your locale
- Microsoft HTML Help Workshop or a Help authoring tool compatible with Microsoft HTML Help
- Java 2 SDK, Standard Edition, international version
- Java Runtime Environment (JRE), international version
- Oracle Help for Java (available from the Oracle Technology Network, <http://www.oracle.com/technetwork/topics/utilsoft-085729.html>)
- MKS Toolkit
- Command-line version of the zip file utility PKZIP

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**Important:** Before using the SDK, install all the applications listed in their default locations on the local drive of the source build machine.

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To test your translated applications, you also need to run them on Windows in the target locale. That computer also needs to have, or have network access to, a machine with a complete BRM installation.

## Unpacking Help Files for Java Applications

Before following this procedure, install the Localization SDK. See "Installing the Localization SDK on Windows" in *BRM Installation Guide*.

To prepare for localizing the online Help for any Java application:

1. Run the **PrepareHelp** command in the **JAVA\_PROJECTS** directory.

This command unpacks the Help and deletes the search index.

```
W:\SDK_locale\JAVA_PROJECTS> PrepareHelp
```

Where *SDK\_locale* is the Windows locale for the version of the Localization SDK you installed; for example, **ESP** for Spanish or **FRA** for French. See "[Locale Names](#)".

2. For each localization, go to the **JAVA\_PROJECTS** directory and copy the folder **help\_Java\_locale** to a folder with the name **help\_new\_Java\_locale**.

*Java\_locale* is a two-letter ISO 639 language code for a locale and *new\_Java\_locale* is the language code that matches your new localization.

The folder **help\_Java\_locale** uses the locale for the version of the Localization SDK you installed. For example, if you installed the English Localization SDK, the folder is called **help\_en**. For the French Localization SDK, it is called **help\_fr**.

For a list of some common locale names supported by BRM, see "[Locale Names](#)".

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**Important:** If some files are not translated, do not delete their original versions in **help\_Java\_locale**. You need a complete set of files to rebuild Help.

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The files are ready to be translated. After you have translated a client, see "[Building Java Applications](#)".

## Translating the Clients

In general, the BRM Java and MFC clients and their Help systems have the same localization requirements common to those platforms. See the following section for specific information about Payment Tool Help.

### Localizing Help for Payment Tool

Payment Tool is an MFC application that uses Microsoft HTML Help. To localize the Help for Payment Tool:

1. Copy the **MFC\_PROJECTS\Help\_SDK\_locale** directory to **MFC\_PROJECTS\Help\_locale**. *SDK\_locale* is the Windows locale of the SDK you are using, and *locale* is the Windows locale of the localization you are creating.

For example, if you are using the English SDK and localizing into French, copy **MFC\_PROJECTS\Help\_ENU** to **MFC\_PROJECTS\Help\_FRA**.

2. Extract the Help files from **paymenttool.chm**. You can do this using Microsoft HTML Help Workshop or other applications.
3. Create translated versions of the files extracted from the **.chm** file.
4. Create a new **.chm** file using the localized files.

Optionally, you can open the **paymenttool.hhp** project file in Microsoft HTML Help Workshop and create the **.chm** file from that project.

## Building the Clients

This section describes how to create localized versions of BRM Java client applications. For information on localizing the Self-Care Manager server application, see "[Localizing Self-Care Manager](#)".

## Building Java Applications

These sections describe the required steps for building Java applications.

### Building Properties Files

You can create all the JAR files with the same command or create them individually.

To create a JAR file of your translated properties files:

1. At a Windows command prompt, go to the **JAVA\_PROJECTS** directory.
2. Set up an environment variable:

```
set CLIENTS_DEST=W:\Client_dest
```

3. Go to **W:\SDK\_locale\JAVA\_PROJECTS** and run **makecertificate.bat**.

Where *SDK\_locale* is the Windows locale for the version of the Localization SDK you installed.

You can do this from the command line or through Windows Explorer.

When you run **makecertificate.bat**, you create a keystore password and a key password.

4. Enter the passwords you created when running **makecertificate.bat** into the **signjar.bat** file, located in the same folder:
  - Enter the keystore password for STOREPASSWORD.
  - Enter the key password for KEYPASSWORD.
5. Run the **makeResourceJars** command:

```
W:\SDK_locale\JAVA_PROJECTS> makeResourceJars Java_locale [app_name]
```

where

- *Java\_locale* is the two-letter ISO 639 language code.
- *app\_name* is the abbreviated name of an application; for example, **ebrowser**. Specify this only if you are building a JAR file for a single application.

If a filename is not specified, this command builds a locale-specific JAR file for each application and puts the JAR files in the **Client\_dest** directory.

If a filename is specified, the command builds a single locale-specific JAR file and places it in the **Client\_dest** directory.

For example, to create a JAR file for a French localization of Event Browser, enter the following command:

```
W:\SDK_locale\JAVA_PROJECTS> makeResourceJars fr ebrowser
```

---



---

**Tip:** Enter `makeResourceJars` with no arguments to see its syntax.

---



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### Application Names for `makeResourceJars` Command

To create a JAR file for a single application with the `makeResourceJars` command, you specify the application with its abbreviated name. Table 43–1 shows the names of JAR files for applications.

**Table 43–1** Names of JAR Files for Applications

| Application                                 | Name for <code>makeResourceJars</code> |
|---|--|
| Event Browser                               | ebrowser                               |
| Invoice Viewer                              | invoice                                |
| Pricing Center                              | price                                  |
| Customer Center                             | custcent                               |
| Config Center                               | bmf                                    |
| Field Validation Editor (Config Center)     | fve                                    |
| Resource Editor (Config Center)             | re                                     |
| Brand Creation (Config Center Branding)     | bct                                    |
| Bulk Accounts (Config Center IPT)           | bat                                    |
| Access Privileges (Config Center Branding)  | perm                                   |
| Zone Mapper (Config Center)                 | zmp                                    |
| WebKit                                      | webkit                                 |
| GSM Manager Client (Customer Center Add-on) | gsm                                    |
| SIM Administrator                           | sim                                    |
| Number Administrator                        | num                                    |

### Building Help for Java Applications

You can use the `BuildHelp` command to build the Help files (including creating the search index) for one Java application or all of them. It is useful to review the Help in one Java client before the entire set is complete.

1. Add the path to the `java` command to your Path environment variable.

Environment variables are available on the **Advanced** tab of the System control panel. You can use either the system or user Path variable, whichever works best in your environment.

Add this location to the beginning of the Path variable:

```
Java_install_dir\bin
```

where `Java_install_dir` is the JDK installation directory; for example:

```
C:\jdk1.5.0_09\bin
```

2. Add the path to the Oracle Help for Java (OHJ) Help indexer to your CLASSPATH variable. For example:

```
C:\ohelp\help4-indexer.jar
```

3. If necessary, set up this environment variable:

```
set CLIENTS_DEST=W:\Client_dest
```

4. In a command window, go to **W:\SDK\_locale\JAVA\_PROJECTS**.
5. Run the **BuildHelp** command:

```
W:\SDK_locale\JAVA_PROJECTS> BuildHelp Java_locale_country [filename]
```

where

- *SDK\_locale* is the Windows locale for the version of the Localization SDK you installed.
- *Java\_locale\_country* is the two-letter ISO 639 language code plus ISO 3166 country code; for example, **en\_US**.
- *filename* is the root name (the name without the locale) of the original JAR file. For example, in the English Localization SDK, the Customer Center Help file is **Customer\_Center\_Help\_en.jar**. The root name is **Customer\_Center\_Help.jar**.

Specify this only if you are building Help for a single application.

This command builds the Help file or files that match the locale and puts them in the **Client\_dest** directory, which is a peer of the **JAVA\_PROJECTS** directory.

For example, to build the Help file for a French localization of Customer Center using the English version of the Localization SDK, enter this:

```
W:\ENU\JAVA_PROJECTS> BuildHelp fr_FR Customer_Center_Help.jar
```

## Preparing Customer Center

Customer Center requires a few additional steps before packaging.

1. Copy the **CustomerCenter\_en.html** file to **CustomerCenter\_Java\_locale.html**, where *Java\_locale* is the Java name for the new locale. For example, if creating a French version, copy the file to **CustomerCenter\_fr.html**.
2. Translate the localizable strings in **CustomerCenter\_Java\_locale.html**.
3. Change all instances of **\_en** in the file to *\_Java\_locale*. For example, for a French version, change **\_en** to **\_fr**.
4. Save and close **CustomerCenter\_Java\_locale.html**.
5. Copy **CustomerCenter\_en.jnlp** to **CustomerCenter\_Java\_locale.jnlp**; for example, **CustomerCenter\_fr.jnlp**.
6. Repeat earlier step 2 and 3 for **CustomerCenter\_Java\_locale.jnlp** to translate the localizable strings and change **\_en** to *\_Java\_locale*.
7. Save and close **CustomerCenter\_Java\_locale.jnlp**.

## Building Payment Tool

After you translate Payment Tool, the MFC application, you need to build it.

1. Verify that you have the **W** drive mapped to **C:\Program Files\Portal Software\Localization SDK**.
2. Go to **W:\SDK\_locale\MFC\_PROJECTS**.
3. Copy all the **\*Res** folders to **W:\MFC\_PROJECTS**.
4. In a command window, enter **W:\SDK\_locale\MFC\_PROJECTS\L10Nbuild.bat**.

This command builds four resource DLLs in the release folder of each project and copies them to the **W:\Client\_Dest\Release** directory.

5. Test Payment Tool. See "[Testing Payment Tool](#)".
6. Create a folder under **MFC\_PROJECTS\PaymentToolRes** and name it using the three-letter Windows locale for your localization.  
For example, for a French localization of Payment Tool, create this folder:  
**MFC\_PROJECTS\PaymentToolRes\FRA**
7. Save a copy of the original .rc (resource file) outside of the SDK.
8. Copy your translated version of the application .rc file in the application directory.  
For example:  
**MFC\_PROJECTS\PaymentToolRes**
9. Copy the .rc for your Windows application into the locale-specific directory.  
For example:  
**MFC\_PROJECTS\PaymentToolRes\FRA**

### Testing Payment Tool

To test Payment Tool and its Help:

1. Verify that your Windows Regional Settings is set to the correct application localization.
2. Go to your BRM client application installation directory; for example, **C:\Program Files\Portal Software\PaymentCtr**.
3. Back up the original English .chm and resource type .dll files in the application directory to another location.
4. Copy your localized version of the **PaymentToolRes.dll** file from **W:\Client\_Dest\Release** to **C:\Program Files\Portal Software\PaymentCtr**.
5. Copy your localized version of the .chm file from **W:\SDK\_locale\MFC\_PROJECTS\Help\_locale** to **C:\Program Files\Portal Software\Application\_Name**, where *locale* represents the Windows locale and *Application\_Name* represents the name of the MFC application; for example, **C:\Program Files\Portal Software\PaymentCtr**.
6. Go to the **C:\Program Files\Common Files\Portal Software** directory.
7. Back up the original English versions of these files to another location:
  - **GridIOWizRes.dll**
  - **PaymentToolRes.dll**
  - **PinMFCRes601.dll**
  - **PinUninstallRes.dll**
8. Go to the **W:\Client\_Dest\Release** directory.
9. Copy your localized versions of **GridIOWizRes.dll**, **PaymentToolRes.dll**, **PinMFCRes601.dll**, and **PinUninstallRes.dll** to **C:\Program Files\Common Files\Portal Software**.

10. From the start options, choose **Payment Tool**, which is under **Portal**, or run **PaymentTool.exe** from its installation folder, such as **C:\Program Files\Portal Software\PaymentCtr**.

## Packaging Your BRM Client Localizations

To add the localized client files to a BRM client application:

1. Verify that you have the W drive mapped to **C:\Program Files\Portal Software\Localization SDK**.
2. Create the **W:\SDK\_locale\zips** directory.
3. Download the zip file for the BRM application.
4. In a command window, go to the **W:\SDK\_locale\bin** directory.
5. Enter the following command, replacing the variables with the actual package name and local names.

```
W:\SDK_locale\bin> package_name Java_locale Windows_locale
```

For example, to package a German version of Pricing Center, enter:

```
W:\SDK_locale\bin> Package_PricingCenter.bat de deu
```

This creates a zip file in the **zips** directory. This zip file has the same name as the original application zip file, but with the Java locale added.

See "[Locale Names](#)" for a list of Java and Windows locales.

The following BRM packages are available.

- **Package\_ConfigurationCenter.bat** packages Field Validation Editor and Configuration Center.
- **Package\_ConfigurationCenterBranding.bat** packages Access Privileges, Brand Manager, and Configuration Center.
- **Package\_CustomerCenter.bat** packages Customer Center and Event Browser.
- **Package\_GSMMgrClient.bat** packages the GSM Customer Center Extension.
- **Package\_NumAdmin.bat** packages Number Administration Center.
- **Package\_PaymentCenter.bat** packages Payment Center.
- **Package\_PaymentTool.bat** packages Payment Tool.
- **Package\_PermissionCenter.bat** packages Permissioning Center.
- **Package\_PricingCenter.bat** packages Pricing Center, Resource Editor, and Zone Mapper.
- **Package\_SIMAdmin.bat** packages SIM Administration Center.
- **Package\_RevenueAssurance.bat** packages Revenue Assurance Center.
- **Package\_SuspenseManagement.bat** packages Suspense Management Center.
- **Package\_VoucherAdministration.bat** packages Voucher Administration Center.
- **Package\_WebKit.bat** packages Self-Care Manager (see "[Localizing Self-Care Manager](#)" for details on Self-Care Manager).

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**Important:** These packages assume you are using the English Localization SDK. If you are using a different version of the SDK, you need to edit these `.bat` files to add the correct Windows locale to the name of the zip files. For example, if you are using the French SDK, change `7.5_PaymentTool.zip` to `7.5_PaymentTool_FRA.zip`.

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## Modifying Localized Versions of Customer Center

This section explains how to use the BRM Localization SDK or the Customer Center SDK to customize localized versions of Customer Center.

### About Simple Customization

The Localization SDK is available in the same language versions as BRM client applications. If you use a language version of Customer Center that BRM supports and want to make minor modifications, such as changing the original localized translation or changing the date format, use the Localization SDK in that language. See "[Simple Customization for Localized Versions of Customer Center](#)".

The Customer Center SDK is a superset of the Localization SDK so you can also use the Customer Center SDK to make these minor changes, but it is recommended that you use the Localization SDK in your language for this purpose.

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**Note:** The Customer Center SDK is available only in English.

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### About Advanced Customization

If you want to make extensive modifications to Customer Center, such as adding or removing a localized string or tab, you must use the Customer Center SDK. To use the Customer Center SDK to make extensive modifications to Customer Center, see "[Advanced Customization for Localized Versions of Customer Center](#)".

You may need to use both the Customer Center SDK and the Localization SDK for advanced customization. See "[When to Use the Localization SDK for Advanced Customization](#)".

### Before You Begin

Before you customize the localized versions of Customer Center, you should be familiar with the following topics:

- [Using Customer Center SDK](#)
- [Customizing the Customer Center Interface](#)
- [Customizing the Customer Center Help System](#)

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**Note:** The property files for BRM Java applications are in Unicode.

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### Simple Customization for Localized Versions of Customer Center

Use this procedure to make simple customizations to localized versions of Customer Center, such as modifying an original translation or changing the date format, by using the Localization SDK. For more information, see "[About Simple Customization](#)".



If you want to remove or add strings or tabs in Customer Center, see "[About Advanced Customization](#)" and "[Advanced Customization for Localized Versions of Customer Center](#)".

1. Install Customer Center for the language you will customize.  
See "Installing Customer Center on Windows" in *BRM Installation Guide*.
2. Install the Localization SDK in the language you will customize.  
See the following:
  - [System Requirements for the Localization SDK](#)
  - "Installing the Localization SDK on Windows" in *BRM Installation Guide*
3. Convert the property file from Unicode to the encoding that supports your locale.
4. Find what you want to change, such as the original translation or date format, in the Localization SDK.
5. Change it.
6. Convert the property file back to Unicode.
7. Run the **makeResourceJars** batch file to generate a signed **CustomerCenter\_Java\_locale.jar** file.  
For more information, see the **readme.txt** file in the Localization SDK installation.
8. Deploy your custom **CustomerCenter\_Java\_locale.jar** file.  
See "[Deploying a Simple Customization of Customer Center](#)".

### Deploying a Simple Customization of Customer Center

If you are using a WebStart installation of Customer Center, use this procedure to deploy your custom localized **CustomerCenter\_Java\_locale.jar** file.

