Oracle® Identity Management

Application Developer's Guide

10*g* (10.1.4.0.1)

B15997-01

July 2006

Oracle Identity Management Application Developer's Guide, 10*g* (10.1.4.0.1)

B15997-01

Copyright © 1999, 2006, Oracle. All rights reserved.

Primary Author: Ellen Desmond

Contributors: Vasuki Ashok , Tridip Bhattacharya, Ramakrishna Bollu, Saheli Dey, Ajay Keni, Ganesh Kirti, Ashish Kolli, Stephen Lee, Samit Roy, David Lin, Saurabh Shrivastava, Arun Theebaprakasam, Andy Tian

The Programs (which include both the software and documentation) contain proprietary information; they are provided under a license agreement containing restrictions on use and disclosure and are also protected by copyright, patent, and other intellectual and industrial property laws. Reverse engineering, disassembly, or decompilation of the Programs, except to the extent required to obtain interoperability with other independently created software or as specified by law, is prohibited.

The information contained in this document is subject to change without notice. If you find any problems in the documentation, please report them to us in writing. This document is not warranted to be error-free. Except as may be expressly permitted in your license agreement for these Programs, no part of these Programs may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose.

If the Programs are delivered to the United States Government or anyone licensing or using the Programs on behalf of the United States Government, the following notice is applicable:

U.S. GOVERNMENT RIGHTS Programs, software, databases, and related documentation and technical data delivered to U.S. Government customers are "commercial computer software" or "commercial technical data" pursuant to the applicable Federal Acquisition Regulation and agency-specific supplemental regulations. As such, use, duplication, disclosure, modification, and adaptation of the Programs, including documentation and technical data, shall be subject to the licensing restrictions set forth in the applicable Oracle license agreement, and, to the extent applicable, the additional rights set forth in FAR 52.227-19, Commercial Computer Software—Restricted Rights (June 1987). Oracle USA, Inc., 500 Oracle Parkway, Redwood City, CA 94065.

The Programs are not intended for use in any nuclear, aviation, mass transit, medical, or other inherently dangerous applications. It shall be the licensee's responsibility to take all appropriate fail-safe, backup, redundancy and other measures to ensure the safe use of such applications if the Programs are used for such purposes, and we disclaim liability for any damages caused by such use of the Programs.

Oracle, JD Edwards, PeopleSoft, and Siebel are registered trademarks of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.

The Programs may provide links to Web sites and access to content, products, and services from third parties. Oracle is not responsible for the availability of, or any content provided on, third-party Web sites. You bear all risks associated with the use of such content. If you choose to purchase any products or services from a third party, the relationship is directly between you and the third party. Oracle is not responsible for: (a) the quality of third-party products or services; or (b) fulfilling any of the terms of the agreement with the third party, including delivery of products or services and warranty obligations related to purchased products or services. Oracle is not responsible for any loss or damage of any sort that you may incur from dealing with any third party.

Portions of this document are from "The C LDAP Application Program Interface," an Internet Draft of the Internet Engineering Task Force (Copyright (C) The Internet Society (1997-1999). All Rights Reserved), which expires on 8 April 2000. These portions are used in accordance with the following IETF directives: "This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English."

RSA and RC4 are trademarks of RSA Data Security. Portions of Oracle Internet Directory have been licensed by Oracle Corporation from RSA Data Security.

Oracle Directory Manager requires the JavaTM Runtime Environment. The JavaTM Runtime Environment, Version JRE 1.1.6. ("The Software") is developed by Sun Microsystems, Inc. 2550 Garcia Avenue, Mountain View, California 94043. Copyright (c) 1997 Sun Microsystems, Inc.

This product contains SSLPlus Integration SuiteTM version 1.2, from Consensus Development Corporation.

iPlanet is a registered trademark of Sun Microsystems, Inc.

Contents

3 Extensions to the LDAP Protocol

12 PL/SQL Server Plug-ins

15 DBMS_LDAP PL/SQL Reference

16 Java API Reference

17 DBMS_LDAP_UTL PL/SQL Reference

18 DAS_URL Interface Reference

B DSML Syntax

C Migrating from Netscape LDAP SDK API to Oracle LDAP SDK API

Glossary

Index

List of Figures

List of Tables

Preface

Oracle Identity Management Application Developer's Guide explains how to modify applications to work with the Oracle Identity Management infrastructure. For the purposes of this book, this infrastructure consists of Oracle Application Server Single Sign-On, Oracle Internet Directory, Oracle Delegated Administration Services, and the Directory Integration Platform.

This preface contains these topics:

- Audience
- Documentation Accessibility
- Related Documents
- Conventions

Audience

The following readers can benefit from this book:

- Developers who want to integrate applications with the Oracle Identity Management infrastructure. This process involves storing and updating information in an Oracle Internet Directory server. It also involves modifying applications to work with mod_osso, an authentication module on the Oracle HTTP Server.
- Anyone who wants to learn about the LDAP APIs and Oracle extensions to these APIs.

Documentation Accessibility

Our goal is to make Oracle products, services, and supporting documentation accessible, with good usability, to the disabled community. To that end, our documentation includes features that make information available to users of assistive technology. This documentation is available in HTML format, and contains markup to facilitate access by the disabled community. Accessibility standards will continue to evolve over time, and Oracle is actively engaged with other market-leading technology vendors to address technical obstacles so that our documentation can be accessible to all of our customers. For more information, visit the Oracle Accessibility Program Web site at

`http://www.oracle.com/accessibility/`

Accessibility of Code Examples in Documentation

Screen readers may not always correctly read the code examples in this document. The conventions for writing code require that closing braces should appear on an otherwise empty line; however, some screen readers may not always read a line of text that consists solely of a bracket or brace.

Accessibility of Links to External Web Sites in Documentation

This documentation may contain links to Web sites of other companies or organizations that Oracle does not own or control. Oracle neither evaluates nor makes any representations regarding the accessibility of these Web sites.

TTY Access to Oracle Support Services

Oracle provides dedicated Text Telephone (TTY) access to Oracle Support Services within the United States of America 24 hours a day, seven days a week. For TTY support, call 800.446.2398.

Related Documents

For more information, see these Oracle resources:

- *Oracle Identity Management Infrastructure Administrator's Guide*
- *Oracle Internet Directory Administrator's Guide*
- *Oracle Identity Management Integration Guide*
- *Oracle Identity Management Guide to Delegated Administration*
- *Oracle Application Server Single Sign-On Administrator's Guide*
- *PL/SQL User's Guide and Reference*
- *Oracle Database Application Developer's Guide - Fundamentals*
- *Oracle Security Developer Tools Reference*

For additional information, see:

- Chadwick, David. *Understanding X.500—The Directory.* Thomson Computer Press, 1996.
- Howes, Tim and Mark Smith. *LDAP: Programming Directory-enabled Applications with Lightweight Directory Access Protocol.* Macmillan Technical Publishing, 1997.
- Howes, Tim, Mark Smith and Gordon Good, *Understanding and Deploying LDAP Directory Services.* Macmillan Technical Publishing, 1999.
- Internet Assigned Numbers Authority home page, `http://www.iana.org`, for information about object identifiers
- Internet Engineering Task Force (IETF) documentation available at: `http://www.ietf.org`, especially:
  - The LDAPEXT charter and LDAP drafts
  - The LDUP charter and drafts
  - RFC 2254, "The String Representation of LDAP Search Filters"
  - RFC 1823, "The LDAP Application Program Interface"
- The OpenLDAP Community, `http://www.openldap.org`

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

What's New in the SDK?

This document acquaints you with new features in the Oracle Internet Directory Software Developer's Kit—both in the present release and in previous releases. Use the links provided to learn more about each feature.

New Features in the 10*g* (10.1.4.0.1) SDK

The 10*g* (10.1.4.0.1) SDK adds:

- Java plug-in support.

  Server plug-ins can now be written in Java as well as in PL/SQL. For more information, please see Chapter 11, "Developing Plug-ins for the Oracle Internet Directory Server" and Chapter 13, "Java Server Plug-ins".

- Paging and sorting of LDAP search results.

  You can now obtain paged and sorted results from LDAP searches. For more information, please see "Sorted LDAP Search Results" and "Paged LDAP Search Results" in Chapter 3, "Extensions to the LDAP Protocol".

- Added functionality for hierarchical searches.

  You can now traverse the hierarchy in either direction and specify the number of levels of the hierarchy to search. For more information, please see "Performing Hierarchical Searches"in Chapter 3, "Extensions to the LDAP Protocol".

- Support for all three modes of SASL Digest-MD5 authentication.

  Oracle Internet Directory now supports all three modes with the Java Naming and Directory Interface (JNDI) of jdk1.4 API or with the OpenLDAP Java API. For more information, please see "SASL Authentication" in Chapter 3, "Extensions to the LDAP Protocol" and "Example: Using SASL Digest-MD5 auth-int and auth-conf Modes" in Chapter 5, "Using the Java API Extensions to JNDI".

New Features in the Release 10.1.2 SDK

The release 10.1.2 SDK adds:

- Centralized user provisioning.

  This feature enables you to provision application users into the Oracle Identity Management infrastructure. To learn more, see Chapter 19, "Oracle Directory Integration Platform User Provisioning Java API Reference".

- Dynamic password verifiers

This feature addresses the needs of applications that provide parameters for password verifiers only at runtime. To learn more, see "Creating Dynamic Password Verifiers" in Chapter 3.

- Binary support for `ldapmodify`, `ldapadd`, and `ldapcompare` plug-ins

  Directory plug-ins can now access binary attributes in the directory database. To learn more, see "Binary Support in the PL/SQLPlug-in Framework" in Chapter 12.

- Plug-in support for the Oracle Directory Integration Platform Server

  These Java hooks enable an enterprise to incorporate its own business rules and to tailor footprint creation to its needs. To learn more, see Appendix A.

New Features in the Release 9.0.4 SDK

The following features made their debut in the release 9.0.4 SDK:

- URL API for Oracle Delegated Administration Services

  This API enables you to build administrative and self-service consoles that delegated administrators can use to perform directory operations. To learn more, see Chapter 8.

- PL/SQL API Enhancements:

  - New functions in the LDAP v3 standard. Previously available only in the C API, these functions are now available in PL/SQL.
  - Functions that enable proxied access to middle-tier applications.
  - Functions that create and manage provisioning profiles in the Oracle Directory Integration Platform.

  To learn more, see Chapter 7.

- Plug-in support for external authentication

  This feature enables administrators to use Microsoft Active Directory to store and manage security credentials for Oracle components. To learn more, see Chapter 11.

- Server discovery using DNS

  This feature enables directory clients to discover the host name and port number of a directory server. It reduces the cost of maintaining directory clients in large deployments. To learn more, see "Discovering a Directory Server" in Chapter .

- XML support for the directory SDK and directory tools

  This feature enables LDAP tools to process XML as well as LDIF notation. Directory APIs can manipulate data in a DSML 1.0 format.

- Caching for client-side referrals

  This feature enables clients to cache referral information, speeding up referral processing. To learn more, see "LDAP Session Handle Options" in Chapter 8.

Part I

Programming for Oracle Identity Management

Part I shows you how to modify your applications to work with the different components of Oracle Identity Management. This section begins with an introduction to the Oracle Internet Directory SDK and to LDAP programming concepts. You then learn how to use the three LDAP APIs and their extensions to enable applications for Oracle Internet Directory.

Part I contains these chapters:

1

Developing Applications for Oracle Identity Management

Oracle Identity Management provides a shared infrastructure for all Oracle applications. It also provides services and interfaces that facilitate third-party enterprise application development. These interfaces are useful for application developers who need to incorporate identity management into their applications.

This chapter discusses these interfaces and recommends application development best practices in the Oracle Identity Management environment.

There are two types of applications that can be integrated with Oracle Identity Management:

- Existing applications already used in the enterprise. The enterprise might have already invested in such applications and would benefit from their integration with the Oracle Identity Management infrastructure.
- New applications being developed by corporate IT departments or ISVs that are based on the Oracle technology stack

This chapter contains the following topics:

Benefits of Integrating with Oracle Identity Management

Enterprise applications integrating with the Oracle Identity Management infrastructure receive the following benefits:

- **Integration facilitates faster application deployment with lower costs**: Enterprises (primarily Oracle customers) already using an existing Oracle Identity Management infrastructure can deploy new applications using the self-service console of Oracle Delegated Administration Services. Delegating application administration to users reduces the deployment cost of the application.
- **Seamless integration with Oracle applications**: Because all Oracle applications rely on the Oracle Identity Management infrastructure, new enterprise applications can use all the features Oracle Identity Management offers.

- **Seamless integration with third-party identity management solutions**: Because the Oracle Identity Management infrastructure already has built-in capabilities for integrating with third-party identity management solutions, application developers can take advantage of the identity management features.

Oracle Identity Management Services Available for Application Integration

Custom applications can use Oracle Identity Management through a set of documented and supported services and APIs. For example:

- Oracle Internet Directory provides LDAP APIs for C, Java, and PL/SQL, and is compatible with other LDAP SDKs.
- Oracle Delegated Administration Services provides a core self-service console that can be customized to support third-party applications. In addition, they provide a number of services for building customized administration interfaces that manipulate directory data.
- Oracle Directory Integration Services facilitate the development and deployment of custom solutions for synchronizing Oracle Internet Directory with third-party directories and other user repositories.
- Oracle Provisioning Integration Services provide a mechanism for provisioning third-party applications, as well as a means of integrating the Oracle environment with other provisioning systems.
- OracleAS Single Sign-On provides APIs for developing and deploying partner applications that share a single sign-on session with other Oracle Web applications.
- JAZN is the Oracle implementation of the Java Authentication and Authorization Service (JAAS) Support standard. JAZN allows applications developed for the Web using the Oracle J2EE environment to use the identity management infrastructure for authentication and authorization.

Integrating Existing Applications with Oracle Identity Management

An enterprise may have already deployed certain applications to perform critical business functions. The Oracle Identity Management infrastructure provides the following services that can be leveraged by the deployment to modify existing applications:

- **Automated User Provisioning**: The deployment can develop a custom provisioning agent that automates the provisioning of users in the existing application in response to provisioning events in the Oracle Identity Management infrastructure. This agent must be developed using the interfaces of Oracle Provisioning Integration Service.

  See Also: *Oracle Internet Directory Administrator's Guide* for more information about developing automated user provisioning.

- **User Authentication Services**: If the user interface of the existing application is based on HTTP, integrating it with Oracle HTTP Server and protecting its URL using `mod_osso` will authenticate all incoming user requests using the OracleAS Single Sign-On service.
- **Centralized User Profile Management**: If the user interface of the existing application is based on HTTP, and it is integrated with OracleAS Single Sign-On for authentication, the application can use the self-service console of Oracle

Delegated Administration Services to enable centralized user profile management. The self-service console can be customized by the deployment to address the specific needs of the application.

Integrating New Applications with Oracle Identity Management

Application developers can use the services provided by the Oracle Identity Management infrastructure more extensively if they are developing a new application or planning a new release of an existing application. Application developers should consider the following integration points:

- **User Authentication Services**: The application developer has the following options:
  - If the application is based on J2EE, it can use the services provided by the Oracle Application Server Java Authentication and Authorization Service (JAAS) Provider interface.
  - If the application relies on Oracle Containers for J2EE (OC4J), it can use the services provided by `mod_osso` to authenticate users and obtain important information about the user in the HTTP headers.
  - If the application is a standalone Web-based application, it can use OracleAS Single Sign-On as a partner application using the OracleAS Single Sign-On APIs.
  - If the application provides an interface that is not Web-based, it can use the Oracle Internet Directory LDAP APIs (available in C, PL/SQL and Java) to authenticate users.
- **Centralized Profile Management**: The application developer has the following options available:
  - The application developer can model application-specific profiles and user preferences as attributes in Oracle Internet Directory.
  - If the user interface of the application is based on HTTP, and it is integrated with OracleAS Single Sign-On for authentication, the application can leverage the self-service console of Oracle Delegated Administration Services to enable centralized user profile management. The self-service console can be customized by the deployment to address the specific needs of the application.
  - The application can also retrieve user profiles at run time using the Oracle Internet Directory LDAP APIs (available in C, PL/SQL and Java).
- **Automated User Provisioning**: Application developers should consider the following options:
  - If the user interface of the application is based on HTTP and it is integrated with OracleAS Single Sign-On for authentication, then the application developer can implement automated user provisioning the first time a user accesses the application
  - The application can also be integrated with the Oracle Internet Directory Provisioning Integration Service, which enables it to automatically provision or de-provision user accounts in response to administrative actions, such as adding an identity, modifying the properties of an existing identity, or deleting an existing identity in the Oracle Identity Management infrastructure

    See Also: *Oracle Identity Management Integration Guide*

Oracle Internet Directory Programming: An Overview

This section introduces you to the Oracle Internet Directory Software Developer's Kit. It provides an overview of how an application can use the kit to integrate with the directory. You are also acquainted with the rest of the directory product suite.

The section contains these topics:

- Programming Languages Supported by the Oracle Internet Directory SDK
- Oracle Internet Directory SDK Components
- Application Development in the Oracle Internet Directory Environment
- Other Components of Oracle Internet Directory

Programming Languages Supported by the Oracle Internet Directory SDK

The SDK is for application developers who use C, C++, and PL/SQL. Java developers must use the JNDI provider from Sun Microsystems to integrate with the directory.

Oracle Internet Directory SDK Components

Oracle Internet Directory Software Developer's Kit 10*g* (10.1.4.0.1) consists of the following:

- A C API compliant with LDAP Version 3
- A PL/SQL API contained in a PL/SQL package called `DBMS_LDAP`
- Sample programs
- *Oracle Identity Management Application Developer's Guide* (this document)
- Command-line tools

Application Development in the Oracle Internet Directory Environment

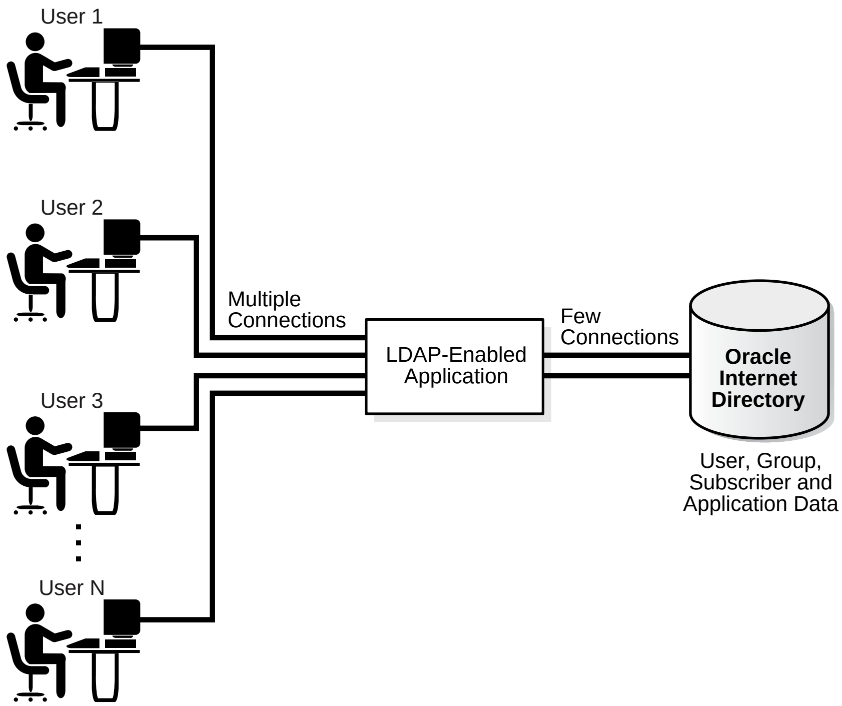
This section contains these topics:

- Architecture of a Directory-Enabled Application
- Oracle Internet Directory Interactions During the Application Life Cycle
- Services and APIs for Integrating Applications with Oracle Internet Directory
- Integrating Existing Applications with Oracle Internet Directory
- Integrating New Applications with Oracle Internet Directory

Architecture of a Directory-Enabled Application

Most directory-enabled applications are backend programs that simultaneously handle multiple requests from multiple users. Figure 1–1 shows how a directory is used by such applications.

Figure 1–1 A Directory-Enabled Application



As Figure 1–1 shows, when a user request involves an LDAP-enabled operation, the application processes the request using a smaller set of pre-created directory connections.

Oracle Internet Directory Interactions During the Application Life Cycle

Table 1–1 on page 1-5 walks you through the directory operations that an application typically performs during its lifecycle.

Table 1–1 Interactions During Application Lifecycle

Point in Application Lifecycle	Logic
Application Installation	**1.** Create an application identity in the directory. The application uses this identity to perform most of its LDAP operations. **2.** Give the application identity LDAP authorizations by making it part of the correct LDAP groups. These authorizations enable the application to accept user credentials and authenticate them against the directory. The directory can also use application authorizations to proxy for the user when LDAP operations must be performed on the user's behalf.
Application Startup and Bootstrap	The application must retrieve credentials that enable it to authenticate itself to the directory. If the application stores configuration metadata in Oracle Internet Directory, it can retrieve that metadata and initialize other parts of the application. The application can then establish a pool of connections to serve user requests.

Table 1–1 (Cont.) Interactions During Application Lifecycle

Point in Application Lifecycle	Logic
Application Runtime	For every end-user request that needs an LDAP operation, the application can: - Pick a connection from the pool of LDAP connections. - Switch the user to the end-user identity if the LDAP operation needs to be performed with the effective rights of the end-user. - Perform the LDAP operation by using either the regular API or the API enhancements described in this chapter. - Ensure that the effective user is now the application identity once the LDAP operation is complete. - Return the LDAP connection back to the pool of connections.
Application Shutdown	Abandon any outstanding LDAP operations and close all LDAP connections.
Application Deinstallation	Remove the application identity and the LDAP authorizations granted to it.

Services and APIs for Integrating Applications with Oracle Internet Directory

Application developers can integrate with Oracle Internet Directory by using the services and APIs listed and described in Table 1–2 on page 1-6.

Table 1–2 Services and APIs for Integrating with Oracle Internet Directory

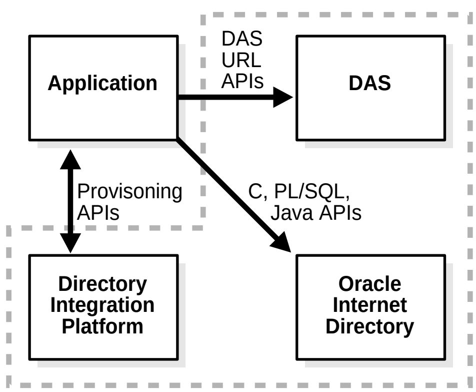
Service/API	Description	More Information
Standard LDAP APIs in C, PL/SQL and Java	These provide basic LDAP operations. The standard LDAP API used in Java is the JNDI API with the LDAP service provider from Sun Microsystems.	Chapter 2, "Developing Applications with Standard LDAP APIs"
Oracle Extensions to Standard C, PL/SQL and Java APIs	These APIs provide programmatic interfaces that model various concepts related to identity management.	Chapter 4, "Developing Applications With Oracle Extensions to the Standard APIs"

Table 1–2 (Cont.) Services and APIs for Integrating with Oracle Internet Directory

Service/API	Description	More Information
Oracle Delegated Administration Services	Oracle Delegated Administration Services consists of a self-service console and administrative interfaces. You can modify the administrative interfaces to support third-party applications.	■ Chapter 8, "Integrating with Oracle Delegated Administration Services" ■ The chapter about the delegated administration services framework in *Oracle Identity Management Guide to Delegated Administration*
Oracle Directory Provisioning Integration Service	You can use the Oracle Provisioning Integration System to provision third-party applications and integrate other provisioning systems.	■ Chapter 7, "Developing Provisioning-Integrated Applications" ■ *Oracle Identity Management Integration Guide*
Oracle Internet Directory Plug-ins	You can use plug-ins to customize directory behavior in certain deployments.	■ Chapter 11, "Developing Plug-ins for the Oracle Internet Directory Server" ■ The chapter about plug-ins in *Oracle Internet Directory Administrator's Guide* ■ Appendix A, "Java Plug-ins for User Provisioning"

Figure 1–2 shows an application leveraging some of the services illustrated in Table 1–2 on page 1-6.

Figure 1–2 An Application Leveraging APIs and Services



As Figure 1–2 shows, the application integrates with Oracle Internet Directory as follows:

- Using PL/SQL, C, or Java APIs, it performs LDAP operations directly against the directory.
- In some cases, it directs users to self-service features of Oracle Delegated Administration Services.
- It is notified of changes to entries for users or groups in Oracle Internet Directory. The Oracle Directory Provisioning Integration Service provides this notification.

Integrating Existing Applications with Oracle Internet Directory

Your enterprise may already have deployed applications that you may have wanted to integrate with the Oracle identity management infrastructure. You can still integrate these applications using the services presented in Table 1–3.

Table 1–3 Services for Modifying Existing Applications

Service	Description	More Information
Automated User Provisioning	You can develop an agent that automatically provisions users when provisioning events occur in the Oracle identity management infrastructure. You use interfaces of the Oracle Directory Provisioning Integration Service to develop this agent.	Chapter 7, "Developing Provisioning-Integrated Applications"
User Authentication Services	If your user interface is based on HTTP, you can integrate it with the Oracle HTTP Server. This enables you to use mod_osso and OracleAS Single Sign-On to protect the application URL.	*Oracle Application Server Single Sign-On Administrator's Guide*
Centralized User Profile Management	If your user interface is based on HTTP and is integrated with OracleAS Single Sign-On, you can use the Oracle Internet Directory Self-Service Console to manage user profiles centrally. You can tailor the console to the needs of your application.	▪ Chapter 8, "Integrating with Oracle Delegated Administration Services" ▪ The chapter about the delegated administration services framework in *Oracle Identity Management Guide to Delegated Administration*

Integrating New Applications with Oracle Internet Directory

If you are developing a new application or planning a new release of an existing application, you have many directory integration options at your disposal. Table 1–4 on page 1-9 lists and describes these.

Table 1–4 Application Integration Points

Integration Point	Available Options	More Information
User Authentication Services	If your application is based on J2EE, it can use the JAZN interface to authenticate users. If it relies on OC4J, it can use mod_osso for the same purpose. The second option enables the application to obtain information about the user from HTTP headers. If your application is Web based and standalone, it can still integrate with OracleAS Single Sign-On, then it can still leverage Oracle Application Server Single Sign-On by becoming a partner application using the single sign-on APIs. Finally, if the application provides a non-Web user interface, it can use the Oracle Internet Directory LDAP APIs to integrate users.	■ *Oracle Containers for J2EE Developer's Guide* ■ *Oracle Application Server Single Sign-On Administrator's Guide* ■ Part II, "Oracle Internet Directory Programming Reference". This section is devoted to the various LDAP APIs.
User Authorization Services	If your application is based on J2EE, it can use the JAZN interface to implement and enforce user authorizations for application resources. The application can define authorizations as groups in Oracle Internet Directory and can then check the authorizations of a user by checking his or her group membership. It can use the Oracle Internet Directory LDAP APIs for this purpose.	■ *Oracle Containers for J2EE Developer's Guide* ■ Part II, "Oracle Internet Directory Programming Reference". This section is devoted to the various LDAP APIs.
Centralized Profile Management	You can define application-specific profiles and user preferences as attributes in Oracle Internet Directory. If your user interface is based on HTTP and is integrated with OracleAS Single Sign-On, you can use the Oracle Internet Directory Self-Service Console to manage user profiles centrally. You can tailor the console to the needs of your application. Additionally, you can use the Oracle Internet Directory LDAP APIs to retrieve user profiles at runtime.	■ The chapter about deployment considerations in *Oracle Internet Directory Administrator's Guide* ■ Chapter 8, "Integrating with Oracle Delegated Administration Services" ■ *Oracle Identity Management Guide to Delegated Administration* ■ Part II of this guide, which is devoted to the various LDAP APIs
Automated User Provisioning	If your user interface is based on HTTP and it is integrated with OracleAS Single Sign-On, you can implement automated user provisioning the very first time a user accesses the application. You use the Oracle Directory Provisioning Integration Service to integrate the application with the Oracle identity management infrastructure. Once integrated, the application can provision or deprovision user accounts automatically when an administrator adds, modifies, or deletes an identity.	Chapter 7, "Developing Provisioning-Integrated Applications"

Other Components of Oracle Internet Directory

The SDK is just one component in the directory suite. Here are the others:

- Oracle directory server, LDAP Version 3
- Oracle directory replication server
- Oracle Directory Manager, a Java-based graphical user interface

- Oracle Internet Directory bulk tools
- *Oracle Internet Directory Administrator's Guide*

2

Developing Applications with Standard LDAP APIs

This chapter takes a high-level look at the operations that the standard LDAP API enables. It explains how to integrate your applications with the API. Before presenting these topics, the chapter revisits the **Lightweight Directory Access Protocol (LDAP)**.