1. Go to the directory where you installed Customer Center on your Web server, *Customer\_Center\_Home*.
2. Create a new folder named **custom** in *Customer\_Center\_Home*.
3. Copy the signed **CustomerCenter\_Java\_locale.jar** file that you generated using the Localization SDK to the *Customer\_Center\_Home\custom* folder.
4. Copy and paste the following text into the file *Customer\_Center\_Home\custom\custom.jnlp*:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- JNLP File for Custom jar files -->
<jnlp
  spec="1.0+"
  codebase="http://your_server"
  href="custom/custom.jnlp">

  <information>
    <title>Custom</title>
    <vendor>XYZ, Inc.</vendor>
  </information>

  <security>
    <!-- <all-permissions/> -->
  </security>

  <resources>
```

```

        <j2se version="1.4*" />
        <jar href="custom/CustomerCenter_Java_locale.jar" />

    </resources>

    <component-desc/>

</jnlp>

```

5. Uncomment the following line in the **CustomerCenter\_Java\_locale.jnlp** file by removing the `<!--` and `-->` characters shown here:

```
<!-- <extension name="Customized" href="custom/custom.jnlp" /> -->
```

6. In the same file, remove the reference to the original **CustomerCenter\_Java\_locale.jar**, by making it an HTML comment:

```
<!-- <jar href="lib/CustomerCenter_Java_locale.jar" /> -->
```

7. Save the **custom.jnlp** file.
8. Restart Customer Center.

## Advanced Customization for Localized Versions of Customer Center

Use this procedure to customize a non-English version of Customer Center extensively, such as renaming or removing fields or adding entirely new fields, by using the Customer Center SDK. For more information, see ["About Advanced Customization"](#).

In some cases, you may also need to use the Localization SDK. See ["When to Use the Localization SDK for Advanced Customization"](#).

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**Tip:** If you use a language that BRM supports and want to make minor modifications to Customer Center, such as changing some translations, see ["About Simple Customization"](#) and ["Simple Customization for Localized Versions of Customer Center"](#).

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1. Install Customer Center for the language you will customize.  
See ["Installing Customer Center on Windows"](#) in *BRM Installation Guide*.
2. Install the Customer Center SDK.  
See ["Using Customer Center SDK"](#).

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**Note:** The Customer Center SDK is available only in English.

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3. Go to the Customer Center SDK install directory, *CCSDK\_Home*.
4. Find the resources used in Customer Center in this file:  
`ccsdkinstall\CustCntr\Settings\CustomerCenterResources.properties`
5. Copy the *key* for the string you want to modify. These string entries use this syntax:

```
custinfo.service.label=value
```

6. Go to the `CCSDK_Home\CustCntr\custom` directory.
7. Paste the key you copied into the properties file **CustomizedResources.properties**, and add your custom *value* next to the key, separated by an equal sign (=).

For example:

```
custinfo.service.label=customized label value
```

8. To add new key-value pairs or to enter new values for existing keys in Customer Center, repeat steps 5 through 7 for copying the *key*, going to the `CCSDK_Home\CustCntr\custom` directory, pasting the key into the properties file and adding your custom *value*.
9. When you finish editing this file, run the `CCSDK_Home\buildAll.bat` script with the **CustCntr** parameter.

This builds the **ccCustom.jar** file that contains **CustomizedResources.properties** and any other customizations. This script also signs the **ccCustom.jar** JAR file with your own certificate and copies the results to the `CCSDK_Home\lib` directory.

---



---

**Important:** If you generate both a **ccCustom.jar** file using the Customer Center SDK and a **CustomerCenter\_Java\_locale.jar** file using the Localization SDK, you *must* use the same certificate to sign both JAR files.

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10. Create a new folder called **custom** under the directory where you installed Customer Center on your Web server, `Customer_Center_Home`.
11. Copy the **ccCustom.jar** file from `CCSDK_Home\lib` to the `Customer_Center_Home\custom` folder.
12. Deploy your custom localized JAR files.

See "[Deploying an Advanced Customization of Customer Center](#)".

### Deploying an Advanced Customization of Customer Center

If you are using a WebStart installation of Customer Center, use this procedure to deploy your custom localized JAR files, such as **ccCustom.jar** or **CustomerCenter\_Java\_locale.jar** or both.

1. Go to the directory where you installed Customer Center on your Web server (your WebStart installation directory), `Customer_Center_Home`.
2. Create a new folder named **custom** in `Customer_Center_Home`.
3. Copy any modified JAR files to `Customer_Center_Home\custom`.
4. Copy the **custom.jnlp** file from the `CCSDK_Home\CustCntr\custom` folder to the `Customer_Center_Home\custom` folder.
5. Uncomment the following line in the `Customer_Center_Home\CustomerCenter_Java_locale.jnlp` file by removing the `<!--` and `-->` characters shown here:

```
<!-- <extension name="Customized" href="custom/custom.jnlp" /> -->
```

If you used the Localization SDK to create a custom version of **CustomerCenter\_Java\_locale.jar**, do the following also:

- a. Add this line:

```
<jar href="custom/CustomerCenter_Java_locale.jar" />
```

To the file `Customer_Center_Home\custom\custom.jnlp` as shown here:

```
<resources>
  <j2se version="1.4*" />
  <jar href="custom/ccCustom.jar" />
  <jar href="custom/CustomerCenter_Java_locale.jar" />
```

- b. Remove the reference to the original `CustomerCenter_Java_locale.jar` file in `Customer_Center_Home\CustomerCenter_Java_locale.jnlp` by making it an HTML comment:

```
<!-- <jar href="lib/CustomerCenter_Java_locale.jar" /> -->
```

6. Restart Customer Center.

### When to Use the Localization SDK for Advanced Customization

You might need to use the Localization SDK for these reasons:

- A few property files are not available in the Customer Center SDK; they are available only in the Localization SDK. If you need to change strings in these property files, you need the Localization SDK.
- Because the Customer Center SDK is in English, you may need to use the Localization SDK to identify the key name for the string you want to modify.

#### Finding key-value pairs to customize in the properties files

Several resource files are used to build the `CustomerCenter_Java_locale.jar` file.

When customizing Customer Center, you may not be able to find a key-value pair you need to modify for your localization in the properties files. To find keys for text in the user interface or for error messages, browse the following resource files:

- These resource files contain text that appears in the Customer Center UI:
  - `com/portal/app/comp/AppViewResources_1.properties`
  - `com/portal/app/cc/CustomerCenterResources_1.properties`
  - `com/portal/app/cc/comp/CCViewResources_1.properties`
- These resource files contain error messages that may appear in Customer Center error dialogs:
  - `com/portal/bas/comp/IAViewResources_1.properties`
  - `com/portal/bas/IACoreResources_1.properties`
- You can also find key-value pairs for the Event Browser in these resource files:
  - `com/portal/browse/BrowserResources_1.properties`
  - `com/portal/browse/EventTemplates_1.properties`
  - `com/portal/search/SearchResources_1.properties`

## Localizing Self-Care Manager

To run your localized version of Self-Care Manager, you need a Web server and a servlet engine. For more information, see "Installing Self-Care Manager on Windows" in *BRM Installation Guide*.

To localize Self-Care Manager:

1. Verify that you have the W drive mapped to **C:\Program Files\Portal Software\Localization SDK**.
2. Download the English version of Self-Care Manager. Save the zip file to any temporary directory.
3. Install English Self-Care Manager. You do not need to install a Web server or servlet engine at this point. You need to install Self-Care Manager just to get access to its files, not to actually run it.

For information, see "Installing BRM Client Applications on Windows" in *BRM Installation Guide*.

4. Copy the file **webkit\_en.war** from *Self-Care\_Manager\_install\_dir\WebKit* to **W:\SDK\_locale\zips**.

If you installed Self-Care Manager in the default location, *Self-Care\_Manager\_install\_dir* is **C:\Program Files\Portal Software\WebKit**.

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**Note:** Create the **zips** directory if it does not already exist. The directory is not created by default.

---

5. Copy the Self-Care Manager zip file you downloaded from the temporary directory to **W:\SDK\_locale\zips**.
6. Localize the file **web.xml** in **W:\SDK\_locale\JAVA\_PROJECTS\WebKit**, as follows:
  - a. Change each instance of **htmlui\_en** to **htmlui\_Java\_locale**.
  - b. In this line:
 

```
<display-name>WebKit</display-name>
```

 Change **WebKit** to something else, to distinguish it from the English version.
  - c. Save the file as **web\_Java\_locale.xml** in the same directory.
7. Go to **W:\SDK\_locale\JAVA\_PROJECTS\WebKit\webkit\_ui** and take these steps for the HTML version of Self-Care Manager:
  - a. Copy **webkit\_L10N\_en.txt** to **webkit\_L10N\_Java\_locale.txt**. For *Java\_locale*, use the Java locale. For a list, see "[Locale Names](#)".
 

For example, if you are localizing into French, copy this file to **webkit\_L10N\_fr.txt**.
  - b. Translate the strings in **webkit\_L10N\_Java\_locale.txt**. This file contains the strings that need to be localized in Self-Care Manager files. For more information, see "[Translating the Self-Care Manager Localized Strings File](#)".
8. Go to the **JAVA\_PROJECTS** directory.
9. Set up the **CLIENTS\_DEST** environment variable if you have not already set it:
 

```
set CLIENTS_DEST=W:\Client_dest
```
10. Enter this command to make the Self-Care Manager JAR file:
 

```
W:\SDK_locale\JAVA_PROJECTS> makeResourceJars locale webkit
```
11. Go to **W:\SDK\_locale\bin**.
12. Enter this command to package the localized version of Self-Care Manager:

```
W:\SDK_locale\bin> Package_WebKit.bat locale
```

The localized Self-Care Manager package is created in the **W:\SDK\_locale\zips** directory.

13. To install and run the localized version of Self-Care Manager, follow the installation instructions in "Installing Self-Care Manager on Windows" in *BRM Installation Guide*.

## Translating the Self-Care Manager Localized Strings File

Notes about localizing the **webkit\_L10N\_en.txt** file:

- This file should contain only UTF8 characters.
- The first set of variables are global variables that will be changed in each localized file. All localized files are listed in this file.
- Some file names are followed by a set of variables specific to that file. Other file names have no variables listed. Those files use only the global variables.
- Precede each line of comments with a # character.

## Creating a Localized Self-Care Manager Installation for UNIX

After you have completed localizing Self-Care Manager for Windows, you can package Self-Care Manager to run on UNIX.

---

---

**Note:** These steps do not apply to Windows.

---

---

1. On the UNIX computer, create a directory for the English installation for Self-Care Manager.

```
system% mkdir tarfile_dir
```

2. Download the Self-Care Manager UNIX English version.

3. Go to the directory:

```
system% cd tarfile_dir
```

4. Extract the Self-Care Manager **tar** file. For example:

```
system% tar xvf SelfCareMgr_solaris.tar
```

5. On your Windows system, unzip the localized **7.3.1\_SelfCareMgr\_Java\_locale.zip** file you created for Windows to get the **webkit\_Java\_locale.war** file.

6. Use **ftp** to transfer **webkit\_Java\_locale.war** from your Windows system to your UNIX system. Use binary transfer mode:

```
ftp webkit_Java_locale.war Self-Care_Manager_dir/fg
```

7. Go to *Self-Care\_Manager\_dir* on the UNIX system. This is the directory where you extracted the English **tar** file for the UNIX version of Self-Care Manager.

8. Remove the English Self-Care Manager WAR file:

```
system% rm Self-Care_Manager_dir/fg/WebKit/webkit_en.war
```

9. Make a **tar** file from the directory:

```
system% tar cvf WebKit_Java_locale.tar Self-Care_Manager_dir
```

## Localizing Object Initialization Files

There are two text files that contain Payment Tool text strings that must be translated:

- **init\_objects\_source.txt**, which is the translatable portion of the **init\_objects.source** file
- **init\_objects\_ddebit\_source.txt**, which is the translatable portion of the **init\_objects\_ddebit.source** file

To localize these files:

1. Copy these files from the **Server\_Files** directory to a directory outside of the SDK.
2. Translate the files with the applications you prefer.
3. Convert their encoding to UTF8 by using the **CharConv** application in the **Server Files** directory.

---

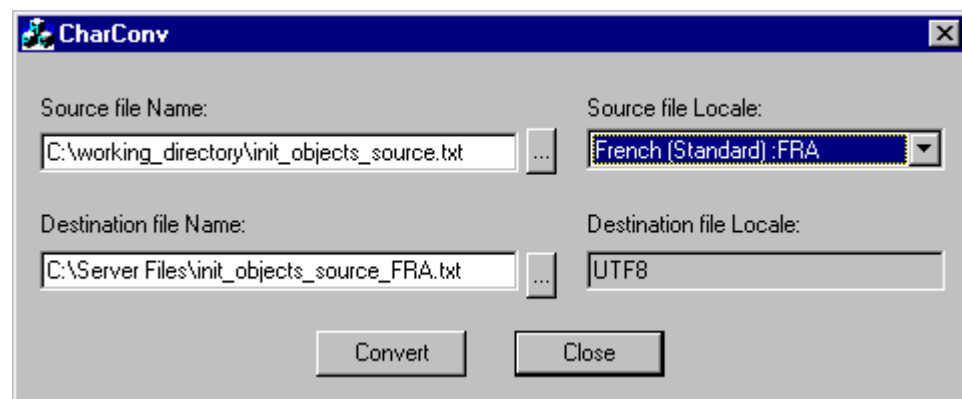
**Note:** The **CharConv** application needs to be run on a Windows system that includes the code page for the locale. For Asian locales, you must run the application on its Windows localization.

---

- a. Select the source file from the directory.
- b. Select the destination directory and file name. Rename the file to include the Windows locale in the file name.

In the example shown in [Figure 43–1](#), **init\_objects\_source.txt** is converted and put in its delivery directory at the same time:

**Figure 43–1 CharConv Dialog Box**



- c. Select your source file locale.
- d. In **Destination file Locale**, select **UTF8**.
- e. Click **Convert**.

A message either confirms that the conversion was successful or displays an error message.

## Adding the New Locale to the Object Initialization Files

If you are creating your own BRM localization, add your translations into **init\_objects.source** and **init\_objects\_ddebit.source**. The procedure is similar for both files.

To localize **init\_objects.source**:

1. Save a backup copy of *BRM\_Home/sys/dd/init\_objects.source*, where *BRM\_Home* is the directory in which you installed BRM components.
2. Open **init\_objects.source** and find the Payment Tool section for the English locale.

It starts and ends with the following lines:

```
# /config/paymenttool - standard payment tool configuration for English locale
: IS0639
```

...

```
# END /config/paymenttool - standard payment tool configuration for English
locale : IS0639
```

3. Add the contents of **init\_objects\_source\_locale.txt** after the English section.

---



---

**Tip:** If you are adding several locales, you might want to organize the Payment Tool text blocks by putting them in alphabetical order according to that first line, which is always in English.

---



---

4. Save and close **init\_objects.source**.

To localize **init\_objects\_ddebit.source**:

1. Copy **init\_objects\_ddebit\_source\_locale.txt** into **init\_objects\_ddebit.source** in the same manner.
2. Save a backup copy of *BRM\_Home/sys/dd/init\_objects\_ddebit.source* and open it.
3. Open *BRM\_Home/sys/dd/init\_objects\_ddebit.source* and find the Payment Tool section for the English locale.

It starts and ends with the following lines:

```
# /config/paymenttool - standard payment tool configuration for English locale
: IS0639
```

...

```
# END /config/paymenttool - standard payment tool configuration for English
locale : IS0639
```

4. Add the contents of **init\_objects\_source\_ddebit\_locale.txt** after the English section.

---



---

**Tip:** If you are adding several locales, you might want to organize the Payment Tool text blocks by putting them in alphabetical order according to that first line of the Payment Tool text block, which is always in English.

---



---

5. Save and close **init\_objects\_ddebit.source**.



## Localizing and Customizing Strings

Table 43–2 lists the files that you can customize to support your business model. For example, you can add new reasons to the `reasons.locale` file or new payment channels to the `payment_channel.locale` file. These files are all located in `BRM_Home/sys/msg`.

**Table 43–2 Files Associated with Localization and String Customization**

| File in <code>BRM_Home/sys/msg</code>                                    | Contains   |
|--|--|
| <code>active_mediation/active_mediation.en_US</code>                     | List of subscriber preferences used for active mediation.  |
| <code>businessprofiles/business_profile_descr.en_US</code>               | List of business profile descriptions to display in a third-party CRM application.   |
| <code>devicestates/device_states.en_US</code>                            | List of names you use for device states in the Device Management framework.  |
| <code>eradescr/era_descr.en_US</code>                                    | Descriptions of promotions for GSM Customer Center Extension.  |
| <code>errorcodes/errors.en_US</code>                                     | Server error messages.   |
| <code>featuresandprofilestates/features_and_profiles_states.en_US</code> | Service provisioning states for GSM Customer Center Extension.   |
| <code>lifecycle_states/lifecycle_states.en_US</code>                     | List of life cycle states used for subscriber life cycle management.   |
| <code>localedescr/locale_descr.en_US</code>                              | Descriptions of the locales that BRM supports, used by Customer Center.  |
| <code>newsfeed/newsfeed.en_US</code>                                     | List of localized strings for News Feed.   |
| <code>note/note.en_US</code>   | List of types and permissible statuses of a <code>/note</code> object.   |
| <code>numcategories/num_categories.en_US</code>                          | Number attributes for Number Administration Center.  |
| <code>numdevicestates/num_device_states.en_US</code>                     | List of status settings for a number in Number Administration Center and Customer Center.                                    |
| <code>numvanities/num_vanities.en_US</code>                              | List of vanity numbers in Number Administration Center.  |
| <code>ordersimstatus/order_sim_status.en_US</code>                       | List of status settings for an order in SIM Administration Center.   |
| <code>paymentchannel/payment_channel.en_US</code>                        | List of payment channel IDs that can be included in payments received by BRM.  |
| <code>reasoncodes/reasons.en_US</code>                                   | List of reasons for account changes (such as charges and credits) in Customer Center and for payment status in Payment Tool. |
| <code>revenueassurance/ra_alert_message.en_US</code>                     | List of alert messages that BRM uses when notifying analysts that a revenue assurance threshold has been exceeded.           |
| <code>simcardtypes/sim_card_types.en_US</code>                           | List of SIM card types for SIM Administration Center.  |
| <code>simdevicestates/sim_device_states.en_US</code>                     | List of status settings for SIM devices in SIM Administration Center.  |
| <code>suspense_reason_code/suspense_reason_code.en_US</code>             | List of reasons for call failures in Suspense Management Center.   |

**Table 43–2 (Cont.) Files Associated with Localization and String Customization**

| File in <i>BRM_Home/sys/msgsl</i>   | Contains  |
|---|---|
| <code>system_filter_set/system_filterset_edr_field_values.en_US</code>              | List of EDR fields and values that Pipeline Manager uses as filtering criteria for system products and discounts. |
| <code>telcofeaturesandprofilestates/telco_features_and_profiles_states.en_US</code> | Service provisioning states for GSM Customer Center Extension. These states are specific to telco.                |
| <code>voucher_devicestates/device_state_voucher.en_US</code>                        | List of status settings for voucher devices in Voucher Administration Center.                                     |
| <code>voucher_orderstates/order_state_voucher.en_US</code>                          | List of order statuses to display in Voucher Administration Center.   |

## Creating New Strings and Customizing Existing Strings

To create new strings or customize existing strings:

1. Open the appropriate file.
2. Locate and edit any existing strings you want to customize.
3. Add any new strings using the standard format.
4. Save the file.
5. Load the strings using the `load_localized_strings` utility. See "[Loading Localized or Customized Strings](#)".

---

**Note:** Use the appropriate file suffix for the locale. For example, to load SIM card formats in the German language, use the file named `sim_card_types.de`. See "[Locale Names](#)".

---

## Localizing Existing Strings

---

**Important:** If you are only localizing the strings:

- *Do not* edit the ID, DOMAIN, or VERSION strings in these files.
  - Be sure to preserve the double quotes (") and semicolon (;) around any strings that you change.
  - There must be a space before a semicolon (;).
- 

To localize any of these files:

1. Make a copy of the file and open it.
2. Change the LOCALE to the BRM name for the new locale.  
For BRM locale names, see "[Locale Names](#)".
3. Translate the text strings for STRING and HELPSTR.
4. Rename the file by changing the suffix from `.en_US` to the BRM locale name for your locale. For example, a Traditional Chinese version of `errors.en_US` is named `errors.zh_TW`.
5. Convert the file to UTF8 encoding.

## Loading Localized or Customized Strings

You use the `load_localized_strings` utility to load the contents of a string file into a `/strings` object in the BRM database.

---

**Caution:** When loading reason codes from the `reasons.locale` file, `load_localized_strings` also loads information from this file into the `/config/map_glid` object. If customized to specify service types and event types for event-level adjustments, the utility also loads information into the `/config/reason_code_scope` object. Though the utility does not overwrite existing strings in the `/strings` object unless you direct it to, it *does* overwrite the `/config/reason_code_scope` and `/config/map_glid` objects.

---



---

**Note:**

- The `load_localized_strings` utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.
  - You must install the SUNWnamos module on a Solaris system and set your locale properly to use `load_localized_strings` without error.
- 

1. Use the following command to run the `load_localized_strings` utility:

```
load_localized_strings string_file_name.locale
```

For example:

```
load_localized_strings sim_device_states.en_US
```

2. Look in the `load_localized_strings.log` file to find any errors. The log file is either in the directory from which the utility was started or in a directory specified in the configuration file.
3. Verify that the strings were loaded by displaying the `/strings` objects using the Object Browser or the `robj` command with the `testnap` utility. See ["Reading Objects by Using Object Browser"](#) for information on how to use Object Browser. See ["Using testnap"](#) for general instructions on using `testnap`.

---

**Note:** For the `reasons.locale` file, you should also use one of these methods to check the `/config/map_glid` and `/config/reason_code_scope` objects.

---

4. Stop and restart the Connection Manager (CM). For more information, see "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.
5. If the strings are displayed in a GUI application, stop and restart the application to display the strings.

## Localizing BRM Reports

To create localized versions of BRM report templates, use their conversion routines. For more information, see "[Localizing BRM Reports](#)".

## About Customizing Server Software

This section provides an introduction to customizing server software.

### Setting the Default Language for Customer Accounts

The `/account` object contains the `PIN_FLD_LOCALE` field. During BRM account creation, the CSR can set the value of this field using the BRM locale list in Customer Center. By default in Customer Center, the `PIN_FLD_LOCALE` field is set to the locale of the CSR's system.

The `PIN_FLD_LOCALE` field is set by the `PCM_OP_CUST_SET_LOCALE` opcode. This opcode reads the `PCM_OP_CUST_POL_PREP_LOCALE` and `PCM_OP_CUST_POL_VALID_LOCALE` policy opcodes. When you develop a Web page for creating customer accounts, you need to set this field.

### Customizing Canonicalization

To customize canonicalization, use the `PCM_OP_CUST_POL_CANONICALIZE` opcode.

This opcode is called by `PCM_OP_CUST_COMMIT_CUSTOMER`, `PCM_OP_CUST_SET_NAMEINFO`, and the Customer Center search screen. `PCM_OP_CUST_POL_CANONICALIZE` searches for localized (non-English) customer input string fields.

The default implementation of the `PCM_OP_CUST_POL_CANONICALIZE` opcode is the `en_US` locale. Canonicalization handles Latin-based characters only. You must customize this opcode for other languages.

### Exporting Data to an LDAP Server

For languages other than English, the data exported to the directory structure using Lightweight Directory Access Protocol (LDAP) is in UTF8 format. If you need native encodings, you must write conversion applications that operate on the data in the directory server to convert it in place.

## Locale Names

Following is a list of locales for which BRM supports canonicalization. You can also use this list to get common BRM, UNIX, and Java locale names. For information on canonicalization, see "[About Canonicalization](#)".

In naming localized files, use the more general two-letter locale names when possible, but in some cases the more specific four-letter locale names are needed. For example:

- Use `zh_TW` for Traditional Chinese.
- Use `en_US` for English files.
- Use `pt_BR` for Brazilian Portuguese.

[Table 43–3](#) lists many common locale names. You can get complete locale name lists on the Web.

**Table 43–3 Common Locale Names**

| <b>Language (ISO-639)</b> | <b>Country (ISO-3166)</b>  | <b>UNIX, Java, and BRM Locale</b>       | <b>Windows Locale</b> |
|---------------------------|----------------------------|---|-----------------------|
| Chinese (Simplified)      | People's Republic of China | zh_CN                                   | CHS                   |
| Chinese (Traditional)     | Republic of China (Taiwan) | zh_TW                                   | CHT                   |
| Danish                    | Denmark                    | da_DK                                   | DAN                   |
| Dutch                     | Netherlands                | nl_NL                                   | NLD                   |
| Dutch                     | Belgium                    | nl_BE                                   | NLB                   |
| English                   | Australia                  | en_AU                                   | ENA                   |
| English                   | Canada                     | en_CA                                   | ENC                   |
| English                   | Ireland                    | en_IE                                   | ENI                   |
| English                   | New Zealand                | en_NZ                                   | ENZ                   |
| English                   | South Africa               | en_ZA                                   | ENS                   |
| English                   | United Kingdom             | en_UK (BRM)<br>en_GB (Java and UNIX)    | ENG                   |
| English                   | United States              | en_US                                   | ENU                   |
| Finnish                   | Finland                    | fi_FI                                   | FIN                   |
| French                    | France                     | fr_FR                                   | FRA                   |
| French                    | Belgium                    | fr_BE                                   | FRB                   |
| French                    | Canada                     | fr_CA                                   | FRC                   |
| French                    | Luxembourg                 | fr_LU                                   | FRL                   |
| French                    | Switzerland                | fr_CH                                   | FRS                   |
| German                    | Germany                    | de_DE                                   | DEU                   |
| German                    | Austria                    | de_AT                                   | DEA                   |
| German                    | Luxembourg                 | de_LU                                   | DEL                   |
| German                    | Switzerland                | de_CH                                   | DES                   |
| Japanese                  | Japan                      | ja_JP                                   | JPN                   |
| Korean                    | Korea                      | ko_KR                                   | KOR                   |
| Italian                   | Italy                      | it_IT                                   | ITA                   |
| Italian                   | Switzerland                | it_CH                                   | ITS                   |
| Norwegian (Bokmal)        | Norway                     | no_NO                                   | NOR                   |
| Norwegian (Nynorsk)       | Norway                     | no_NY (BRM and UNIX)<br>no_NO_NY (Java) | NON                   |
| Portuguese                | Portugal                   | pt_PT                                   | PTG                   |
| Portuguese                | Brazil                     | pt_BR                                   | PTB                   |
| Spanish                   | Spain                      | es_ES                                   | ESP                   |
| Spanish                   | Argentina                  | es_AR                                   | ESS                   |
| Spanish                   | Bolivia                    | es_BO                                   | ESB                   |
| Spanish                   | Chile                      | es_CL                                   | ESL                   |
| Spanish                   | Colombia                   | es_CO                                   | ESO                   |

**Table 43–3 (Cont.) Common Locale Names**

| <b>Language (ISO-639)</b> | <b>Country (ISO-3166)</b> | <b>UNIX, Java, and BRM Locale</b> | <b>Windows Locale</b> |
|---------------------------|---------------------------|-----------------------------------|-----------------------|
| Spanish                   | Costa Rica                | es_CR                             | ESC                   |
| Spanish                   | Dominican Republic        | es_DO                             | ESD                   |
| Spanish                   | Ecuador                   | es_EC                             | ESF                   |
| Spanish                   | El Salvador               | es_SV                             | ESE                   |
| Spanish                   | Guatemala                 | es_GT                             | ESG                   |
| Spanish                   | Mexico                    | es_MX                             | ESM                   |
| Spanish                   | Nicaragua                 | es_NI                             | ESI                   |
| Spanish                   | Panama                    | es_PA                             | ESA                   |
| Spanish                   | Paraguay                  | es_PY                             | ESZ                   |
| Spanish                   | Peru                      | es_PE                             | ESR                   |
| Spanish                   | Puerto Rico               | es_PR                             | ESU                   |
| Spanish                   | Uruguay                   | es_UY                             | ESY                   |
| Spanish                   | Venezuela                 | es_VE                             | ESV                   |
| Swedish                   | Sweden                    | sv_SE                             | SVE                   |

---

---

## Handling Non-ASCII Code on the BRM Server

This chapter describes the character-encoding conversion-layer macros you use with languages other than English (that is, any non-ASCII character encoding) in your Oracle Communications Billing and Revenue Management (BRM) system.

### About Character-Encoding Conversion

To work with different languages, BRM applications must use a character encoding that supports them. If you want to support any Western European language or East Asian language, the macros described in this chapter are required. You must use the conversion macros with any BRM client, server, or Web application localization that is *not* written in Java. Without these macros, only the 7-bit ASCII encoding works.

---

---

**Note:** These macros are not required for English language applications, but using the macros facilitates later translations.

---

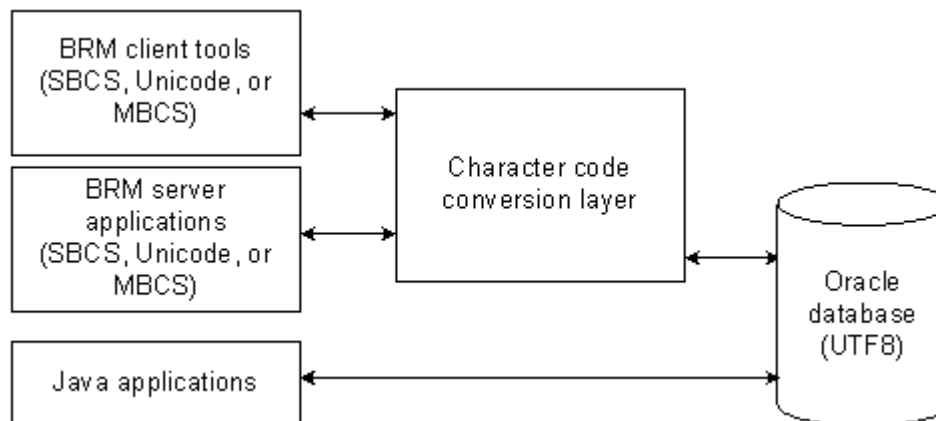
---

BRM supports localizations using Latin 1 and some of the East Asian encodings for Japanese, Korean, Traditional Chinese, and Simplified Chinese only.

### About Converting Multibyte or Unicode to and from UTF8

Figure 44–1 shows the relationships between the BRM applications and the character-encoding conversion layer:

**Figure 44–1** BRM Applications and the Character-Encoding Conversion Layer



If you are developing a command-line application or a third-party integration, use the macros that convert either Unicode or multibyte input strings to UTF8 and from UTF8:

- [PIN\\_CONVERT\\_STR\\_TO\\_UTF8](#)
- [PIN\\_CONVERT\\_UTF8\\_TO\\_STR](#)

The macros check the defined preprocessor directive (`_MBCS` and `_UNICODE`) to call the direct conversion macros and call the supporting function and macro.

If you are developing a BRM client application or working with multibyte or Unicode only, use the direct conversion macros to change the character encoding. See "[About Converting Multibyte or Unicode to and from UTF8](#)":

- [PIN\\_CONVERT\\_MBCS\\_TO\\_UTF8](#)
- [PIN\\_CONVERT\\_UTF8\\_TO\\_UNICODE](#)
- [PIN\\_CONVERT\\_UNICODE\\_TO\\_UTF8](#)
- [PIN\\_CONVERT\\_UTF8\\_TO\\_MBCS](#)

The macros are located in the Portal Communication Module (PCM) library. The header file is in `pcm.h`.

## Direct Conversion Macros

[Table 44–1](#) lists the functions available in the direct conversion macros.

**Table 44–1** *Direct Conversion Macros*

| Function                                    | Description   |
|---|---|
| <a href="#">PIN_CONVERT_MBCS_TO_UTF8</a>    | Converts a multibyte character string to UTF8.        |
| <a href="#">PIN_CONVERT_UNICODE_TO_UTF8</a> | Converts Unicode characters to UTF8.                  |
| <a href="#">PIN_CONVERT_UTF8_TO_MBCS</a>    | Converts UTF8 characters to multibyte.                |
| <a href="#">PIN_CONVERT_UTF8_TO_UNICODE</a> | Converts a UTF8 character string to a Unicode string. |

## Supporting Functions and Macros

[Table 44–2](#) lists the supporting functions and macros.

**Table 44–2** *Supporting Functions and Macros*

| Function                        | Description  |
|---------------------------------|--|
| <a href="#">pin_IsValidUtf8</a> | Determines whether a specified string is using UTF8 encoding.  |
| <a href="#">PIN_MBSLEN</a>      | Determines the length of the multibyte string.   |
| <a href="#">PIN_SETLOCALE</a>   | Sets, changes, or queries some or all of the current program locale, specified by locale and category. |

## Universal Macros

[Table 44–3](#) lists the universal macros.



**Table 44-3 Universal Macros**

| <b>Function</b>                         | <b>Description</b>  |
|---|---|
| <a href="#">PIN_CONVERT_STR_TO_UTF8</a> | Converts translatable database data to UTF8.  |
| <a href="#">PIN_CONVERT_UTF8_TO_STR</a> | Calls <a href="#">PIN_CONVERT_UTF8_TO_MBCS</a> when <code>_MBCS</code> is defined, and calls <a href="#">PIN_CONVERT_UTF8_TO_UNICODE</a> when <code>_UNICODE</code> is defined. This macro is called whenever translatable data is retrieved from the database. |

## PIN\_CONVERT\_MBCS\_TO\_UTF8

This macro converts a multibyte character string to UTF8.

---

---

**Important:** You need to use **setlocale** before calling this macro.

---

---

### Syntax

```
int32
PIN_CONVERT_MBCS_TO_UTF8 (
    char                *pLocaleStr,
    char                *pMultiByteStr,
    int32               nMultiByteLen,
    unsigned char       *pUTF8Str,
    int32               nUTF8size,
    pin_errbuf_t        *ebufp);
```

### Parameters

#### ***pLocaleStr***

Indicates the locale of the multibyte string input. The locale string argument can have following values:

- **en\_US** - US-English locale
- **""** - System default locale
- **NULL** - Where LC\_CTYPE is set to the appropriate locale before calling the macro

#### ***pMultiByteStr***

Points to the character string to be converted.

#### ***nMultiByteLen***

Specifies the number of characters to be converted in the string pointed to by *pMultiByteStr*. If this value is **1**, the string is assumed to be NULL-terminated and the length is calculated automatically.

#### ***pUTF8Str***

Points to the buffer that receives the converted UTF8 string.

#### ***nUTF8size***

Specifies the size of the buffer pointed to by *pUTF8Str*.

#### ***ebufp***

A pointer to the error buffer. If this macro is successful, the error buffer is **NULL**; otherwise, it indicates the cause of the error.

### Return Values

[Table 44-4](#) lists the values returned by PIN\_CONVERT\_MBCS\_TO\_UTF8.

**Table 44–4** *PIN\_CONVERT\_MBCS\_TO\_UTF8 Return Values*

| SourceString<br>pMultiByteStr | Number of<br>Characters to<br>Convert in Input<br>String<br>nMultiByteLen | Buffer pUTF8Str             | Buffer Size in<br>Bytes nUTF8size | Return Value         |
|-------------------------------|---|-----------------------------|-----------------------------------|----------------------|
| Null terminated               | Any number  | pMultiByteStr =<br>pUTF8Str | Any size                          | 0 (ERR)              |
| NULL                          | Any number  | Any                         | Any size                          | 0 (ERR)              |
| Any                           | < -1  | Any                         | Any size                          | 0 (ERR)              |
| Any                           | 0   | Any                         | Any size                          | 0 (ERR)              |
| Null terminated               | -1 or > 0   | NULL                        | !=0                               | 0 (ERR)              |
| Not null terminated           | >0  | NULL                        | !=0                               | 0 (ERR)              |
| Any                           | Any number  | !=NULL                      | <=0                               | 0 (ERR)              |
| Not null terminated           | Any number  | pMultiByteStr =<br>pUTF8Str | Any size                          | 0 (ERR)              |
| Null terminated               | -1 or > 0   | !=NULL                      | >0                                | Converted characters |
| Not null terminated           | > 0   | !=NULL                      | >0                                | Converted characters |
| Null terminated               | -1 or > 0   | !=NULL                      | >0                                | Converted characters |
| Null terminated               | -1 or > 0   | NULL                        | 0                                 | Required buffer size |
| Not null terminated           | -1 or > 0   | NULL                        | 0                                 | Required buffer size |
| Null terminated               | -1 or > 0   | NULL                        | 0                                 | Required buffer size |

## Error Handling

If *pMultiByteStr* and *pUTF8Str* are the same, the macro fails and the error buffer returns **PIN\_ERR\_BAD\_ARG**. If the macro encounters an invalid character in the source string, the macro fails; it sets the return value to 0 and the error buffer to the respective error code as shown in [Table 44–5](#):

**Table 44–5** *Error Codes*

| Returned Error Code    | Value | Reserved Bit in ebuf | Error Description                     |
|------------------------|-------|----------------------|---------------------------------------|
| PIN_ERR_BAD_ARG        | 4     | 0                    | Bad argument                          |
| PIN_ERR_BAD_LOCALE     | 71    | 0                    | Invalid locale string                 |
| PIN_ERR_CONV_MULTIBYTE | 72    | 0                    | Error in multibyte to UTF8 conversion |
| PIN_ERR_NULL_PTR       | 39    | 0                    | Empty string passed                   |

## PIN\_CONVERT\_STR\_TO\_UTF8

This macro converts translatable database data to UTF8.

### Syntax