This chapter contains these topics:

Sample Code

Sample code is available at this URL:

`http://www.oracle.com/technology/sample_code/`

Look for the Oracle Identity Management link under Sample Applications—Fusion Middleware.

History of LDAP

LDAP began as a lightweight front end to the X.500 Directory Access Protocol. LDAP simplifies the X.500 Directory Access Protocol in the following ways:

- It uses TCP/IP connections. These are lightweight compared to the OSI communication stack required by X.500 implementations
- It eliminates little-used and redundant features of the X.500 Directory Access Protocol
- It uses simple formats to represent data elements. These formats are easier to process than the complicated and highly structured representations in X.500.

- It uses a simplified version of the X.500 encoding rules used to transport data over networks.

LDAP Models

LDAP uses four basic models to define its operations:

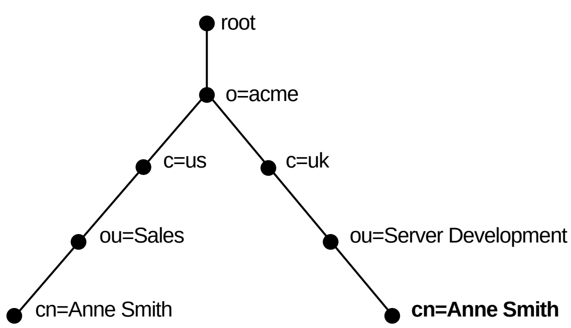
- Naming Model
- Information Model
- Functional Model
- Security Model

Naming Model

The LDAP naming model enables directory information to be referenced and organized. Each entry in a directory is uniquely identified by a distinguished name (**DN**). The DN tells you exactly where an entry resides in the directory hierarchy. A **directory information tree (DIT)** is used to represent this hierarchy.

Figure 2–1 illustrates the relationship between a distinguished name and a directory information tree.

Figure 2–1 A Directory Information Tree



The DIT in Figure 2–1 shows entries for two employees of Acme Corporation who are both named Anne Smith. It is structured along geographical and organizational lines. The Anne Smith represented by the left branch works in the Sales division in the United States. Her counterpart works in the Server Development division in the United Kingdom.

The Anne Smith represented by the right branch has the common name (`cn`) Anne Smith. She works in an organizational unit (`ou`) named Server Development, in the country (`c`) of United Kingdom of Great Britain and Northern Ireland (`uk`), in the organization (`o`) Acme. The DN for this Anne Smith entry looks like this:

```
cn=Anne Smith,ou=Server Development,c=uk,o=acme
```

Note that the conventional format for a distinguished name places the lowest DIT component at the left. The next highest component follows, on up to the root.

Within a distinguished name, the lowest component is called the **relative distinguished name (RDN)**. In the DN just presented, the RDN is `cn=Anne Smith`. The RDN for the entry immediately above Anne Smith's RDN is `ou=Server Development`. And the RDN for the entry immediately above `ou=Server`

Development is c=uk, and so on. A DN is thus a sequence of RDNs separated by commas.

To locate a particular entry within the overall DIT, a client uniquely identifies that entry by using the full DN—not simply the RDN—of that entry. To avoid confusion between the two Anne Smiths in the global organization depicted in Figure 2–1, you use the full DN for each. If there are two employees with the same name in the same organizational unit, you can use other mechanisms. You may, for example, use a unique identification number to identify these employees.

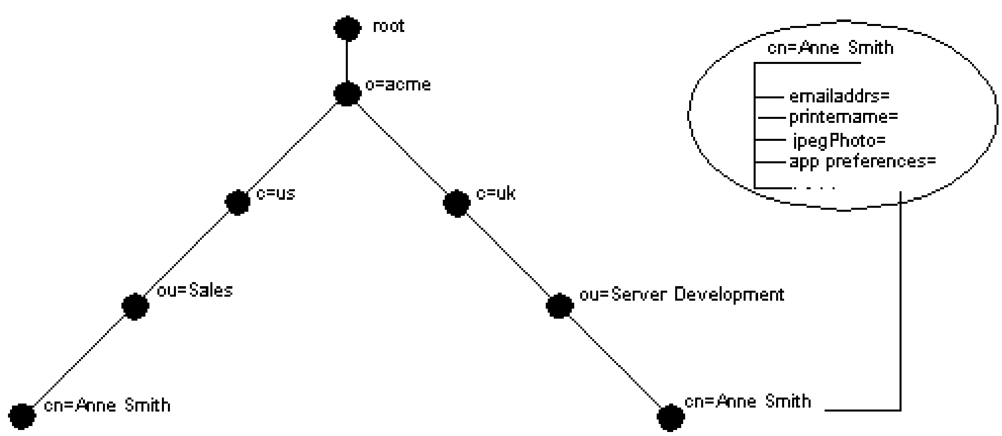
Information Model

The LDAP information model determines the form and character of information in the directory. This model uses the concept of entries as its defining characteristic. In a directory, an **entry** is a collection of information about an object. A telephone directory, for example, contains entries for people. A library card catalog contains entries for books. An online directory may contain entries for employees, conference rooms, e-commerce partners, or shared network resources such as printers.

In a typical telephone directory, a person entry contains an address and a phone number. In an online directory, each of these pieces of information is called an **attribute**. A typical employee entry contains attributes for a job title, an e-mail address, and a phone number.

In Figure 2–2, the entry for Anne Smith in Great Britain (uk) has several attributes. Each provides specific information about her. Those listed in the balloon to the right of the tree are emailaddrs, printername, jpegPhoto, and app preferences. Note that the rest of the bullets in Figure 2–2 are also entries with attributes, although these attributes are not shown.

Figure 2–2 Attributes of the Entry for Anne Smith



Each attribute consists of an attribute type and one or more attribute values. The **attribute type** is the kind of information that the attribute contains—jobTitle, for instance. The **attribute value** is the actual information. The value for the jobTitle attribute, for example, might be manager.

Functional Model

The LDAP functional model determines what operations can be performed on directory entries. Table 2–1 on page 2-4 lists and describes the three types of functions:

Table 2–1 LDAP Functions

Function	Description
Search and read	The read operation retrieves the attributes of an entry whose name is known. The list operation enumerates the children of a given entry. The search operation selects entries from a defined area of the tree based on some selection criteria known as a search filter. For each matching entry, a requested set of attributes (with or without values) is returned. The searched entries can span a single entry, an entry's children, or an entire subtree. Alias entries can be followed automatically during a search, even if they cross server boundaries. An abandon operation is also defined, allowing an operation in progress to be canceled.
Modify	This category defines four operations that modify the directory: ▪ Modify—change existing entries. You can add and delete values. ▪ Add—insert entries into the directory ▪ Delete—remove entries from the directory ▪ Modify RDN—change the name of an entry
Authenticate	This category defines a bind operation. A bind enables a client to initiate a session and prove its identity to the directory. Oracle Internet Directory supports several authentication methods, from simple clear-text passwords to public keys. The unbind operation is used to terminate a directory session.

Security Model

The LDAP security model enables directory information to be secured. This model has several parts:

- Authentication

  Ensuring that the identities of users, hosts, and clients are correctly validated

- Access Control and Authorization

  Ensuring that a user reads or updates only the information for which that user has privileges

- Data Integrity: Ensuring that data is not modified during transmission

- Data Privacy

  Ensuring that data is not disclosed during transmission

- Password Policies

  Setting rules that govern how passwords are used

Authentication

Authentication is the process by which the directory server establishes the identity of the user connecting to the directory. Directory authentication occurs when an LDAP bind operation establishes an LDAP session. Every session has an associated user identity, also referred to as an authorization ID.

Oracle Internet Directory provides three authentication options: anonymous, simple, and SSL.

Anonymous Authentication If your directory is available to everyone, users may log in anonymously. In **anonymous authentication**, users leave the user name and password fields blank when they log in. They then exercise whatever privileges are specified for anonymous users.

Simple Authentication In **simple authentication**, the client uses an unencrypted DN and password to identify itself to the server. The server verifies that the client's DN and password match the DN and password stored in the directory.

Authentication Using Secure Sockets Layer (SSL) **Secure Sockets Layer (SSL)** is an industry standard protocol for securing network connections. It uses a **certificate** exchange to authenticate users. These certificates are verified by trusted certificate authorities. A certificate ensures that an entity's identity information is correct. An entity can be an end user, a database, an administrator, a client, or a server. A **Certificate Authority (CA)** is an application that creates public key certificates that are given a high level of trust by all parties involved.

You can use SSL in one of the three authentication modes presented in Table 2–2.

Table 2–2 SSL Authentication Modes

SSL Mode	Description
No authentication	Neither the client nor the server authenticates itself to the other. No certificates are sent or exchanged. In this case, only SSL encryption and decryption are used.
One-way authentication	Only the directory server authenticates itself to the client. The directory server sends the client a certificate verifying that the server is authentic.
Two-way authentication	Both client and server authenticate themselves to each other, exchanging certificates.

In an Oracle Internet Directory environment, SSL authentication between a client and a directory server involves three basic steps:

1. The user initiates an LDAP connection to the directory server by using SSL on an SSL port. The default SSL port is `636`.
2. SSL performs the handshake between the client and the directory server.
3. If the handshake is successful, the directory server verifies that the user has the appropriate authorization to access the directory.

> **See Also:** *Oracle Advanced Security Administrator's Guide* for more information about SSL.

Access Control and Authorization

The authorization process ensures that a user reads or updates only the information for which he or she has privileges. The directory server ensures that the user—identified by the authorization ID associated with the session—has the requisite permissions to perform a given directory operation. Absent these permissions, the operation is disallowed.

The mechanism that the directory server uses to ensure that the proper authorizations are in place is called access control. And an access control item (ACI) is the directory metadata that captures the administrative policies relating to access control.

An ACI is stored in Oracle Internet Directory as user-modifiable operational attributes. Typically a whole list of these ACI attribute values is associated with a directory object.

This list is called an access control list (ACL). The attribute values on that list govern the access policies for the directory object.

ACIs are stored as text strings in the directory. These strings must conform to a well-defined format. Each valid value of an ACI attribute represents a distinct access control policy. These individual policy components are referred to as ACI Directives or ACIs and their format is called the ACI Directive format.

Access control policies can be prescriptive: their security directives can be set to apply downward to all entries at lower positions in the **directory information tree (DIT)**. The point from which an access control policy applies is called an **access control policy point (ACP)**.

Data Integrity

Oracle Internet Directory uses SSL to ensure that data is not modified, deleted, or replayed during transmission. This feature uses cryptographic checksums to generate a secure message digest. The checksums are created using either the **MD5** algorithm or the **Secure Hash Algorithm (SHA)**. The message digest is included in each network packet.

Data Privacy

Oracle Internet Directory uses **public key encryption** over SSL to ensure that data is not disclosed during transmission. In public-key encryption, the sender of a message encrypts the message with the public key of the recipient. Upon delivery, the recipient decrypts the message using his or her private key. The directory supports two levels of encryption:

- DES40

  The DES40 algorithm, available internationally, is a **DES** variant in which the secret key is preprocessed to provide forty effective **key** bits. It is designed for use by customers outside the USA and Canada who want to use a DES-based encryption algorithm.

- RC4_40

  Oracle is licensed to export the RC4 data encryption algorithm with a 40-bit key size to virtually all destinations where Oracle products are available. This makes it possible for international corporations to safeguard their entire operations with fast cryptography.

Password Policies

A password policy is a set of rules that govern how passwords are used. When a user attempts to bind to the directory, the directory server uses the password policy to ensure that the password provided meets the various requirements set in that policy.

When you establish a password policy, you set the following types of rules, to mention just a few:

- The maximum length of time a given password is valid
- The minimum number of characters a password must contain
- The ability of users to change their passwords

About the Standard LDAP APIs

The standard LDAP APIs enable you to perform the fundamental LDAP operations described in "LDAP Models". These APIs are available in C, PL/SQL, and Java. The first two are part of the directory SDK. The last is part of the JNDI package provided by Sun Microsystems. All three use TCP/IP connections. They are based on LDAP Version 3, and they support SSL connections to Oracle Internet Directory.

This section contains these topics:

- API Usage Model
- Getting Started with the C API
- Getting Started with the Java API
- Getting Started with the DBMS_LDAP Package

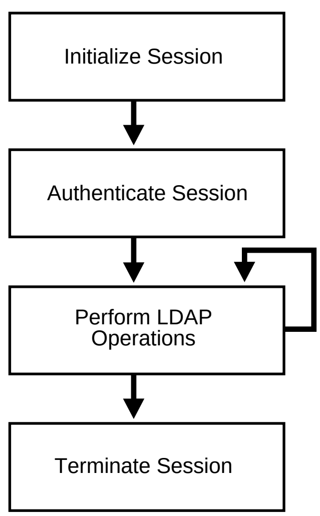
API Usage Model

Typically, an application uses the functions in the API in four steps:

1. Initialize the library and obtain an LDAP session handle.
2. Authenticate to the LDAP server if necessary.
3. Perform some LDAP operations and obtain results and errors, if any.
4. Close the session.

Figure 2–3 illustrates these steps.

Figure 2–3 Steps in Typical DBMS_LDAP Usage



Getting Started with the C API

When you build applications with the C API, you must include the header file `ldap.h`, located at `$ORACLE_HOME/ldap/public`. In addition, you must dynamically link to the library located at `$ORACLE_HOME/lib/libclntsh.so.10.1`.

> **See Also:** "Sample C API Usage" on page 14-40 to learn how to use the SSL and non-SSL modes.

Getting Started with the DBMS_LDAP Package

The DBMS_LDAP package enables PL/SQL applications to access data located in enterprise-wide LDAP servers. The names and syntax of the function calls are similar to those of the C API. These functions comply with current recommendations of the **Internet Engineering Task Force (IETF)** for the C API. Note though that the PL/SQL API contains only a subset of the functions available in the C API. Most notably, only synchronous calls to the LDAP server are available in the PL/SQL API.

To begin using the PL/SQL LDAP API, use this command sequence to load DBMS_LDAP into the database:

1. Log in to the database, using SQL*Plus. Run the tool in the Oracle home in which your database is present. Connect as SYSDBA.

   ```
   SQL> CONNECT / AS SYSDBA
   ```

2. Load the API into the database, using this command:

   ```
   SQL> @?/rdbms/admin/catladap.sql
   ```

Getting Started with the Java API

Java developers can use the Java Naming and Directory Interface (JNDI) from Sun Microsystems to gain access to information in Oracle Internet Directory. The JNDI is found at this link:

http://java.sun.com/products/jndi

Although no Java APIs are provided in this chapter, the section immediately following, "Initializing the Session by Using JNDI", shows you how to use wrapper methods for the Sun JNDI to establish a basic connection.

Initializing an LDAP Session

All LDAP operations based on the C API require clients to establish an LDAP session with the LDAP server. For LDAP operations based on the PL/SQL API, a database session must first initialize and open an LDAP session. Most Java operations require a Java Naming and Directory Interface (JNDI) connection. The `oracle.ldap.util.jndi` package, provided here, simplifies the work involved in achieving this connection.

The section contains the following topics:

Initializing the Session by Using the C API

The C function `ldap_init()` initializes a session with an LDAP server. The server is not actually contacted until an operation is performed that requires it, allowing options to be set after initialization.

`ldap_init` has the following syntax:

```
LDAP *ldap_init
(
const char      *hostname,
int             portno
```

```
);
```

Table 2–3 lists and defines the function parameters.

Table 2–3 Parameters for ldap_init()

Parameter	Description
hostname	Contains a space-separated list of directory host names or IP addresses represented by dotted strings. You can pair each host name with a port number as long as you use a colon to separate the two. The hosts are tried in the order listed until a successful connection is made. Note: A suitable representation for including a literal IPv6[10] address in the host name parameter is desired, but has not yet been determined or implemented in practice.
portno	Contains the TCP port number of the directory you would like to connect to. The default LDAP port of 389 can be obtained by supplying the constant LDAP_PORT. If a host includes a port number, this parameter is ignored.

ldap_init() and ldap_open() both return a session handle, or pointer, to an opaque structure that must be passed to subsequent calls to the session. These routines return NULL if the session cannot be initialized. You can check the error reporting mechanism for your operating system to determine why the call failed.

Initializing the Session by Using DBMS_LDAP

In the PL/SQL API, the function DBMS_LDAP.init() initiates an LDAP session. This function has the following syntax:

```
FUNCTION init (hostname IN VARCHAR2, portnum  IN PLS_INTEGER )
RETURN SESSION;
```

The function init requires a valid host name and port number to establish an LDAP session. It allocates a data structure for this purpose and returns a handle of the type DBMS_LDAP.SESSION to the caller. The handle returned from the call should be used in all subsequent LDAP operations defined by DBMS_LDAP for the session. The API uses these session handles to maintain state about open connections, outstanding requests, and other information.

A single database session can obtain as many LDAP sessions as required, although the number of simultaneous active connections is limited to 64. One database session typically has multiple LDAP sessions when data must be obtained from multiple servers simultaneously or when open sessions that use multiple LDAP identities are required.

Note: The handles returned from calls to DBMS_LDAP.init() are dynamic constructs. They do not persist across multiple database sessions. Attempting to store their values in a persistent form, and to reuse stored values at a later stage, can yield unpredictable results.

Initializing the Session by Using JNDI

The oracle.ldap.util.jndi package supports basic connections by providing wrapper methods for the JNDI implementation from Sun Microsystems. If you want to use the JNDI to establish a connection, see the following link:

http://java.sun.com/products/jndi

Here is an implementation of `oracle.ldap.util.jndi` that establishes a non-SSL connection:

```
import oracle.ldap.util.jndi
import javax.naming.*;

public static void main(String args[])
{
  try{
       InitialDirContext ctx = ConnectionUtil.getDefaultDirCtx(args[0], // host
                                                  args[1],  // port
                                                  args[2],  // DN
                                                  args[3];  // password)
       // Do work
     }
  catch(NamingException ne)
  {
    // javax.naming.NamingException is thrown when an error occurs
  }
}
```

Note:

- *`DN`* and *`password`* represent the bind DN and password. For anonymous binds, set these to `""`.
- You can use `ConnectionUtil.getSSLDirCtx()` to establish a no-authentication SSL connection.

Authenticating an LDAP Session

Individuals or applications seeking to perform operations against an LDAP server must first be authenticated. If the `dn` and `passwd` parameters of these entities are null, the LDAP server assigns a special identity, called anonymous, to these users. Typically, the anonymous user is the least privileged user of the directory.

Once a bind operation is complete, the directory server remembers the new identity until another bind occurs or the LDAP session terminates (`unbind_s`). The LDAP server uses the identity to enforce the security model specified by the enterprise in which it is deployed. The identity helps the LDAP server determine whether the user or application identified has sufficient privileges to perform search, update, or compare operations in the directory.

Note that the password for the bind operation is sent over the network in clear text. If your network is not secure, consider using SSL for authentication and other LDAP operations that involve data transfer.

This section contains these topics:

- Authenticating an LDAP Session by Using the C API
- Authenticating an LDAP Session by Using DBMS_LDAP

Authenticating an LDAP Session by Using the C API

The C function `ldap_simple_bind_s()` enables users and applications to authenticate to the directory server using a DN and password.

The function ldap_simple_bind_s() has this syntax:

```
int ldap_simple_bind_s
(
LDAP* ld,
char* dn,
char* passwd
);
```

Table 2–4 lists and describes the parameters for this function.

Table 2–4 Arguments for ldap_simple_bind_s()

Argument	Description
ld	A valid LDAP session handle
dn	The identity that the application uses for authentication
passwd	The password for the authentication identity

If the dn and passwd parameters for are NULL, the LDAP server assigns a special identity, called anonymous, to the user or application.

Authenticating an LDAP Session by Using DBMS_LDAP

The PL/SQL function simple_bind_s enables users and applications to use a DN and password to authenticate to the directory. simple_bind_s has this syntax:

```
FUNCTION simple_bind_s ( ld IN SESSION, dn IN VARCHAR2, passwd IN VARCHAR2)
RETURN PLS_INTEGER;
```

Note that this function requires as its first parameter the LDAP session handle obtained from init.

The following PL/SQL code snippet shows how the PL/SQL initialization and authentication functions just described might be implemented.

```
DECLARE
retvalPLS_INTEGER;
my_sessionDBMS_LDAP.session;

BEGIN
retval:= -1;
-- Initialize the LDAP session
my_session:= DBMS_LDAP.init('yow.acme.com',389);
--Authenticate to the directory
retval:=DBMS_LDAP.simple_bind_s(my_session,'cn=orcladmin',
'welcome');
```

In the previous example, an LDAP session is initialized on the LDAP server yow.acme.com. This server listens for requests at TCP/IP port number 389. The identity cn=orcladmin, whose password is welcome, is then authenticated. Once authentication is complete, regular LDAP operations can begin.

Searching the Directory

Searches are the most common LDAP operations. Applications can use complex search criteria to select and retrieve entries from the directory.

This section contains these topics:

- Program Flow for Search Operations
- Search Scope
- Filters
- Searching the Directory by Using the C API
- Searching the Directory by Using DBMS_LDAP

Note: This release of the DBMS_LDAP API provides only synchronous search capability. This means that the caller of the search functions is blocked until the LDAP server returns the entire result set.

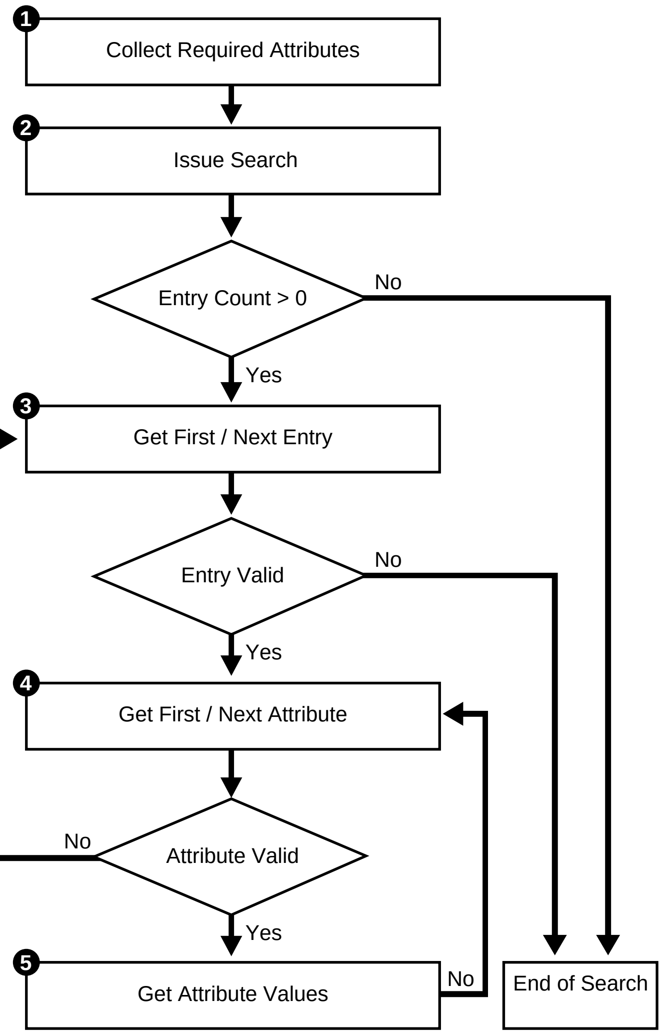
Program Flow for Search Operations

The programming required to initiate a typical search operation and retrieve results can be broken down into the following steps:

1. Decide what attributes must be returned; then place them into an array.
2. Initiate the search, using the scope options and filters of your choice.
3. Obtain an entry from result set.
4. Obtain an attribute from the entry obtained in step 3.
5. Obtain the values of the attributes obtained in step 4; then copy these values into local variables.
6. Repeat step 4 until all attributes of the entry are examined.
7. Repeat Step 3 until there are no more entries

Figure 2–4 on page 2-13 uses a flow chart to represent these steps.

Figure 2–4 Flow of Search-Related Operations



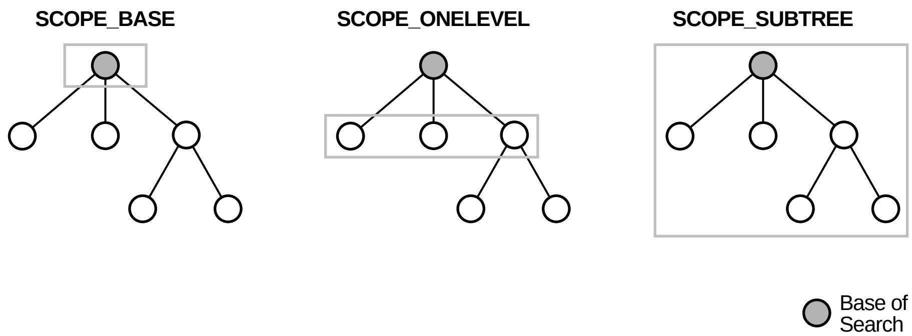
Search Scope

The scope of a search determines how many entries the directory server examines relative to the search base. You can choose one of the three options described in Table 2–5 and illustrated in Figure 2–5 on page 2-14.

Table 2–5 Options for search_s() or search_st() Functions

Option	Description
SCOPE_BASE	The directory server looks only for the entry corresponding to the search base.
SCOPE_ONELEVEL	The directory server confines its search to the entries that are the immediate children of the search base entry.
SCOPE_SUBTREE	The directory server looks at the search base entry and the entire subtree beneath it.

Figure 2–5 The Three Scope Options



In Figure 2–5, the search base is the shaded circle. The shaded rectangle identifies the entries that are searched.

Filters

A search filter is an expression that enables you to confine your search to certain types of entries. The search filter required by the `search_s()` and `search_st()` functions follows the string format defined in RFC 1960 of the Internet Engineering Task Force (IETF). As Table 2–6 shows, there are six kinds of search filters. These are entered in the format *`attribute operator value`*.

Table 2–6 Search Filters

Filter Type	Format	Example	Matches
Equality	(*att*=*value*)	(sn=Keaton)	Surnames exactly equal to `Keaton`.
Approximate	(*att*~=*value*)	(sn~=Ketan)	Surnames approximately equal to `Ketan`.
Substring	(attr=[*leading*]*[*any*]*[*trailing*]	(sn=*keaton*)	Surnames containing the string `keaton`.
		(sn=keaton*)	Surnames starting with `keaton`.
		(sn=*keaton)	Surnames ending with `keaton`.
		(sn=ke*at*on)	Surnames starting with `ke`, containing `at` and ending with `on`.
Greater than or equal	*attr*>=*value*	(sn>=Keaton)	Surnames lexicographically greater than or equal to `Keaton`.
Less than or equal	(*attr*<=*value*)	(sn<=Keaton)	Surnames lexicographically less than or equal to `Keaton`.
Presence	(*attr*=*)	(sn=*)	All entries having the `sn` attribute.

You can use boolean operators and prefix notation to combine these filters to form more complex filters. Table 2–7 on page 2-15 provides examples. In these examples, the

& character represents AND, the | character represents OR, and the ! character represents NOT.

Table 2–7 Boolean Operators

Filter Type	Format	Example	Matches
AND	`(&(filter1)(filter2)). . .)`	`(&(sn=keaton)(objectclass=inetOrgPerson))`	Entries with surname of `Keaton` and object class of `InetOrgPerson`.
OR	`(|(filter1)(filter2)). . .)`	`(|(sn~=ketan)(cn=*keaton))`	Entries with surname approximately equal to `ketan` or common name ending in `keaton`.
NOT	`(!(filter))`	`(!(mail=*))`	Entries without a mail attribute.

The complex filters in Table 2–7 can themselves be combined to create even more complex, nested filters.

Searching the Directory by Using the C API

The C function `ldap_search_s()` performs a synchronous search of the directory.