```
int32
PIN_CONVERT_STR_TO_UTF8 (
    char          *pLocaleStr,
    char          *pSourceStr,
    int32         nSourceLen,
    unsigned char *pUTF8Str,
    int32         nUTF8size,
    pin_errbuf_t *ebufp);
```

---

## PIN\_CONVERT\_UNICODE\_TO\_UTF8

This macro converts Unicode characters to UTF8.

---

**Important:** You need to use **setlocale** before calling this macro.

---

### Syntax

```
int32
PIN_CONVERT_UNICODE_TO_UTF8 (
    wchar_t          *pUnicodeStr,
    int              nUnicodeLen,
    unsigned char    *pUTF8Str,
    int              nUTF8,
    pin_errbuf_t     *ebufp);
```

### Parameters

***pUnicodeStr***

Points to the character string to be converted.

***nUnicode***

Specifies the number of characters to be translated in the string pointed to by *pUnicodeStr*.

***pUTF8Str***

Points to a buffer that receives the translated UTF8 string.

***nUTF8***

Specifies the size of the buffer pointed to by *pUTF8Str*.

### Return Values

Returns **NULL** in the error buffer if the macro is successful. Returns the cause of the error if the macro fails.

### Error Handling

If *pUnicodeStr* and *pUTF8Str* are the same, the macro fails, and the error buffer returns **PIN\_ERR\_BAD\_ARG**. If the macro encounters an invalid character in the source string, the macro fails; it sets *nUTF8* to **0** and sets the error buffer to the respective error code as shown in [Table 44-6](#):

**Table 44-6 Error Handling Codes**

| Returned Error Code  | Value | Reserved Bit in ebuf | Error Description                   |
|----------------------|-------|----------------------|-------------------------------------|
| PIN_ERR_BAD_ARG      | 4     | 0                    | Bad argument                        |
| PIN_ERR_CONV_UNICODE | 73    | 1                    | Error in UTF8 to Unicode conversion |
| PIN_ERR_BAD_UTF8     | 75    | 0                    | Invalid UTF8 characters             |
| PIN_ERR_NULL_PTR     | 39    | 0                    | Empty string passed                 |

## PIN\_CONVERT\_UTF8\_TO\_MBCS

This macro converts UTF8 characters to multibyte.

---

---

**Important:** You need to use **setlocale** before calling this macro.

---

---

### Syntax

```
int32
PIN_CONVERT_UTF8_TO_MBCS (
    char                *pLocaleStr,
    unsigned char       *pUTF8Str,
    int                 nUTF8Len,
    char                *pMultiByteStr,
    int                 nMultiByte,
    pin_errbuf_t        *ebufp);
```

### Parameters

#### ***pLocaleStr***

Indicates the locale of the multibyte string input. The locale string argument can have following values:

- **en\_US** - US-English locale
- **""** - System default locale
- **NULL** - Where LC\_CTYPE is set to the appropriate locale before calling the macro

#### ***pUTF8Str***

Points to the character string to be converted.

#### ***nUTF8Len***

Specifies the number of bytes to be converted in the string pointed to by *pUTF8Str*.

#### ***pMultiByteStr***

Points to the buffer that receives the converted multibyte string.

#### ***nMultiByte***

Specifies the size of the buffer pointed to by *pMultiByteStr*.

#### ***ebufp***

A pointer to the error buffer. If this macro is successful, the error buffer is **NULL**; otherwise, it indicates the cause of the error.

### Return Values

[Table 44-7](#) lists the values returned by PIN\_CONVERT\_UTF8\_TO\_MBCS.

**Table 44–7 Values Returned by PIN\_CONVERT\_UTF8\_TO\_MBCS**

| Source String<br>pUTF8Str | Number of<br>Characters to be<br>Converted in Input<br>String nUTF8Len | Buffer<br>pMultibyteStr     | Buffer Size in<br>Bytes nMultibyte | Returned Value       |
|---------------------------|--|-----------------------------|------------------------------------|----------------------|
| Null terminated           | Any number   | pMultibyteStr =<br>pUTF8Str | Any size                           | 0 (ERR)              |
| NULL                      | Any number   | Any                         | Any size                           | 0 (ERR)              |
| Any                       | < -1   | Any                         | Any size                           | 0 (ERR)              |
| Any                       | 0  | Any                         | Any size                           | 0 (ERR)              |
| Null terminated           | -1 or > 0  | NULL                        | !=0                                | 0 (ERR)              |
| Not null terminated       | >0   | NULL                        | !=0                                | 0 (ERR)              |
| Any                       | Any number   | !=NULL                      | <=0                                | 0 (ERR)              |
| Not null terminated       | Any number   | pMultibyteStr =<br>pUTF8Str | Any size                           | 0 (ERR)              |
| Null terminated           | -1 or > 0  | !=NULL                      | >0                                 | Converted characters |
| Not null terminated       | > 0  | !=NULL                      | >0                                 | Converted characters |
| Null terminated           | -1 or > 0  | !=NULL                      | >0                                 | Converted characters |
| Null terminated           | -1 or > 0  | NULL                        | 0                                  | Required buffer size |
| Not null terminated       | -1 or > 0  | NULL                        | 0                                  | Required buffer size |
| Null terminated           | -1 or > 0  | NULL                        | 0                                  | Required buffer size |

## Error Handling

If *pMultiByteStr* and *pUTF8Str* are the same, the macro fails and the error buffer returns `PIN_ERR_BAD_ARG`. If the macro encounters an invalid character in the source string, the macro fails; it sets the return value to 0 and the error buffer to `PIN_ERR_BAD_UTF8` as shown in [Table 44–8](#):

**Table 44–8 Error Handling Codes**

| Returned Error Code                 | Value | Reserved Bit in ebuf | Error Description                           |
|-------------------------------------|-------|----------------------|---|
| <code>PIN_ERR_BAD_ARG</code>        | 4     | 0                    | Bad argument                                |
| <code>PIN_ERR_BAD_LOCALE</code>     | 71    | 0                    | Invalid locale string                       |
| <code>PIN_ERR_CONV_MULTIBYTE</code> | 72    | 1                    | Error in UTF8 to multibyte conversion       |
| <code>PIN_ERR_BAD_UTF8</code>       | 75    | 0                    | Invalid UTF8 characters                     |
| <code>PIN_ERR_NULL_PTR</code>       | 39    | 0                    | Empty string passed                         |
| <code>PIN_ERR_NO_MEM</code>         | 1     | 1                    | Can't allocate enough memory for conversion |

## PIN\_CONVERT\_UTF8\_TO\_STR

This macro calls "[PIN\\_CONVERT\\_UTF8\\_TO\\_MBCS](#)" when **\_MBCS** is defined and calls "[PIN\\_CONVERT\\_UTF8\\_TO\\_UNICODE](#)" when **\_UNICODE** is defined. This macro is called whenever translatable data is retrieved from the database.

### Syntax

```
int32
PIN_CONVERT_UTF8_TO_STR(
    char                *pLocaleStr,
    char                *pUTF8Str,
    int32               nUTF8Len,
    unsigned char       *pBuffer,
    int32               nBufferSize,
    pin_errbuf_t        *ebufp);
```



## PIN\_CONVERT\_UTF8\_TO\_UNICODE

This macro converts a UTF8 character string to a Unicode string.

### Syntax

---

**Important:** You need to use **setlocale** before calling this macro.

---

```
int32
PIN_CONVERT_UTF8_TO_UNICODE(
    unsigned char    *pUTF8Str,
    int              nUTF8,
    wchar_t          *pUnicodeStr,
    int              nUnicode,
    pin_errbuf_t     *ebufp);
```

### Parameters

***pUTF8Str***

Points to the character string to be converted.

***nUTF8***

Specifies the number of bytes to be converted in the string pointed to by *pUTF8Str*.

***pUnicodeStr***

Points to a buffer that receives the converted Unicode string.

***nUnicode***

Specifies the size of the buffer pointed to by *pUnicodeStr*.

***ebufp***

A pointer to the error buffer. If this macro is successful, the error buffer is **NULL**; otherwise, it indicates the cause of the error.

### Return Values

Table 44-9 lists the return values for PIN\_CONVERT\_UTF8\_TO\_UNICODE.

**Table 44-9 Values Returned by PIN\_CONVERT\_UTF8\_TO\_UNICODE**

| Source String<br><i>pUTF8str</i> | Number of Bytes to<br>Convert in Input<br>String <i>nUTF8</i> | Buffer<br><i>pUnicodeStr</i>            | Buffer Size in<br>Bytes <i>nUnicode</i> | Returned Value |
|----------------------------------|---|---|---|----------------|
| Null terminated                  | Any number  | <i>pUTF8str</i> =<br><i>pUnicodeStr</i> | Any size                                | 0 (ERR)        |
| NULL                             | Any number  | Any                                     | Any size                                | 0 (ERR)        |
| Any                              | < -1  | Any                                     | Any size                                | 0 (ERR)        |
| Any                              | 0   | Any                                     | Any size                                | 0 (ERR)        |
| Null terminated                  | -1 or > 0   | NULL                                    | !=0                                     | 0 (ERR)        |
| Not null terminated              | >0  | NULL                                    | !=0                                     | 0 (ERR)        |
| Any                              | Any number  | !=NULL                                  | <=0                                     | 0 (ERR)        |

**Table 44–9 (Cont.) Values Returned by PIN\_CONVERT\_UTF8\_TO\_UNICODE**

| Source String<br>pUTF8str | Number of Bytes to<br>Convert in Input<br>String nUTF8 | Buffer<br>pUnicodeSrt     | Buffer Size in<br>Bytes nUnicode | Returned Value       |
|---------------------------|--|---------------------------|----------------------------------|----------------------|
| Not null terminated       | Any number   | pUTF8str =<br>pUnicodeSrt | Any size                         | 0 (ERR)              |
| Null terminated           | -1 or > 0  | !=NULL                    | >0                               | Converted characters |
| Not null terminated       | > 0  | !=NULL                    | >0                               | Converted characters |
| Null terminated           | -1 or > 0  | !=NULL                    | >0                               | Converted characters |
| Null terminated           | -1 or > 0  | NULL                      | 0                                | Required buffer size |
| Not null terminated       | -1 or > 0  | NULL                      | 0                                | Required buffer size |
| Null terminated           | -1 or > 0  | NULL                      | 0                                | Required buffer size |

## Error Handling

If *pUnicodeStr* and *pUTF8Str* are the same, the macro fails and the error buffer returns **PIN\_ERR\_BAD\_ARG**. If the macro encounters an invalid character in the source string, the macro fails; it sets the return value to 0 and the error buffer to **PIN\_ERR\_BAD\_UTF8** as shown in [Table 44–10](#):

**Table 44–10 Error Handling Codes**

| Returned Error Code  | Value | Reserved Bit in ebuf | Error Description                   |
|----------------------|-------|----------------------|-------------------------------------|
| PIN_ERR_BAD_ARG      | 4     | 0                    | Bad argument                        |
| PIN_ERR_CONV_UNICODE | 73    | 1                    | Error in UTF8 to Unicode conversion |
| PIN_ERR_BAD_UTF8     | 75    | 0                    | Invalid UTF8 characters             |

## pin\_IsValidUtf8

This function determines whether a specified string is using UTF8 encoding.

### Syntax

```
int32
pin_IsValidUTF8(
    unsigned char    *pUTF8Str,
    int32            nUTF8Len,
    pin_errbuf_t     *ebufp);
```

### Parameters

***pUTF8Str***

Points to the character string to be checked for UTF8 encoding.

***nUTF8Len***

Specifies the number of bytes to be checked in the string pointed to by *pUTF8Str*.

***ebufp***

A pointer to the error buffer. If this macro is successful, the error buffer is **NULL**; otherwise, it indicates the cause of the error.

### Return Values

Returns a positive value if *pUTF8Str* is a valid UTF8 string.

### Error Handling

This macro returns 0 if *pUTF8Str* is not a valid UTF8 string or if any errors occur. [Table 44–11](#) lists the error codes.

**Table 44–11 Error Handling Codes**

| Returned Error Code | Value | Reserved Bit in ebuf | Error Description       |
|---------------------|-------|----------------------|-------------------------|
| PIN_ERR_NULL_PTR    | 39    | 0                    | Empty string passed     |
| PIN_ERR_BAD_UTF8    | 75    | 0                    | Invalid UTF8 characters |

## PIN\_MBSLEN

This macro determines the length of the multibyte string.

### Syntax

```
int32
PIN_MBSLEN(
    char          *pLocaleStr,
    char          *pMultiByteStr,
    pin_errbuf_t *ebufp);
```

### Parameters

#### ***pLocaleStr***

Indicates the locale information of the input multibyte string. The locale string argument can have the following values:

- **en\_US** - US-English locale
- **""** - System default locale
- **NULL** - Where LC\_CTYPE is set to the appropriate locale before calling the macro

#### ***pMultiByteStr***

Points to the multibyte character string.

#### ***ebufp***

A pointer to the error buffer. If this macro is successful, the error buffer is **NULL**; otherwise, it indicates the cause of the error.

### Return Values

Returns the length of the multibyte string.

### Error Handling

This macro returns **0** if any errors occur.

## PIN\_SETLOCALE

This macro sets, changes, or queries some or all of the current program locale, specified by locale and category. Locale-dependent categories include date and currency formats.

### Syntax

```
char*
PIN_SETLOCALE(
    const int      n_category,
    char           *locale_p,
    pin_errbuf_t   *ebufp);

*int32
PIN_MBSLEN(
    const int      ncategory,
    char           *locale_p,
    pin_errbuf_t   *ebufp);
```

### Parameters

#### *n\_category*

The parts of a program's locale that are affected. The macros used for category and the parts of the program they affect are:

- LC\_ALL – All categories, as listed below.
- LC\_COLLATE – The `strcoll`, `_strcoll`, `wscoll`, `_wscoll`, and `strxfrm` macros.
- LC\_CTYPE – The character-handling functions (except `isdigit`, `isxdigit`, `mbstowcs`, and `mbtowc`, which are unaffected).
- LC\_MONETARY – Monetary format information returned by the `localeconv` function.
- LC\_NUMERIC – Decimal-point character for the formatted output routines (such as `printf`), for the data-conversion routines, and for the non-currency formatting information returned by `localeconv`.
- LC\_TIME – The `strftime` and `wcsftime` functions.

#### *locale\_p*

Indicates the locale.

#### *ebufp*

A pointer to the error buffer. If this macro is successful, the error buffer is `NULL`; otherwise, it indicates the cause of the error.

The null pointer is a special directive that tells `PIN_SETLOCALE` to query rather than set the international environment.

### Return Values

Returns a pointer to the string associated with the specified locale and category.

## Error Handling

If the locale or category is invalid, the macro returns a null pointer and sets the error buffer to PIN\_ERR\_BAD\_LOCALE as shown in [Table 44-12](#):

**Table 44-12** Error Handling Code

| Returned Error Code | Value | Reserved Bit in ebuf | Error Description     |
|---------------------|-------|----------------------|-----------------------|
| PIN_ERR_BAD_LOCALE  | 71    | 0                    | Invalid locale string |

## Conversion Code Example

The following code sample shows how to get the locale from the account information and convert the locale from BRM locale to platform locale:

```
vp = PIN_FLIST_FLD_GET(tmp_acctinfo_flistp, PIN_FLD_LOCALE,
    1, ebufp);
    if (vp == NULL) { /* Set default locale */
        strcpy(infranet_locale, "en_US");
    } else {
        strcpy(infranet_locale, (char *)vp);
    }
    locale = PIN_MAP_INFRANET_TO_PLATFORM_LOCALE(infranet_locale,
        ebufp);
```

The following function shows how to convert a UTF8 string to an MBCS string:

```
static char *
fm_inv_pol_convert_utf8_to_str(
    char          *orig_str,
    char          *locale,
    pin_errbuf_t  *ebufp)
{
    int          orig_size = 0;
    int          dest_size = 0;
    char        *strbuf = NULL;

    orig_size = strlen((char *)orig_str) + 1;

    /* First round, get the required buffer size for output string */
    dest_size = PIN_CONVERT_UTF8_TO_MBCS(locale,
        (unsigned char *)orig_str,
        orig_size, NULL, 0, ebufp);

    if (dest_size == 0) {
        if( PIN_ERR_IS_ERR( ebufp )) {
            PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_DEBUG,
                "PIN_CONVERT_UTF8_TO_MBCS Failed",
                ebufp);
            PIN_ERR_CLEAR_ERR(ebufp);
        }
        return NULL;
    }

    strbuf = (char *)pin_malloc(sizeof(char)*(dest_size + 1));
    if (strbuf == NULL) {
        pin_set_err(ebufp, PIN_ERRLOC_FM,
            PIN_ERRCLASS_SYSTEM_DETERMINATE,
            PIN_ERR_NO_MEM, 0, 0, 0);
        PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_DEBUG,
            "PIN_CONVERT_UTF8_TO_MBCS Failed",
            ebufp);
        PIN_ERR_CLEAR_ERR(ebufp);
        return NULL;
    }