The syntax for `ldap_search_s()`looks like this:

```
int ldap_search_s
(
LDAP*         ld,
char*         base,
int           scope,
char*         filter
int           attrsonly,
LDAPMessage** res
);
```

`ldap_search_s` works with several supporting functions to refine the search. The steps that follow show how all of these C functions fit into the program flow of a search operation. Chapter 14, "C API Reference", examines all of these functions in depth.

1. Decide what attributes must be returned; then place them into an array of strings. The array must be null terminated.
2. Initiate the search, using `ldap_search_s()`. Refine your search with scope options and filters.
3. Obtain an entry from the result set, using either the `ldap_first_entry()` function or the `ldap_next_entry()` function.
4. Obtain an attribute from the entry obtained in step 3. Use either the `ldap_first_attribute()` function or the `ldap_next_attribute()` function for this purpose.
5. Obtain all the values for the attribute obtained in step 4; then copy these values into local variables. Use the `ldap_get_values()` function or the `ldap_get_values_len()` function for this purpose.
6. Repeat step 4 until all attributes of the entry are examined.

7. Repeat step 3 until there are no more entries.

Table 2–8 Arguments for ldap_search_s()

Argument	Description
`ld`	A valid LDAP session handle
`base`	The DN of the search base.
`scope`	The breadth and depth of the DIT to be searched.
`filter`	The filter used to select entries of interest.
`attrs`	The attributes of interest in the entries returned.
`attrso`	If set to `1`, only returns attributes.
`res`	This argument returns the search results.

Searching the Directory by Using DBMS_LDAP

You use the function `DBMS_LDAP.search_s()`to perform directory searches if you use the PL/SQL API.

Here is the syntax for `DBMS_LDAP.search_s()`:

```
FUNCTION search_s
(
ld       IN  SESSION,
base     IN  VARCHAR2,
scope    IN  PLS_INTEGER,
filter   IN  VARCHAR2,
attrs    IN  STRING_COLLECTION,
attronly IN  PLS_INTEGER,
res      OUT MESSAGE
)
RETURN PLS_INTEGER;
```

The function takes the arguments listed and described in Table 2–9 on page 2-16.

Table 2–9 Arguments for DBMS_LDAP.search_s() and DBMS_LDAP.search_st()

Argument	Description
`ld`	A valid session handle
`base`	The DN of the base entry in the LDAP server where search should start
`scope`	The breadth and depth of the **DIT** that needs to be searched
`filter`	The filter used to select entries of interest
`attrs`	The attributes of interest in the entries returned
`attronly`	If set to `1`, only returns the attributes
`res`	An `OUT` parameter that returns the result set for further processing

`search_s` works with several supporting functions to refine the search. The steps that follow show how all of these PL/SQL functions fit into the program flow of a search operation.

1. Decide what attributes need to be returned; then place them into the `DBMS_LDAP.STRING_COLLECTION` data-type.

2. Perform the search, using either `DBMS_LDAP.search_s()`or `DBMS_LDAP.search_st()`. Refine your search with scope options and filters.
3. Obtain an entry from the result set, using either`DBMS_LDAP.first_entry()` or `DBMS_LDAP.next_entry()`.
4. Obtain an attribute from the entry obtained in step 3. Use either `DBMS_LDAP.first_attribute()` or `DBMS_LDAP.next_attribute()` for this purpose.
5. Obtain all the values for the attribute obtained in step 4; then copy these values into local variables. Use either `DBMS_LDAP.get_values()` or `DBMS_LDAP.get_values_len()` for this purpose.
6. Repeat step 4 until all attributes of the entry are examined.
7. Repeat step 3 until there are no more entries.

Terminating the Session

This section contains these topics:

- Terminating the Session by Using the C API
- Terminating the Session by Using DBMS_LDAP

Terminating the Session by Using the C API

Once an LDAP session handle is obtained and all directory-related work is complete, the LDAP session must be destroyed. In the C API, the `ldap_unbind_s()` function is used for this purpose.

`ldap_unbind_s()` has this syntax:

```
int ldap_unbind_s
(
LDAP* ld
);
```

A successful call to `ldap_unbind_s()`closes the TCP/IP connection to the directory. It de-allocates system resources consumed by the LDAP session. Finally it returns the integer `LDAP_SUCCESS` to its callers. Once `ldap_unbind_s()`is invoked, no other LDAP operations are possible. A new session must be started with `ldap_init()`.

Terminating the Session by Using DBMS_LDAP

The `DBMS_LDAP.unbind_s()` function destroys an LDAP session if the PL/SQL API is used. `unbind_s` has the following syntax:

```
FUNCTION unbind_s (ld IN SESSION )  RETURN PLS_INTEGER;
```

`unbind_s` closes the TCP/IP connection to the directory. It de-allocates system resources consumed by the LDAP session. Finally it returns the integer `DBMS_LDAP.SUCCESS` to its callers. Once the `unbind_s` is invoked, no other LDAP operations are possible. A new session must be initiated with the `init` function.

3

Extensions to the LDAP Protocol

This chapter describes extensions to the LDAP protocol that are available in Oracle Internet Directory 10*g* (10.1.4.0.1).

This chapter contains these topics:

SASL Authentication

Oracle Internet Directory supports two mechanisms for SASL-based authentication. This section describes the two methods. It contains these topics:

- SASL Authentication by Using the DIGEST-MD5 Mechanism
- SASL Authentication by Using External Mechanism

SASL Authentication by Using DIGEST-MD5

SASL Digest-MD5 authentication is the required authentication mechanism for LDAP Version 3 servers (RFC 2829). LDAP Version 2 does not support Digest-MD5.

To use the Digest-MD5 authentication mechanism, you can use either the Java API or the C API to set up the authentication. The C API supports only `auth` mode.

See Also:

- Java-specific information in "Using DIGEST-MD5 to Perform SASL Authentication" on page 5-8 and "Example: Using SASL Digest-MD5 auth-int and auth-conf Modes" on page 5-8.
- C-specific information in "Authenticating to the Directory" on page 14-10 and "SASL Authentication Using Oracle Extensions" on page 14-12.

The SASL Digest-MD5 mechanism includes three modes, each representing a different security level or "Quality of Protection." They are:

- `auth`—Authentication only. Authentication is required only for the initial bind. After that, information is passed in clear text.
- `auth-int`—Authentication plus integrity. Authentication is required for the initial bind. After that, check sums are used to guarantee the integrity of the data.
- `auth-conf`—Authentication plus confidentiality. Authentication is required for the initial bind. After that, encryption is used to protect the data. Five cipher choices are available:
  - DES
  - 3DES
  - RC4
  - RC4-56
  - RC4-40

These are all symmetric encryption algorithms.

Prior to 10*g* (10.1.4.0.1), Oracle Internet Directory supported only the `auth` mode of the Digest-MD5 mechanism. As of 10*g* (10.1.4.0.1), Oracle Internet Directory supports all three modes with the Java Naming and Directory Interface (JNDI) of jdk1.4 API or with the OpenLDAP Java API. The Oracle LDAP SDK supports only `auth` mode.

Out of the box, Oracle Internet Directory SASL Digest-MD5 authentication supports generation of static SASL Digest-MD5 verifiers based on user or password, but not based on realm. If you want to use SASL Digest-MD5 with realms, you must enable reversible password generation by changing the value of the `orclpasswordencryptionenable` attribute to 1 in the related password policy before provisioning new users. The LDIF file for modifying the value should look like this:

```
dn: cn=default,cn=pwdPolicies,cn=Common,cn=Products,cn=OracleContext
changetype: modify
replace: orclpwdencryptionenable
orclpwdencryptionenable: 1
```

The Digest-MD5 mechanism is described in RFC 2831 of the Internet Engineering Task Force. It is based on the HTTP Digest Authentication (RFC 2617).

See Also:

- Internet Engineering Task Force Web site, at `http://www.ietf.org`.
- Open LDAP class libraries `http://www.openldap.org`.

Steps Involved in SASL Authentication by Using DIGEST-MD5

SASL Digest-MD5 authenticates a user as follows:

1. The directory server sends data that includes various authentication options that it supports and a special token to the LDAP client.
2. The client responds by sending an encrypted response that indicates the authentication options that it has selected. The response is encrypted in such a way that proves that the client knows its password.
3. The directory server then decrypts and verifies the client's response.

SASL Authentication by Using External Mechanism

The following is from section 7.4 of RFC 2222 of the Internet Engineering Task Force.

The mechanism name associated with external authentication is "EXTERNAL". The client sends an initial response with the authorization identity. The server uses information, external to SASL, to determine whether the client is authorized to authenticate as the authorization identity. If the client is so authorized, the server indicates successful completion of the authentication exchange; otherwise the server indicates failure.

The system providing this external information may be, for example, IPsec or SSL/TLS.

If the client sends the empty string as the authorization identity (thus requesting the authorization identity be derived from the client's authentication credentials), the authorization identity is to be derived from authentication credentials that exist in the system which is providing the external authentication.

Oracle Internet Directory provides the SASL external mechanism over an SSL mutual connection. The authorization identity (DN) is derived from the client certificate during the SSL network negotiation.

Using Controls

The LDAPv3 Protocol, as defined by RFC 2251, allows extensions by means of controls. Oracle Internet Directory supports several controls. Some are standard and described by RFCs. Other controls, such as the CONNECT_BY control for hierarchical searches are Oracle-specific. You can use controls with either Java or C.

Controls can be sent to a server or returned to the client with any LDAP message. These controls are referred to as server controls. The LDAP API also supports a client-side extension mechanism through the use of client controls. These controls affect the behavior of the LDAP API only and are never sent to a server.

For information about using LDAP controls in C, see "Working With Controls" on page 14-14.

For information about using LDAP controls in Java, see the documentation for the JNDI package `javax.naming.ldap` at `http://java.sun.com/products/jndi`.

The following controls are supported by Oracle Internet Directory 10*g* (10.1.4.0.1):

Table 3–1 Controls Supported by Oracle Internet Directory

Object Identifier	Name	Description
2.16.840.1.113730.3.4.2	GSL_MANAGE_DSA_ CONTROL	Used to manage referrals, dynamic groups, and alias objects in Oracle Internet Directory. For more information, please see RFC 3296, "Named Subordinate References in Lightweight Directory Access Protocol (LDAP) Directories," at `http://www.ietf.org`.
2.16.840.1.113894.1.8.1	OID_RESET_ PROXYCONTROL_ IDENTITY	Used to perform a proxy switch of an identity on an established LDAP connection. For example, suppose that Application A connects to the directory server and then wishes to switch to Application B. It can simply do a rebind by supplying the credentials of Application B. However, there are times when the proxy mechanism for the application to switch identities could be used even when the credentials are not available. With this control, Application A can switch to Application B provided Application A has the privilege in Oracle Internet Directory to proxy as Application B.
2.16.840.1.113894.1.8.2	OID_ APPLYUSEPASSWORD _POLICY	Sent by applications that require Oracle Internet Directory to check for account lockout before sending the verifiers of the user to the application. If Oracle Internet Directory detects this control in the verifier search request and the user account is locked, then Oracle Internet Directory will not send the verifiers to the application. It will send an appropriate password policy error.
2.16.840.1.113894.1.8.3	CONNECT_BY	See "Performing Hierarchical Searches" on page 3-9
2.16.840.1.113894.1.8.4	OID_CLIENT_IP_ ADDRESS	Intended for a client to send the end user IP address if IP lockout is to be enforced by Oracle Internet Directory.
2.16.840.1.113894.1.8.5	GSL_REQDATTR_ CONTROL	Used with dynamic groups. Directs the directory server to read the specific attributes of the members rather than the membership lists.
2.16.840.1.113894.1.8.6	OID_PASSWORD_ REQUEST_CONTROL	Password policy control. Request control that the client sends to get a response from the server.
2.16.840.1.113894.1.8.7	OID_PASSWORD_ EXPWARNING_ CONTROL	Password policy control. Response control that the server sends when the pwdExpireWarning attribute is enabled and the client sends the request control. The response control value contains the time in seconds to password expiration.
2.16.840.1.113894.1.8.8	OID_PASSWORD_ GRACELOGIN_ CONTROL	Password policy control. The response control that the server sends when grace logins are configured and the client sends a request control. The response control value contains the remaining number of grace logins.
2.16.840.1.113894.1.8.9	OID_PASSWORD_ MUSTCHANGE_ CONTROL	Password policy control. The response control that the server sends when forced password reset is enabled and the client sends the request control. The client must force the user to change the password upon receipt of this control.
2.16.840.1.113894.1.8.14	OID_DYNAMIC_ VERIFIER_REQUEST_ CONTROL	The request control that the client sends when it wants the server to create a dynamic password verifier. The server uses the parameters in the request control to construct the verifier.
2.16.840.1.113894.1.8.15	OID_DYNAMIC_ VERIFIER_RESPONSE_ CONTROL	The response control that the server sends to the client when an error occurs. The response control contains the error code.
2.16.840.1.113894.1.8.16	OID_ APPLYALLPWDPOLICI ES_CONTROL	If this control is included in a verifier search request, all password policies that are applicable to the user are applied to the verifier search.

Table 3–1 (Cont.) Controls Supported by Oracle Internet Directory

Object Identifier	Name	Description
2.16.840.1.113894.1.8.23	GSL_CERTIFICATE_ CONTROL	Certificate search control. The request control that the client sends to specify how to search for a user certificate.
1.2.840.113556.1.4.473	OID_SEARCH_ SORTING_REQUEST_ CONTROL	See "Sorted LDAP Search Results" on page 3-10.
1.2.840.113556.1.4.319	OID_SEARCH_ PAGING_CONTROL	See "Paged LDAP Search Results" on page 3-10.

To find out what controls are available in your Oracle Internet Directory installation, type:

```
ldapsearch -p port -b "" -s base "objectclass=*"
```

Look for entries that begin with `supportedcontrol=`.

Proxying on Behalf of End Users

Often applications must perform operations that require impersonating an end user. An application may, for example, want to retrieve resource access descriptors for an end user. (Resource access descriptors are discussed in the concepts chapter of *Oracle Internet Directory Administrator's Guide*.)

A proxy switch occurs at run time on the JNDI context. An LDAP v3 feature, proxying can only be performed using `InitialLdapContext`, a subclass of `InitialDirContext`. If you use the Oracle extension `oracle.ldap.util.jndi.ConnectionUtil` to establish a connection (the example following), `InitialLdapContext` is always returned. If you use JNDI to establish the connection, make sure that it returns `InitialLdapContext`.

To perform the proxy switch to an end user, the user DN must be available. To learn how to obtain the DN, see the sample implementation of the `oracle.ldap.util.User` class at this URL:

http://www.oracle.com/technology/sample_code/

Look for the Oracle Identity Management link under Sample Applications—Fusion Middleware, then look for "Sample Application Demonstrating Proxy Switching using Oracle Internet Directory Java API."

This code shows how the proxy switch occurs:

```
import oracle.ldap.util.jndi.*;
import javax.naming.directory.*;
import javax.naming.ldap.*;
import javax.naming.*;

public static void main(String args[])
{
  try{
       InitialLdapContext appCtx=ConnectionUtil.getDefaultDirCtx(args[0], // host
                                                           args[1], // port
                                                           args[2], // DN
                                                           args[3]; // pass)
         // Do work as application
         // . . .
         String userDN=null;
```

```
            // assuming userDN has the end user DN value
            // Now switch to end user
            ctx.addToEnvironment(Context.SECURITY_PRINCIPAL, userDN);
            ctx.addToEnvironment("java.naming.security.credentials", "");
            Control ctls[] = {
              new ProxyControl()
            };
            ((LdapContext)ctx).reconnect(ctls);
            // Do work on behalf of end user
            // . . .
         }
     catch(NamingException ne)
         {
        // javax.naming.NamingException is thrown when an error occurs
         }
}
```

The `ProxyControl` class in the code immediately preceding implements a `javax.naming.ldap.Control`. To learn more about LDAP controls, see the LDAP control section of *Oracle Identity Management User Reference*. Here is an example of what the `ProxyControl` class might look like:

```
import javax.naming.*;
import javax.naming.ldap.Control;
import java.lang.*;

public class ProxyControl implements Control {

   public byte[] getEncodedValue() {
      return null;
   }

   public String getID() {
      return "2.16.840.1.113894.1.8.1";
   }

   public boolean isCritical() {
      return false;
   }
}
```

Creating Dynamic Password Verifiers

You can modify the LDAP authentication APIs to generate application passwords dynamically—that is, when users log in to an application. This feature has been designed to meet the needs of applications that provide parameters for password verifiers only at runtime.

This section contains the following topics:

- Request Control for Dynamic Password Verifiers
- Syntax for DynamicVerifierRequestControl
- Parameters Required by the Hashing Algorithms
- Configuring the Authentication APIs
- Response Control for Dynamic Password Verifiers
- Obtaining Privileges for the Dynamic Verifier Framework

Request Control for Dynamic Password Verifiers

Creating a password verifier dynamically involves modifying the LDAP authentication APIs `ldap_search` or `ldap_modify` to include parameters for password verifiers. An LDAP control called `DynamicVerifierRequestControl` is the mechanism for transmitting these parameters. It takes the place of the password verifier profile used to create password verifiers statically. Nevertheless, dynamic verifiers, like static verifiers, require that the directory attributes `orclrevpwd` (synchronized case) and `orclunsyncrevpwd` (unsynchronized case) be present and that these attributes be populated.

Note that the `orclpwdencryptionenable` attribute of the password policy entry in the user's realm must be set to `1` if `orclrevpwd` is to be generated. If you fail to set this attribute, an exception is thrown when the user tries to authenticate. To generate `orclunsyncrevpwd`, you must add the crypto type 3DES to the entry `cn=defaultSharedPINProfileEntry,cn=common,cn=products,cn=oraclecontext`.

Syntax for DynamicVerifierRequestControl

The request control looks like this:

```
DynamicVerifierRequestControl
controlOid:  2.16.840.1.113894.1.8.14
criticality:  FALSE
controlValue: an OCTET STRING whose value is the BER encoding of the following
type:

ControlValue ::= SEQUENCE {

                  version [0]
                  crypto  [1] CHOICE OPTIONAL {
                     SASL/MD5  [0] LDAPString,
                     SyncML1.0 [1] LDAPString,
                     SyncML1.1 [2] LDAPString,
                     CRAM-MD5  [3] LDAPString },
                  username [1] OPTIONAL LDAPString,
                  realm    [2] OPTIONAL LDAPString,
                  nonce    [3] OPTIONAL LDAPString,
                 }
```

Note that the parameters in the control structure must be passed in the order in which they appear. Table 3–2 defines these parameters.

Table 3–2 Parameters in DynamicVerifierRequestControl

Parameter	Description
`controlOID`	The string that uniquely identifies the control structure.
`crypto`	The hashing algorithm. Choose one of the four identified in the control structure.
`username`	The distinguished name (DN) of the user. This value must always be included.
`realm`	A randomly chosen realm. It may be the identity management realm that the user belongs to. It may even be an application realm. Required only by the SASL/MD5 algorithm.
`nonce`	An arbitrary, randomly chosen value. Required by SYNCML1.0 and SYNCML1.1.

Parameters Required by the Hashing Algorithms

Table 3–3 lists the four hashing algorithms that are used to create dynamic password verifiers. The table also lists the parameters that each algorithm uses as building blocks. Note that, although all algorithms use the user name and password parameters, they differ in their use of the `realm` and `nonce` parameters.

Table 3–3 Parameters Required by the Hashing Algorithms

Algorithm	Parameters Required
SASL / MD5	`username`, `realm`, `password`
SYNCML1.0	`username`, `password`, `nonce`
SYNCML1.1	`username`, `password`, `nonce`
CRAM-MD5	`username`, `password`

Configuring the Authentication APIs

Applications that require password verifiers to be generated dynamically must include `DynamicVerifierRequestControl` in their authentication APIs. Either `ldap_search` or `ldap_compare` must incorporate the `controlOID` and the control values as parameters. They must BER-encode the control values as shown in "Syntax for DynamicVerifierRequestControl"; then they must send both `controlOID` and the control values to the directory server.

Parameters Passed If ldap_search Is Used

If you want the application to authenticate the user, use `ldap_search` to pass the control structure. If `ldap_search` is used, the directory passes the password verifier that it creates to the client.

`ldap_search` must include the DN of the user, the `controlOID`, and the control values. If the user's password is a single sign-on password, the attribute passed is `authpassword`. If the password is a numeric pin or another type of unsynchronized password, the attribute passed is `orclpasswordverifier;orclcommonpin`.

Parameters Passed If ldap_compare Is Used

If you want Oracle Internet Directory to authenticate the user, use `ldap_compare` to pass the control structure. In this case, the directory retains the verifier and authenticates the user itself.

Like `ldap_search`, `ldap_compare` must include the DN of the user, the `controlOID`, the control values, and the user's password attribute. For `ldap_compare`, the password attribute is `orclpasswordverifier;orclcommonpin` (unsynchronized case).

Response Control for Dynamic Password Verifiers

When it encounters an error, the directory sends the LDAP control `DynamicVerifierResponseControl` to the client. This response control contains the error code. To learn about the error codes that the response control sends, see the troubleshooting chapter in *Oracle Internet Directory Administrator's Guide*.

Obtaining Privileges for the Dynamic Verifier Framework

If you want the directory to create password verifiers dynamically, you must add your application identity to the VerifierServices group of directory administrators. If you fail to perform this task, the directory returns an LDAP_INSUFFICIENT_ACCESS error.

Performing Hierarchical Searches

One of the server controls you can pass to an LDAP search function is CONNECT_BY. This is an Oracle-specific control that causes the search to traverse a hierarchy. For example, if you search for all the users in group1, without the CONNECT_BY control, the search function will return only users who are direct members of group1. If you pass the CONNECT_BY control, however, the search function will traverse the hierarchy. If group2 is a member of group1, the search will also return users in group2. If group3 is a member of group2, the search will also return users in group3, and so forth.

New Features of the CONNECT_BY Control

In 10*g* (10.1.4.0.1), the CONNECT_BY control has been enhanced in two ways:

- You can now traverse the hierarchy in either direction. That is, you can search through all containers in which an entry is contained, as well as through all containers contained within an entry.
- You can now specify the number of levels of the hierarchy to search.

Value Fields in the CONNECT_BY Control

In previous releases, the CONNECT_BY control required no values. Because of the new functionality, you can now pass one or both of the following values to CONNECT_BY:

- Hierarchy-establishing attribute–A string representing the attribute to be searched. This value is necessary only when searching through all containers in which an entry is contained. When searching through containers contained within an entry, you need not provide this value because the search filter provides that information.
- Number of levels–An integer representing the number of levels to traverse. If the value is 0, the search will traverse all levels. The default value is 0, so you need not pass this value if you want the search to traverse all leve.s

Example 1: Find All the Groups to Which a User Belongs

Using a filter such as (member=cn=jsmith), you do not need to provide the hierarchy-establishing attribute member because it is in the search filter. You do not need to pass a value for the number of levels because 0 is the default.

Example 2: Find Only the Groups to Which a User Directly Belongs

Using the same filter as in Example 1, you would pass the integer control value 1. The result would be the same as if you did not use the CONNECT_BY control at all.

Example 3: Find All Members of a Group

In this case, your search filter would specify (objectclass=*), but if you want to find all members of group1, the attribute for traversing the hierarchy is member. For this search, you must pass the string "member" as the hierarchy-establishing attribute. You do not need to pass a value for the number of levels because 0 is the default.

Example 4: Finding all Managers of a User

This is similar to Example 3, except that you want to find all managers of the user `jsmith`, so `manager` is the attribute for traversing the hierarchy. For this search, you would pass the string `"manager"`. You do not need to pass a value for the number of levels because `0` is the default.

> **See Also:**
>
> - "ldap_search_ext, ldap_search_ext_s, ldap_search, and ldap_search_s" on page 14-17.
> - "Working With Controls" on page 14-14.

Sorted LDAP Search Results

As of Oracle Internet Directory 10*g* (10.1.4.0.1), you can obtain sorted results from an LDAP search, as described by IETF RFC 2891. You request sorted results by passing a control of type 1.2.840.113556.1.4.473 to the search function. The server returns a response control is of type 1.2.840.113556.1.4.474. Error processing and other details are described in RFC 2891.

> **See Also:** IETF RFC 2891, "LDAP Control Extension for Server Side Sorting of Search Results," at `http://www.ietf.org`.

Sorting and paging may be used together.

The Oracle Internet Directory implementation of RFC 2891 has the following limitations:

- It supports only one `attributeType` in the control value.
- It uses the default ordering rule defined in the schema for each attribute.
- Linguistic sorting is not supported.
- The default sorting order is ascending.
- If a sort key is a multi-valued attribute, and an entry has multiple values for that attriute, and there are no other controls that affect the sorting order, then the server uses the least value, according to the ordering rule for that attribute.
- The sort attribute must be searchable. That is, it must be a cataloged attribute in Oracle Internet Directory.

Paged LDAP Search Results

As of Oracle Internet Directory 10*g* (10.1.4.0.1), you can obtain paged results from an LDAP search, as described by IETF RFC 2696. You request sorted results by passing a control of type 1.2.840.113556.1.4.319 to the search function. Details are described in RFC 2696.

> **See Also:** IETF RFC 2696, "LDAP Control Extension for Simple Paged Results Manipulation," at `http://www.ietf.org`.

Sorting and paging may be used together.

The Oracle Internet Directory implementation of RFC 2696 has the following limitations:

- The number of entries in a page might be less than the page size if an ACI partially blocks some entries from the search results.
- The paging response control does not contain the total entry count estimation. The return value is always 0.

4

Developing Applications With Oracle Extensions to the Standard APIs

This chapter introduces the Oracle extensions to the Java and PL/SQL LDAP APIs. Chapter 4 explains how the Java extensions are used. Chapter 5 is about the PL/SQL extensions. Oracle does not support extensions to the C API.

This chapter contains these topics:

Sample Code

Sample code is available at this URL:

`http://www.oracle.com/technology/sample_code/`

Look for the Oracle Identity Management link under Sample Applications—Fusion Middleware.

Using Oracle Extensions to the Standard APIs

The APIs that Oracle has added to the existing APIs fulfill these functions:

- User management

  Applications can set or retrieve various user properties
- Group management

  Applications can query group properties
- Realm management

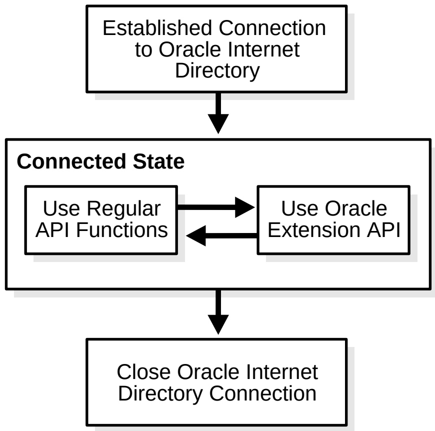
  Applications can set or retrieve properties about identity management realms
- Server discovery management

  Applications can locate a directory server in the Domain Name System (DNS)

Subsequent sections examine each of these functions in detail. Note that applications must use the underlying APIs for such common tasks as establishing and closing connections and looking up directory entries not searchable with the API extensions.

Figure 4–1 shows what program flow looks like when the API extensions are used.

Figure 4–1 Programmatic Flow for API Extensions



As Figure 4–1 shows, an application first establishes a connection to Oracle Internet Directory. It can then use the standard API functions and the API extensions interchangeably.

Creating an Application Identity in the Directory

Before an application can use the LDAP APIs and their extensions, it must establish an LDAP connection. Once it establishes a connection, it must have permission to perform operations. But neither task can be completed if the application lacks an identity in the directory.

Creating an Application Identity

Creating an application identity in the directory is relatively simple. Such an entry requires only two object classes: `orclApplicationEntity` and `top`. You can use either Oracle Directory Manager or an LDIF file to create the entry. In LDIF notation, the entry looks like this:

```
dn: orclapplicationcommonname=application_name
changetype: add
objectclass:top
objectclass: orclApplicationEntity
userpassword: password
```

The value provided for `userpassword` is the value that the application uses to bind to the directory.

Assigning Privileges to an Application Identity

To learn about the privileges available to an application, see the chapter about delegating privileges for an Oracle technology deployment in *Oracle Internet Directory Administrator's Guide*. After identifying the right set of privileges, add the application entity DN to the appropriate directory groups. The reference just provided explains how to perform this task using either Oracle Directory Manager or the `ldapmodify` command.

Managing Users

This section describes user management features of the LDAP APIs.