    /* Second round, do the string conversion */
    dest_size = PIN_CONVERT_UTF8_TO_MBCS(locale,
        (unsigned char *)orig_str,
```

```
        orig_size, strbuf, dest_size + 1, ebufp);

    if (dest_size == 0) {
        if( PIN_ERR_IS_ERR( ebufp )) {
            PIN_ERR_LOG_EBUF(PIN_ERR_LEVEL_DEBUG,
                "PIN_CONVERT_UTF8_TO_MBCS Failed",
                ebufp);
            PIN_ERR_CLEAR_ERR(ebufp);
        }
        pin_free(strbuf);
        return NULL;
    }

    return strbuf;
}
```



# Part VI

---

## Programming Utilities

Part VI provides reference information about Oracle Communications Billing and Revenue Management (BRM) developer utilities. It contains the following chapter:

- [Developer Utilities](#)



---

## Developer Utilities

This chapter provides reference information for Oracle Communications Billing and Revenue Management (BRM) developer utilities.

## load\_config

Use this utility to load the contents of XML configuration files into configuration (**/config/\***) objects in the BRM database.

---

**Important:** To connect to the BRM database, this utility needs a configuration (**pin.conf**) file in the directory from which it is run. For information about creating configuration files for BRM utilities, see "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

Before loading the contents of a file, the utility validates the contents against the file's XML schema definition (XSD). To do this, the utility needs the following entries in its **pin.conf** file:

**Table 45–1** *load\_config pin.conf* Entries Required for XML Validation

| XML File to Validate                   | Required pin.conf Entry   |
|--|---|
| config_lifecycle_states.xml            | - load_config validation_module libLoadValidSLM LoadValidSLM_init                 |
| config_service_state_map.xml           | - load_config validation_module libLoadValidSLM LoadValidSLM_init                 |
| config_subscriber_preferences_map.xml  | - load_config validation_module libLoadValidTCFAAA LoadValidTelcoAAA_init         |
| config_collections_scenario_params.xml | - load_config validation_module libLoadValidCollections LoadValidCollections_init |

The location of the XSD must be specified in the XML file. If the contents do not conform to the XSD, the load operation fails.

After validating the XML contents against the XSD, the utility converts the XML file into one or more configuration objects, depending on the structure of the XML file.

If any syntax errors occur, the load operation fails.

---

**Note:** You can load separate configuration objects for each brand by setting the user in the utility's **pin.conf** file to the appropriate brand.

---

### Location

*BRM\_Home*/apps/load\_config

where *BRM\_Home* is the directory in which you installed BRM components.

### Syntax

```
load_config [-d] [-h] [-l] [-n] [-r] [class] [-t] [-T] [-v] [-w] [class] [config_file]
```

## Parameters

**-d**

Creates a log file for debugging purposes. Use this parameter for debugging when the utility appears to have run with no errors but the configuration objects have not been loaded into the database.

**-h**

Displays syntax and parameters for the utility.

**-l**

Lists all validated configuration objects in the BRM database that are associated with *config\_file*.

**-n**

Creates a configuration object when a validation library is not loaded. Use this parameter to skip the validation and to load the contents of the XML file into the database schema when the corresponding validation library is not loaded. When the library is loaded, validation happens irrespective of whether this parameter is passed or not.

In the absence of the validation library and this parameter, the utility returns an error and exits.

**-r class**

Deletes all instances of the specified class from the BRM database.

To specify the *class*, do not include */config/*. For example, to specify the */config/lifecycle\_states* class, enter *lifecycle\_states*.

**-t**

Runs the utility in test mode to validate the XML file against its XML schema definition. This parameter does not load data into a configuration object or overwrite any existing data in the objects.

**Tip:** To avoid load errors based on XML content problems, run the utility with this option *before* loading data into the object.

**-T**

Validates configuration objects in the BRM database that are associated with *config\_file*.

**-v**

Displays information about successful or failed processing as the utility runs.

**-w class**

Writes information from all objects of the specified class in the database to *config\_file*.

To specify the *class*, do not include */config/*. For example, to specify the */config/lifecycle\_states* class, enter *lifecycle\_states*.

This parameter can be used to copy configuration data from one system to another. The generated XML does not conform to a particular XSD. Before loading the contents of *config\_file* into another database schema, you must associate it with an XSD that defines the appropriate format.

**config\_file**

The XML file for which the utility performs one of the following actions:

- Loads the file's contents into the database schema

- Loads information from objects in the database schema into the file

This must be the last parameter listed on the command line.

If the XML file is in the same directory from which you run the utility, specify only the file name. If it is in a different directory, include the entire path for the file.

## Results

If the utility does not notify you that it was successful, look in the **default.pinlog** file to find any errors. This log file is either in the directory from which the utility was run or in a directory specified in the utility's configuration file.

To verify that the configuration information was loaded, display the configuration objects by using one of the following features:

- Object Browser
- **testnap** utility's **robj** command

See "[Reading an Object and Writing Its Contents to a File](#)" for more information.

---

---

**Important:** You must stop and restart the Connection Manager (CM) to make new service life cycle and service state mapping data available.

See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

---

---

---

## load\_config\_provisioning\_tags

Use the `load_config_provisioning_tags` utility to load provisioning tags into the `/config/provisioning_tag` object in the BRM database. You define provisioning tags in the `pin_config_provisioning_tags.xml` file in `BRM_Home/sys/data/config`.

Use this utility when you create provisioning tags using the provisioning tag framework.

For information about creating provisioning tags, see "Working with Provisioning Tags" in *BRM Setting Up Pricing and Rating*.

For information about the syntax of the XML file, see "Configuring Provisioning Tags" in *BRM Setting Up Pricing and Rating*.

---

**Caution:** The `load_config_provisioning_tags` utility overwrites existing instances of the `/config/provisioning_tag` object. If you are updating provisioning tags, you cannot load new or changed tags only. You must load the complete set of provisioning tags each time you run the `load_config_provisioning_tags` utility.

---

When you run this utility, the `pin_config_provisioning_tags.xml` and `business_configuration.xsd` files must be in the same directory. By default, both files are in `BRM_Home/sys/data/config`.

---

**Important:** To connect to the BRM database, the `load_config_provisioning_tags` utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

### Location

`BRM_Home/bin`

### Syntax

```
load_config_provisioning_tags [-d] [-v] [-t] [-h] pin_config_provisioning_tags_
file
```

### Parameters

**-d**

Creates a log file for debugging purposes. Use this parameter for debugging when the utility appears to have run with no errors, but the data has not been loaded into the database.

**-v**

Displays information about successful or failed processing as the utility runs.

```
load_pin_config_provisioning_tags any_other_parameter -v > filename.log
```

**-t**

Runs the utility in test mode to validate the XML file. This parameter does *not* create, modify, or delete any entries in the `/config/provisioning_tag` object.

---

---

**Tip:** To avoid load errors based on XML content problems, run the utility with this option *before* loading data into the database.

---

---

**-h**

Displays help information for using this utility.

***pin\_config\_provisioning\_tags\_file***

The name and location of the file that defines provisioning tags. The default **pin\_config\_provisioning\_tags.xml** file is in *BRM\_Home/sys/data/config*. The utility can take any XML file name as a parameter if the file's contents conform to the appropriate schema definition.

---

---

**Important:** The file must be in the same directory as the **business\_configuration.xsd** file.

---

---

If you do not run the utility from the directory in which the file is located, you must include the complete path to the file, for example:

```
load_config_provisioning_tags BRM_Home/sys/data/config/pin_config_provisioning_tags.xml
```

## Validity Checks

The utility validates the XML file against rules defined in the **business\_configuration.xsd** file. This file resides in the *BRM\_Home/sys/data/config* directory.

The utility validates the following:

- The service name length is from 1 to 1,023 characters.
- The service names listed in the file are unique.

## Results

If **load\_config\_provisioning\_tags** does not notify you that it was successful, look in the log file (normally **default.pinlog**) for error messages. The log file is located in the directory from which the utility was started or in a directory specified in the **pin.conf** configuration file.

To verify that the objects were loaded, you can display the **/config/provisioning\_tag** object by using the Object Browser, or use the **robj** command with the **testnap** utility. See "[Reading an Object and Fields](#)".

---

---

**Important:** You must restart the Connection Manager (CM) to make new provisioning tags available. See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

---

---



---

## load\_localized\_strings

Use this utility to load localized strings into the BRM database. This utility reads localized strings from various customizable files and stores them as **/strings** objects in the BRM database. These files include error code files, locale description files, reason code files, and a variety of other files.

---

**Important:** Use only one locale for each type of file.

---

For information on modifying and loading localized string files, see ["Localizing and Customizing Strings"](#).

---

**Note:** You cannot load separate **/config/map\_glid** objects for each brand. All brands use the same object.

---



---

**Caution:** When loading reason codes from the **reasons.locale** file, **load\_localized\_strings** also loads information from this file into the **/config/map\_glid** object. If customized to specify services and event types for event-level adjustments, the utility also loads information into the **/config/reason\_code\_scope** object. While the utility doesn't overwrite existing strings in the **/strings** object unless you direct it to, it *does* overwrite the **/config/reason\_code\_scope** and **/config/map\_glid** objects.

---



---

**Important:** To connect to the BRM database, the **load\_localized\_strings** utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

### Location

*BRM\_Home/data/config*

### Syntax

```
load_localized_strings [-v] [-f] [-h] filename.locale
```

### Parameters

**-v**

Displays information about successful or failed processing as the utility runs.

**load\_localized\_strings any\_other\_parameter -v > filename.log**

**-f**

Forces strings to be stored in the BRM database, overwriting localized strings with the same IDs. If you do not use **-f**, string objects are not stored when localized strings with the same IDs already exist.

---

---

**Note:** This parameter has no effect on either the `/config/reason_code_scope` or `/config/map_glid` object. These objects are *always* completely overwritten by the utility.

---

---

**-h**

Displays help about using the `load_localized_strings` utility.

***filename.locale***

The name and location of the file that contains the localized strings.

- For sample BRM files `errors`, `locale_desc`, and `reasons`, see ["Sample Files"](#).
- `locale` is the BRM locale, based on ISO-639 and ISO-3166 standards. See ["Locale Names"](#).

---

---

**Tip:** If you copy the `filename.locale` file to the same directory from which you run the `load_localized_strings` utility, you do not have to specify the path or the file name.

---

---

## Results

If the `load_localized_strings` utility doesn't notify you that it was successful, look in the `load_localized_strings.log` file to find any errors. The log file is either in the directory from which the utility was started, or in a directory specified in the configuration file.

## Sample Files

Use the following American English files as examples of how to set up localized or customized error message, locale description, and reason code files. The following files are loaded into the BRM database when you install BRM:

- `errors.en_US` in `BRM_Home/sys/messages/errorcodes`
- `locale_descr.en_US` in `BRM_Home/sys/messages/localedescr`
- `reasons.en_US` in `BRM_Home/sys/messages/reasoncodes`

For information on other sample files you can localize or customize, see ["Localizing and Customizing Strings"](#).

---

## load\_pin\_config\_business\_type

Customer Center and Self-Care Manager use business type definitions to display the appropriate entry fields for an account. For example, when a CSR selects **File – New – Consumer**, the Account Creation wizard only displays entries appropriate for a consumer. The wizard would not display the **Company** or **Job title** entry fields.

### Using the load\_pin\_config\_business\_type Utility

Use this utility to load updates to the business types defined in the *BRM\_Home/data/config/pin\_config\_business\_type* file into the */config/business\_type* storable object in the BRM database. When you load new business type definitions, you overwrite the old */config/business\_type* object.

You must restart the Connection Manager (CM) after running this utility.

If an account is created outside of Customer Center, the default value for "Unknown business type" is used.

---



---

**Note:** You cannot load separate */config/business\_type* objects for each brand. All brands use the same object.

---



---



---



---

**Important:** If */config/business\_type* isn't loaded, the value for PIN\_FLD\_BUSINESS\_TYPE included in the */account* object at account creation must either be zero or not included in the input list. Otherwise, PCM\_OP\_CUST\_POL\_VALID\_BILLINFO returns a validation error.

---



---

### Examples of Business Type Definitions

You can append your own business type definitions to the end of the list of definitions provided in *pin\_config\_business\_type*, or create a new definition file. The file must include a 0 "Unknown business type" entry. Keep the current entries of 1 "Consumer" and 2 "Business" in place and append your new entry after them.

The format for each entry is an integer value plus an associated quoted string with a semicolon at the end of the statement. The length of the string is limited to 1024 characters. Multi-line string entries are valid as long as there is a closing quote before the carriage return and an opening quote on the following line, for example:

```
0 "Unknown business type";
1 "Consumer";
2 "Business";
3 "This is a valid quoted string entry "
  "that spans more than one line";
```

There can be only one quoted string associated with each integer. The string description is not used for validation, but provides a way to record the meaning of each integer value.

To add a business type definition, use a text editor to open the *pin\_config\_business\_type* file and follow the guidelines provided in the comment section to add your new value to the end of the existing definitions. For example, for an employee account, you might want the Account Creation wizard to display a field for the CSR to enter an

employee ID number. To add the new value to the `/config/business_type` object for an employee business type, add it to the end of the existing definitions in the `pin_config_business_type` file:

```
0 "Unknown business type";
1 "Consumer";
2 "Business";
3 "Employee";
```

## Location

`BRM_Home/data/config`

## Syntax

```
load_pin_config_business_type [-d] [-v] [-?] filename
```

## Parameters

### -d

Writes error information for debugging purposes to the utility log file. By default, the file is located in the same directory as the utility and is called `default.pinlog`. You can specify a different name and location in the `Infranet.properties` file.

### -v

Displays information about successful or failed processing as the utility runs.

### -?

Displays the syntax and parameters for this utility.

### filename

The file containing the business type definitions, typically, `BRM_Home/data/config/pin_config_business_type`.

## Results

Table 45–2 lists the possible completion values this utility returns. The returned value is saved in the `default.pinlog` file:

**Table 45–2** `load_pin_config_business_type` Returned Values

| Value | Description  |
|-------|--|
| 0     | success  |
| 1     | bad flag   |
| 2     | error parsing input file (default is <code>pin_config_business_type</code> ) |
| 3     | error opening PCM connection   |
| 4     | error opening transaction  |
| 5     | error deleting old <code>/config/business_type</code> object                 |
| 6     | error creating new <code>/config/business_type</code> object                 |
| 7     | error committing transaction   |

---

## load\_pin\_device\_permit\_map

Use this utility to load device-to-service mapping information into the BRM database.

You use a mapping file to define which service types can be associated with a particular device type. A sample file is provided as *BRM\_Home/sys/data/config/pin\_device\_permit\_map*. Each mapping file contains information about one device type in one brand.

---

---

**Note:** This utility is brand-aware. You can load separate */config/device\_permit\_map* objects for each brand.

---

---

After defining device-to-service mappings, you use the **load\_pin\_device\_permit\_map** utility to load the mapping data into a */config/device\_permit\_map* object. Each */config/device\_permit\_map* object contains mapping information for all the device types in one brand.

---

---

**Note:** You must load the mapping data into the database and restart the CM before you can use device management features. Because device management configuration data is always customized, it is not loaded during BRM installation.

---

---

You must load device-to-service mapping information for each unique combination of device type and brand. For example, if the same device type exists in several different brands, you must load mapping information for that device type into the */config/device\_permit\_map* object for each brand.

If the mapping definitions are the same for all brands or if you are not using branding, you can create a single */config/device\_permit\_map* object by using the **root** login when you run **load\_pin\_device\_permit\_map**. The device management opcodes automatically check the */config/device\_permit\_map* object associated with **root** if they can't find an object associated with a device's brand. See "[Device Management and Brands](#)" for more information.

The mapping information you load into a */config/device\_permit\_map* object gets its brand association from the BRM login specified in the configuration file used with **load\_pin\_device\_permit\_map**. So when you load mapping information for a device type in a particular brand, you must edit the configuration file to use a login associated with that brand. See "Running Utilities with a Branded Database" in *BRM Managing Customers*.

The **load\_pin\_device\_permit\_map** utility shares a configuration file with the **load\_pin\_device\_state** utility. This file is generated during installation and is located in *BRM\_Home/apps/device\_management/Infranet.properties*.

See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide* for more information about configuration files.

### Location

*BRM\_Home/bin*

## Syntax

```
load_pin_device_permit_map [-v] [-d] map_file
```

## Parameters

### **-v**

Displays information about successful or failed processing as the utility runs.

### **-d**

Writes error information for debugging purposes to the utility log file. By default, the file is located in the same directory as the utility and is called **default.pinlog**. You can specify a different name and location in the **Infranet.properties** file.

### **map\_file**

The name and location of the file that contains the device-to-service mapping data. A sample file is supplied as *BRM\_Home/sys/data/config/pin\_device\_permit\_map*. You can modify this file or create a new one.

The file includes lines specifying the device type (such as */device/voucher*) and the service types (such as */service/telco/gsm/telephony*) that can be associated with it. In this example, four service types can be associated with */device/voucher*.

```
/device/voucher      :/service/telco/gsm/telephony
                    :/service/telco/gsm/sms
                    :/service/telco/gsm/fax
                    :/service/telco/gsm/data
```

The sample file includes additional information about the correct syntax for entries.

## Results

If the **load\_pin\_device\_permit\_map** utility does not notify you that it was successful, look in the log file (normally **default.pinlog**) for error messages. The log file is located in the directory from which the utility was started, or in a directory specified in the **Infranet.properties** configuration file.

---

## load\_pin\_device\_state

Use this utility to load state-change definitions for devices into the BRM database.

You use a state change definition file to define, which state changes are valid and which policy opcodes to call for each state change. A sample file is provided as *BRM\_Home/sys/data/config/pin\_device\_state*.

---

**Note:** This utility is brand-aware. You can load separate */config/device\_state/apn* objects for each brand.

---

After defining the state changes, you run the **load\_pin\_device\_state** utility to load the definitions into the database as a */config/device\_state* object.

---

**Note:** You must load the state change definitions into the database and restart the Connection Manager before you can use device management features. Because device management configuration data is always customized, it is not loaded during BRM installation.

---

Because */config/device\_state* objects are brand aware, you load an object for each unique combination of device type and brand. For example, if you have two device types (A and B) that are offered by two brands (1 and 2) and a third device type (C) that is offered only by Brand 1, you load */config/device\_state* objects for these five combinations: A1, A2, B1, B2, and C1.

If you aren't using branding or if the state change definitions for a device type are the same for all brands, you can create a single */config/device\_state* object for that device type by using the **root** login. The device management opcodes automatically check the */config/device\_state* object associated with **root** if they can't find an object associated with a device's brand.

*/config/device\_state* objects get their brand associations from the BRM login used to create them. So in the scenario mentioned above, you would need to use two different logins (for Brands 1 and 2) to create */config/device\_state* objects for the three device types. See "Running Utilities with a Branded Database" in *BRM Managing Customers*.

The **load\_pin\_device\_state** utility shares a configuration file with the **load\_pin\_device\_permit\_map** utility. This file is generated during installation and is located in *BRM\_Home/apps/device\_management/Infranet.properties*.

When you enter state change information into the state change definition file, you must refer to the localized text strings that describe the valid states for a particular device type. You must define these text strings and load them into the database by using the **load\_localized\_strings** utility. A sample localized strings file for device states is located in *BRM\_Home/sys/msgsgs/device\_states/device\_states.en-US*.

### Location

*BRM\_Home/bin*

### Syntax

```
load_pin_device_state [-v] [-d] state_change_file
```

## Parameters

**-v**

Displays information about successful or failed processing as the utility runs.

**-d**

Writes error information for debugging purposes to the utility log file. By default, the file is located in the same directory as the utility and is called **default.pinlog**. You can specify a different name and location in the **Infranet.properties** file.

### **state\_change\_file**

The name and location of the state change definitions file, where *device* represents the device type. For example, the default file for Number Management is **pin\_device\_state\_num**. Each device type must have its own file.

A sample state change definition file is provided in *BRM\_Home/sys/data/config/pin\_device\_state*.

Use this syntax for entries:

```
storable_object_type
```

```
device_type
```

```
state_id: state_type: strid_id: string_ver:opcode_num:flags
```

```
next_id1: opcode_num1:flags1
```

```
next_id2: opcode_num2:flags2
```

- **storable\_object\_type**

A subclass of **/config/device\_state**, for example **/config/device\_state/sim**. The storable object type must be the first non-comment line in the file. Only one storable object type can be specified.

- **device\_type**

The device type, for example **/device/sim**. The device type must be the second non-comment line in the file. Only one device type can be specified.

- **state\_id**

An integer state ID, such as **0, 1, 2**, and so on. State IDs can be freely assigned, except for 0, which is reserved for the Raw state.

- **state\_type**

An integer representing the state type to which **state\_id** belongs. The state type determines the valid behaviors of states of that type. There are four possible values:

**0 (RAW)**: Includes the state that marks the beginning of the device life cycle. Only one state can be of this type. States of type RAW can transition only to states of type INIT. Device objects cannot be saved in the Raw state.

**1 (INIT)**: Includes all the states in which the device can be saved immediately after its creation. States of type INIT can transition to states of type INIT, NORMAL, or END.

**2 (NORMAL)**: Includes all the working states between INIT and END. States of type NORMAL can transition to INIT states, other NORMAL states, and END states.



3 (END): Includes all the terminal states of the life cycle. Devices cannot be transitioned from states of this type.

- **str\_id**

ID of the state's localized text string in */string*. You must load these text strings into the database by using a text file and the **load\_localized\_strings** utility.

- **str\_version**

Version number of the state's localized text string in */string*.

- **opcode\_num**

The opcode number of the first policy opcode to be called during a transition from **state\_id**. Device opcode numbers are specified in the **device.h** file. This file is located in *BRM\_Home/include/ops* directory.

- **flags**

Flags to be used when calling the opcode specified by **opcode\_num**. Flags are listed in the **pin\_device.h** file and explained in the opcode documentation.

- **next\_idx**

An integer state ID that specifies a device state to which **state\_id** can transition. Any integer value is allowed except 0, which is reserved for the Raw state.

- **opcode\_numx**

Specifies the policy opcode called just after the state change to **next\_idx** is complete. Device opcode numbers are specified in the **device.h** file. This file is located in *BRM\_Home/include/ops* directory.

- **flagsx**

Flags to be used when calling the opcode specified by the matching **opcode\_numx**. Flags are listed in the **pin\_device.h** file and explained in the opcode documentation.

The sample state change definitions file includes additional information about the correct syntax for entries. Its location is *BRM\_Home/sys/data/config/pin\_device\_state*.

## Results

If the **load\_pin\_device\_state** utility doesn't notify you that it was successful, look in the log file (normally **default.pinlog**) for error messages. The log file is located in the directory from which the utility was started, or in a directory specified in the **Infranet.properties** configuration file.

The utility fails if it detects duplicate state IDs in the state change definitions file. It also fails if the file contains more than one storable object or device type entry.

## load\_pin\_excluded\_logins

Use this utility to load a list of service types that identify users through alias names rather than service logins. See "Improving Search Performance for Prepaid Services" in *BRM Telco Integration*.

You specify which service types identify users through alias names in the *BRM\_Home/sys/data/config/pin\_excluded\_logins.xml* file. You then load the file into the */config/login\_exclusion* object in the BRM database.

When you run the utility, the *pin\_excluded\_logins.xml* and *business\_configuration.xsd* files must be in the same directory. By default, both files are in *BRM\_Home/sys/data/config*.

After running this utility, you must stop and restart the Connection Manager (CM). See "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

---

---

**Note:** You cannot load separate */config/login\_exclusion* objects for each brand. All brands use the same object.

---

---

---

---

**Important:** To connect to the BRM database, the *load\_pin\_excluded\_logins* utility needs a configuration file in the directory from which it is run. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

---

### Location

*BRM\_Home/bin*

### Syntax

```
load_pin_excluded_logins [-v] [-d] [-t] [-h] xml_file
```

### Parameters

**-v**

Displays information about successful or failed processing as the utility runs.

**-d**

Creates a log file for debugging purposes. Use this parameter for debugging when the utility seemed to run without error but the data was not loaded into the database.

**-t**

Runs the utility in test mode to validate the XML file. This parameter does *not* create, modify, or delete any entries in the */config/login\_exclusion* object.

---

---

**Tip:** To avoid load errors based on XML content problems, run the utility with this option *before* loading data into the database.

---

---

**-h**

Displays help information for using this utility.

**xml\_file**

The name and location of the XML file. The default XML file is *BRM\_Home/sys/data/config/pin\_excluded\_logins.xml*, but the utility can take any XML file name as a parameter as long as the file's contents conform to the appropriate schema definition.

If you copy the file to the same directory from which you run the load utility, specify only the file name. If you run the command in a different directory from where the file is located, you must include the entire path for the file.

---

---

**Important:** The file must be in the same directory as the **business\_configuration.xsd** and **pin\_excluded\_logins.xml** files.

---

---

## Validity Checks

The utility validates the XML file against rules defined in the **pin\_excluded\_logins.xsd** file. This file resides in the *BRM\_Home/sys/data/config* directory, and you must point to it through a **business\_configuration.xsd** file in the directory that contains your working XML file.

The utility validates the following:

- The service name length is from 1 to 1,023 characters.
- The service names listed in the file are unique.

## Results

If the **load\_pin\_excluded\_logins** utility doesn't notify you that it was successful, look in the log file (normally **default.pinlog**) for error messages. The log file is located in the directory from which the utility was started or in a directory specified in the **pin.conf** configuration file.

## load\_pin\_order\_state

Use this utility to load state-change definitions for orders into the BRM database.

You define which state changes are valid and which policy opcodes to call for each state change in a state change definition file. A sample file is provided as *BRM\_Home/sys/data/config/pin\_order\_state*.

After defining the state changes, you use the **load\_pin\_order\_state** utility to load the definitions into the database as a **/config/order\_state** object.

---

---

**Note:** This utility is brand-aware. You can load separate **/config/order\_state** objects for each brand.

---

---

---

---

**Note:** You must load the state change definitions into the database and restart the CM before you can use order management features. Because order management configuration data is always customized, it is not loaded during BRM installation.

---

---

Because **/config/order\_state** objects are brand aware, you load an object for each unique combination of order type and brand. For example, if you have two order types (A and B) that occur in two brands (1 and 2) and a third order type (C) that occurs only in Brand 1, you load **/config/order\_state** objects for these five combinations: A1, A2, B1, B2, and C1.

If you aren't using branding or if the state change definitions for a order type are the same for all brands, you can create a single **/config/order\_state** object for that order type by using the **root** login. The order management opcodes automatically check the **/config/order\_state** object associated with **root** if they can't find an object associated with an order's brand.

**/config/order\_state** objects get their brand associations from the BRM login used to create them. So in the scenario mentioned in the previous paragraph, you would need to use two different logins (for Brands 1 and 2) to create **/config/order\_state** objects for the three order types. See "Running Utilities with a Branded Database" in *BRM Managing Customers*.

When you enter state change information into the state change definition file, you must refer to the localized text strings that describe the valid states for a particular order type. You must define these text strings and load them into the database by using the **load\_localized\_strings** utility. A sample localized strings file for order states is located in *BRM\_Home/sys/msgs/order\_states/order\_states.en-US*.

### Location

*BRM\_Home/bin*

### Syntax

```
load_pin_order_state [-v] [-d] state_file_order
```

## Parameters

**-v**

Displays information about successful or failed processing as the utility runs.

**-d**

Writes error information for debugging purposes to the utility log file. By default, the file is located in the same directory as the utility and is called **default.pinlog**. You can specify a different name and location in the **Infranet.properties** file.

### **state\_file\_order**

The name and location of the state change definitions file, where *order* represents the order type. For example, for Number Management, the file could be **pin\_order\_state\_num**. Each order type must have its own file.

A sample state change definition file is provided in *BRM\_Home/sys/data/config/pin\_order\_state*.

Use this syntax for entries:

```
storable_object_type
```

```
order_type
```

```
state_id: state_type: strid_id: string_ver
: next_id1
: next_id2
```

- **storable\_object\_type**

A subclass of */config/order\_state*, for example */config/order\_state/sim*. The storable object type must be the first non-comment line in the file. Only one storable object type can be specified.

- **order\_type**

The order type, for example */order/voucher*. The order type must be the second non-comment line in the file. Only one order type can be specified.

- **state\_id**

An integer state ID, such as 0, 1, 2, and so on. State IDs can be freely assigned, except for 0, which is reserved for the Raw state.

- **state\_type**

An integer representing the state type to which **state\_id** belongs. The state type determines the valid behaviors of states of that type. There are four possible values:

**0 (RAW)**: Includes the state that marks the beginning of the order life cycle. Only one state can be of this type. States of type RAW can transition only to states of type INIT. Order objects cannot be saved in raw state.

**1 (INIT)**: Includes all the states in which the order can be saved immediately after its creation. States of type INIT can transition to states of type INIT, NORMAL, or END.

**2 (NORMAL)**: Includes all the working states between INIT and END. States of type NORMAL can transition to INIT states, other NORMAL states, and END states.

**3 (END)**: Includes all the terminal states of the life cycle. Orders cannot be transitioned from states of this type.

- **str\_id**  
ID of the state's localized text string in */string*. You must load these text strings into the database via a text file and the **load\_localized\_strings** utility.
- **str\_version**  
Version number of the state's localized text string in */string*.
- **next\_idx**  
An integer state ID that specifies a order state to which **state\_id** can transition. Any integer value is allowed except 0, which is reserved for Raw state.

The sample state change definitions file includes additional information about the correct syntax for entries. Its location is *BRM\_Home/sys/data/config/pin\_order\_state*.

## Results

If the **load\_pin\_order\_state** utility doesn't notify you that it was successful, look in the log file (normally **default.pinlog**) for error messages. The log file is located in the directory from which the utility was started, or in a directory specified in the **Infranet.properties** configuration file.

The utility fails if it detects duplicate state IDs in the state change definitions file. It also fails if the file contains more than one storable object or order type entry.

---

## load\_pin\_rtp\_trim\_flist

Use this utility to specify account and service object fields to be included in the flist sent to a real-time rerating, discounting, or zoning pipeline. The main uses for this utility include:

- Improving system efficiency by removing (trimming) fields that Pipeline Manager doesn't use.
- Supporting custom iScripts and iRules in the real-time pipeline by adding fields to flists which are not included by default.

See "Customizing Flists Sent to a Real-Time Pipeline" in *BRM System Administrator's Guide*.

You can configure a different set of fields to be included in the flist based on event type.

Account object fields are included in the PIN\_FLD\_INHERITED\_INFO substruct in the flist. Service object fields are included in the PIN\_FLD\_INHERITED\_INFO.PIN\_FLD\_SERVICE\_INFO substruct.

---

**Note:** You cannot load separate `/config/rtp/trim_flist` objects for each brand. All brands use the same object.

---



---

**Important:** You can't remove fields from the PIN\_FLD\_INHERITED\_INFO substruct or the subordinate PIN\_FLD\_INHERITED\_INFO.PIN\_FLD\_SERVICE\_INFO substruct.

---

You specify the list of required fields in an XML file (*field\_list.xml*) and then load the file using the utility.

---

**Important:**

- If you use the utility to add new fields to the flist, you must update the input modules of the all pipelines to add the fields to the EDR container.
  - After you use the utility, you must restart BRM.
- 

### Location

`BRM_Home/bin`

### Syntax

```
load_pin_rtp_trim_flist -f field_list.xml [-v] [-d]
```

### Parameters

**-f *field\_list.xml***

Specifies the XML file that describes which fields should be read. For a sample flist, see `BRM_Home/sys/data/config/pin_config_rtp_trim_flist.xml`.

**-v**

Displays information about successful or failed processing as the utility runs.

**-d**

Creates a log file for debugging purposes. Use this parameter for debugging when the utility appears to have run with no errors, but the data has not been loaded into the database.



---

## parse\_custom\_ops\_fields

Use this BRM Perl script to parse include files for custom fields and opcodes and to generate memory-mappable files that extend the opcode and field name-to-number mapping tables. This allows you to use custom fields and opcodes by using their name or number in applications.

---

**Note:** You can define opcodes and fields without including them in the mapping tables; however, you can't use them in client applications or **testnap** by using their symbolic names instead of numbers.

---

The **parse\_custom\_ops\_fields** script reads the specifications of opcodes and fields from the *input* header file and creates corresponding entries in the *output* memory-mapped file or header file.

The script also generates a Java class for each field. You must compile each class with **JavaPCM.jar** in the **CLASSPATH**. You can either include the **CLASS** files in a **JAR** file, or build them in a base directory and leave them there. Then you must add the **JAR** file or the base directory to the **CLASSPATH**.

If you build the class files in the base directory, make sure the base directory matches the package name. For example, if the *java\_package* is **com.portal.classFiles**, then the base directory must be **/com/portal/classFiles**.

For custom fields, the script creates a properties file in the *java\_package* directory, named **InfranetPropertiesAdditions.properties**. You must append this file to your **Infranet.properties** file.

### Location

*BRM\_Home/bin*

### Syntax

```
parse_custom_ops_fields -L language -I input -O output -P java_package
```

### Parameters

#### *language*

The BRM API used. It can be **pcmc** (for PCM C), or **pcmjava** (for Java PCM).

---

**Note:** **perlpcmif** is a wrapper API for PCM C. If you run the script with the **pcmc** option, you can call custom opcodes in your Perl PCM-based client applications.

---

#### *input*

The header file you create for your custom opcodes and fields.

#### *output*

The memory-mapped file or directory for the output of the script. If *language* is **pcmjava**, then *output* must be a directory having some correspondence with the Java

package. For example, if the *java\_package* is in **com.portal.classFiles**, then *output* must be **f:/mysource/com/portal/classFiles**.

***java\_package***

The Java package, where you want to put the generated classes.

---

## pin\_adu\_validate

Use this utility to dump and validate information for one or more accounts from the BRM database.

For more information on using **pin\_adu\_validate** utility, see "About Dumping and Validating Account-Related Information" in *BRM Managing Customers*.

---

---

**Note:** To connect to the BRM database, this utility needs a configuration file in the directory from which you run it. The **pin.conf** file for this utility is in *BRM\_Home/sys/diagnostics/pin\_adu\_validate*. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

---

### Location

*BRM\_Home/sys/diagnostics/pin\_adu\_validate*

### Syntax

```
pin_adu_validate [-dump [-validate]] [-report]
```

### Parameters

#### **-dump**

Uses the account search list in the input file configured in the **pin\_adu\_validate** configuration file (**pin.conf**) to search for storable objects associated with the accounts in the BRM database and dumps the object data into an output file.

#### **-validate**

Performs the predefined validations enabled in the **pin\_adu\_validate** configuration file (**pin.conf**) file and any custom validations defined in the PCM\_OP\_ADU\_POL\_VALIDATE policy opcode.

---

---

**Note:** To perform validation, you must specify both the **-dump** and **-validate** options at the same time.

---

---

#### **-report**

Searches for account information in the BRM database using the account search list in the input file configured in the **pin\_adu\_validate** configuration file (**pin.conf**) file and provides statistical data about the accounts, such as the number of object instances found for each object specified in the **pin.conf** file. The statistical data is written to the Connection Manager (CM) log file.

---

---

**Note:** **pin\_adu\_validate** uses the date ranges configured in the **pin.conf** file to provide statistics for most commonly updated objects. See "Limiting Dump Information by Specifying a Date Range" in *BRM Managing Customers*.

---

---

Sample output:

```
Number of /account object instances found for the account [82828]: 1
```

Number of **/service/email** object instances found for the account [82828]: 1  
Number of **/service/ip** object instances found for the account [82828]: 1  
Number of **/payinfo/cc** object instances found for the account [82828]: 1

## pin\_bus\_params

Use the **pin\_bus\_params** utility to retrieve and load configurable business parameters for the **/config/business\_params** objects in the BRM database. These parameters enable optional BRM features or control things like the tracking level for write-off reversals, whether to validate exclusions for discounts, and so forth.

You use this utility to perform two tasks:

- Retrieve the contents of a **/config/business\_params** object and convert its contents into XML for easy modification.
- Load a modified XML file containing a parameter class and its associated parameters into the appropriate **/config/business\_params** object in the BRM database.

The utility retrieves the **/config/business\_params** objects, converts them to XML, and writes them into the **BRM\_Home/sys/data/config/pin\_bus\_params\_ParameterClassName.xml.out** file. The utility also loads the objects into BRM from this file, converting them back into the format required by the object. You can optionally place the file in a different location, but if you do, you must also copy the **bus\_params\_conf.xsd** file from the **BRM\_Home/xsd** directory to the new location and modify the file to include the correct relative paths to the **bus\_params\_ParameterClassName.xsd** files.

You can use another utility, **pin\_cfg\_bpdump**, to dump the contents of all business parameters in XML format. You can direct the XML output to a file or to a utility or application. See "Dumping Business Parameters in XML Format" in *BRM System Administrator's Guide*.

---

---

**Note:** This utility is brand-aware. You can load separate **/config/business\_params** objects for each brand.

---

---

---

---

**Caution:** When loading business parameters, the **pin\_bus\_params** utility overwrites the **/config/business\_params** object for the parameter class that appears in the XML file. If you are updating some of the parameters in the class, you cannot load the new parameters only. You must load a complete set of parameters for the class.

---

---

The **pin\_bus\_params** utility is a perl script. To run the utility, you *must* set path to perl in your environment.

---

---

**Important:** To connect to the BRM database, the **pin\_bus\_params** utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

---

### Location

**BRM\_Home/bin**

## Syntax

For retrieving a `/config/business_params` object for a parameter class:

```
pin_bus_params [-h] -r ParameterClassTag bus_params_ParameterClassName.xml
```

For loading a `/config/business_params` object from a specified file:

```
pin_bus_params [-h] bus_params_ParameterClassName.xml
```

## Parameters

### **-r**

Retrieves the contents of a `/config/business_params` object and converts it to XML for editing.

### **-h**

Displays the syntax and parameters for this utility.

### **ParameterClassTag**

Specifies the parameter class tag for the parameter class you are retrieving. This parameter is case sensitive and uses the following naming convention:

**BusParamsObjectClassName**

Where *ObjectClassName* is the name of the class in the `/config/business_params` object. For example, the object class name for the `/config/business_params` object that contains the business parameters that control billing is **billing**, so the parameter class tag is **BusParamsBilling**. This parameter is case sensitive.

### **bus\_params\_ParameterClassName.xml**

If you use the `-r` parameter, this parameter specifies the name and location of the XML output file created by the utility. This file contains the business parameters for the class identified in the *ParameterClassName* part of the file name.

If you do not use the `-r` parameter, this parameter specifies the name and location of the XML input file that you are loading into the `/config/business_params` object. This file contains the business parameters for the class identified in the *ParameterClassName* part of the file name. BRM overwrites the `/config/business_params` object that class.

To specify a different directory, include the full path and file name, as in the following example that loads XML file contents into the `/config/business_params` object for the **billing** business parameters:

```
pin_bus_params C:\param_conf\bus_params_billing.xml
```

---

---

**Important:** If you are loading parameters from a directory other than `BRM_Home/sys/data/config`, the directory you are using must contain a **business\_configuration.xsd** file. The utility uses the **bus\_params\_ParameterClassName.xsd** file to validate the XML file.

---

---

## Validity Checks

The utility checks XML validity against rules defined in the **bus\_params\_ParameterClassName.xsd** file. This file resides in the `BRM_Home/sys/data/config` directory, and you must point to it through a **bus\_params\_config.xsd** file in the directory that contains your working XML file.

The validity check ensures that the XML meets these standards:

- The parameter class name in the file is unique.
- The parameter class contains at least one parameter.

## Results

The **pin\_bus\_params** utility notifies you when it successfully creates or modifies the **/config/business\_params** object. Otherwise, look in the **default.pinlog** file for errors. This file is either in the directory from which the utility was started, or in a directory specified in the utility configuration file.

If you use the utility to load a **/config/business\_params** object, you can display the object by using the Object Browser, or use the **robj** command with the **testnap** utility. See "[Reading an Object and Writing Its Contents to a File](#)". This example shows an element in the **/config/business\_params** object:

```

0 PIN_FLD_POID                POID [0] 0.0.0.1 /config/business_params 10830 0
0 PIN_FLD_CREATED_T          TSTAMP [0] (1083892760) Thu May 06 18:19:20 2004
0 PIN_FLD_MOD_T              TSTAMP [0] (1083892760) Thu May 06 18:19:20 2004
0 PIN_FLD_READ_ACCESS        STR [0] "G"
0 PIN_FLD_WRITE_ACCESS       STR [0] "S"
0 PIN_FLD_ACCOUNT_OBJ        POID [0] 0.0.0.1 /account 1 0
0 PIN_FLD_DESCR              STR [0] "Business logic parameters for AR"
0 PIN_FLD_HOSTNAME           STR [0] "-"
0 PIN_FLD_NAME               STR [0] "ar"
0 PIN_FLD_PROGRAM_NAME       STR [0] "-"
0 PIN_FLD_VALUE              STR [0] ""
0 PIN_FLD_VERSION            STR [0] ""

...

0 PIN_FLD_PARAMS             ARRAY [2] allocated 4, used 4
1  PIN_FLD_DESCR              STR [0] "Enable/Disable payment suspense management.
                                The parameter values can be 0 (disabled),
                                1 (enabled). Default is 0 (disabled)."
```

```

1  PIN_FLD_PARAM_NAME         STR [0] "payment_suspense_enable"
1  PIN_FLD_PARAM_TYPE         INT [0] 1
1  PIN_FLD_PARAM_VALUE        STR [0] "1"
```

---

**Important:** To connect to the BRM database, you must restart the Connection Manager (CM) to activate new business parameters. For information on restarting the CM, see "Starting and Stopping the BRM System" in *BRM System Administrator's Guide*.

For multischema systems, you must also refresh the configuration data by running the **pin\_multidb** perl script with the **-R CONFIG** parameter set. For more information, see "pin\_multidb" in *BRM System Administrator's Guide*.

---

## pin\_cfg\_bpdump

Use the **pin\_cfg\_bpdump** utility to dump BRM business parameters in XML format. You can direct the output to a file or to another utility or application, such as a diagnostic application.

For more information, see "Dumping Business Parameters in XML Format" in *BRM System Administrator's Guide*.

---

---

**Important:** To connect to the BRM database, the **pin\_cfg\_bpdump** utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

---

### Location

*BRM\_Home*/diagnostics/pin\_cfg\_bpdump

### Syntax

**pin\_cfg\_bpdump**

### Parameters

This utility has no parameters.

### Results

The **pin\_cfg\_bpdump** utility outputs in XML format the contents of all `/config/business_params` objects.

The **pin\_cfg\_bpdump** utility does not produce **pinlog** notifications of success or failure. If there is an error, the utility produces no output. You can refer to the CM and DM logs for information about the problem.



## pin\_crypt\_app

Use this utility to encrypt files, plaintext, and plaintext passwords; generate encryption keys; load keys into memory; store root keys in root key wallets; and automatically modify the Oracle Data Manager (DM) **pin.conf** file.

For more information, see the following:

- [Generating an Encrypted AES Key](#)
- [About Encrypting Passwords](#)
- [Configuring the Data Manager for Oracle ZT PKI Encryption](#)

### Location

*BRM\_Home/bin*

### Syntax

To encrypt files, plaintext, and plaintext passwords:

```
pin_crypt_app [-enc [-f Filename] | Plaintext | Plaintext_passwd]
```

To generate an encrypted AES key:

```
pin_crypt_app [-genkey -key Key | -update_dm_conf]
```

To generate or modify a root key:

```
pin_crypt_app [-genrootkey]
```

To generate a 256-bit encrypted key from the AES key provided:

```
pin_crypt_app [-key AES_key]
```

To encrypt files and plaintext, and to generate a key using the Oracle ZT PKI algorithm:

```
pin_crypt_app [-useZT -enc -f Filename | -enc Plaintext | -genkey -key Key]
```

To display the syntax and parameters for this utility:

```
pin_crypt_app [-help]
```

### Parameters

#### **-enc**

Encrypts files, plaintext, and plaintext passwords. Use the following options with this parameter:

- **-f *Filename*** — The utility uses AES encryption to encrypt the specified file. *Filename* is the name of the file to encrypt.
- ***Plaintext*** — The utility uses AES encryption to encrypt the specified plaintext. *Plaintext* is the text to encrypt.
- ***Plaintext\_password*** — The utility uses AES encryption to encrypt the specified password. *Plaintext\_password* is the text to encrypt.

**-genkey**

Generates a 256-bit encrypted AES key. BRM generates a random AES key internally to generate the encrypted AES key. Use the following options with this parameter:

- **-key** — The utility generates a 256-bit encrypted AES key. *Key* is the 256-bit key in hexadecimal notation (64 hexadecimal characters).
- **-update\_dm\_conf** — The utility adds the new key to the *BRM\_Home/sys/dm\_oracle/pin.conf* file.

---

---

**Note:** If this is the first time that an AES key has been created, stop and restart the DM when prompted by the **pin\_crypt\_app** utility.

---

---

The **-key** and **-update\_dm\_conf** options can be combined.

**-genrootkey**

Generates or modifies a root key and stores it in a root key wallet. The root key is used for encryption using the Oracle ZT PKI-approved encryption algorithm.

For more information on the Oracle ZT PKI encryption algorithm, see "[Configuring the Data Manager for Oracle ZT PKI Encryption](#)".

**-key AES\_key**

Generates a 256-bit encrypted key from the specified AES key. Use this parameter if you already have an AES key and do not want BRM to generate one internally.

**-useZT**

Uses the Oracle ZT PKI algorithm to encrypt files and plaintext and to generate a key. Use the following options with this parameter:

- **-enc -f *Filename*** — The utility uses the Oracle ZT PKI encryption algorithm to encrypt the specified file. *Filename* is the name of the file to encrypt.
- **-enc *Plaintext*** — The utility uses the Oracle ZT PKI encryption algorithm to encrypt the specified plaintext. *Plaintext* is the text to encrypt.
- **-genkey -key *Key*** — The utility uses the Oracle ZT PKI encryption algorithm to generate a 256-bit encrypted key. *Key* is the 256-bit key in hexadecimal notation (64 hexadecimal characters).

**-help**

Displays the syntax and parameters for this utility.

## Results

The **pin\_crypt\_app** utility returns the output when the operation is successful. It does not return errors.

---

## pin\_crypt\_upgrade

Use the **pin\_crypt\_upgrade** utility to migrate MD5-encrypted data to the AES encryption scheme. This utility uses the **psiu\_encrypt** and **psiu\_decrypt** APIs.

---

**Important:** Before you run the **pin\_crypt\_upgrade** utility, the DM **pin.conf** file must contain the existing MD5 plaintext key in the **decrypt** entry and an encrypted AES key in the **crypt** entry. This utility uses both keys to upgrade all fields that are set to *encryptable*. For more information, see "[Migrating Data from MD5 to AES Encryption](#)". For information on generating an encrypted AES key, see "[Generating an Encrypted AES Key](#)".

---

### Location

*BRM\_Home/bin*

### Syntax

```
pin_crypt_upgrade [-d] [-v] [MM/DD/YYYY]
```

### Parameters

**-d**

Sets the log level to debug and writes debug information to the log file for this process. If not set, the only output is error-level information.

**-v**

Displays information about successful or failed processing as the utility runs.

**MM/DD/YYYY**

Upgrades the records that are modified before the date specified. If this parameter is not specified, the current **pin\_virtual\_time** is used to retrieve the records.

### Results

The **pin\_crypt\_upgrade** utility notifies you only if it encounters errors. Look in the **default.pinlog** file for errors. This file is either in the directory from which the utility was started or in a directory specified in the utility configuration file.

---

**Note:** The **pin\_crypt\_upgrade** utility automatically runs the **pin\_crypt\_rewrite** utility. The **pin\_crypt\_rewrite** utility is an internal application. Do not run the **pin\_crypt\_rewrite** manually.

---

## pin\_deploy

Transport definitions for storable classes and fields from one BRM server to another. This utility reads storable class and field definitions from a Portal Object Definition Language (PODL) file and loads them into the BRM data dictionary. This utility also exports storable class and field definitions from the BRM data dictionary to a PODL file.

---

---

**Important:** Before attempting to create new storable classes, verify that enough space is available in the BRM database. This utility can not test for available space. If the available space is exhausted before deployment is complete, new storable classes might be in an inconsistent state.

---

---

See "[Deploying Custom Fields and Storable Class Definitions](#)".

### Location

*BRM\_Home*/**bin**

### Commands

There are five commands for **pin\_deploy**:

- [Verify](#)
- [Create](#)
- [Replace](#)
- [Class](#)
- [Field](#)

To print the syntax and parameters for this utility, type **-h** or **-help**.

### Verify

Connect to BRM server, determine changes to be made, and report any conflicts. May alternatively accept PODL from **stdin**.

```
pin_deploy verify [file_one file_two ... file_N]
```

Example:

```
pin_deploy verify myobj.podl
```

Connects to the default database schema specified in the **pin.conf** file, determines the changes required for creating the class and field definitions contained in the PODL file, and reports conflicts.

### Verify for dm\_invoice

If your BRM installation includes a separate **dm\_invoice** database, you can use two parameters with the **verify** command:

- Use the **-d** switch to connect to a **dm\_invoice** database for a BRM installation that initially used a **dm\_oracle** database schema to store **/invoice** objects. If you use the

**-d** switch, specify the target database schema by database number. Omit the **-d** switch and database number to connect to the default database schema.

- Use the **-e** switch to print debugging information to the logfile.

```
pin_deploy verify [-de] [target_db] [file_one file_two ... file_N]
```

Example:

```
pin_deploy verify -de 0.0.6.1 myobj.podl
```

Connects to the **dm\_invoice** database 0.0.6.1, determines the changes required for creating the class and field definitions contained in the PODL file, reports conflicts, and prints debugging information to the logfile.

## Create

Load storable class and field definitions into the data dictionary. Succeeds only if there are no conflicts. If there are conflicts, they are reported and no action occurs. May alternatively accept PODL from **stdin**.

```
pin_deploy create [file_one file_two ... file_N]
```

Example:

```
pin_deploy create myobj.podl
```

Connects to the default database schema specified in the **pin.conf** file, creates the class and field definitions contained in the PODL file, and prints debugging information to the logfile. If conflicts are encountered, the operation fails without taking any action.

## Create for dm\_invoice

If your BRM installation includes a separate **dm\_invoice** database, you can use two parameters with the **create** command:

- Use the **-d** switch to connect to a **dm\_invoice** database for a BRM installation that initially used a **dm\_oracle** database schema to store **/invoice** objects. If you use the **-d** switch, specify the target database schema by database number. Omit the **-d** switch and database number to connect to the default database schema.
- Use the **-e** switch to print debugging information to the logfile.

```
pin_deploy create [-de] [target_db] [file_one file_two ... file_N]
```

Example:

```
pin_deploy create -de 0.0.6.1 myobj.podl
```

Connects to the **dm\_invoice** database 0.0.6.1, creates the class and field definitions contained in the file, and prints debugging information to the logfile. If conflicts are encountered, the operation fails without taking any action.

## Replace

Load storable class and field definitions into the data dictionary. Overwrites storable class and field definitions even if conflicts exist. The SQL table and column names for storable classes can not be overwritten. When loading field definitions, only the field description attribute is overwritten. May alternatively accept PODL from **stdin**.

```
pin_deploy replace [file_one file_two ... file_N]
```

Example:

```
pin_deploy replace myobj.podl
```

Connects to the default database schema specified in the **pin.conf** file, creates the class and field definitions contained in the PODL file, and prints debugging information to the logfile. If conflicts occur, existing definitions are overwritten.

## Replace for dm\_invoice

If your BRM installation includes a separate **dm\_invoice** database, you can use two parameters with the **replace** command:

- Use the **-d** switch to connect to a **dm\_invoice** database for a BRM installation that initially used a **dm\_oracle** database schema to store **/invoice** objects. If you use the **-d** switch, specify the target database schema by database number. Omit the **-d** switch and database number to connect to the default database schema.
- Use the **-e** switch to print debugging information to the logfile.

```
pin_deploy replace [-de] [target_db] [file_one file_two...file_N]
```

Example:

```
pin_deploy replace -de 0.0.6.1 myobj.podl
```

Connects to the **dm\_invoice** database 0.0.6.1, creates the class and field definitions contained in the PODL file, and prints debugging information to the logfile. If conflicts occur, existing definitions are overwritten.

## Class

Export storable class definitions from a BRM server in PODL format. May specify any number of storable classes on command line. If no storable classes are specified, then all classes will be exported.

```
pin_deploy class [-mnsdp] [class_one class_two ... class_N]
```

**[-m]** Export storable class implementation.

**[-n]** Export storable class interface.

**[-s]** Include all subclasses of specified storable class.

**[-c]** Include field definitions for all customer-defined fields within storable classes.

**[-p]** Include field definitions for all BRM-defined fields within storable classes.

Examples:

```
pin_deploy class -mn /account /bill
```

Export definitions for the **/account** and **/bill** storable classes from a BRM server in PODL format. Includes both implementations and interfaces.