Directory-enabled applications need to perform the following operations:

- Retrieve properties of user entries

  These properties are stored as attributes of the user entry itself—in the same way, for example, that a surname or a home address is stored.

- Retrieve extended user preferences

  These preferences apply to a user but are stored in a DIT different from the DIT containing user entries. Extended user preferences are either user properties common to all applications or user properties specific to an application. Those of the first type are stored in a common location in the Oracle Context. Those of the second type are stored in the application-specific DIT.

- Query the group membership of a user
- Authenticate a user given a simple name and credential

  Typically an application uses a fully qualified DN, GUID, or simple user name to identify a user. In a hosted environment, the application may use both a user name and a realm name for identification.

Managing Groups

Groups are modeled in Oracle Internet Directory as a collection of distinguished names. Directory-enabled applications must access Oracle Internet Directory to obtain the properties of a group and to verify that a given user is a member of that group.

A group is typically identified by one of the following:

- A fully qualified LDAP distinguished name
- A global unique identifier
- A simple group name along with a subscriber name

Managing Realms

An identity management realm is an entity or organization that subscribes to the services offered in the Oracle product stack. Directory-enabled applications must access Oracle Internet Directory to obtain realm properties such as user search base or password policy.

A realm is typically identified by one of the following:

- A fully qualified LDAP distinguished name
- A global unique identifier
- A simple enterprise name

Discovering a Directory Server

Directory server discovery (DSD) enables automatic discovery of the Oracle directory server by directory clients. It enables deployments to manage the directory host name and port number information in the central DNS server. All directory clients perform a DNS query at runtime and connect to the directory server. Directory server location information is stored in a DNS service location record (SRV).

An SRV contains:

- The DNS name of the server providing LDAP service
- The port number of the corresponding port
- Any parameters that enable the client to choose an appropriate server from multiple servers

DSD also allows clients to discover the directory host name information from the `ldap.ora` file itself.

This section contains these topics:

- Benefits of Oracle Internet Directory Discovery Interfaces
- Usage Model for Discovery Interfaces
- Determining Server Name and Port Number From DNS
- Environment Variables for DNS Server Discovery
- Programming Interfaces for DNS Server Discovery

See Also:

- "Discovering LDAP Services with DNS" by Michael P. Armijo at this URL:

  `http://www.ietf.org`.

- "A DNS RR for specifying the location of services (DNS SRV)", Internet RFC 2782 at the same URL.

Benefits of Oracle Internet Directory Discovery Interfaces

Typically, the LDAP host name and port information is provided statically in a file called `ldap.ora` which is located on the client in `$ORACLE_HOME/network/admin`. For large deployments with many clients, this information becomes very cumbersome to manage. For example, each time the host name or port number of a directory server is changed, the `ldap.ora` file on each client must be modified.

Directory server discovery eliminates the need to manage the host name and port number in the `ldap.ora` file. Because the host name information resides on one central DNS server, the information must be updated only once. All clients can then discover the new host name information dynamically from the DNS when they connect to it.

DSD provides a single interface to obtain directory server information without regard to the mechanism or standard used to obtain it. Currently, Oracle directory server information can be obtained either from DNS or from `ldap.ora` using a single interface.

Usage Model for Discovery Interfaces

The first step in discovering host name information is to create a discovery handle. A discovery handle specifies the source from which host name information will be discovered. In case of the Java API, the discovery handle is created by creating an instance of the `oracle.ldap.util.discovery.DiscoveryHelper` class.

```
DiscoveryHelper disco = new DiscoveryHelper(DiscoveryHelper.DNS_DISCOVER);
```

The argument `DiscoveryHelper.DNS_DISCOVER` specifies the source. In this case the source is DNS.

Each source may require some inputs to be specified for discovery of host name information. In the case of DNS these inputs are:

- domain name
- discover method
- SSL mode

Detailed explanation of these options is given in "Determining Server Name and Port Number From DNS".

```
// Set the property for the DNS_DN
disco.setProperty(DiscoveryHelper.DNS_DN,"dc=us,dc=fiction,dc=com");
// Set the property for the DNS_DISCOVER_METHOD
disco.setProperty(DiscoveryHelper.DNS_DISCOVER_METHOD
   ,DiscoveryHelper.USE_INPUT_DN_METHOD);
// Set the property for the SSLMODE
disco.setProperty(DiscoveryHelper.SSLMODE,"0");
```

Now the information can be discovered.

```
// Call the discover method
disco.discover(reshdl);
```

The discovered information is returned in a result handle (`reshdl`). Now the results can be extracted from the result handle.

```
ArrayList result =
(ArrayList)reshdl.get(DiscoveryHelper.DIR_SERVERS);
if (result != null)
{
   if (result.size() == 0) return;
   System.out.println("The hostnames are :-");
   for (int i = 0; i< result.size();i++)
   {
      String host = (String)result.get(i);
      System.out.println((i+1)+".'"+host+"'");
   }
}
```

Determining Server Name and Port Number From DNS

Determining a host name and port number from a DNS lookup involves obtaining a domain and then searching for SRV resource records based on that domain. If there is more than one SRV resource record, they are sorted by weight and priority. The SRV resource records contain host names and port numbers required for connection. This information is retrieved from the resourcerecords and returned to the user.

There are three approaches for determining the domain name required for lookup:

- Mapping the distinguished name (DN) of the naming context
- Using the domain component of local machine
- Looking up the default SRV record in the DNS

Mapping the DN of the Naming Context

The first approach is to map the distinguished name (DN) of naming context into domain name using the algorithm given here.

The output domain name is initially empty. The DN is processed sequentially from right to left. An RDN is able to be converted if it meets the following conditions:

- It consists of a single attribute type and value
- The attribute type is `dc`
- The attribute value is non-null

If the RDN can be converted, then the attribute value is used as a domain name component (label).

The first such value becomes the rightmost, and the most significant, domain name component. Successive converted RDN values extend to the left. If an RDN cannot be converted, then processing stops. If the output domain name is empty when processing stops, then the DN cannot be converted into a domain name.

For the DN `cn=John Doe,ou=accounting,dc=example,dc=net`, the client converts the dc components into the DNS name `example.net`.

Search by Domain Component of Local Machine

Sometimes a DN cannot be mapped to a domain name. For example, the DN `o=Oracle IDC,Bangalore` cannot be mapped to a domain name. In this case, the second approach uses the domain component of the local machine on which the client is running. For example, if the client machine domain name is `mc1.acme.com`, the domain name for the lookup is `acme.com`.

Search by Default SRV Record in DNS

The third approach looks for a default SRV record in the DNS. This record points to the default server in the deployment. The domain component for this default record is `_default`.

Once the domain name has been determined, it is used to send a query to DNS. The DNS is queried for SRV records specified in Oracle Internet Directory-specific format. For example, if the domain name obtained is `example.net`, the query for non-SSL LDAP servers is for SRV resource records having the owner name `_ldap._tcp._oid.example.net`.

It is possible that no SRV resource records are returned from the DNS. In such a case the DNS lookup is performed for the SRV resource records specified in standard format. For example, the owner name would be `_ldap._tcp.example.net`.

> **See Also:** The chapter about directory administration in *Oracle Internet Directory Administrator's Guide*.

The result of the query is a set of SRV records. These records are then sorted and the host information is extracted from them. This information is then returned to the user.

Note: The approaches mentioned here can also be tried in succession, stopping when the query lookup of DNS is successful. Try the approaches in the order as described in this section. DNS is queried only for SRV records in Oracle Internet Directory-specific format. If none of the approaches is successful, then all the approaches are tried again, but this time DNS is queried for SRV records in standard format.

Environment Variables for DNS Server Discovery

The following environment variables override default behavior for discovering a DNS server.

Table 4–1 Environment Variables for DNS Discovery

Environment Variable	Description
ORA_LDAP_DNS	IP address of the DNS server containing the SRV records. If the variable is not defined, then the DNS server address is obtained from the host machine.
ORA_LDAP_DNSPORT	Port number on which the DNS server listens for queries. If the variable is not defined, then the DNS server is assumed to be listening at standard port number 53.
ORA_LDAP_DOMAIN	Domain of the host machine. If the variable is not defined, then the domain is obtained from the host machine itself.

Programming Interfaces for DNS Server Discovery

The programming interface provided is a single interface to discover directory server information without regard to the mechanism or standard used to obtain it. Information can be discovered from various sources. Each source can use its own mechanism to discover the information. For example, the LDAP host and port information can be discovered from the DNS acting as the source. Here DSD is used to discover host name information from the DNS.

See Also: For detailed reference information and class descriptions, refer to the Javadoc located on the product CD.

5

Using the Java API Extensions to JNDI

This chapter explains how to use Java extensions to the standard directory APIs to perform many of the operations introduced in Chapter 3. The chapter presents use cases. The Oracle extensions to the standard APIs are documented in full in *Oracle Internet Directory API Reference*.

The chapter contains the following topics:

Sample Code

Sample code is available at this URL:

`http://www.oracle.com/technology/sample_code/`

Look for the Oracle Identity Management link under Sample Applications–Oracle Application Server.

Installing the Java Extensions

The Java extensions are installed along with the standard Java APIs when the LDAP client is installed. The APIs and their extensions are found at `$ORACLE_HOME/jlib/ldapjclnt10.jar`.

Using the oracle.java.util Package to Model LDAP Objects

In Java, LDAP entities—users, groups, realms, and applications—are modeled as Java objects instead of as handles. This modeling is done in the `oracle.java.util` package. All other utility functionality is modeled either as individual objects—as, for example, `GUID`—or as static member functions of a utility class.

For example, to authenticate a user, an application must follow these steps:

1. Create `oracle.ldap.util.User` object, given the user DN.
2. Create a `DirContext` JNDI object with all of the required properties, or get one from a pool of `DirContext` objects.
3. Invoke the `User.authenticateUser` method, passing in a reference to the `DirContext` object and the user credentials.
4. If the `DirContext` object was retrieved from a pool of existing `DirContext` objects, return it to that pool.

Unlike their C and PL/SQL counterparts, Java programmers do not have to explicitly free objects. The Java garbage collection mechanism performs this task.

The Classes PropertySetCollection, PropertySet, and Property

Many of the methods in the user, subscriber, and group classes return a `PropertySetCollection` object. The object represents a collection of one or more LDAP entries. Each of these entries is represented by a `PropertySet` object, identified by a DN. A property set can contain attributes, each represented as a property. A property is a collection of one or more values for the particular attribute it represents. An example of the use of these classes follows:

```
PropertySetCollection psc = Util.getGroupMembership( ctx,
                                                     myuser,
                                                     null,
                                                     true );
    // for loop to go through each PropertySet
    for (int i = 0; i < psc.size(); i++ ) {

    PropertySet ps = psc.getPropertySet(i);

   // Print the DN of each PropertySet
   System.out.println("dn:  " + ps .getDN());

   // Get the values for the "objectclass" Property
   Property objectclass = ps.getProperty( "objectclass" );


   // for loop to go through each value of Property "objectclass"
   for (int j = 0; j< objectclass.size(); j++) {

       // Print each "objectclass" value
       System.out.println("objectclass:  " + objectclass.getValue(j));
   }
}
```

The entity `myuser` is a user object. The `psc` object contains all the nested groups that myuser belongs to. The code loops through the resulting entries and prints out all the object class values of each entry.

Managing Users

All user-related functionality is abstracted in a Java class called `oracle.ldap.util.User`. The process works like this:

1. Construct a `oracle.ldap.util.User` object based on a DN, GUID, or simple name.
2. Invoke `User.authenticateUser(DirContext, int, Object)` to authenticate the user if necessary.
3. Invoke `User.getProperties(DirContext)` to get the attributes of the user entry.
4. Invoke `User.getExtendedProperties(DirContext, int, String[])` to get the extended properties of the user. `int` is either shared or application-specific. `String[]` is the object that represents the type of property desired. If `String[]` is null, all properties in a given category are retrieved.
5. Invoke `PropertySetCollection.getProperties(int)` to get the metadata required to parse the properties returned in step 4.
6. Parse the extended properties and continue with application-specific logic. This parsing is also performed by application-specific logic.

Authenticating Users

User authentication is a common LDAP operation that compares the credentials that a user provides at login with the user's credentials in the directory. Oracle Internet Directory supports the following:

- Arbitrary attributes can be used during authentication
- Appropriate password policy exceptions are returned by the authentication method. Note, however, that the password policy applies only to the `userpassword` attribute.

The following code fragment shows how the API is used to authenticate a user:

```
 // User user1 - is a valid User Object
        try
        {
                user1.authenticateUser(ctx,
                    User.CREDTYPE_PASSWD, "welcome");

                // or
                // user1.authenticateUser(ctx, <any
attribute>, <attribute value>);
        }
        catch (UtilException ue)
        {
                // Handle the password policy error
accordingly
                if (ue instanceof PasswordExpiredException)
                        // do something
                else if (ue instanceof GraceLoginException)
                        // do something
        }
```

Creating Users

The subscriber class uses the `createUser()` method to programmatically create users. The object classes required by a user entry are configurable through Oracle Delegated Administration Services. The `createUser()` method assumes that the client understands the requirement and supplies the values for the mandatory attributes during user creation. If the programmer does not supply the required information the server will return an error.

The following snippet of sample code demonstrates the usage.

```
// Subscriber sub is a valid Subscriber object
// DirContext ctx is a valid DirContext

// Create ModPropertySet object to define all the attributes and their values.
ModPropertySet mps = new ModPropertySet();
mps.addProperty(LDIF.ATTRIBUTE_CHANGE_TYPE_ADD,"cn", "Anika");
mps.addProperty(LDIF.ATTRIBUTE_CHANGE_TYPE_ADD,"sn", "Anika");
mps.addProperty(LDIF.ATTRIBUTE_CHANGE_TYPE_ADD,"mail",
"Anika@oracle.com");

// Create user by specifying the nickname and the ModPropertySet just defined
User newUser = sub.createUser( ctx, mps);

// Print the newly created user DN
System.out.println( newUser.getDN(ctx) );

// Perform other operations with this new user
```

Retrieving User Objects

The subscriber class offers the `getUser()` method to replace the public constructors of the User class. A user object is returned based on the specified information.

The following is a piece of sample code demonstrating the usage:

```
// DirContext ctx is contains a valid directory connection with
sufficient privilege to perform the operations

// Creating RootOracleContext object
RootOracleContext roc = new RootOracleContext(ctx);

// Obtain a Subscriber object representing the default
subscriber
Subscriber sub = roc.getSubscriber(ctx,
Util.IDTYPE_DEFAULT, null, null);

// Obtain a User object representing the user whose
nickname is "Anika"
User user1 = sub.getUser(ctx, Util.IDTYPE_SIMPLE, "Anika",
null);
// Do work with this user

The getUser() method can retrieve users based on DN, GUID
and simple name.  A getUsers() method is also available to
perform a filtered search to return more than one user at a
time.  The returned object is an array of User objects.
For example,

// Obtain an array of User object where the user's nickname
starts with "Ani"
```

```
User[] userArr = sub.getUsers(ctx, Util.IDTYPE_SIMPLE,
"Ani", null);
// Do work with the User array
```

Retrieving Objects from Realms

This section describes how the Java API can be used to retrieve objects in identity management realms.

The `RootOracleContext` class represents the root Oracle Context. Much of the information needed for identity management realm creation is stored within the root Oracle Context. The `RootOracleContext` class offers the `getSubscriber()` method. It replaces the public constructors of the subscriber class and returns an identity management realm object based on the specified information.

The following is a piece of sample code demonstrating the usage:

```
// DirContext ctx contains a valid directory
// connection with sufficient privilege to perform the
// operations

// Creating RootOracleContext object
RootOracleContext roc = new RootOracleContext(ctx);

// Obtain a Subscriber object representing the
// Subscriber with simple name "Oracle"
Subscriber sub = roc.getSubscriber(ctx,
Util.IDTYPE_SIMPLE, "Oracle", null);

// Do work with the Subscriber object
```

Example: Search for OracleAS Single Sign-On Login Name

The following example shows how to find a user's login name when you have the simple name, GUID, or DN. The Oracle Application Server Single Sign-On login name is also referred to as nickname.

There are two parts to this example:

1. Determine which attribute is used to store the nickname in this realm.
2. Retrieve the User object and determine the value of the nickname attribute.

```
import javax.naming.*;
import javax.naming.directory.*;
import javax.naming.ldap.*;
import oracle.ldap.util.jndi.*;
import oracle.ldap.util.*;
import java.io.*;

public class NickNameSearch {

   public static void main(String[] args)
      throws Exception
   {
      InitialLdapContext ctx = ConnectionUtil.getDefaultDirCtx( args[0],
                                    args[1], args[2],args[3]);

      RootOracleContext roc=new RootOracleContext(ctx);
      Subscriber sub = null;
      sub = roc.getSubscriber(ctx, Util.IDTYPE_DEFAULT, null, null) ;
```

```
      PropertySetCollection psc = sub.getProperties(ctx,
                                  Subscriber.USER_NAMING_PROPERTIES, null);

      String nickNameAttribute = null;
      try
      {
          nickNameAttribute = (String)
psc.getPropertySet(0).getProperty(Subscriber.USER_NAMING_ATTR_SIMPLE).getValue(0);
      }
      catch (Exception e)
      {
         // unable to retrieve the attribute name
         System.exit(0);
      }
      System.out.println("Nickname attribute: " + nickNameAttribute);

      // Retrieve user using simple name, guid or DN
      User user = sub.getUser(ctx, Util.IDTYPE_SIMPLE,"orcladmin", null);
      System.out.println("user DN: " + user.getDN(ctx));

      // Retrieve nickname value using User object
      psc = user.getProperties(ctx, new String[]{ nickNameAttribute });

      String nickName = null;
      try
      {
          nickName = (String)
psc.getPropertySet(0).getProperty(nickNameAttribute).getValue(0);
      }
      catch (Exception e)
      {
         // unable to retrieve the attribute value
         System.exit(0);
      }
      System.out.println("Nickname : " + nickName);
   }
}
```

Discovering a Directory Server

A new Java class, the public class, has been introduced:

```
public class oracle.ldap.util.discovery.DiscoveryHelper
```

This class provides a method for discovering specific information from the specified source.

Table 5–1 Methods for Directory Server Discovery

Method	Description
`discover`	Discovers the specific information from a given source
`setProperty`	Sets the properties required for discovery
`getProperty`	Accesses the value of properties

Two new methods are added to the existing Java class `oracle.ldap.util.jndi.ConnectionUtil`:

- `getDefaultDirCtx`: This overloaded function determines the host name and port information of non-SSL ldap servers by making an internal call to `oracle.ldap.util.discovery.DiscoveryHelper.discover()`.
- `getSSLDirCtx`: This overloaded function determines the host name and port information of SSL ldap servers by making an internal call to `oracle.ldap.util.discovery.DiscoveryHelper.discover()`.

Example: Discovering a Directory Server

The following is a sample Java program for directory server discovery:

```
import java.util.*;
import java.lang.*;
import oracle.ldap.util.discovery.*;
import oracle.ldap.util.jndi.*;

public class dsdtest
{
  public static void main(String s[]) throws Exception
  {
    HashMap reshdl = new HashMap();
    String result = new String();
    Object resultObj = new Object();
    DiscoveryHelper disco = new
DiscoveryHelper(DiscoveryHelper.DNS_DISCOVER);

// Set the property for the DNS_DN
disco.setProperty(DiscoveryHelper.DNS_DN,"dc=us,dc=fiction,dc=com")
;

// Set the property for the DNS_DISCOVER_METHOD
disco.setProperty(DiscoveryHelper.DNS_DISCOVER_METHOD,
   DiscoveryHelper.USE_INPUT_DN_METHOD);

// Set the property for the SSLMODE
disco.setProperty(DiscoveryHelper.SSLMODE,"0");

// Call the discover method
int res=disco.discover(reshdl);
if (res!=0)
   System.out.println("Error Code returned by the discover method is :"+res) ;

// Print the results
printReshdl(reshdl);
}

public static void printReshdl(HashMap reshdl)
{
  ArrayList result = (ArrayList)reshdl.get(DiscoveryHelper.DIR_SERVERS);

if (result != null)
{
  if (result.size() == 0) return;
  System.out.println("The hostnames are :-");
  for (int i = 0; i< result.size();i++)
  {
      String host = (String)result.get(i);
      System.out.println((i+1)+".
'"+host+"'");
```

```
      }
    }
  }
}
```

Using DIGEST-MD5 to Perform SASL Authentication

When using JNDI to create a SASL connection, you must set these `javax.naming.Context` properties:

- `Context.SECURITY_AUTHENTICATION = "DIGEST-MD5"`
- `Context.SECURITY_PRINCIPAL`

The latter sets the principal name. This name is a server-specific format. It can be either of the following:

- The DN—that is, `dn:`—followed by the fully qualified DN of the entity being authenticated
- The string `u:` followed by the user identifier.

  The Oracle directory server accepts just a fully qualified DN such as `cn=user,ou=my department,o=my company`.

> **Note:** The SASL DN must be normalized before it is passed to the API that calls the SASL bind. To generate SASL verifiers, Oracle Internet Directory supports only normalized DNs.

Example: Using SASL Digest-MD5 auth-int and auth-conf Modes

The following code provides an example of Java LDAP/JNDI using SASL Digest-MD5.

```
/* $Header: LdapSasl.java 27-oct-2005.11:26:59 qdinh Exp $ */

/* Copyright (c) 2003, 2005, Oracle. All rights reserved.  */

/*
  DESCRIPTION
   <short description of component this file declares/defines>

  PRIVATE CLASSES
   <list of private classes defined - with one-line descriptions>

  NOTES
   <other useful comments, qualifications, and so on.>

  MODIFIED    (MM/DD/YY)
   qdinh       04/23/03 - Creation
*/

/**
*  @version $Header: LdapSasl.java 27-oct-2005.11:26:59 qdinh Exp $
*  @author  qdinh   *  @since   release specific (what release of product did this
appear in)
*/

package oracle.ldap.util.jndi;
```

```
import javax.naming.*;
import javax.naming.directory.*;
import javax.naming.ldap.*;
import oracle.ldap.util.jndi.*;
import oracle.ldap.util.*;
import java.lang.*;
import java.util.*;
public class LdapSasl
{
   public static void main( String[] args)
       throws Exception
   {

    int numofargs;

    numofargs = args.length;

    Hashtable hashtable = new Hashtable();

    // Look through System Properties for Context Factory if it is available
    // then set the CONTEXT factory only if it has not been set
    // in the environment -
    // set default to com.sun.jndi.ldap.LdapCtxFactory

    hashtable.put(Context.INITIAL_CONTEXT_FACTORY,
          "com.sun.jndi.ldap.LdapCtxFactory");
    // possible valid arguments
    // args[0] - hostname
    // args[1] - port number
    // args[2] - Entry DN
    // args[3] - Entry Password
    // args[4] - QoP [ auth | auth-int | auth-conf ]
    // args[5] - SASL Realm
    // args[6] - Cipher Choice
    //    If QoP == "auth-conf" then args[6] cipher choice can be
    //     - des
    //     - 3des
    //     - rc4
    //     - rc4-56
    //     - rc4-40

    hashtable.put(Context.PROVIDER_URL, "ldap://"+args[0]+":"+args[1]);
        hashtable.put(Context.SECURITY_AUTHENTICATION, "DIGEST-MD5");
    System.out.println("hash put security dn: " + args[2]);
    hashtable.put(Context.SECURITY_PRINCIPAL, args[2] );
    hashtable.put(Context.SECURITY_CREDENTIALS, args[3] );

    // For Quality of Protection modes
    // 1. Authentication and Data Integrity Mode - "auth-int"
    // 2. Authentication and Data Confidentiality Mode  "auth-conf"

    //
    // hashtable.put("javax.security.sasl.qop",args[4]);
    hashtable.put("javax.naming.security.sasl.realm", args[5]);

    // Setup Quality of Protection
    //
    // System.out.println("hash sasl.qop: " + args[4]);

    hashtable.put("javax.security.sasl.qop",args[4]);
```

```
    if (numofargs > 4)
    {
    if (args[4].equalsIgnoreCase("AUTH-CONF"))
    {

        //  Setup a cipher choice only if QoP == "auth-conf"
        String strength = "high";
        String cipher = new String(args[6]);
                if (cipher.compareToIgnoreCase("rc4-40") == 0)
        strength = "low";
        else if (cipher.compareToIgnoreCase("rc4-56") == 0 ||
             cipher.compareToIgnoreCase("des")== 0 )
        strength = "medium";
        else if (cipher.compareToIgnoreCase("3des") == 0 ||
             cipher.compareToIgnoreCase("rc4") == 0)
        strength = "high";

        // setup cipher choice
        System.out.println("hash sasl.strength:"+strength);
        hashtable.put("javax.security.sasl.strength",strength);
    }

    // set maxbuffer length if necessary
    if (numofargs > 7 && !"".equals(args[6]))
        hashtable.put("javax.security.sasl.maxbuf", args[5].toString());
    }


    // Enable Debug --
    // hashtable.put("com.sun.jndi.ldap.trace.ber", System.err);

    LdapContext ctx = new InitialLdapContext(hashtable,null);


    // At this stage - SASL Digest -MD5 has been successfully

    System.out.println("sasl bind successful");

    // Ldap Search Scope Options
    //
    // - Search base - OBJECT_SCOPE
    // - One Level   - ONELEVEL_SCOPE
    // - Sub Tree    - SUBTREE_SCOPE
    //
        // Doing an LDAP Search
    PropertySetCollection psc =
Util.ldapSearch(ctx,"o=oracle,dc=com","objectclass=*",SearchControls.OBJECT_SCOPE,
                           new String[] {"*"});
      // Print out the serach result
    Util.printResults(psc);

    System.exit(0);

 }                                                              }
```

6

Using the API Extensions in PL/SQL

This chapter explains how to use PL/SQL extensions to the standard directory APIs to manage and authenticate users. Note that the Oracle extensions do not include PL/SQL APIs that create users. The Oracle extensions to the standard APIs are documented in full in Chapter 17.

This chapter contains these topics:

- Sample Code
- Installing the PL/SQL Extensions
- Using Handles to Access Directory Data
- Managing Users
- Authenticating Users
- Dependencies and Limitations of the PL/SQL LDAP API

Sample Code

Sample code is available at this URL:

`http://www.oracle.com/technology/sample_code/`

Look for the Oracle Identity Management link under Sample Applications–Oracle Application Server.

Installing the PL/SQL Extensions

The PL/SQL extensions are installed with the `DBMS_LDAP` package when the Oracle database is installed. You must run the script `$ORACLE_HOME/rdbms/admin/catldap.sql`.

Using Handles to Access Directory Data

Most of the extensions described in this chapter are helper functions. They access data about specific LDAP entities such as users, groups, realms, and applications. In many cases, these functions must pass a reference to one of these entities to the standard API functions. To do this, the API extensions use opaque data structures called handles. The steps that follow show an extension creating a user handle:

1. Establish an LDAP connection or get one from a pool of connections.
2. Create a user handle from user input. This could be a DN, a GUID, or a single sign-on user ID.

3. Authenticate the user with the LDAP connection handle, user handle, or credentials.
4. Free the user handle.
5. Close the LDAP connection, or return the connection back to the connection pool.

Managing Users

The steps that follow show how the `DBMS_LDAP_UTL` package is used to create and use a handle that retrieves user properties from the directory.

1. Invoke `DBMS_LDAP_UTL.create_user_handle(user_hd, user_type, user_id)` to create a user handle from user input. The input can be a DN, a GUID, or a single sign-on user ID.
2. Invoke `DBMS_LDAP_UTL.set_user_handle_properties(user_hd, property_type, property)` to associate a realm with the user handle.
3. Invoke `DBMS_LDAP_UTL.get_user_properties(ld, user_handle, attrs, ptype, ret_pset_coll)` to place the attributes of a user entry into a result handle.
4. Invoke `DBMS_LDAP_UTL.get_property_names(pset, property_names)` and `DBMS_LDAP_UTL.get_property_values(pset, property_name, property_values)` to extract user attributes from the result handle that you obtained in step 3.

Authenticating Users

Use `DBMS_LDAP_UTL.authenticate_user(session, user_handle, auth_type, cred, binary_cred)` to authenticate a user to the directory. This function compares the password provided by the user with the password attribute in the user's directory entry.

Dependencies and Limitations of the PL/SQL LDAP API

The PL/SQL LDAP API for this release has the following limitations:

- The LDAP session handles obtained from the API are valid only for the duration of the database session. The LDAP session handles cannot be written to a table and reused in other database sessions.
- Only synchronous versions of LDAP API functions are supported in this release.

  The PL/SQL LDAP API requires a database connection to work. It cannot be used in client-side PL/SQL engines (like Oracle Forms) without a valid database connection.

7

Developing Provisioning-Integrated Applications

As of 10*g* (10.1.4.0.1), new APIs are available for developing provisioning-integrated applications. Please refer to:

- The Oracle Provisioning Service Concepts chapter in *Oracle Identity Management Integration Guide*
- The Deploying Provisioning-Integrated Applications chapter in *Oracle Identity Management Integration Guide*

8

Integrating with Oracle Delegated Administration Services

This chapter explains how to integrate applications with Oracle Delegated Administration Services. This Web tool enables you to more easily develop tools for administering application data in the directory.

It contains the following sections:

- What Is Oracle Delegated Administration Services?
- Integrating Applications with the Delegated Administration Services
- Java APIs Used to Access URLs

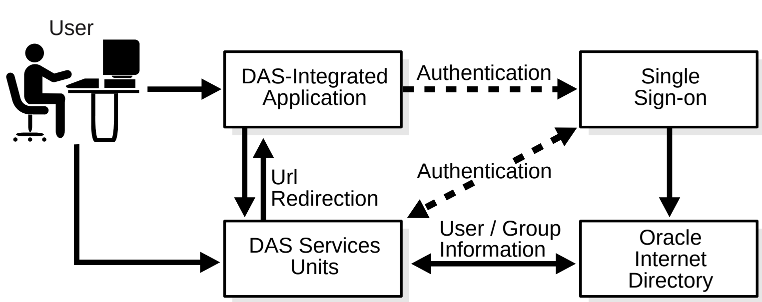
What Is Oracle Delegated Administration Services?

Oracle Delegated Administration Services consists of a set of pre-defined, Web-based service units for performing directory operations on behalf of users. These units enable directory users to update their own information.

The delegated administration services provide most of the functionality that directory-enabled applications require. You can use the service units to create user and group entries, search for entries, and change user passwords.

You can embed delegated administration service units in your applications. If, for example, you are building a Web portal, you can add service units that enable users to change application passwords stored in the directory. Each service unit has a corresponding URL stored in the directory. At runtime, an application can find the URL by querying the directory.

Figure 8–1 Overview of Delegated Administration Services



How Applications Benefit from Oracle Delegated Administration Services

An application based on Oracle Delegated Administration Services is more advanced than one based on earlier types of APIs. First, an application developed using the service units is language independent because the units are Web based. This means that the application can handle input and requests from any type of user or application, eliminating the need for a costly custom solution or configuration. Second, Oracle Delegated Administration Services comes with the Oracle Internet Directory Self-Service Console, a GUI development tool that automates many of the directory-oriented application requirements (such as Create, Edit, and Delete). Third, Oracle Delegated Administration Services is integrated with Oracle Application Server Single Sign-On. The application is automatically authenticated by the single sign-on server. This means that the application can query the directory on a user's behalf.

Integrating Applications with the Delegated Administration Services

This section contains these topics:

- Integration Profile
- Integration Methodology and Considerations

Integration Profile

An application integrated with Oracle Delegated Administration Services has the following characteristics:

- It is a Web-based GUI.
- It is integrated with Oracle Application Server Single Sign-On through mod_osso.
- It has operations that it must perform by way of a signed-on user. It can perform these operations using Oracle Delegated Administration Services.
- It has users or groups stored in Oracle Internet Directory and can use Oracle Delegated Administration Services for user and group management.
- It runs on the Oracle Application Server infrastructure or middle-tier. The discovery mechanism for the service URLs is inaccessible otherwise.

Integration Methodology and Considerations

Table 8–1 on page 8-2 identifies the tasks that are required to integrate an application with Oracle Delegated Administration Services.

Table 8–1 Integration Considerations

Point in Application Lifecycle	Considerations
Application design time	Examine the various services that Oracle Delegated Administration Services provides. Identify integration points within the application GUI. Make code changes to pass parameters to the Oracle Delegated Administration Services self-service units and to process return parameters from Oracle Delegated Administration Services. Introduce code in the bootstrap and installation logic to dynamically discover the location of Oracle Delegated Administration Services units from configuration information in Oracle Internet Directory. To do this, use Oracle Internet Directory Service Discovery APIs.

Table 8–1 (Cont.) Integration Considerations

Point in Application Lifecycle	Considerations
Application installation time	Determine the location of Oracle Delegated Administration Services units and store them in local repository.
Application runtime	Display Oracle Delegated Administration Services URLs in application GUI shown to users. Pass the appropriate parameters to the Oracle Delegated Administration Services by using URL encoding. Process return codes from Oracle Delegated Administration Services through the URL return.
Ongoing administrative activities	Provide the capability to refresh the location of Oracle Delegated Administration Services and its URLs in the administrator screens. Do this in case the deployment moves the location of Oracle Delegated Administration Services after the application has been installed.

Use Case 1: Create User

This use case shows how to integrate the Create User unit with a custom application. In the custom application page, Create User is shown as a link.

1. Identify the base URL for Oracle Delegated Administration Services by using this Java API string:

   ```
   baseUrl = Util.getDASUrl(ctx,DASURL_BASE)
   ```

   This API returns the base URL in this form: `http://`*`host_name`*`:`*`port/`*

2. Get the URL for the `Create User` unit by using this string:

   ```
   relUrl = Util.getDASUrl ( ctx , DASURL_CREATE_USER )
   ```

   The return value is the relative URL to access the Create User unit.

   The specific URL is the information needed to generate the link dynamically for the application.

   You can customize the parameters in Table 8–2 on page 8-3 for this unit.

Table 8–2 URL Parameters for Oracle Delegated Administration Services

Parameter	Description
`homeURL`	The URL that is linked to the global button **Home** in the Oracle Delegated Administration Services unit. When the calling application specifies this value, you can click **Home** to redirect the Oracle Delegated Administration Services unit to the URL specified by this parameter.
`doneURL`	This URL is used by Oracle Delegated Administration Services to redirect the Oracle Delegated Administration Services page at the end of each operation. In the case of Create User, once the user is created, clicking **OK** redirects the URL to this location.
`cancelURL`	This URL is linked with all the **Cancel** buttons shown in Oracle Delegated Administration Services units. Any time the user clicks Cancel, the page is redirected to the URL specified by this parameter.
`enablePA`	This parameter takes a Boolean value of true or false. This will enable the **Assign Privileges** section in a User or Group operation. If `enablePA` is passed with value of true in the Create User page, then the **Assign Privileges to User** section will also appear on the Create User Page.

3. Build the link with the parameters set to the following values:

```
baseUrl = http://acme.mydomain.com:7777/
relUrl =  oiddas/ui/oracle/ldap/das/admin/AppCreateUserInfoAdmin
homeURL = http://acme.mydomain.com/myapp
cancelURL = http://acme.mydomain.com/myapp
doneURL = http://acme.mydomain.com/myapp
enablePA = true
```

   The complete URL looks like this:

```
http://acme.mydomain.com:7777/oiddas/ui/oracle/ldap/das/admin/
AppCreateUserInfoAdmin?homeURL=http://acme.mydomain.com/myapp&
cancelURL=http://acme.mydomain.com/myapp&
doneURL=http://acme.mydomain.com/myapp&
enablePA=true
```

4. You can now embed this URL in the application.

Use Case 2: User LOV

List of Values (LOV) is implemented using JavaScript to invoke and pass values between the LOV calling window and the LOV page. The application invoking the LOV needs to open a popup window using JavaScript. Because Java scripts have security restrictions, no data may cross domains. Due to this limitation, only pages in the same domain can access the LOV units.

Base and relative URLs can be invoked the same way as they are for Create User. Sample files are located at:

```
$ORACLE_HOME/ldap/das/samples/lov
```

The samples illustrate how the LOV can be invoked and data can be passed between the calling application and the Oracle Delegated Administration Services unit. A Complete illustration of the LOV invocation is beyond the scope of this chapter.

Java APIs Used to Access URLs

Java APIs can be used to discover URLs for Oracle Delegated Administration Services. More details about these APIs are provided in Chapter 4, "Developing Applications With Oracle Extensions to the Standard APIs" and in Chapter 18, "DAS_URL Interface Reference". The API functions that address URL discovery are `getDASUrl(DirContext ctx, String urlTypeDN)` and `getAllDASUrl(DirContext ctx)`.

9

Developing Applications for Single Sign-On

This chapter explains how to develop applications to work with mod_osso. The chapter contains the following topics:

What Is mod_osso?

In OracleAS release 10.1.2, you use mod_osso, an authentication module on the Oracle HTTP Server, to enable applications for single sign-on. mod_osso is a simple alternative to the single sign-on SDK, used in earlier releases to integrate partner applications. mod_osso simplifies the authentication process by serving as the sole partner application to the single sign-on server. By doing so, it renders authentication transparent for OracleAS applications.

After authenticating users, mod_osso transmits the simple header values that applications need to validate them. These include the following:

- User name
- User GUID
- Language and territory

Table 9–1 lists all of the user attributes that mod_osso passes to applications. The table also recommends attributes to use as keys, or handles, to retrieve additional user attributes from Oracle Internet Directory.

Table 9–1 User Attributes Passed to Partner Applications

HTTP Header Name	Description	Source	Use as Key or Handle?
`Osso-User-Guid`	Single sign-on user's globally unique user ID (GUID).	Single sign-on user's globally unique user ID (GUID).	Recommended.
`Osso-Subscriber-Guid`	Realm GUID.	Realm entry in Oracle Internet Directory.	Recommended.

Table 9–1 (Cont.) User Attributes Passed to Partner Applications

HTTP Header Name	Description	Source	Use as Key or Handle?
`Remote-User`	User nickname as entered by user on the login page.	Single sign-on login page.	Recommended for pre-9.0.4 applications only.
`Osso-Subscriber`	User-friendly name for a realm.	Realm entry in Oracle Internet Directory.	Not recommended. Use GUID headers to perform user searches in Oracle Internet Directory.
`Accept-Language`	Language and territory in ISO format.	Single sign-on server.	Not applicable.

mod_osso interoperates only with the Oracle HTTP listener. You can use OracleAS SSO Plug-in to protect applications that work with third-party listeners such as Sun One and IIS. To learn how to use OracleAS SSO Plug-in, see the appendix about this tool in *Oracle HTTP Server Administrator's Guide*.

Protecting Applications Using mod_osso: Two Methods

mod_osso redirects the user to the single sign-on server only if the URL you request is configured to be protected. You can secure URLs in one of two ways: statically or dynamically. Static directives simply protect the application, ceding control over user interaction to mod_osso. Dynamic directives not only protect the application, they also enable it to regulate user access.

This section contains the following topics:

- Protecting URLs Statically
- Protecting URLs with Dynamic Directives

Protecting URLs Statically

You can statically protect URLs with mod_osso by applying directives to the `mod_osso.conf` file. This file is found at `$ORACLE_HOME/Apache/Apache/conf`. In the example that follows, a directory named `/private`, located just below the Oracle HTTP Server document root, is protected by this directive:

```
<IfModule mod_osso.c>

  <Location /private>
    AuthType Basic
    require valid-user
  </Location>

</IfModule>
```

After making the entry, restart the Oracle HTTP Server:

```
$ORACLE_HOME/opmn/bin/opmnctl restartproc type=ohs
```

Finally, populate the directory with pages and then test them. For example:

```
http://host:port/private/helloworld.html
```

Protecting URLs with Dynamic Directives

Dynamic directives are HTTP response headers that have special error codes that enable an application to request granular functionality from the single sign-on system without having to implement the intricacies of the single sign-on protocol. Upon receiving a directive as part of a simple HTTP response from the application, mod_osso creates the appropriate single sign-on protocol message and communicates it to the single sign-on server.

OracleAS supports dynamic directives for Java servlets and JSPs. The product does not currently support dynamic directives for PL/SQL applications.

Table 9–2 lists commonly requested dynamic directives.

Table 9–2 Commonly Requested Dynamic Directives

Directive	Status Code	Headers
Request Authentication	401, 499	-
Request Forced Authentication	499	`Osso-Paranoid: true`
Single Sign-Off	470	`Osso-Return-URL` This is the URL to return to after single sign-off is complete

Developing Applications Using mod_osso

This section explains how to write and enable applications using mod_osso. The section contains the following topics:

- Developing Statically Protected PL/SQL Applications
- Developing Statically Protected Java Applications
- Developing Java Applications That Use Dynamic Directives
- A Word About Non-GET Authentication

Developing Statically Protected PL/SQL Applications

What follows is an example of a simple mod_osso-protected application. This application logs the user in to the single sign-on server, displays user information, and then logs the user out of both the application and the single sign-on server.

Use the following steps to write and enable a PL/SQL application using mod_osso.

1. Create the schema where application procedure will be loaded.

```
sqlplus sys/sys_password as sysdba
create user schema_name identified by schema_password;
grant connect,  resource to schema_name;
```

2. Load the following procedure into the schema and grant the public access to the procedure:

```
create or replace procedure show_user_info
 is
 begin
    begin
        htp.init;
     exception
         when others then null;
     end;
     htp.htmlOpen;
     htp.bodyOpen;
     htp.print('<h2>Welcome to Oracle Single Sign-On</h2>');
```

```
     htp.print('<pre>');
     htp.print('Remote user:'
        || owa_util.get_cgi_env('REMOTE_USER'));
     htp.print('User DN:'
        || owa_util.get_cgi_env('Osso-User-Dn'));
     htp.print('User Guid:'
        || owa_util.get_cgi_env('Osso-User-Guid'));
     htp.print('Subscriber:'
        || owa_util.get_cgi_env('Osso-Subscriber'));
     htp.print('Subscriber DN:'
        || owa_util.get_cgi_env('Osso-Subscriber-Dn'));
     htp.print('Subscriber Guid:'
        || owa_util.get_cgi_env('Osso-Subscriber-Guid'));
     htp.print('</pre>');
     htp.print('<a href=/osso_logout?'
        ||'p_done_url=http://my.oracle.com>Logout</a>');

     htp.bodyClose;
     htp.htmlClose;
end show_user_info;
/
show errors;

grant execute on show_user_info to public;
```

3. Create a database access descriptor (DAD) for the application in the `dads.conf` file, located at `$ORACLE_HOME/Apache/modplsql/conf`:

```
<Location /pls/DAD_name>
       SetHandler pls_handler
       Order deny,allow
       AllowOverride None
       PlsqlDatabaseConnectString    hostname:port:SID
       PlsqlDatabasePassword         schema_password
       PlsqlDatabaseUsername         schema_name
       PlsqlDefaultPage              schema_name.show_user_info
       PlsqlDocumentTablename        schema_name.wwdoc_document
       PlsqlDocumentPath             docs
       PlsqlDocumentProcedure        schema_name.wwdoc_process.process_
                                     download
       PlsqlAuthenticationMode       Basic
       PlsqlPathAlias                url
       PlsqlPathAliasProcedure       schema_name.wwpth_api_alias.process_
                                     download
       PlsqlSessionCookieName        schema_name
       PlsqlCGIEnvironmentList       OSSO-USER-DN
       PlsqlCGIEnvironmentList       OSSO-USER-GUID
       PlsqlCGIEnvironmentList       OSSO-SUBSCRIBER
       PlsqlCGIEnvironmentList       OSSO-SUBSCRIBER-DN
       PlsqlCGIEnvironmentList       OSSO-SUBSCRIBER-GUID
</Location>
```

4. Protect the application DAD by entering the following lines in the `mod_osso.conf` file:

```
<Location /pls/DAD_name>
  require valid-user
  authType Basic
</Location>
```

Note: The assumption here is that mod_osso is already configured for single sign-on. This step is performed when OracleAS is installed.

5. Restart the Oracle HTTP Server:

   http://*host*:*port*/private/helloworld.html

6. To test whether the newly created functions and procedures are protected by mod_osso, try to access them from a browser:

   http://*host*:*port*/pls/DAD/schema_name.show_user_info

   Selecting the URL should invoke the single sign-on login page if `mod_osso.conf` has been configured properly and mod_osso is registered with the single sign-on server.

Developing Statically Protected Java Applications

Use the following steps to write and enable a servlet or JSP application using mod_osso:

1. Write the JSP or servlet. Like the PL/SQL application example immediately preceding, the simple servlet that follows logs the user in, displays user information, and then logs the user out.

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

/**
 * Example servlet showing how to get the SSO User information
 */

public class SSOProtected extends HttpServlet
{

    public void service(HttpServletRequest request,
         HttpServletResponse response)
        throws IOException, ServletException
    {
        response.setContentType("text/html");

        // Show authenticated user informationsingle sign-on
        PrintWriter out = response.getWriter();
        out.println("<h2>Welcome to Oracle Single Sign-On</h2>");
        out.println("<pre>");
        out.println("Remote user: "
            + request.getRemoteUser());
        out.println("Osso-User-Dn: "
            +  request.getHeader("Osso-User-Dn"));
        out.println("Osso-User-Guid: "
            +  request.getHeader("Osso-User-Guid"));
        out.println("Osso-Subscriber: "
            +  request.getHeader("Osso-Subscriber"));
        out.println("Osso-User-Dn: "
            +  request.getHeader("Osso-User-Dn"));
        out.println("Osso-Subscriber-Dn: "
            +  request.getHeader("Osso-Subscriber-Dn"));
        out.println("Osso-Subscriber-Guid: "
```

```
        +  request.getHeader("Osso-Subscriber-Guid"));
    out.println("Lang/Territory: "
        + request.getHeader("Accept-Language"));
    out.println("</pre>");
    out.println("<a href=/osso_logout?"
        +"p_done_url=http://my.oracle.com>Logout</a>");
```

2. Protect the servlet by entering the following lines in the `mod_osso.conf` file:

   ```
   <Location /servlet>
      require valid-user
      authType Basic
   </Location>
   ```

3. Deploy the servlet. If you need help, see the overview chapter in *Oracle Containers for J2EE Servlet Developer's Guide*. This chapter provides an example of a servlet and shows how to deploy it.

4. Restart the Oracle HTTP Server and OC4J:

   ```
   $ORACLE_HOME/opmn/bin/opmnctl restartproc type=ohs
   $ORACLE_HOME/opmn/bin/opmnctl stopproc type=oc4j
   $ORACLE_HOME/opmn/bin/opmnctl startproc type=oc4j
   ```

5. Test the servlet by trying to access it from the browser. Selecting the URL should invoke the login page.

   The process is this: when you try to access the servlet from the browser, you are redirected to the single sign-on server for authentication. Next you are redirected back to the servlet, which displays user information. You may then select the logout link to log out of the application as well as the single sign-on server.

Developing Java Applications That Use Dynamic Directives

Applications that use dynamic directives require no entry in `mod_osso.conf` because mod_osso protection is written directly into the application as one or more dynamic directives. The servlets that follow show how such directives are incorporated. Like their "static" counterparts, these sample "dynamic" applications generate user information.

This section covers the following topics:

- Java Example #1: Simple Authentication
- Java Example #2: Single Sign-Off

Java Example #1: Simple Authentication

This servlet uses the `request.getRemoteUser()` method to check the mod_osso cookie for the user name. If the user name is absent, the servlet issues dynamic directive `499`, a request for simple authentication. The key lines are in boldface.

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

/**
 * Example servlet showing how to use
 * Dynamic Directive for login
 */

public class SSODynLogin extends HttpServlet
```

```
{

    public void service(HttpServletRequest request,
         HttpServletResponse response)
        throws IOException, ServletException
    {
        String l_user     = null;

        // Try to get the authenticate user name
        try
        {
            l_user = request.getRemoteUser();
        }
        catch(Exception e)
        {
            l_user = null;
        }

        // If user is not authenticated then generate
        // dynamic directive for authentication
        if((l_user == null) || (l_user.length() <= 0) )
        {
           response.sendError(499, "Oracle SSO");
        }
        else
        {
            // Show authenticated user information
            response.setContentType("text/html");
            PrintWriter out = response.getWriter();
            out.println("<h2>Welcome to Oracle Single Sign-On</h2>");
            out.println("<pre>");
            out.println("Remote user: "
                + request.getRemoteUser());
            out.println("Osso-User-Dn: "
                +  request.getHeader("Osso-User-Dn"));
            out.println("Osso-User-Guid: "
                +  request.getHeader("Osso-User-Guid"));
            out.println("Osso-Subscriber: "
                +  request.getHeader("Osso-Subscriber"));
            out.println("Osso-User-Dn: "
                +  request.getHeader("Osso-User-Dn"));
            out.println("Osso-Subscriber-Dn: "
                +  request.getHeader("Osso-Subscriber-Dn"));
            out.println("Osso-Subscriber-Guid: "
                +  request.getHeader("Osso-Subscriber-Guid"));
            out.println("Lang/Territory: "
                + request.getHeader("Accept-Language"));
            out.println("</pre>");
        }
    }
```

Note: If Oracle JAAS Provider is used, the directive code `401` may be substituted for `499`.

Java Example #2: Single Sign-Off

This servlet is invoked when users select the login link within an application. The application sets the URL to return to when sign-off is complete; then it issues a directive that sends users to the single sign-off page. The key lines are in boldface.

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

/**
 * Example servlet showing how to use
 * Dynamic Directive for logout
 */

public class SSODynLogout extends HttpServlet
{
    public void service (HttpServletRequest request,
         HttpServletResponse response)
        throws ServletException, IOException
    {
        // Set the return URL
        response.setHeader("Osso-Return-Url",
               "http://my.oracle.com" );
        // Send Dynamic Directive for logout
        response.sendError(470, "Oracle SSO");
    }
}
```

Note: Alternatively, you can redirect to the `osso_logout` URL on that computer.

A Word About Non-GET Authentication

The first page of a mod_osso-protected application must be a URL that uses the GET authentication method. If the POST method is used, the data that the user provides when logging in is lost during redirection to the single sign-on server. When deciding whether to enable the global user inactivity timeout, please note that users are redirected after timing out and logging in again.

Global Inactivity Timeout and Dynamic Directives

If you are using Global Inactivity Timeout and Dynamic Directive for enabling Single Sign-On for your applications, then you can use the `Osso-Idle-Timeout-Exceeded` HTTP header in your application to determine the timeout status. This header value is set to `true` if timeout has occurred, otherwise it is set to `false`.

The following example shows how you can use the `Osso-Idle-Timeout-Exceeded` HTTP header:

```
// Get the timeout status
String timeoutStatus = request.getHeader("Osso-Idle-Timeout-Exceeded")
// Check if user has timedout
if ( (timeoutStatus != null) && timeoutStatus.equalsIgnoreCase("true") )
{
   response.setHeader( "Osso-Paranoid", "true" );
   response.sendError(499, "Oracle SSO");
}
else
{
  // Display page content here
}
```

Security Issues

This section describes security considerations when developing applications for OracleAS Single Sign-On. It contains these topics:

- Single Sign-Off and Application Logout
- Secure Transmission of mod_osso Cookies

Single Sign-Off and Application Logout

If you build custom applications using OracleAS, note the following: when global logout, or single sign-off, is invoked, only the single sign-on and mod_osso cookies are cleared. This means that an OracleAS application must be coded to store single sign-on user and realm names in either the OC4J session or in the application session. The application must then compare these values to those passed by mod_osso. If a match occurs, the application must show personalized content. If no match occurs, which means that the mod_osso cookie is absent, the application must clear the application session and force the user to log in.

This section covers the following topics:

- Application Login: Code Examples
- Application Logout: Recommended Code

Application Login: Code Examples

The first two code examples in this section do not incorporate the logic prescribed in the section immediately preceding. The third example does incorporate this logic. Although these are Java examples, they could be examples written in other languages such as Perl, PL/SQL, and CGI.

Bad Code Example #1

```
// Get user name from application session. This session was
// established by the application cookie or OC4J session cookie
String username = request.getSession().getAttribute('USER_NAME');

// Get subscriber name from application session. This session was
// established by the application cookie or OC4J session cookie.
String subscriber = request.getSession().getAttribute('SUBSCRIBER_NAME');

// Get user security information from application session. This session was
established  by the application cookie or OC4J session cookie
String user_sec_info = request.getSession().getAttribute('USER_APP_SEC');

if((username != null) && (subscriber!= null))
{
  // Show personalized user content
  show_personalized_page(username, subscriber, user_sec_info);
}
else
{
  // Send Dynamic Directive for login
  response.sendError( 499, "Oracle SSO" );
```

Bad Code Example #2

```
// Get SSO username from http header
String username = request.getRemoteUser();
```

```
// Get subscriber name from SSO http header
String subscriber = request.getHeader('OSSO-SUBSCRIBER');

// Get user security information from application session.
// This session was established by the application or OC4J session.
String user_sec_info =request.getSession().getAttribute('USER_APP_SEC');

if((ssousername != null)&&(subscriber!= null))
{
  // Show personalized user content
show_personalized_page(username, subscriber, user_sec_info);
}
else
{
  // Send Dynamic Directive for login
response.sendError( 499, "Oracle SSO" );
}
```

Recommended Code

```
// Get user name from application session. This session was
// established by the application or OC4J session
String username = request.getSession().getAttribute('USER_NAME');

// Get subscriber name from application session. This session was
// established by the application or OC4J session
String subscriber = request.getSession().getAttribute('SUBSCRIBER_NAME');

// Get user security information from application session.
 // This session was established by the application or OC4J session.
String user_sec_info = request.getSession().getAttribute('USER_APP_SEC');

// Get username and subscriber name from JAZN API */
JAZNUserAdaptor jaznuser  = (JAZNUserAdaptor)requset.getUserPrincipal();
     String ssousername   = jaznuser.getName();
     String ssosubscriber = jaznuser.getRealm().getName();

// If you are not using JAZN api then you can also get the username and
// subscriber name from mod_osso headers
String ssousername   = request.getRemoteUser();
String ssosubscriber = request.getHeader('OSSO-SUBSCRIBER');

// Check for application session. Create it if necessary.
if((username == null) || (subscriber == null) )
  {
   ...Code to create application session. Get the user information from
   JAZN api (or mod_osso headers if you are not using JAZN api) and populate the
   application session with user, subscriber, and user security info.
  }

if((username != null)&&(subscriber != null)
  &&(ssousername != null)&&(ssosubscriber != null)
  &&(username.equalsIgnoreCase(ssousername) == 0 )
  &&(subscriber.equalsIgnoreCase(ssosubscriber) == 0))
{
  // Show personalized user content
show_personalized_page(username, subscriber, user_sec_info);
}
else
{
     ...Code to Wipe-out application session, followed by...
```

```
// Send Dynamic Directive for login
// If you are using JAZN then you should use following code
// response.sendError( 401);

// If you are not using JAZN api then you should use following code
// response.sendError( 499, "Oracle SSO" );
}
```

Application Logout: Recommended Code

Most applications that authenticate users have a logout link. In a single-sign-on-enabled application, the user invokes the dynamic directive for logout in addition to other code in the logout handler of the application. Invoking the logout directive initiates single sign-off, or global logout. The example that follows shows what single sign-off code should look like in Java:

```
// Clear application session, if any
String l_return_url := return url to your application
response.setHeader( "Osso-Return-Url", l_return_url);
response.sendError( 470, "Oracle SSO" );
```

Secure Transmission of mod_osso Cookies

You can add the `OssoSecureCookies` directive to set the `Secure` flag on all cookies created by mod_osso. This tells the browser to only transmit those cookies on connections secured by HTTPS.

An example of this directive, in the mod_osso configuration file located in `$ORACLE_HOME/Apache/Apache/conf/mod_osso.conf`, is as follows:

```
<IfModule mod_osso.c>
    OssoIpCheck off
    OssoIdleTimeout off
    OssoSecureCookies on
    OssoConfigFile osso/osso.conf

    <Location /j2ee/webapp>
        require valid-user
        AuthType Basic
    </Location>