```
pin_deploy class -s /event
```

Export the **/event** storable class interface along with all of its subclasses.

## Field

Export field definitions from a BRM server in PODL format. May specify any number of fields by name. If no fields are specified, then all fields will be exported unless the **-c** or **-p** parameters are used.

```
pin_deploy field [-cp] [field_one field_two ... field_N]
```

**[-c]** Include field definitions for all customer-defined fields.

**[-p]** Include field definitions for all BRM-defined fields.

Examples:

```
pin_deploy field PIN_FLD_PRODUCTS PIN_FLD_NAMEINFO
```

Export definitions for the PIN\_FLD\_PRODUCTS and PIN\_FLD\_NAMEINFO fields from a BRM server in PODL format.

```
pin_deploy field -cp
```

Export definitions for all customer and BRM-defined fields from a BRM server in PODL format.

## pin\_uei\_deploy

Use this utility to migrate event import templates from one BRM database schema to another. You use event import templates to load data from log files into BRM as billable events. For more information, see "Migrating Event Import Templates from One BRM Database Schema to Another" in *BRM Setting Up Pricing and Rating*.

---

---

**Note:** This utility is brand-aware. You can load separate **/config/gel/template** objects for each brand.

---

---

---

---

**Important:** To connect to the BRM database, the **pin\_uei\_deploy** utility needs a configuration file in the directory from which you run the utility. See "Creating Configuration Files for BRM Utilities" in *BRM System Administrator's Guide*.

---

---

### Location

*BRM\_Home*/bin

### Syntax

```
pin_uei_deploy  -l|-c|-m|-d|-r|-v  
                -t template name -i input_file -o output_file [-h]
```

### Parameters

**-t *template\_name***

The name of the template.

This parameter is followed by the name of the event import template that you *read*, *create*, *delete*, or *modify* (depending on the command).

**-i *input\_file***

The input file (event import template) to load into the database schema.

**-o *output\_file***

The output file to save on the local system.

**-h**

Displays the syntax and parameters for this utility.

### Commands

- [List](#)
- [Create](#)
- [Modify](#)
- [Delete](#)
- [Read](#)
- [Verbose](#)



## List

Lists all event import templates stored in the database schema.

```
pin_uei_deploy -l
```

There are no parameters for this command.

## Create

Creates the specified event import template.

```
pin_uei_deploy -t template_name -c -i output_file
```

Example:

Create an event import template named **CDR3** and load it into the database schema:

```
pin_uei_deploy -t CDR3 -c -i CDRoutput
```

---

---

**Note:** If an event import template with the same name exists in the database schema, the operation fails and **pin\_uei\_deploy** logs an error. Delete the existing event import template first, or overwrite it by using the modify operation.

---

---

## Modify

Modifies the specified event import template.

```
pin_uei_deploy -t template_name -m -i output_file
```

Example:

Load into the database schema an event import template called **CDR3** and overwrite the existing template with the same name:

```
pin_uei_deploy -t CDR3 -m -i CDRoutput
```

## Delete

Deletes the specified event import template.

```
pin_uei_deploy -t template_name -d
```

Example:

Delete the event import template named **CDR3**:

```
pin_uei_deploy -t CDR3 -d
```

## Read

Reads the specified event import template from the database schema.

```
pin_uei_deploy -t template_name -r -o output_file
```

Example:

Read the event import template named **CDR3**, and save it to an output file on the local system named **CDRoutput**:

```
pin_uei_deploy -t CDR3 -r -o CDRoutput
```

## Verbose

Displays information about successful or failed processing as the utility runs.

**pin\_wei\_deploy -v** *any\_other\_parameter*

---

## pin\_virtual\_time

Use the BRM **pin\_virtual\_time** utility to adjust or display BRM's current time and date, without affecting the operating system time and date. This utility is useful for testing billing and other time-sensitive functions in BRM.

For information about using the **pin\_virtual\_time** utility, see "Testing Your Price List" in *BRM Setting Up Pricing and Rating*.

---

**Caution:** Use **pin\_virtual\_time** only with a test database. You should not change the BRM system time on a production BRM database.

---



---

**Note:**

- If you use **pin\_virtual\_time** with a BRM system that includes the Pipeline Manager, you need to set the **VirtualTime** parameter for the DAT\_BalanceBatch module to **True** to ensure that balances are calculated correctly. See "DAT\_BalanceBatch" in *BRM System Administrator's Guide*.
  - To test custom client applications that are connected to the CM, you can use PCM\_OP\_GET\_PIN\_VIRTUAL\_TIME to get the virtual time that is set by **pin\_virtual\_time**.
- 

## Operation

To run BRM with **pin\_virtual\_time** enabled:

1. Make sure all BRM components are stopped.
2. Configure all BRM components, via their **pin.conf** files, to use **pin\_virtual\_time**. A file containing time and date information for the **pin\_virtual\_time** utility is created the first time that **pin\_virtual\_time** is run. BRM recommends you designate *BRM\_Home/lib/pin\_virtual\_time\_file* with the **-f** parameter.
3. Type **pin\_virtual\_time** with the **-m** option to set the mode and value of the time.

---

**Important:** If there are multiple BRM machines, run **pin\_virtual\_time** on all of them.

---

4. Start all BRM components.
5. Perform testing as desired.
6. Between testing stages, adjust the time with **pin\_virtual\_time**. You can change modes.
7. After completing testing, stop all BRM components
8. Remove or comment out (with #) the **pin\_virtual\_time** entry in the **pin.conf** files.
9. Perform database cleanup if needed.

## Dependencies

All BRM server component **pin.conf** files must contain the following line to use **pin\_virtual\_time** to set BRM's time:

```
- - pin_virtual_time BRM_Home/lib/pin_virtual_time_file
```

The *pin\_virtual\_time\_file* file contains the information that BRM requires to determine the time/date mode and how to set it.

The *pin\_virtual\_time\_file* file is mapped into memory by **pin\_virtual\_time** when each BRM component starts up. If different BRM components are running on different machines (for example, the Connection Manager on one machine and the Data Manager on another), then **pin\_virtual\_time** must be enabled in the **pin.conf** files on both machines, and whenever **pin\_virtual\_time** is set on one machine it must be set correspondingly on the other machine(s). Failure to do so may cause BRM to operate incorrectly.

See "Using Configuration Files to Connect and Configure Components" in *BRM System Administrator's Guide* for information on setting up **pin.conf** files.

---

---

**Note:** Make sure installation is complete before you put a **pin\_virtual\_time** line in the **pin.conf** file for your DM.

---

---

## Syntax

```
pin_virtual_time [-i interval] [-m mode [time_value] [-y]]  
[-f filename] [-h | -H | -?]
```

## Parameters

By default (without the **-m** option), **pin\_virtual\_time** prints the current **pin\_virtual\_time** to *stdout* once and then exits.

### **-i interval**

Print the current BRM time every *interval* seconds to *stdout* (until interrupted by CTRL C).

### **-m mode [time\_value] [-y]**

Set BRM according to *mode* and *time\_value*:

#### **mode**

0 = Use operating system time (normal mode). BRM uses operating system time with no adjustments.

1 = Use *time\_value* as a constant time (freeze mode). Time is frozen at the specified time until the **pin\_virtual\_time** command is used again to change the time or mode. *Use only when absolutely necessary, because BRM expects time to be moving.*

2 = Use *time\_value* as the new time, and keep the clock running (offset mode). Time is adjusted to the time specified, and then advances one second every second. This is the mode that should be used for testing.

#### **time\_value**

Use the format *MMDDHHMM[CC]YY[.SS]*.

### **-y**

Accept backwards movement. Allow the specified time to be before the current **pin\_virtual\_time** (time can be moved backwards).

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**Caution:** Move time backwards only when rebuilding BRM from scratch. Otherwise, moving time backwards can cause severe data corruption.

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### **-f filename**

Store the **pin\_virtual\_time** structure in the designated file and location. BRM recommends *BRM\_Home/lib/filename*. This path and file name must match the path and file name specified in the **pin\_virtual\_time** line in the **pin.conf** files for each BRM component.

### **-h, -H, -?**

Displays the syntax and parameters for this utility.

## Results

If the utility doesn't notify you that it was successful, look in the utility log file (**default.pinlog**) to find any errors. The log file is either in the directory from which the utility was started, or in a directory specified in the configuration file.

## Examples

Print the current **pin\_virtual\_time** setting and mode:

```
% pin_virtual_time
mode 2 940102477 Sat Oct 16 12:34:37 1999
```

Print current **pin\_virtual\_time** every four seconds:

```
% pin_virtual_time -i 4
mode 2 940102527 Sat Oct 16 12:35:27 1999
mode 2 940102531 Sat Oct 16 12:35:31 1999
mode 2 940102535 Sat Oct 16 12:35:35 1999
mode 2 940102539 Sat Oct 16 12:35:39 1999
^C
%
```

Set **pin\_virtual\_time** to offset mode 12/31/98 11:30:43:

```
% pin_virtual_time -m 2 123111301998.43
filename BRM_Home/lib/pin_virtual_time_file, mode 2, time: Thu Dec 31 11:30:43
1998
```

Set **pin\_virtual\_time** to normal mode:

```
% pin_virtual_time -m 0
filename BRM_Home/lib/pin_virtual_time_file, mode 0
```

## testnap

The **testnap** utility enables a developer to manually interact with the BRM server by establishing a PCM connection with the Connection Manager (CM) and then executing PCM operations by using that connection. Using **testnap**, a developer can perform the following tasks:

- Create input flists
- Save input and output flists
- Send opcodes
- View return (output) flists
- Create, view, modify, and delete objects and their fields
- Open, commit, and abort transactions

For examples and information on using **testnap**, see ["Testing Your Applications and Custom Modules"](#).

Opcode Workbench, part of the Developer Center offers similar functionality in a GUI-based application. See ["Testing Your Applications and Custom Modules"](#) and the Opcode Workbench help system for detailed information.

## Dependencies

The **testnap** utility requires a **pin.conf** configuration file to connect to your BRM system. You can either use the CM's **pin.conf** file, or run **testnap** from a directory that contains a suitable **pin.conf** file, such as *BRM\_Home/sys/test*.

The **testnap** utility relies on POID logins and types to identify the specific account or storable class to modify. A POID database number is required as a placeholder only.

The necessary **pin.conf** information is:

```
- nap cm_name hostname # Name of the system where the cm is
running.
- nap userid 0.0.0.1 /service/pcm_client 1 # Database number, 0.0.0.1 by
default.
- nap login_type 1 # Type 1 means login with password.
- nap login_name root.0.0.0.n # Username testnap uses to log in to
Portal.
- nap login_pw password # Password is "password" by default.
Differs from one Portal installation to another.
- nap cm_ptr ip hostname 11960 # CM pointer: protocol hostname port. Allows
multiple CM's to be specified in a pin.conf file. The application will try them
consecutively until one works or there are no more "cm_ptr" entries.
```

The correct path to the shared libraries must also be configured. The library path is configured by default to point to the standard libraries in *BRM\_Home/lib*. If the libraries are not in *BRM\_Home/lib*, then you must set the library path environment appropriately.

## Syntax

```
testnap
command [args]
```

## Parameters

The **testnap** utility allocates numerous internal buffers, which are used to store object or flist fields. Buffers are referenced by integers of the user's choice. Every time a new buffer is referenced, **testnap** allocates that new buffer.

- If you do not specify a buffer number for a command that expects one, you will be prompted for a buffer number.
- The **meta** keyword causes **testnap** to display the size of external buffer fields. By default, the contents of external buffer fields are displayed.

## Testnap Commands

- **r** {<<token [file]} [buf]  
Read an flist or object from a file and put it in a **testnap** buffer. The <<token operator causes **testnap** to read from **stdin** until the token string is read.
- **r+** {<<token [file]} [buf]  
Read and append flist to existing **buf**. The <<token operator causes **testnap** to read from **stdin** until the token string is read.
- **w** [buf] [file]  
Write contents of **testnap** buffer to a file.
- **w+** [buf] [file]  
Append contents of a **testnap** buffer to the same file.
- **l**  
List the **testnap** buffers that are currently in use.
- **d** [buf]  
Display a **testnap** buffer.
- **!** *cmds* [args]  
Run a shell command (for UNIX systems only).
- **s** [buf]  
Save an flist or object from the input buffer to a **testnap** buffer.
- **<** [file]  
Execute cmd script.
- **p** [<property> <value>]  
Display or set properties.
- **q**  
Quit this program.
- **h, help,?**  
Print usage help message.
- **create** {[buf] | [poid]}  
Create an object. Run PCM\_OP\_CREATE\_OBJ and print the return flist to **stdout**. The poid keyword causes the poid id of the object that is created to be the poid id specified in the input flist.

- **delete** *[[buf] | [- <db> <type> <id>]*  
Delete an object. Run PCM\_OP\_DELETE\_OBJ and print the return flist to **stdout**. The poid of the object to be deleted can be specified on the command line.
- **robj** *[[buf] | [- <db> <type> <id>] [meta]*  
Read an object. Run PCM\_OP\_READ\_OBJ using either the poid in the flist in **buf**, or the poid specified on the command line. Prints the return flist (the contents of the object) to **stdout**.
- **rflds** *buf [meta]*  
Read fields. Run PCM\_OP\_READ\_FLDS using the flist in **buf**, and print the return flist to **stdout**. Each field (or row) in the field list must be in a valid flist format. The values for the last field are arbitrary, but must be valid for their type. For example, you have to include "" for **STR** fields and (some number) for a **TSTAMP** field. If either of these fields are blank, an error is returned.
- **wflds** *[buf]*  
Write fields. Run PCM\_OP\_WRITE\_FLDS and print the return flist to **stdout**.
- **dflds** *[buf]*  
Delete fields. Run PCM\_OP\_DELETE\_FLDS and print the return flist to **stdout**.
- **search** *buf [meta] [count]*  
Search. Run PCM\_OP\_SEARCH and print the return flist to **stdout**. The **count** operator sets the PCM\_OPFLG\_COUNT\_ONLY flag, which causes **search** to return only the number of matches found by the search. The count is returned as the **ELEM\_ID** of the **RESULTS** array on the output flist.
- **ssrch** *buf [meta]*  
Step-search. Run PCM\_OP\_STEP\_SEARCH and print the return flist to **stdout**.
- **snext** *buf [meta]*  
Step-search next. Run PCM\_OP\_STEP\_NEXT to get the next object in a step search, and print the return flist to **stdout**.
- **send** *buf*  
End step-search. Run PCM\_OP\_STEP\_END and print the return flist to **stdout**.
- **gdd** *[[buf] | [- <db> <type> <id>]*  
Get data dictionary. Run PCM\_OP\_GET\_DD and print the return flist to **stdout**. The poid can be specified on the command line.
- **sdd** *<flags> [buf]*  
Set data dictionary. Run PCM\_OP\_SET\_DD and print the return flist to **stdout**.
- **sort** *buf sort\_buf [descending\_flag]*  
Read contents of **buf**, sort it non-recursively using the template in **sort\_buf**, and print the sorted flist to **stdout**. Available on UNIX only. The descending flag is optional, with **0** (the default) indicating ascending order, and any non-zero integer indicating descending order.  
  
Sorting is not implemented for the following:
  - POID
  - BINSTRS



- BUFFERS
- ERRBUFS

The number of ARRAY elements in the sort specification is ignored. Use 0. Sort specifications just need valid numbers. The numbers are not necessarily valid or desired values for the current sort; they are basically required place-holders.

- **rsort** *buf sort\_buf [descending\_flag]*  
Recursive sort. Read contents of **buf**, sort it recursively using the template in **sort\_buf**, and print the sorted flist to **stdout**. Available on UNIX only. The descending flag is optional, with 0 (the default) indicating ascending order, and any non-zero integer indicating descending order.
- **open** [**ro** | **rw** | **lock** {[*buf*] | [- <db> <type> <id>]}]  
Open transaction. Run PCM\_OP\_TRANS\_OPEN and print the return flist to **stdout**.
- **commit**  
Commit the current transaction. Run PCM\_OP\_TRANS\_COMMIT and print the return flist to **stdout**.
- **abort**  
Cancel the current transaction. Run PCM\_OP\_TRANS\_ABORT and print the return flist to **stdout**.
- **inc** [*buf*]  
Increment one or more fields of an object. Run PCM\_OP\_INC\_FLDS and print the return flist to **stdout**.
- **noop** [*buf*]  
Run non-operational opcode. Run PCM\_OP\_TEST\_LOOPBACK on that database schema and print the return flist to **stdout**.
- **pass** [*buf*]  
Run a pass\_thru op to server. Run PCM\_OP\_PASS\_THRU, an extension op that just sends an flist to a DM that supports it.
- **xop** *op flag buf*  
Run opcode *op* with flags set to *flag*, the contents of **buf** as the input flist, and print the sorted flist to **stdout**.
- **id**  
Print user and session ID.
- **echo** *string*  
Echo a string.

## Error Handling

If an error occurs, the contents of the error buffer (**ebuf**) which corresponds to the error are written to **stderr**.

## Error Example 1

```
# Delete attempt with the - argument missing:
pin@demo5-668> testnap
```

```
==> database 0.0.0.1 from pin.conf "userid"

delete 0.0.0.1 /account 1

ERROR: bad number "0.0.0.1"
no object to use for delete
```

## Error Example 2

```
# Attempt to read a non-existent object:

robj - 0.0.0.1 /account 11988

PCM_OP_READ_OBJ failed: err 3:PIN_ERR_NOT_FOUND, field 0/16:PIN_FLD_POID,
    loc 4:PIN_ERRLOC_DM, errclass 4:PIN_ERRCLASS_APPLICATION, rec_id 0, resvd
30001
```

For more information on the error buffer, see ["Understanding API Error Handling and Logging"](#).

## Examples

For an extensive set of examples, refer to the *Examples* section of ["Testing Your Applications and Custom Modules"](#).