</IfModule>
```

Forced Authentication

Applications protected by Oracle Application Server Single Sign-On have the option to force a user to re-authenticate during application runtime. The Forced Authentication process requires the user to log in to Oracle Single Sign-On, even if the user already has a valid Single Sign-On session. This can be desirable in situations requiring a high level of security, such as transferring money online. Forced Authentication requires Oracle HTTP Server version 10.1.3.1.0 or later and Oracle Application Server Single Sign-On version 9.0.4 or later.

To use this feature, protected applications must keep some user session states in order to verify that the forced authentication process was successful. These applications must record the `Osso-Cookie-Timestamp` request header value (time1) as well as the current time (time2) just before forcing the user to authenticate. After re-authentication, the user accesses the application again. At this time, the application compares the current `Osso-Cookie-Timestamp` request header value (time3) to time1 and time2. The application must ensure that time3 is later than both time1 and time2. If this is not the case, the application must reject the user session and prevent the user from performing any security-sensitive operations.

The value of `Osso-Cookie-Timestamp` is a string which represents the hexadecimal encoding of the calendar time when an OracleAS Single Sign-On session starts. This time value represents the number of seconds elapsed since 00:00:00 on January 1, 1970 (also known as "the Epoch"). The following steps outline the process:

1. Obtain the `Osso-Cookie-Timestamp` value from a valid existing OracleAS Single Sign-On session. Record this as time1.
2. Obtain the current time. Record this as time2.
3. Trigger the forced authentication by setting the `Osso-Paranoid` request header to `true` and then return HTTP status 499 to Oracle HTTP Server.
4. Oracle HTTP Server redirects the user to the OracleAS Single Sign-On server and requires the user to re-authenticate.
5. When the user accesses the protected application, obtain the new `Osso-Cookie-Timestamp` value. This is time3.
6. Application verifies that time3 is later than time1 and time2. The application rejects the user login session if this is not the case.

The following is a code sample of Forced Authentication:

```
//About to execute sensitive security operation.
//user should have already been forced to login.
//verify timestamps
if(!checkForcedAuthSuccess(l_session))
{
   //forced authentication was unsuccessful
   destroyUserSession();
}
else
{
   //successful forced authentication
}
public boolean checkForcedAuthSuccess(HttpSession session
{
   try
   {
   SessionStateObject state = session.getAttribute("SESSION_STATE")

   //get the current cookie timestamp (time3)
   l_currTimestampStr = (String) request.getHeader("Osso-Cookie-Timestamp");

   //convert hex to decimal & get date
   l_decValue = convertHexToDecimal(l_currTimestampStr);
   l_decValue *= 1000;
   l_currTimestampDate = new Date(decValue);

   //time when user was forced to authenticate (time2)
   l_forcedCheckDate = state.getForcedCheckTime();
   //previous mod_osso cookie timestamp (time1)
   l_previousAuthDate = state.getPreviousAuthTimestamp();
   // current auth timestamp needs to be AFTER prevAuthDate
   // current auth timestamp needs to be AFTER forcedCheckDate
```

```
   if((l_currTimestampDate.after(l_previousAuthDate)) &&
      (l_currTimestampDate.after(l_forcedCheckDate)))
   {
      l_ret = true;
   }
   else
   {
      l_ret = false;
   }
}
catch(Exception ex)
   {
   throw new RuntimeException("Unable to check forcedAuth status.", ex);
   }
return l_ret;
}
```

See Also: *Oracle Application Server Single Sign-On Administrator's Guide*

10

Integrating J2EE Applications and Oracle Internet Directory

This chapter is designed to provide a short overview of APIs you can use in J2EE applications to get information about user permissions, groups, and policies from Oracle Internet Directory.

Oracle Containers for J2EE (OC4J) is a J2EE certified server implementation. OC4J supports the standard J2EE security APIs.

In addition to the standard security APIs, OC4J provides a set of security features collectively known as JAZN. JAZN includes the Oracle Application Server Java Authentication and Authorization Service (JAAS) Provider, the JAZN User Manager, the JAAS Policy Management API, and the Realm API. OC4J is fully integrated with Oracle Application Server Single Sign-On and Oracle Internet Directory. JAZN security APIs provide features not found in standard J2EE security APIs.

The OracleAS JAAS Provider is an implementation of Java Authentication and Authorization Services (JAAS) that stores security policies in either XML files or in Oracle Internet Directory. OC4J applications can use JAAS Policy Management APIs for fine-grained authorization.

This document discusses the following topics:

- Standard J2EE Security APIs
- OC4J Security APIs
- JAAS Policy Management APIs

Standard J2EE Security APIs

The J2EE standard implementation includes security APIs that can be used by Java Servlets and Enterprise JavaBeans (EJBs) to get information about users and roles. These APIs work independently from Oracle Internet Directory. They retrieve information about users who have already been authenticated, regardless of whether the application is integrated with Oracle Identity Management.

The `javax.servlet.http` package, which is part of the Java Servlet specification, includes the following methods for obtaining information about users:

- `javax.servlet.http.HttpServletRequest.getUserPrincipal()`
- `javax.servlet.http.HttpServletRequest.isUserInRole()`
- `javax.servlet.http.HttpServletRequest.getRemoteUser()`

To learn more about the `javax.servlet.http` package, see:

http://java.sun.com/products/servlet/2.2/javadoc/index.html

Similarly, the `javax.ejb` package, which is part of the Enterprise JavaBeans specification, includes the following methods for obtaining information about users:

- `javax.ejb.EJBContext.getCallerPrincipal()`
- `javax.ejb.EJBContext.isCallerInRole()`

To learn more about the `javax.ejb` package, see:

http://java.sun.com/j2ee/1.4/docs/api/javax/ejb/package-tree.html

OC4J Security APIs

JAZN security APIs are based on the package `com.evermind.security`. This class specifies a user manager to authenticate and authorize users and groups that attempt to access a J2EE application. The default JAZN user manager is `JAZNUserManager`, which supports LDAP-based providers and is integrated with Oracle Application Server Single Sign-On and Oracle Internet Directory.

To access Oracle Internet Directory information using `JAZNUserManager`, you must configure JAZN to use the LDAP-based provider, `jazn-ldap`, as described in the *Oracle Containers for J2EE Security Guide*.

JAZN supports the following `com.evermind.security.User` methods to retrieve user attributes from Oracle Internet Directory:

- `getDescription()` returns a short description of this user or null if no description is present.
- `getGroups()` returns the groups that this user belongs to, if known and supported.
- `getName()` returns the username of this user.
- `hasPermission()` checks whether this user has the named permission.
- `isMemberOf()` checks whether this user is a member of the specified group.

See *JAAS Provider API Reference* for more information.

Applications that need additional user attributes, such as email address or Oracle Internet Directory-specific attributes, must use the Oracle Internet Directory APIs. These are found in *Oracle Internet Directory API Reference* and discussed in Chapter 2 and Chapter 5.

JAZN APIs do not support user creation. Use either the Oracle Internet Directory APIs or Oracle Delegated Administration Services to create users.

Sample Code

The sample code that follows shows both standard J2EE and JAZN APIs being used to retrieve user information after authentication has occurred.

```
package oracle.security.jazn.samples.http;

import java.io.IOException;
import java.util.Date;
import java.util.Properties;
import javax.naming.*;
import javax.servlet.*;
import javax.servlet.http.*;
```

```
/**
 * A simple demo that exercises the Servlet security APIs.
 *
 */
public class CallerInfo extends HttpServlet {

    public CallerInfo()
    {
                super();
    }

    public void init(ServletConfig config)
        throws ServletException
    {
                super.init(config);
    }

    public void doGet(HttpServletRequest request, HttpServletResponse
             response)
        throws ServletException, IOException
    {
                ServletOutputStream out = response.getOutputStream();

                response.setContentType("text/html");
                out.println("<HTML><BODY bgcolor='#FFFFFF'>");

                //Standard J2EE APIs
                out.println("request.getRemoteUser = " +
                             request.getRemoteUser() + "<br>");
                out.println("request.isUserInRole('FOO') = " +
                             request.isUserInRole("FOO") + "<br>");
                out.println("request.isUserInRole('ar_manager') = " +
                             request.isUserInRole("ar_manager") + "<br>");
                out.println("request.isUserInRole('ar_developer') = " +
                             request.isUserInRole("ar_developer") + "<br>");
                out.println("request.getUserPrincipal = " +
                             request.getUserPrincipal() + "<br>");



                //JAZN-LDAP APIs
                //Get the User principal from request
                com.evermind.security.User user =
                  (com.evermind.security.User)request.getUserPrincipal();
                //getDescription API Test
                try {
                        java.lang.String s = user.getDescription();
                        out.println("<b>getDescription</b> API Result: ["
                                    +s+ "]<br>");
                }catch(Throwable e) {
                        out.println("<b>getDescription</b> API FAILED: " +
                                     e.toString() + "<br>");
                }

                //getGroups API Test
                try {
                        java.util.Set s = user.getGroups();
                        out.println("<b>getGroups</b> API Result: [" +s+
```

```
                    "]<br>");
        }catch(Throwable e) {
                out.println("<b>getGroups</b> API FAILED: " +
                             e.toString() + "<br>");
        }

        //getName API Test
        try {
                java.lang.String s = user.getName();
                out.println("<b>getName</b> API Result: [" +s+
                            "]<br>");
        }catch(Throwable e) {
                out.println("<b>getName</b> API FAILED: " +
                             e.toString() + "<br>");
        }

        //hasPermission API Test
        try {
                com.evermind.server.rmi.RMIPermission p = new
                    com.evermind.server.rmi.RMIPermission("login");
                boolean b = user.hasPermission(p);
                out.println("<b>hasPermission</b> API Result: [" + b
                            + "]<br>");
        }catch(Throwable e) {
                out.println("<b>hasPermission</b> API FAILED: " +
                            e.toString() + "<br>");
        }

        //isMemberOf API Test
        try {
                java.util.Set s = user.getGroups();
                java.util.Iterator itr = s.iterator();
                boolean b = false;
                if(itr.hasNext())
                {
                        b =
            user.isMemberOf((com.evermind.security.Group)itr.next());
                }
                out.println("<b>isMemberOf</b> API Result: [" +b+
                            "]<br>");
        }catch(Throwable e) {
                out.println("<b>isMemberOf</b> API FAILED: " +
                            e.toString() + "<br>");
        }


        out.println("</BODY>");
        out.println("</HTML>");
    }
}
```

JAAS Policy Management APIs

OC4J includes a highly scalable Java Authentication and Authorization Service (JAAS) provider, OracleAS JAAS Provider. J2EE applications integrated with Oracle Internet Directory can take advantage of the JAAS provider for enforcing fine-grained access control over protected resources.

OracleAS JAAS Provider supports using Oracle Internet Directory as the JAAS permissions and policies repository. OracleAS JAAS Provider is integrated with Oracle Internet Directory and OracleAS Single Sign-On to enhance application security.

This section includes the following topics

- JAAS Policy Management
- Retrieving User Policies and Permissions using Standard JAAS APIs

JAAS Policy Management

Permissions may be granted or revoked either by using the JAZN Admintool from the command line or programmatically, by using JAZN APIs.

The Admintool `jazn.jar` is found in the infrastructure installation under `$ORACLE_HOME/j2ee/home`. Set the `ORACLE_HOME` and `J2EE_HOME` environment variables before using it.

The following command line grants user `scott` permissions to read the file `foo.txt`. The realm name `scottsRealm` is defined in Oracle Internet Directory and the user name `scott` exists in Oracle Internet Directory:

```
java -jar jazn.jar -grantperm scottsRealm -user scott java.io.FilePermission
foo.txt, read
```

For more details on using the Admintool for User Management, see *Oracle Containers for J2EE Security Guide* Appendix B, "Using the JAZN Admintool".

To programmatically grant users permissions, you can use the JAZN's API as follows:

```
//get JAZNConfiguration related info
JAZNConfig jc = JAZNConfig.getJAZNConfig();

//create a Grantee for "scott"
RealmManager realmmgr = jc.getRealmManager();
Realm realm = realmMgr.getRealm("scottsRealm");
UserManager userMgr = realm.getUserManager();
final RealmUser user = userMgr.getUser("scott");

//grant scott file permission
JAZNPolicy policy = jc.getPolicy();

if ( policy != null) {
     Grantee gtee = new Grantee( (Principal) user);
     java.io.FilePermission fileperm = new java.io.FilePermission("foo.txt",
"read");
     policy.grant( gtee, fileperm);
}
```

For further details, see the *JAAS Provider API Reference* and the *Oracle Containers for J2EE Security Guide*.

Retrieving User Policies and Permissions using Standard JAAS APIs

Servlets may be run in either `doasprivileged` or `runas`mode. This causes them to be run in `Subject.doAsPrivileged` or `Subject.doAs` blocks, respectively. When servlets are run in either of these modes, you can check permissions by using either of two standard APIs: Policy APIs or AccessController. To retrieve policies, configure your servlet to use `doasprivileged` mode. For more information on how to configure `doasprivileged` or `runas` mode, see "Configuring J2EE Authorization" in *Oracle Containers for J2EE Security Guide.*

The following code snippets show how to check permissions if user scott has permission to read `foo.txt`.

Checking or Listing Permissions Using javax.security.auth.Policy.

This approach allows you not only to check permissions, but also to list all the permissions granted to a user or group. If you only need to check the permissions granted to the user or group, and not code-based permissions, this approach is faster.

```
//create Permission
FilePermission perm = new FilePermission("/home/scott/foo.txt","read");
{
javax.security.auth.Policy currPolicy =
    javax.security.auth.Policy.getPolicy();
// Query policy now
System.out.println("Policy permissions for this subject are " +
    currPolicy.getPermissions(Subject.getSubject(acc),null));

//Check Permissions
System.out.println("Policy.impiles permission: "+ perm +" ?  " +
    currPolicy.getPermissions(Subject.getSubject(acc),null).implies(perm));
}
```

Checking Permissions Using AccessController

Irrespective of whether the Security Manager is turned on or off, this code will check to see whether the subject or user executing this has permissions.

Note: If this snippet is executed in a servlet configured for `runas` mode, the code base also might require permission.

```
 //create Permission
FilePermission perm = new FilePermission("/home/scott/foo.txt","read");
{
  //get current AccessControlContext
  AccessControlContext acc = AccessController.getContext();
   AccessController.checkPermission(perm);
}
```

For information about policy APIs provided by the OracleAS JAAS Provider, please see *Oracle Containers for J2EE Security Guide* Appendix A, "OracleAS JAAS Provider and Sample" and *Oracle Containers for J2EE Security Guide* Appendix B, "Using the JAZN Admintool"

For information about the Oracle Internet Directory Java APIs, see *Oracle Internet Directory API Reference* and Chapter 5, "Using the Java API Extensions to JNDI".

Part II

Server Plug-ins

Part II discusses Oracle Internet Directory server plug-ins and the plug-in framework. It contains these chapters:

11

Developing Plug-ins for the Oracle Internet Directory Server

This chapter introduces Oracle Internet Directory server plug-ins and presents an overview of the plug-in framework for Oracle Internet Directory.

This chapter contains these topics:

What is a Server Plug-in?

A server plug-in is a customized program that can be used to extend the capabilities of the Oracle Internet Directory server. A server plug-in can be a PL/SQL package, Java program or package, shared object or library, or a dynamic link library on Windows. Each plug-in has a configuration entry in the Oracle Internet Directory Server. The configuration entry specifies the conditions for invoking the plug-in. The conditions for invoking a plugin include:

- An LDAP operation, such as `ldapbind` or `ldapmodify`
- A timing, relative to the LDAP operation, such as pre_bind or post_modify

Supported Languages for Server Plug-ins

As of 10*g* (10.1.4.0.1), Oracle Internet Directory supports plug-ins in Java as well as in PL/SQL. This chapter provides information common to Java and PL/SQL plug-ins. Chapter 12 provides information specific to PL/SQL plug-ins and Chapter 13 provides information specific to Java plug-ins.

Server Plug-in Prerequisites

To develop Oracle Internet Directory plug-ins, you should be familiar with the following topics:

- Generic LDAP concepts
- Oracle Internet Directory
- Oracle Internet Directory integration with Oracle Application Server

You should have programming skills in one of the following areas:

- SQL, PL/SQL, and database RPCs
- Java

Server Plug-in Benefits

Some of the ways you can extend LDAP operations by using plug-ins include the following:

- You can validate data before the server performs an LDAP operation on the data.
- You can perform actions that you define after the server successfully completes an LDAP operation.
- You can define extended operations.
- You can authenticate users through external credential stores.
- You can replace an existing server module with your own server module

On startup, the directory server loads your plug-in configuration and library. It calls your plug-in functions while processing various LDAP requests.

> **See Also:** The chapter about the password policy plug-in in *Oracle Internet Directory Administrator's Guide*. The chapter contains an example of how to implement your own password value checking and place it into the Oracle Internet Directory server.

Guidelines for Designing Plug-ins

Use the following guidelines when designing plug-ins:

- Use plug-ins to guarantee that when a specific LDAP operation is performed, related actions are also performed.
- Use plug-ins only for centralized, global operations that should be invoked for the program body statement, regardless of which user or LDAP application issues the statement.
- Do not create recursive plug-ins. For example, creating a `pre_ldap_bind` plug-in that itself issues an `ldapbind` statement would cause the plug-in to execute recursively until it has run out of resources.

  Use plug-ins judiciously. They are executed every time the associated LDAP operation occurs.

What Is the Server Plug-in Framework?

The plug-in framework is the environment in which you develop, configure, and apply the plug-ins. Each individual plug-in instance is called a plug-in module.

The plug-in framework includes the following:

- Plug-in configuration tools
- Plug-in module interface
- Plug-in LDAP APIs:
  - PL/SQL package `ODS.LDAP_PLUGIN`
  - Java package `oracle.ldap.ospf`

For both languages, you follow these general steps to use the server plug-in framework:

1. Write a user-defined plug-in procedure in PL/SQL or Java.
2. Compile the plug-in module.
3. Register the plug-in module through the configuration entry interface by using either the command line or Oracle Directory Manager.

LDAP Operations and Timings Supported by the Directory

The Oracle Internet Directory server supports plug-ins for the following LDAP operations:

- `ldapadd`
- `ldapbind`
- `ldapcompare`
- `ldapdelete`
- `ldapmoddn` (Java only)
- `ldapmodify`
- `ldapsearch`

Oracle Internet Directory supports four operation timings for plug-ins:

- pre
- post
- when
- when_replace

These are explained in the next four sections.

Pre-Operation Server Plug-ins

The server calls pre-operation plug-in modules before performing the LDAP operation. The main purpose of this type of plug-in is to validate data before the data is used in the LDAP operation.

When an exception occurs in the pre-operation plug-in, one of the following occurs:

- When the return error code indicates warning status, the associated LDAP request proceeds.
- When the return code indicates failure status, the request does not proceed.

If the associated LDAP request fails later on, the directory does not roll back the committed code in the plug-in modules.

Post-Operation Server Plug-ins

The Oracle Internet Directory server calls post-operation plug-in modules after performing an LDAP operation. The main purpose of this type of plug-in is to invoke a function after a particular LDAP operation is executed. For example, logging and notification are post-operation plug-in functions.

When an exception occurs in the post-operation plug-in, the associated LDAP operation is not rolled back.

If the associated LDAP request fails, the post plug-in is still executed.

When-Operation Server Plug-ins

The directory calls when-operation plug-in modules while performing standard LDAP operations. A when-operation plug-in executes immediately before the server's own code for the operation. The main purpose of this type of plug-in is to augment existing operations within the same LDAP transaction. If the when-operation plug-in fails, the standard LDAP operation does not execute. If the when-operation plug-in completes successfully, but the standard LDAP operation fails, then the changes made in the plug-in are not rolled back.

You can, for example, use a when-operation plug-in with the ldapcompare operation. The directory executes its server compare code and executes the plug-in module defined by the plug-in developer.

PL/SQL when-operation plug-ins are supported in `ldapadd`, `ldapdelete`, and `ldapmodify`. Java when_operation plug-ins are supported in `ldapadd`, `ldapdelete`, `ldapmoddn`, `ldapmodify`, and `ldapsearch`.

When_Replace-Operation Server Plug-ins

A when_replace-operation plug-in executes instead of the server's code for the operation. You can, for example, use a when_replace plug-in with the ldapcompare operation. The directory does not execute its compare code. Instead it relies on the plug-in module to perform the comparison.

PL/SQL when_replace-operation plug-ins are supported only in `ldapadd`, `ldapcompare`, `ldapdelete`, `ldapmodify`, and `ldapbind`.

Java when_replace-operation plug-ins are supported in ldapadd, ldapbind, ldapcompare, `ldapdelete`, `ldapmoddn`, `ldapmodify` and `ldapsearch`.

Registering a Plug-in

To enable the directory server to call a plug-in at the right time, you must register the plug-in with the directory server. You do this by creating an entry for the plug-in in the directory schema under `cn=plugin,cn=subconfigsubentry`.

Plug-in Configuration Entry

Table 11–1 lists and describes the object classes and attributes you can specify in a plug-in configuration.

Table 11–1 Plug-in Configuration Objects and Attributes

Name	Value	Mandatory?
`objectclass`	`orclPluginConfig`	Yes

Table 11–1 (Cont.) Plug-in Configuration Objects and Attributes

Name	Value	Mandatory?
`objectclass`	`top`	No
`dn`	Plug-in entry DN	Yes
`cn`	Plug-in entry name	Yes
`orclPluginAttributeList`	A semicolon-separated list of attribute names that controls whether the plug-in takes effect. If the target attribute is included in the list, then the plug-in is invoked. Only for `ldapcompare` and `ldapmodify` plug-ins.	No
`orclPluginEnable`	`0` = disable (default) `1` = enable	No
`orclPluginEntryProperties`	An `ldapsearch` filter type value. For example, if we specify `orclPluginEntryProperties: (&(objectclass=inetorgperson)(sn=Cezanne))`, the plug-in is not invoked if the target entry has `objectclass` equal to `inetorgperson` and `sn` equal to `Cezanne`.	No
`orclPluginIsReplace`	`0` = disable (default) `1` = enable For `when_replace` timing, enable this and set `orclPluginTiming` to `when`.	No
`orclPluginKind`	PL/SQL or Java (Default is PL/SQL)	No

`orclPluginLDAPOperation`	One of the following values:
	`ldapcompare`
	`ldapmodify`
	`ldapbind`
	`ldapadd`
	`ldapdelete`
	`ldapsearch`
	`ldapmoddn` (Java Only)
		Yes

`orclPluginName`	Plug-in name	Yes
`orclPluginFlexfield`	Custom text information (Java only). To indicate a subtype, specify `orclPluginFlexfield;subtypename`, for example, `orclPluginFlexfield;minPwdLength: 8`	No
`orclPluginBinaryFlexfield`	Custom binary information (Java only).	No

Table 11–1 (Cont.) Plug-in Configuration Objects and Attributes

Name	Value	Mandatory?
`orclPluginSecuredFlexfield`	Custom text information that must never be displayed in clear text (Java only). To indicate a subtype, specify `orclPluginSecuredFlexfield;subtypename`, for example `orclPluginSecuredFlexfield;telephonenumber1: 650.123.456`. The value is stored and displayed in encrypted form. In a search result, it might appear as something like this: `orclPluginSecuredFlexfield;telephonenumber1: 1291zjs8134`. Be sure that Oracle Internet Directory has privacy mode enabled to ensure that users cannot retrieve this attribute in clear text. See "Privacy of Retrieved Sensitive Attributes" in *Oracle Internet Directory Administrator's Guide*.	No
`orclPluginRequestGroup`	A semicolon-separated group list that controls if the plug-in takes effect. You can use this group to specify who can actually invoke the plug-in. For example, if you specify `orclpluginrequestgroup:cn=security,cn=groups,dc=oracle,dc=com` when you register the plug-in, the plug-in will not be invoked unless the ldap request comes from the person who belongs to the group `cn=security,cn=groups,dc=oracle,dc=com`.	No
`orclPluginRequestNegGroup`	A semicolon-separated group list that controls if the plug-in takes effect. You can use this group to specify who cannot invoke the plug-in. For example, if you specify `orclpluginrequestgroup: cn=security,cn=groups,dc=oracle,dc=com`, when you register the plug-in, the plug-in is not invoked if the LDAP request comes from the person who belongs to the group `cn=security,cn=groups,dc=oracle,dc=com`.	No
`orclPluginResultCode`	An integer value to specify the ldap result code. If this value is specified, then plug-in will be invoked only if the LDAP operation is in that result code scenario. This is only for the post plug-in type.	No
`orclPluginShareLibLocation`	File location of the dynamic linking library. If this value is not present, then Oracle Internet Directory server assumes the plug-in language is PL/SQL.	No
`orclPluginSubscriberDNList`	A semicolon separated DN list that controls if the plug-in takes effect. If the target DN of an LDAP operation is included in the list, then the plug-in is invoked.	No

Table 11–1 (Cont.) Plug-in Configuration Objects and Attributes

Name	Value	Mandatory?

`orclPluginTiming`	One of the following values:
	`pre`
	`when`
	`post`
	For when_replace timing, specify `when` and enable `orclPluginIsReplace`.
		No

`orclPluginType`	One of the following values:
	`operational`
	`attribute`
	`password_policy`
	`syntax`
	`matchingrule`
	See Also: "LDAP Operations and Timings Supported by the Directory" on page 11-3.
		Yes

`orclPluginVersion`	Supported plug-in version number	No
`orclPluginClassReloadEnabled`	If this value is 1, the server reloads the plug-in class every time it invokes the plug-in. If the value is 0, the server loads the class only the first time it invokes the plug-in.	

Adding a Plug-in Configuration Entry by Using Command-Line Tools

To add a plug-in configuration entry from the command line, create an LDIF file containing the plug-in configuration. Specify a DN under `cn=plugin,cn=subconfigsubentry`.

The following two-part LDIF file, `my_ldif_file.ldif`, creates an entry for an operation-based plug-in called `my_plugin1`:

```
dn: cn=when_comp,cn=plugin,cn=subconfigsubentry
objectclass: orclPluginConfig
objectclass: top
orclPluginName: my_plugin1
orclPluginType: operational
orclPluginTiming: when
orclPluginLDAPOperation: ldapcompare
orclPluginEnable: 1
orclPluginVersion: 1.0.1
orclPluginIsReplace: 1
cn: when_comp
orclPluginKind: PLSQL
orclPluginSubscriberDNList: dc=COM,c=us;dc=us,dc=oracle,dc=com;dc=org,dc=us;
 o=IMC,c=US
orclPluginAttributeList: userpassword

dn: cn=post_mod_plugin, cn=plugin,cn=subconfigsubentry
objectclass: orclPluginConfig
objectclass: top
orclPluginName: my_plugin1
orclPluginType: operational
orclPluginTiming: post
orclPluginLDAPOperation: ldapmodify
```

```
orclPluginEnable: 1
orclPluginVersion: 1.0.1
cn: post_mod_plugin
orclPluginKind: PLSQL
```

Add this file to the directory with a command similar to this:

```
ldapadd -p 389 -h myhost -D binddn -w password -f my_ldif_file.ldif
```

> **Note:** The plug-in configuration entry is not replicated. Replicating it would create an inconsistent state.

Managing Plug-ins by Using Oracle Directory Manager

You can register, edit, and delete plug-ins by using Oracle Directory Manager.

Registering a Plug-in by Using Oracle Directory Manager

To register a plug-in:

1. In the navigator pane, expand Oracle Internet Directory Servers > *directory server instance*, then select Plug-in Management. The Plug-in Management window appears in the right pane.
2. Choose **Create**. The New Plug-in dialog box appears.
3. Enter values in the New Plug-in dialog box.
4. When you have finished entering the values, choose OK. This returns you to the Plug-in Management window. The plug-in you just created is listed in the Plug-in Entry Name column.
5. Choose **Apply**.

Editing a Plug-in by Using Oracle Directory Manager

To edit a plug-in entry:

1. In the navigator pane, expand Oracle Internet Directory Servers > *directory server instance*, then select **Plug-in Management**. The Plug-in Management window appears in the right pane.
2. In the right pane, select the name of the plug-in entry you want to edit, then choose **Edit**. The Plug-in dialog box appears.
3. In the Plug-in dialog box, modify the values in the appropriate fields.
4. Choose **OK**.

Deleting a Plug-in by Using Oracle Directory Manager

To delete a plug-in:

1. In the navigator pane, expand Oracle Internet Directory Servers > *directory server instance*, then select **Plug-in Management**. The Plug-in Management window appears in the right pane.
2. In the right pane, select the name of the plug-in you want to delete, then choose **Edit**. The Plug-in: dialog box appears.

3. In the Plug-in dialog box, choose **Delete**, and, when prompted, confirm your deletion. This returns you to the Plug-in Management window. The plug-in entry you deleted no longer appears in the list.

12

PL/SQL Server Plug-ins

This chapter explains how to use the plug-in framework in PL/SQL.

This chapter contains these topics:

- Designing, Creating, and Using PL/SQL Server Plug-ins
- Examples of PL/SQL Plug-ins
- Binary Support in the PL/SQLPlug-in Framework
- Database Object Types Defined
- Specifications for PL/SQL Plug-in Procedures

Designing, Creating, and Using PL/SQL Server Plug-ins

This section contains these topics:

- PL/SQLPlug-in Caveats
- Creating PL/SQLPlug-ins
- Compiling PL/SQLPlug-ins
- Managing PL/SQL Plug-ins
- Enabling and Disabling PL/SQL Plug-ins
- Exception Handling in a PL/SQL Plug-in
- PL/SQL Plug-in LDAP API
- PL/SQL Plug-ins and Replication
- PL/SQL Plug-in and Database Tools
- PL/SQL Plug-in Security
- PL/SQL Plug-in Debugging
- PL/SQL Plug-in LDAP API Specifications
- Database Limitations

PL/SQLPlug-in Caveats

The following caveats apply to PL/SQL plug-ins:

Types of PL/SQL Plug-in Operations

A PL/SQL plug-in can only be associated with `ldapbind`, `ldapadd`, `ldapmodify`, `ldapcompare`, `ldapsearch`, and `ldapdelete` operations. You cannot associate a PL/SQL plug-in with `moddn`. If you need to associate a plug-in with `moddn`, you must use a Java plug-in.

Naming PL/SQL Plug-ins

Plug-in names (PL/SQL package names) must be unique if they share the same database schema with other plug-ins or stored procedures. But plug-ins can share names with other database schema objects such as tables and views. This kind of sharing is not, however, recommended.

Creating PL/SQLPlug-ins

Creating a PL/SQL plug-in module is like creating a PL/SQL package. Both have a specification part and a body part. The directory, not the plug-in, defines the plug-in specification because the specification serves as the interface between Oracle Internet Directory and the custom plug-in.

For security reasons and for the integrity of the LDAP server, you can compile PL/SQL plug-ins only in the ODS database schema. You must compile them in the database that serves as the back end database of Oracle Internet Directory.

Package Specifications for Plug-in Module Interfaces

Different plug-ins have different package specifications. As Table 12–1 shows, you can name the plug-in package. You must, however, follow the signatures defined for each type of plug-in procedure. See "Specifications for PL/SQL Plug-in Procedures" for details.

Table 12–1 Plug-in Module Interface

Plug-in Item	User Defined	Oracle Internet Directory-Defined
Plug-in Package Name	X	
Plug-in Procedure Name		X
Plug-in Procedure Signature		X

Table 12–2 names the different plug-in procedures. In addition, it lists and describes the parameters that these procedures use.

Table 12–2 Operation-Based and Attribute-Based Plug-in Procedure Signatures

Invocation Context	Procedure Name	IN Parameters	OUT Parameters
Before `ldapbind`	PRE_BIND	ldapcontext, Bind DN, Password	return code, error message
With `ldapbind` but replacing the default server behavior	WHEN_BIND_REPLACE	ldapcontext, bind result, DN, userpassword	bind result, return code, error message
After `ldapbind`	POST_BIND	ldapcontext, Bind result, Bind DN, Password	return code, error message
Before `ldapmodify`	PRE_MODIFY	ldapcontext, DN, Mod structure	return code, error message

Table 12–2 (Cont.) Operation-Based and Attribute-Based Plug-in Procedure Signatures

Invocation Context	Procedure Name	IN Parameters	OUT Parameters
With `ldapmodify`	`WHEN_MODIFY`	ldapcontext, DN, Mod structure	return code, error message
With `ldapmodify` but replacing the default server behavior	`WHEN_MODIFY_REPLACE`	ldapcontext, DN, Mod structure	return code, error message
After `ldapmodify`	`POST_MODIFY`	ldapcontext, Modify result, DN, Mod structure	return code, error message
Before `ldapcompare`	`PRE_COMPARE`	ldapcontext, DN, attribute, value	return code, error message
With `ldapcompare` but replacing the default server behavior	`WHEN_COMPARE_REPLACE`	ldapcontext, Compare result, DN, attribute, value	compare result, return code, error message
After `ldapcompare`	`POST_COMPARE`	ldapcontext, Compare result, DN, attribute, value	return code, error message
Before `ldapadd`	`PRE_ADD`	ldapcontext, DN, Entry	return code, error message
With `ldapadd`	`WHEN_ADD`	ldapcontext, DN, Entry	return code, error message
With `ldapadd` but replacing the default server behavior	`WHEN_ADD_REPLACE`	ldapcontext, DN, Entry	return code, error message
After `ldapadd`	`POST_ADD`	ldapcontext, Add result, DN, Entry	return code, error message
Before `ldapdelete`	`PRE_DELETE`	ldapcontext, DN	return code, error message
With `ldapdelete`	`WHEN_DELETE`	ldapcontext, DN	return code, error message
With `ldapdelete` but replacing the default server behavior	`WHEN_DELETE`	ldapcontext, DN	return code, error message
After `ldapdelete`	`POST_DELETE`	ldapcontext, Delete result, DN	return code, error message
Before `ldapsearch`	`PRE_SEARCH`	ldapcontext, Base DN, scope, filter	return code, error message
After `ldapsearch`	`POST_SEARCH`	Ldap context, Search result, Base DN, scope, filter	return code, error message

See Also:

- "Error Handling" on page 12-5 for valid values for the return code and error message.
- "Specifications for PL/SQL Plug-in Procedures" on page 12-21 for complete supported procedure signatures.

Compiling PL/SQLPlug-ins

You must compile the plug-in module against the same database that serves as the Oracle Internet Directory back end database. Plug-ins are exactly the same as PL/SQL stored procedures. A PL/SQL anonymous block is compiled each time it is loaded into memory. Compilation consists of these stages:

1. Syntax checking: PL/SQL syntax is checked, and a parse tree is generated.
2. Semantic checking: Type checking and further processing on the parse tree.
3. Code generation: The pcode is generated.

If errors occur during the compilation of a plug-in, the plug-in is not created. You can use the `SHOW ERRORS` statement in SQL*Plus or Enterprise Manager to see any compilation errors when you create a plug-in, or you can `SELECT` the errors from the `USER_ERRORS` view.

All plug-in modules must be compiled in the ODS database schema.

Dependencies

Compiled plug-ins have dependencies. They become invalid if an object depended upon, such as a stored procedure or function called from the plug-in body, is modified. Plug-ins that are invalidated for dependency reasons must be recompiled before the next invocation.

Recompiling Plug-ins

Use the `ALTER PACKAGE` statement to manually recompile a plug-in. For example, the following statement recompiles the my_plugin plug-in:

```
ALTER PACKAGE my_plugin COMPILE PACKAGE;
```

Managing PL/SQL Plug-ins

This section explains how to modify and debug plug-ins.

Modifying Plug-ins

Like a stored procedure, a plug-in cannot be explicitly altered. It must be replaced with a new definition.

When replacing a plug-in, you must include the `OR REPLACE` option in the `CREATE PACKAGE` statement. The `OR REPLACE` option enables a new version of an existing plug-in to replace an older version without having an effect on grants made for the original version of the plug-in.

Alternatively, the plug-in can be dropped using the `DROP PACKAGE` statement, and you can rerun the `CREATE PACKAGE` statement.

If the plug-in name (the package name) is changed, you must register the new plug-in again.

Debugging Plug-ins

You can debug a plug-in using the same facilities available for PL/SQL stored procedures.

Enabling and Disabling PL/SQL Plug-ins

To turn the plug-in on or off, modify the value of `orclPluginEnable` in the plug-in configuration object. For example, modify the value of `orclPluginEnable` in `cn=post_mod_plugin,cn=plugins,cn=subconfigsubentry` to be `1` or `0`.

Exception Handling in a PL/SQL Plug-in

Each of the procedures in a PL/SQL plug-in must have an exception handling block that handles errors intelligently and, if possible, recovers from them.

Error Handling

Oracle Internet Directory requires that the return code (`rc`) and error message (`errmsg`) be set correctly in the plug-in procedures.

Table 12–3 provides the values that are valid for the return code.

Table 12–3 Valid Values for the plug-in Return Code

Error Code	Description
`0`	Success
Any number greater than zero	Failure
`-1`	Warning

The `errmsg` parameter is a string value that can pass a user's custom error message back to Oracle Internet Directory server. The size limit for `errmsg` is 1024 bytes. Each time Oracle Internet Directory runs the plug-in program, it examines the return code to determine if it must display the error message.

If, for example, the value for the return code is `0`, the error message value is ignored. If the value of the return code is `-1` or greater than zero, the following message is either logged in the log file or displayed in standard output if the request came from LDAP command-line tools:

```
ldap addition info: customized error
```

Program Control Handling between Oracle Internet Directory and Plug-ins

Table 12–4 shows where plug-in exceptions occur and how the directory handles them.

Table 12–4 Program Control Handling when a Plug-in Exception Occurs

Plug-in Exception Occurred in	Oracle Internet Directory Server Handling
`PRE_BIND`, `PRE_MODIFY`, `PRE_ADD`, `PRE_SEARCH`, `PRE_COMPARE`, `PRE_DELETE`	Depends on return code. If the return code is: ▪ Greater than zero (error), then no LDAP operation is performed ▪ `-1` (warning), then proceed with the LDAP operation
`POST_BIND`, `POST_MODIFY`, `POST_ADD`, `POST_SEARCH`, `WHEN_DELETE`	LDAP operation is completed. There is no rollback.
`WHEN_MODIFY`, `WHEN_ADD`, `WHEN_DELETE`	Rollback the LDAP operation

Table 12–5 shows how the directory responds when an LDAP operation fails.

Table 12–5 Program Control Handling when an LDAP Operation Fails

LDAP Operation Fails in	Oracle Internet Directory Server Handling
PRE_BIND, PRE_MODIFY, PRE_ADD, PRE_SEARCH, WHEN_DELETE	Pre-operation plug-in is completed. There is no rollback.
POST_BIND, POST_MODIFY, POST_ADD, POST_SEARCH, WHEN_DELETE	Proceed with post-operation plug-in. The LDAP operation result is one of the IN parameters.
WHEN_MODIFY, WHEN_ADD, WHEN_DELETE	When types of plug-in changes are rolled back.
WHEN	Changes made in the plug-in program body are rolled back.

PL/SQL Plug-in LDAP API

There are different methods for providing API access:

- Enable a user to utilize the standard LDAP PL/SQL APIs. Note though that, if program logic is not carefully planned, an infinite loop in plug-in execution can result.
- Oracle Internet Directory provides the Plug-in LDAP API. This plug-in does not cause a series of plug-in actions in the directory server if there are plug-ins configured and associated with the LDAP request.

In the Plug-in LDAP API, the directory provides APIs for connecting back to the directory server designated in the plug-in module. You must use this API if you want to connect to the server that is executing the plug-in. If you want to connect to an external server, you can use the DBMS_LDAP API.

Within each plug-in module, an `ldapcontext` is passed from the Oracle directory server. When the Plug-in LDAP API is called, `ldapcontext` is passed for security and binding purposes. When binding with this `ldapcontext`, Oracle Internet Directory recognizes that the LDAP request is coming from a plug-in module. For this type of plug-in bind, the directory does not trigger any subsequent plug-ins. It handles the plug-in bind as a super-user bind. Use this plug-in bind with discretion.

See Also: "PL/SQL Plug-in LDAP API Specifications" on page 12-7.

PL/SQL Plug-ins and Replication

These cases can cause an inconsistent state in a replication environment:

- Plug-in metadata replicated to other nodes
- Changes to directory entries by plug-in programs or other LDAP operations
- Plug-in installation on only some of the participating nodes
- Implementation in the plug-in of extra checking that depends on the directory data

PL/SQL Plug-in and Database Tools

Bulk tools do not support server plug-ins.

PL/SQL Plug-in Security

Some Oracle Internet Directory server plug-ins require that you supply the code that preserves tight security. For example, if you replace the directory's `ldapcompare` or `ldapbind` operation with your own plug-in module, you must ensure that your implementation of this operation does not omit any functionality on which security relies.

To ensure tight security, the following must be done:

- Create the plug-in packages
- Only the LDAP administrator can restrict the database user
- Use the access control list (ACL) to set the plug-in configuration entries to be accessed only by the LDAP administrator
- Be aware of the program relationship between different plug-ins

PL/SQL Plug-in Debugging

Use the plug-in debugging mechanism for Oracle Internet Directory to examine the process and content of plug-ins.The following commands control the operation of the server debugging process.

- To set up plug-in debugging, run this command:

  ```
  % sqlplus ods/password @$ORACLE/ldap/admin/oidspdsu.pls
  ```

- To enable plug-in debugging, run this command:

  ```
  % sqlplus ods/password @$ORACLE/ldap/admin/oidspdon.pls
  ```

- After enabling plug-in debugging, you can use this command in the plug-in module code:

  ```
  plg_debug('debuggingmessage');
  ```

  The resulting debug message is stored in the plug-in debugging table.

- To disable debugging, run this command:

  ```
  % sqlplus ods/password @$ORACLE/ldap/admin/oidspdof.pls
  ```

- To display the debug messages that you put in the plug-in module, run this command:

  ```
  % sqlplus ods/password @$ORACLE/ldap/admin/oidspdsh.pls
  ```

- To delete all of the debug messages from the debug table, run this command:

  ```
  % sqlplus ods/password @$ORACLE/ldap/admin/oidspdde.pls
  ```

PL/SQL Plug-in LDAP API Specifications

Here is the package specification that Oracle Internet Directory provides for the PL/SQL Plug-in LDAP API:

```
CREATE OR REPLACE  PACKAGE LDAP_PLUGIN AS
    SUBTYPE SESSION IS RAW(32);

    -- Initializes the LDAP library and return a session handler
    -- for use in subsequent calls.
    FUNCTION init (ldappluginctx IN ODS.plugincontext)
```

```
      RETURN SESSION;

    -- Synchronously authenticates to the directory server using
    -- a Distinguished Name and password.
    FUNCTION simple_bind_s (ldappluginctx IN ODS.plugincontext,
                            ld            IN SESSION)
      RETURN PLS_INTEGER;

    -- Get requester info from the plug-in context
    FUNCTION get_requester (ldappluginctx IN ODS.plugincontext)
      RETURN VARCHAR2;
END LDAP_PLUGIN;
```

Database Limitations

Oracle Internet Directory 10*g* (10.1.4.0.1) can use several different versions of the Oracle Database for storing directory data. These include Oracle9*i* Database Server Release 2, v9.2.0.6 or later and Oracle Database 10*g*, v10.1.0.4 or later.

In Oracle Application Server 10*g* (10.1.4.0.1), the following plug-in features are not supported in the directory server running against Oracle9*i* Database Server Release 2:

- Windows Domain external authentication plug-in.
- The `simple_bind_s()` function of the LDAP_PLUGIN package provided as the Oracle Internet Directory PL/SQL PLUGIN API for connecting back to the directory server as part of plug-in definitions.

Examples of PL/SQL Plug-ins

This section presents two sample plug-ins. One logs all `ldapsearch` commands. The other synchronizes two directory information trees (DITs).

Example 1: Search Query Logging

Situation: A user wants to know if it is possible to log all of the `ldapsearch` commands.

Solution: Yes. The user can use the post `ldapsearch` operational plug-in for this purpose. They can either log all of the requests or only those that occur under the DNs being searched.

To log all the `ldapsearch` commands:

1. Log all of the `ldapsearch` results into a database table. This log table has these columns:

    - timestamp
    - baseDN
    - search scope
    - search filter
    - required attribute
    - search result

    Use this SQL script to create the table:

    ```
    drop table search_log;
    create table search_log
    ```

```
(timestamp varchar2(50),
basedn varchar2(256),
searchscope number(1);
searchfilter varchar2(256);
searchresult number(1));
drop table simple_tab;
create table simple_tab (id NUMBER(7), dump varchar2(256));
DROP sequence seq;
CREATE sequence seq START WITH 10000;
commit;
```

2. Create the plug-in package specification.

```
CREATE OR REPLACE PACKAGE LDAP_PLUGIN_EXAMPLE1 AS
PROCEDURE post_search
(ldapplugincontext IN  ODS.plugincontext,
result       IN  INTEGER,
baseDN       IN  VARCHAR2,
scope        IN  INTEGER,
filterStr    IN  VARCHAR2,
requiredAttr IN  ODS.strCollection,
rc           OUT INTEGER,
errormsg     OUT VARCHAR2
);
END LDAP_PLUGIN_EXAMPLE1;
/
```

3. Create the plug-in package body.

```
CREATE OR REPLACE PACKAGE BODY LDAP_PLUGIN_EXAMPLE1 AS
PROCEDURE post_search
(ldapplugincontext IN  ODS.plugincontext,
result       IN  INTEGER,
baseDN       IN  VARCHAR2,
scope        IN  INTEGER,
filterStr    IN  VARCHAR2,
requiredAttr IN  ODS.strCollection,
rc           OUT INTEGER,
errormsg     OUT VARCHAR2
)
      IS
BEGIN
   INSERT INTO simple_tab VALUES
(to_char(sysdate, 'Month DD, YYYY HH24:MI:SS'), baseDN, scope, filterStr,
result);
   -- The following code segment demonstrate how to iterate
   -- the ODS.strCollection
   FOR l_counter1 IN 1..requiredAttr.COUNT LOOP
      INSERT INTO simple_tab
        values (seq.NEXTVAL, 'req attr ' || l_counter1 || ' = ' ||
                requiredAttr(l_counter1));
   END LOOP;
   rc := 0;
   errormsg := 'no post_search plug-in error msg';
   COMMIT;
EXCEPTION
   WHEN others THEN
      rc := 1;
      errormsg := 'exception: post_search plug-in';
END;
END LDAP_PLUGIN_EXAMPLE1;
```

```
/
```

4. Register the plug-in entry in Oracle Internet Directory.

```
dn: cn=post_search,cn=plugin,cn=subconfigsubentry
objectclass: orclPluginConfig
objectclass: top
orclPluginName: ldap_plugin_example1
orclPluginType: operational
orclPluginTiming: post
orclPluginLDAPOperation: ldapsearch
orclPluginEnable: 1
orclPluginVersion: 1.0.1
cn: post_search
orclPluginKind: PLSQL
```

Using the `ldapadd` command-line tool to add this entry:

```
% ldapadd -p port_number -h host_name -D bind_dn -w passwd -v \
         -f register_post_search.ldif
```

Example 2: Synchronizing Two DITs

Situation: There are two interdependent products under `cn=Products, cn=oraclecontext`. This interdependency extends down to the users in these products' containers. If a user in the first DIT (product 1) is deleted, the corresponding user in the other DIT (product 2) must be deleted.

Is it possible to set a trigger that, when the user in the first DIT is deleted, calls or passes a trigger to delete the user in the second DIT?

Solution: Yes, we can use the post `ldapdelete` operation plug-in to handle the second deletion occurring in the second DIT.

If the first DIT has the naming context of `cn=DIT1,cn=products,cn=oraclecontext` and the second DIT has the naming context of `cn=DIT2,cn=products,cn=oraclecontext`, the two users share the same ID attribute. Inside of the post `ldapdelete` plug-in module, we can use `LDAP_PLUGIN` and `DBMS_LDAP` APIs to delete the user in the second DIT.

We must set `orclPluginSubscriberDNList` to `cn=DIT1,cn=products,cn=oraclecontext`, so that whenever we delete entries under `cn=DIT1,cn=products,cn=oraclecontext`, the plug-in module is invoked.

Note: When you use a post `ldapmodify` plug-in to synchronize changes between two Oracle Internet Directory nodes, you cannot push all the attributes from one node to the other. This is because the changes (mod structure) captured in the plug-in module include operational attributes. These operational attributes are generated on each node and cannot be modified by using the standard LDAP methods.

When writing your plug-in program, exclude the following operational attributes from synchronization: `authPassword`, `creatorsname`, `createtimestamp`, `modifiersname`, `modifytimestamp`, `pwdchangedtime`, `pwdfailuretime`, `pwdaccountlockedtime`, `pwdexpirationwarned`, `pwdreset`, `pwdhistory`, `pwdgraceusetime`.

The following attributes are used the most in the deployment environment and should be excluded from synchronization first: `pwdchangedtime`, `pwdfailuretime`, `authpassword`, `pwdaccountlockedtime`.

---

1. Assume that the entries under both DITs have been added to the directory. For example, the entry `id=12345,cn=DIT1,cn=products,cn=oraclecontext` is in `DIT1`, and `id=12345,cn=DIT2,cn=products,cn=oraclecontext` is in `DIT2`.
2. Create the plug-in package specification.

```
CREATE OR REPLACE PACKAGE LDAP_PLUGIN_EXAMPLE2 AS
PROCEDURE post_delete
(ldapplugincontext IN  ODS.plugincontext,
result   IN  INTEGER,
dn       IN  VARCHAR2,
rc       OUT INTEGER,
errormsg OUT VARCHAR2
);
END LDAP_PLUGIN_EXAMPLE2;
/
```

3. Create the plug-in package body.

```
CREATE OR REPLACE PACKAGE BODY LDAP_PLUGIN_EXAMPLE2 AS
PROCEDURE post_delete
(ldapplugincontext IN  ODS.plugincontext,
result   IN  INTEGER,
dn       IN  VARCHAR2,
rc       OUT INTEGER,
errormsg OUT VARCHAR2
)
    IS
     retval       PLS_INTEGER;
     my_session   DBMS_LDAP.session;
     newDN        VARCHAR2(256);
BEGIN
   retval        := -1;
   my_session := LDAP_PLUGIN.init(ldapplugincontext);
   -- bind to the directory
   retval := LDAP_PLUGIN.simple_bind_s(ldapplugincontext, my_session);
   -- if retval is not 0, then raise exception
   newDN := REPLACE(dn,'DIT1','DIT2');
```

```
   retval := DBMS_LDAP.delete_s(my_session, newDN);
   -- if retval is not 0, then raise exception
   rc := 0;
   errormsg := 'no post_delete plug-in error msg';
EXCEPTION
   WHEN others THEN
      rc := 1;
      errormsg := 'exception: post_delete plug-in';
END;
END LDAP_PLUGIN_EXAMPLE2;
/
(ldapplugincontext IN  ODS.plugincontext,
result   IN  INTEGER,
dn       IN  VARCHAR2,
rc       OUT INTEGER,
errormsg OUT VARCHAR2
)
    IS
     retval       PLS_INTEGER;
     my_session   DBMS_LDAP.session;
     newDN        VARCHAR2(256);
BEGIN
   retval         := -1;
   my_session := LDAP_PLUGIN.init(ldapplugincontext);
   -- bind to the directory
   retval := LDAP_PLUGIN.simple_bind_s(ldapplugincontext, my_session);
   -- if retval is not 0, then raise exception
   newDN := REPLACE(dn,'DIT1','DIT2');
   retval := DBMS_LDAP.delete_s(my_session, newDN);
   -- if retval is not 0, then raise exception
   rc := 0;
   errormsg := 'no post_delete plug-in error msg';
EXCEPTION
   WHEN others THEN
      rc := 1;
      errormsg := 'exception: post_delete plug-in';
END;
END LDAP_PLUGIN_EXAMPLE2;
/
```

4. Register the plug-in entry with Oracle Internet Directory.

   Construct the LDIF file `register_post_delete.ldif`:

```
dn: cn=post_delete,cn=plugin,cn=subconfigsubentry
objectclass: orclPluginConfig
objectclass: top
orclPluginName: ldap_plugin_example2
orclPluginType: operational
orclPluginTiming: post
orclPluginLDAPOperation: ldapdelete
orclPluginEnable: 1
orclPluginSubscriberDNList: cn=DIT1,cn=oraclecontext,cn=products
orclPluginVersion: 1.0.1
cn: post_delete
orclPluginKind: PLSQL
```

   Use the `ldapadd` command-line tool to add this entry:

```
% ldapadd -p port_number -h host_name -D bind_dn -w passwd -v -f register_
post_delete.ldif
```

Binary Support in the PL/SQLPlug-in Framework

Starting with release 10.1.2, object definitions in the Plug-in LDAP API enable `ldapmodify`, `ldapadd`, and `ldapcompare` plug-ins to access binary attributes in the directory database. Formerly, only attributes of type `VARCHAR2` could be accessed. These object definitions do not invalidate plug-in code that precedes release 10.1.2. No change to this code is required. The new definitions appear in the section "Database Object Types Defined".

The section that you are reading now examines binary operations involving the three types of plug-ins. It includes examples of these plug-ins. The new object definitions apply to pre, post, and when versions of all three.

Note that the three examples use RAW functions and variables in place of LOBs.

Binary Operations with ldapmodify

The `modobj` object that the plug-in framework passes to an `ldapmodify` plug-in now holds the values of binary attributes as `binvals`. This variable is a table of `binvalobj` objects.

The plug-in determines whether a binary operation is being performed by examining the `operation` field of `modobj`. It checks whether any of the values `DBMS_LDAP.MOD_ADD`, `DBMS_LDAP.MOD_DELETE`, and `DBMS_LDAP.MOD_REPLACE` are paired with `DBMS_LDAP.MOD_BVALUES`. The pairing `DBMS_LDAP.MOD_ADD+DBMS_LDAP.MOD_BVALUES`, for example, signifies a binary add in the modify operation.

The example that follows shows a post `ldapmodify` plug-in modifying an entry in another directory. The plug-in is invoked after `ldapmodify` applies the same change to the same entry in the plug-in directory. The entry in the other directory appears under the DIT `cn=users,dc=us,dc=acme,dc=com`.

```
create or replace package moduser as
   procedure post_modify(ldapplugincontext IN ODS.plugincontext,
                         result IN integer,
                         dn IN varchar2,
                         mods IN ODS.modlist,
                         rc OUT integer,
                         errormsg OUT varchar2);
end moduser;
/
show error

CREATE OR REPLACE PACKAGE BODY moduser AS
   procedure post_modify(ldapplugincontext IN ODS.plugincontext,
                         result IN integer,
                         dn IN varchar2,
                         mods IN ODS.modlist,
                         rc OUT integer,
                         errormsg OUT varchar2)
   is
      counter1 pls_integer;
      counter2 pls_integer;
      retval pls_integer := -1;
      user_session DBMS_LDAP.session;
      user_dn varchar(256);
      user_array DBMS_LDAP.mod_array;
      user_vals DBMS_LDAP.string_collection;
      user_binvals DBMS_LDAP.blob_collection;
      ldap_host varchar(256);
```

```
   ldap_port varchar(256);
   ldap_user varchar(256);
   ldap_passwd varchar(256);
begin
   ldap_host :='backup.us.oracle.com';
   ldap_port :='4000';
   ldap_user :='cn=orcladmin';
   ldap_passwd :='welcome';

   plg_debug('START MODIFYING THE ENTRY');

   -- Get a session
      user_session := dbms_ldap.init(ldap_host, ldap_port);

   -- Bind to the directory
      retval := dbms_ldap.simple_bind_s(user_session, ldap_user,
      ldap_passwd);

   -- Create a mod_array
      user_array := dbms_ldap.create_mod_array(mods.count);

   -- Create a user_dn
      user_dn := substr(dn,1,instr(dn,',',1,1))||'cn=users,dc=us,dc=acme,
      dc=com';

     plg_debug('THE CREATED DN IS'||user_dn);

   -- Iterate through the modlist
      for counter1 in 1..mods.count loop

   -- Log the attribute name and operation
      if (mods(counter1).operation > DBMS_LDAP.MOD_BVALUES) then
        plg_debug('THE NAME OF THE BINARY ATTR. IS'||mods(counter1).type);
      else
        plg_debug('THE NAME OF THE NORMAL ATTR. IS'||mods(counter1).type);
      end if;
        plg_debug('THE OPERATION IS'||mods(counter1).operation);

   -- Add the attribute values to the collection
      for counter2 in 1..mods(counter1).vals.count loop
        user_vals(counter2) := mods(counter1).vals(counter2).val;
      end loop;

   -- Add the attribute values to the collection
      for counter2 in 1..mods(counter1).binvals.count loop
        plg_debug('THE NO. OF BYTES OF THE BINARY ATTR. VALUE IS'
        ||mods(counter1).binvals(counter2).length);
        user_binvals(counter2) := mods(counter1).binvals(counter2).binval;
      end loop;

   -- Populate the mod_array accordingly with binary/normal attributes
      if (mods(counter1).operation >= DBMS_LDAP.MOD_BVALUES) then
        dbms_ldap.populate_mod_array(user_array,mods(counter1).operation -
        DBMS_LDAP.MOD_BVALUES,mods(counter1).type,user_binvals);
        user_binvals.delete;
      else
        dbms_ldap.populate_mod_array(user_array,mods(counter1).operation,
        mods(counter1).type,user_vals);
        user_vals.delete;
      end if;
```

```
        end loop;

      -- Modify the entry
         retval := dbms_ldap.modify_s(user_session,user_dn,user_array);
         if retval = 0 then
           rc := 0;
           errormsg:='No error occured while modifying the entry';
         else
           rc := retval;
           errormsg :='Error code'||rc||' while modifying the entry';
         end if;

      -- Free the mod_array
         dbms_ldap.free_mod_array(user_array);

       plg_debug('FINISHED MODIFYING THE ENTRY');

   exception
  WHEN others THEN
   plg_debug (SQLERRM);
  end;
end moduser;
/
show error

exit;
```

Binary Operations with ldapadd

The `entryobj` object that the plug-in framework passes to an `ldapadd` plug-in now holds binary attributes as `binattr`. This variable is a table of `binattrobj` objects. The example that follows shows a post-add plug-in propagating a change (an added user) in the plug-in directory to another directory. In the latter directory, the entry appears under the DIT `cn=users,dc=us,dc=acme,dc=com`.

```
create or replace package adduser as
   procedure post_add(ldapplugincontext IN ODS.plugincontext,
                          result IN integer,
                          dn IN varchar2,
                          entry IN ODS.entryobj,
                          rc OUT integer,
                          errormsg OUT varchar2);
end adduser;
/
show error

CREATE OR REPLACE PACKAGE BODY adduser AS
   procedure post_add(ldapplugincontext IN ODS.plugincontext,
                          result IN integer,
                          dn IN varchar2,
                          entry IN ODS.entryobj,
                          rc OUT integer,
                          errormsg OUT varchar2)
   is
      counter1 pls_integer;
      counter2 pls_integer;
      retval pls_integer := -1;
      s integer;
      user_session DBMS_LDAP.session;
```

```
   user_dn varchar(256);
   user_array DBMS_LDAP.mod_array;
   user_vals DBMS_LDAP.string_collection;
   user_binvals DBMS_LDAP.blob_collection;
   ldap_host varchar(256);
   ldap_port varchar(256);
   ldap_user varchar(256);
   ldap_passwd varchar(256);
begin
   ldap_host :='backup.us.oracle.com';
   ldap_port :='4000';
   ldap_user :='cn=orcladmin';
   ldap_passwd :='welcome';

   plg_debug('START ADDING THE ENTRY');

   -- Get a session
      user_session := dbms_ldap.init(ldap_host, ldap_port);

   -- Bind to the directory
      retval := dbms_ldap.simple_bind_s(user_session, ldap_user, ldap_passwd);

   -- Create a mod_array
      user_array := dbms_ldap.create_mod_array(entry.binattr.count +
      entry.attr.count);

   -- Create a user_dn
      user_dn := substr(dn,1,instr(dn,',',1,1))||'cn=users,dc=us,dc=acme,
      dc=com';
      plg_debug('THE CREATED DN IS'||user_dn);

   -- Populate the mod_array with binary attributes
      for counter1 in 1..entry.binattr.count loop
        for counter2 in 1..entry.binattr(counter1).binattrval.count loop
          plg_debug('THE NAME OF THE BINARY ATTR. IS'||
          entry.binattr(counter1).binattrname);
          s := dbms_lob.getlength(entry.binattr(counter1).
          binattrval(counter2));
          plg_debug('THE NO. OF BYTES OF THE BINARY ATTR. VALUE IS'||s);
          user_binvals(counter2) := entry.binattr(counter1).
          binattrval(counter2);
        end loop;
      dbms_ldap.populate_mod_array(user_array,DBMS_LDAP.MOD_ADD,
      entry.binattr(counter1).binattrname,user_binvals);
      user_binvals.delete;
     end loop;

   -- Populate the mod_array with attributes
      for counter1 in 1..entry.attr.count loop
        for counter2 in 1..entry.attr(counter1).attrval.count loop
          plg_debug('THE NORMAL ATTRIBUTE'||entry.attr(counter1).attrname||'
          HAS THE VALUE'||entry.attr(counter1).attrval(counter2));
          user_vals(counter2) := entry.attr(counter1).attrval(counter2);
        end loop;
      dbms_ldap.populate_mod_array(user_array,DBMS_LDAP.MOD_ADD,
      entry.attr(counter1).attrname,user_vals);
      user_vals.delete;
      end loop;

   -- Add the entry
```

```
         retval := dbms_ldap.add_s(user_session,user_dn,user_array);
         plg_debug('THE RETURN VALUE IS'||retval);
         if retval = 0 then
           rc := 0;
           errormsg:='No error occured while adding the entry';
         else
           rc := retval;
           errormsg :='Error code'||rc||' while adding the entry';
         end if;

      -- Free the mod_array
         dbms_ldap.free_mod_array(user_array);
         retval := dbms_ldap.unbind_s(user_session);

         plg_debug('FINISHED ADDING THE ENTRY');

   exception
 WHEN others THEN
   plg_debug (SQLERRM);
 end;
end adduser;
/
show error

exit;
```

Binary Operations with ldapcompare

The `ldapcompare` plug-in can use three new overloaded module interfaces to compare binary attributes. If you want to use these interfaces to develop a plug-in package that handles both binary and nonbinary attributes, you must include two separate procedures in the package. The package name for both procedures is the same because only one `orclPluginName` can be registered in the plug-in entry.

After updating an existing plug-in package to include a procedure that compares binary attributes, reinstall the package. Recompile packages that depend on the plug-in package.

The three new interfaces look like this:

```
PROCEDURE pre_compare (ldapplugincontext IN ODS.plugincontext,
                       dn          IN VARCHAR2,
                       attrname    IN VARCHAR2,
                       attrval     IN BLOB,
                       rc          OUT INTEGER,
                       errormsg    OUT VARCHAR2 );

PROCEDURE when_compare_replace (ldapplugincontext IN ODS.plugincontext,
                                result      OUT INTEGER,
                                dn          IN VARCHAR2,
                                attrname    IN VARCHAR2,
                                attrval     IN BLOB,
                                rc          OUT INTEGER,
                                errormsg    OUT VARCHAR2 );

PROCEDURE post_compare (ldapplugincontext IN ODS.plugincontext,
                        result      IN INTEGER,
                        dn          IN VARCHAR2,
                        attrname    IN VARCHAR2,
                        attrval     IN BLOB,
                        rc          OUT INTEGER,
```

```
                          errormsg    OUT VARCHAR2 );
```

The example that follows compares a binary attribute of an entry in the plug-in directory with a binary attribute of an entry in another directory. This package replaces the compare code of the server with the compare code of the plug-in. The package handles both binary and nonbinary attributes. As such it contains two separate procedures.

```
create or replace package compareattr as
   procedure when_compare_replace(ldapplugincontext IN ODS.plugincontext,
                          result OUT integer,
                          dn IN varchar2,
                          attrname IN VARCHAR2,
                          attrval IN BLOB,
                          rc OUT integer,
                          errormsg OUT varchar2);
   procedure when_compare_replace(ldapplugincontext IN ODS.plugincontext,
                          result OUT integer,
                          dn IN varchar2,
                          attrname IN VARCHAR2,
                          attrval IN varchar2,
                          rc OUT integer,
                          errormsg OUT varchar2);
end compareattr;
/
show error

CREATE OR REPLACE PACKAGE BODY compareattr AS
   procedure when_compare_replace(ldapplugincontext IN ODS.plugincontext,
                          result OUT integer,
                          dn IN varchar2,
                          attrname IN VARCHAR2,
                          attrval IN varchar2,
                          rc OUT integer,
                          errormsg OUT varchar2)
   is
   pos            INTEGER := 2147483647;
   begin
      plg_debug('START');
      plg_debug('THE ATTRNAME IS'||attrname||' AND THE VALUE IS'||attrval);
      plg_debug('END');
      rc := 0;
      errormsg :='No error!!!';
   exception
   WHEN others THEN
    plg_debug ('Unknown UTL_FILE Error');
   end;

   procedure when_compare_replace(ldapplugincontext IN ODS.plugincontext,
                          result OUT integer,
                          dn IN varchar2,
                          attrname IN VARCHAR2,
                          attrval IN BLOB,
                          rc OUT integer,
                          errormsg OUT varchar2)
   is
      counter pls_integer;
      retval pls_integer := -1;
      cmp_result integer;
      s integer;
```

```
   user_session DBMS_LDAP.session;
   user_entry DBMS_LDAP.message;
   user_message DBMS_LDAP.message;
   user_dn varchar(256);
   user_attrs DBMS_LDAP.string_collection;
   user_attr_name VARCHAR2(256);
   user_ber_elmt DBMS_LDAP.ber_element;
   user_vals DBMS_LDAP.blob_collection;
   ldap_host varchar(256);
   ldap_port varchar(256);
   ldap_user varchar(256);
   ldap_passwd varchar(256);
   ldap_base varchar(256);
begin
   ldap_host :='backup.us.oracle.com';
   ldap_port :='4000';
   ldap_user :='cn=orcladmin';
   ldap_passwd :='welcome';
   ldap_base := dn;

   plg_debug('STARTING COMPARISON IN WHEN REPLACE PLUG-IN');

     s := dbms_lob.getlength(attrval);
     plg_debug('THE NUMBER OF BYTES OF ATTRVAL'||s);

   -- Get a session
      user_session := dbms_ldap.init(ldap_host, ldap_port);

   -- Bind to the directory
      retval := dbms_ldap.simple_bind_s(user_session, ldap_user, ldap_passwd);

   -- issue the search
      user_attrs(1) := attrname;
      retval := DBMS_LDAP.search_s(user_session, ldap_base,
                                   DBMS_LDAP.SCOPE_BASE,
                                  'objectclass=*',
                                   user_attrs,
                                   0,
                                   user_message);

   -- Get the entry in the other OID server
      user_entry := DBMS_LDAP.first_entry(user_session, user_message);

   -- Log the DN and the Attribute name
      user_dn := DBMS_LDAP.get_dn(user_session, user_entry);
      plg_debug('THE DN IS'||user_dn);
      user_attr_name := DBMS_LDAP.first_attribute(user_session,user_entry,
      user_ber_elmt);

   -- Get the values of the attribute
      user_vals := DBMS_LDAP.get_values_blob(user_session, user_entry,
      user_attr_name);

   -- Start the binary comparison between the ATTRVAL and the attribute
   -- values
      if user_vals.count > 0 then
       for counter in user_vals.first..user_vals.last loop
         cmp_result := dbms_lob.compare(user_vals(counter),attrval,
                          dbms_lob.getlength(user_vals(counter)),1,1);
         if  cmp_result = 0 then
```

```
                rc := 0;
                -- Return LDAP_COMPARE_TRUE
                result := 6;
                plg_debug('THE LENGTH OF THE ATTR.'||user_attr_name||' IN THE
                ENTRY IS'||dbms_lob.getlength(user_vals(counter)));
                errormsg :='NO ERROR. THE COMPARISON HAS SUCCEEDED.';
                plg_debug(errormsg);
                plg_debug('FINISHED COMPARISON');
                return;
           end if;
         end loop;
       end if;

     rc := 1;
     -- Return LDAP_COMPARE_FALSE
        result := 5;
        errormsg :='ERROR. THE COMPARISON HAS FAILED.';
        plg_debug('THE LENGTH OF THE ATTR.'||user_attr_name||' IN THE ENTRY IS'
        ||dbms_lob.getlength(user_vals(user_vals.last)));
        plg_debug(errormsg);
        plg_debug('FINISHED COMPARISON');

     -- Free user_vals
        dbms_ldap.value_free_blob(user_vals);
        exception
        WHEN others THEN
          plg_debug (SQLERRM);
        end;
     end compareattr;
     /
     show error

     exit;
```

Database Object Types Defined

This section defines the object types introduced in the Plug-in LDAP API. All of these definitions are in Oracle Directory Server database schema. Note that the API includes object types that enable plug-ins to extract binary data from the database.

```
create or replace type strCollection as TABLE of VARCHAR2(512);
/
create or replace type pluginContext as TABLE of VARCHAR2(512);
/
create or replace type attrvalType as TABLE OF VARCHAR2(4000);
/
create or replace type attrobj as object (
attrname    varchar2(2000),
attrval     attrvalType
);
/
create or replace type attrlist as table of attrobj;
/
create or replace type binattrvalType as TABLE OF BLOB;
/
create or replace type binattrobj as object (
binattrname    varchar2(2000),
binattrval     binattrvalType
);
/
```

```
create or replace type binattrlist as table of binattrobj;
/
create or replace type entryobj as object (
entryname      varchar2(2000),
attr           attrlist,
binattr        binattrlist
);
/
create or replace type entrylist as table of entryobj;
/

create or replace type bvalobj as object (
length         integer,
val            varchar2(4000)
);
/
create or replace type bvallist as table of bvalobj;
/
create or replace type binvalobj as object (
length         integer,
binval         blob
);
/
create or replace type binvallist as table of binvalobj;
/
create or replace type modobj as object (
operation      integer,
type           varchar2(256),
vals           bvallist,
binvals        binvallist
);
/
create or replace type modlist as table of modobj;
```

Specifications for PL/SQL Plug-in Procedures

When you use the plug-ins, you must adhere to the signature defined for each of them. Each signature is provided here.

```
PROCEDURE pre_add (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
entry          IN  ODS.entryobj,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE when_add (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
entry          IN  ODS.entryobj,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE when_add_replace (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
entry          IN  ODS.entryobj,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);
```

```
PROCEDURE post_add (ldapplugincontext IN  ODS.plugincontext,
result         IN  INTEGER,
dn             IN  VARCHAR2,
entry          IN  ODS.entryobj,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE pre_modify (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
mods           IN  ODS.modlist,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE when_modify (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
mods           IN  ODS.modlist,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE when_modify_replace (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
mods           IN  ODS.modlist,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);


PROCEDURE post_modify (ldapplugincontext IN  ODS.plugincontext,
result         IN  INTEGER,
dn             IN  VARCHAR2,
mods           IN  ODS.modlist,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2);

PROCEDURE pre_compare (ldapplugincontext IN  ODS.plugincontext,
dn             IN  VARCHAR2,
attrname       IN  VARCHAR2,
attrval        IN  VARCHAR2,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);

PROCEDURE pre_compare (ldapplugincontext IN ODS.plugincontext,
dn             IN VARCHAR2,
attrname       IN VARCHAR2,
attrval        IN BLOB,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2 );

PROCEDURE when_compare_replace (ldapplugincontext IN  ODS.plugincontext,
result         OUT INTEGER,
dn             IN  VARCHAR2,
attrname       IN  VARCHAR2,
attrval        IN  VARCHAR2,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);
```

```
PROCEDURE when_compare_replace (ldapplugincontext IN ODS.plugincontext,
result          OUT INTEGER,
dn              IN VARCHAR2,
attrname        IN VARCHAR2,
attrval         IN BLOB,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2 );

PROCEDURE post_compare (ldapplugincontext IN  ODS.plugincontext,
result          IN  INTEGER,
dn              IN  VARCHAR2,
attrname        IN  VARCHAR2,
attrval         IN  VARCHAR2,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);

PROCEDURE post_compare (ldapplugincontext IN ODS.plugincontext,
result          IN INTEGER,
dn              IN VARCHAR2,
attrname        IN VARCHAR2,
attrval         IN BLOB,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2 );

PROCEDURE pre_delete (ldapplugincontext IN  ODS.plugincontext,
dn              IN  VARCHAR2,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);

PROCEDURE when_delete (ldapplugincontext IN  ODS.plugincontext,
dn              IN  VARCHAR2,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);
PROCEDURE when_delete_replace (ldapplugincontext IN  ODS.plugincontext,
dn              IN  VARCHAR2,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);

PROCEDURE post_delete (ldapplugincontext IN  ODS.plugincontext,
result          IN  INTEGER,
dn              IN  VARCHAR2,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);

PROCEDURE pre_search (ldapplugincontext IN  ODS.plugincontext,
baseDN          IN  VARCHAR2,
scope           IN  INTEGER,
filterStr       IN  VARCHAR2,
requiredAttr    IN  ODS.strCollection,
rc              OUT INTEGER,
errormsg        OUT VARCHAR2
);

PROCEDURE post_search (ldapplugincontext IN  ODS.plugincontext,
result          IN  INTEGER,
```

```
baseDN         IN  VARCHAR2,
scope          IN  INTEGER,
filterStr      IN  VARCHAR2,
requiredAttr   IN  ODS.strCollection,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);

PROCEDURE pre_bind (ldapplugincontext IN ODS.plugincontext,
dn             IN  VARCHAR2,
passwd         IN  VARCHAR2,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);

PROCEDURE when_bind_replace (ldapplugincontext IN ODS.plugincontext,
result         OUT INTEGER,
dn             IN  VARCHAR2,
passwd         IN  VARCHAR2,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);

PROCEDURE post_bind (ldapplugincontext IN ODS.plugincontext,
result         IN  INTEGER,
dn             IN  VARCHAR2,
passwd         IN  VARCHAR2,
rc             OUT INTEGER,
errormsg       OUT VARCHAR2
);
```

13

Java Server Plug-ins

In response to both customer and internal requests, Oracle has added a Java API to the server plug-in framework for Oracle Internet Directory 10*g* (10.1.4.0.1). Some of the new Oracle Internet Directory features, such as server chaining, were developed using the Java plug-in API.

This chapter contains the following sections:

- Advantages of Java Plug-ins
- Setting Up a Java Plug-in
- Java Plug-in API
- Java Plug-in Error and Exception Handling
- Java Plug-in Debugging and Logging
- Java Plug-in Examples

Advantages of Java Plug-ins

In addition to the advantages of the Java language itself, Java server plug-ins offer the following advantages over PL/SQL plug-ins:

- Bidirectional communication between the server and the plug-in
- The ability of the plug-in to return a search result
- Support for the `moddn` operation
- Better performance
- No knowledge of database required
- Enhanced security
- Enhanced debugging capability

Setting Up a Java Plug-in

Set up a Java plug-in as follows:

1. Create the standalone Java program using the pre-defined class definition and methods. You can implement the plug-in as a jar file or as a package.
2. Compile the plug-in file or package. Before compiling, ensure that your CLASSPATH is set to `$ORACLE_HOME/ldap/jlib/ospf.jar`. Make sure the compilation completes without error.

3. Place the class file, jar, or package in the pre-defined class location `$ORACLE_HOME/ldap/server/plugin`.
4. Register the Java plug-in by adding the plug-in configuration entry.

   You can add the entry by using the command line or by using Oracle Directory Manager. For details, see "Registering a Plug-in" on page 11-4.

The jar file can have any name. The manifest file must contain the attribute Main-Class, followed by the name of the Java plug-in. For example:

```
Main-Class: myjavaplugin
```

The value of the `orclPluginName` attribute in the plug-in configuration entry must correspond with one of the following:

- The name of a class in a class file
- The fully-qualified name of a class in a package
- A jar file name.

If you specify the name as `myjavaplugin`, the server will expect to find the corresponding class `$ORACLE_HOME/ldap/server/plugin/myjavaplugin.class`. If you specify the name as `myjavaplugin.jar` the server will expect to find the corresponding jar file `$ORACLE_HOME/ldap/server/plugin/myjavaplugin.jar`. If you specify the name `my.package.myjavaplugin`, the server will expect the path of the class to be `$ORACLE_HOME/ldap/server/plugin/my/package/myjavaplugin`.

Once you perform these steps, the server will invoke the plug-in whenever the invocation criteria are met.

The classes included in the jar file must not occur in the environment. If they do, unexpected errors might occur. To correct this problem, remove the classes from the environment and restart the Oracle Internet Directory server. If the JAR or class file depends on other JAR files or class files, then append the dependent JAR files or paths of the class files to the `CLASSPATH` and restart the Oracle Internet Directory server.

You can control whether the server reloads the Java plug-in class every time the plug-in executes. If the value of the attribute `orclPluginClassReloadEnabled` is 1, the server reloads the plug-in class every time. If it is 0, the server loads the class only the first time the plug-in executes.

The path of the Oracle Internet Directory Server Plug-in Framework jar file is `$ORACLE_HOME/ldap/jlib/ospf.jar`.

Java Plug-in API

This section presents a high-level overview of the API and explains the role of the main classes and interfaces. For detailed information about all the Java server plug-in classes and interfaces, please see the Javadoc *Oracle Internet Directory API Reference*.

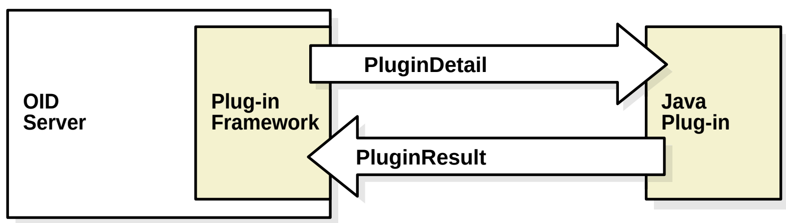
This sections contains the following topics:

Note: Do not use System.exit() in a Java plug-in. Doing so might lead to unpredictable behavior by the Oracle directory server.

Communication Between the Server and Plug-in

All Java plug-ins use the `ServerPlugin` interface for communication between the plug-in and the Oracle Internet Directory server. When the server invokes a Java plug-in, it constructs a `PluginDetail` object and passes information to the plug-in in that object. The plug-in constructs a `PluginResult` object. After it completes its task, the plug-in passes the `PluginResult` object back to the server. In some cases, the plug-in changes or adds to the information it received in the `PluginDetail` and passes the information back to the server in the `PluginResult` object. Figure 13–1 shows the communication between the Oracle Internet Directory server and the Java Plug-ins.

Figure 13–1 Communication Between the Server and the Java Plug-in



The Java plug-in can also use a `ServerLog` class to log messages in a log file for auditing purposes.

Java Plug-in Structure

The general structure for a Java plug-in is:

```
public class Java_Plug-in_Class_Name {extends
ServerPluginAdapter}  {
     public PluginResult
Name_of_ServerPlugin_Method(PluginDetail plgObj)
throws Exception {
      // Plug-in Code
      }
}
```

or

```
public class Java_Plug-in_Class_Name {implements
ServerPlugin}  {
     public PluginResult
Name_of_ServerPlugin_Method(PluginDetail plgObj)
throws Exception {
      // Plug-in Code
      }
}
```

PluginDetail

The `PluginDetail` contains the following information:

- Server

- LdapBaseEntry
- LdapOperation
- PluginFlexfield

Server

This object contains metadata information about the Oracle Internet Directory Server where the plug-in is being executed. It contains the following information:

- Hostname
- Port
- `LdapContext`

The Hostname and the Port indicate the host and port on which the server is running.

The `LdapContext` object allows the plug-in to connect back to the server and inform it that the connection is being acquired from the plug-in. This is necessary, for example, in an ldapbind plug-in that performs an ldapbind itself. By connecting back to the server using this `LdapContext` object, the plug-in prevents the server from invoking the same plug-in, resulting in an infinite loop.

The following code fragment shows how the plug-in retrieves the `Server` object from the `PluginDetail` and connects back to the server:

```
// An LDAP Bind Plug-in
public class MyBindPlugin extends ServerPluginAdapter
{
  …..
  // Retrieve the Server Object from the PluginDetail
  Server srvObj = plgObj.getServer();
  ……
  // This bind will not result in the LDAP Bind Plug-in being called
  // in an infinite loop
  InitialLdapContext myConn =

(InitialLdapContext)srvObj.getLdapContextFromServerPlugin();
  myConn.bind(…);
  ….
}
```

See the Javadoc *Oracle Internet Directory API Reference* for information about the methods used in the example.

LdapBaseEntry

The `LdapBaseEntry` contains the following information:

- DN
- Attributes

The server must send DN information for all of the operations, with the exception of ldapadd. The meaning of the DN for each operation is shown in Table 13–1.

Table 13–1 The Meaning of the DN Information for Each LDAP Operation

Operation	Meaning of DN
ldapadd	No DN sent
ldapbind	The entry to which the directory server is attempting to bind

Table 13–1 (Cont.) The Meaning of the DN Information for Each LDAP Operation

Operation	Meaning of DN
ldapcompare	The base entry on which to perform the compare
ldapdelete	For Pre and When timings, the entry which is to be deleted For Post timing, no DN sent
ldapmoddn	The base entry to be moved
ldapmodify	For Pre and When timings, the entry on which the modification is being performed For Post timing, the modified entry
ldapsearch	The base entry for the search

The Attributes are JNDI attributes.

The `LdapBaseEntry` has methods for accessing the DN and Attributes. For performance reasons, if the `LdapBaseEntry` is a group entry, and the entry cache capability is disabled, the attributes `uniquemember` and `member` are not accessible.

> **See Also:** The Tuning chapter in *Oracle Internet Directory Administrator's Guide* for information about performance tuning.

LdapOperation

Every plug-in is associated with one of the seven basic LDAP operations: add, bind, compare, delete, moddn, modify, or search. The `LdapOperation` object contains the following information, which is passed to all seven operations:

- Bind DN
- Server Controls
- Operation Result Code

The Bind DN is the DN of the identity that is requesting the LDAP operation. Server Controls is a vector that contains control information. If any server controls are passed to the server during an operation, then the control information is passed to the Java plug-in in the Server Controls. The meaning of the Operation Result Code depends on the timing of the operation, as shown in Table 13–1. Note that in the case of a when_replace operation, the plug-in can change the information in the Operation Result Code and pass it to the server in the `PluginResult`.

Table 13–2 Behavior of Operation Result Code

Plug-in Timing	Meaning and Behavior of Operation Result Code
Pre When	Not used
When_replace	Error status of the LDAP operation performed by the plug-in. Output from the plug-in to the server.
Post	Error status of LDAP operation performed by the server. Input to the plug-in from the server.

`LdapOperation` also has methods for retrieving and modifying its contents.

Seven different classes representing the seven LDAP operations extend the `LdapOperation` class. Each of the subclasses includes class-specific information, in addition to the `LdapOperation` information. The classes and class-specific information are shown in Table 13–3. Each class name in Table 13–3 is a link to the section describing the details of that class:

Table 13–3 Subclasses of LdapOperation and Class-specific information.

Class	Class-Specific information
AddLdapOperation	`LdapEntry`
BindLdapOperation	Bind Password
CompareLdapOperation	Attribute Name Attribute Value
DeleteLdapOperation	Delete DN
ModdnLdapOperation	New Parent DN New Relative DN Delete Old RDN New DN
ModifyLdapOperation	`LdapModification`
SearchLdapOperation	Filter Required Attributes Scope `SearchResultSet` (Not sent by server; created by plug-in to return data)

Each class has methods for creating, modifying, and retrieving its information. The class-specific information represents either input to the plug-in, output from the plug-in to the server, or both.

The rest of this section discusses the operation-specific classes in detail.

AddLdapOperation When invoking an ldapadd plug-in, the server constructs an `AddLdapOperation` object containing a `LdapEntry` object to pass information about the entry that is being added. The LdapEntry Object contains the following information:

- DN
- Attributes

The DN represents the DN of the entry to be added. The Attributes are the entry's JNDI Attributes. As Table 13–4 shows, for all operations except the post-operation, the plug-in can modify the information in the `LdapEntry` and return it to the server.

Table 13–4 Behavior of LdapEntry Information for Each Plug-in Timing

Plug-in Timing	Behavior of LdapEntry Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

BindLdapOperation The server passes the following information to an ldapbind plug-in:

- Bind Password

- Proxy Requester DN

Bind Password is the password for the bind. Proxy Requester DN is the DN of the identity requesting a Proxy Switch.

CompareLdapOperation The server passes the following information to an ldapcompare plug-in:

- Attribute Name
- Attribute Value

The Attribute Name is the name to be compared during the ldapcompare operation. As Table 13–5 shows, for all operations except the post-operation, the plug-in can modify the information in the Attribute Name and return it to the server.

Table 13–5 Behavior of the AttributeName for Each Plug-in Timing

Plug-in Timing	Behavior of the Attribute Name Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The Attribute Value is the value to be compared during the ldapcompare operation. As Table 13–6 shows, for all operations except the post-operation, the plug-in can modify the information in the Attribute Value and return it to the server.

Table 13–6 Behavior of the Attribute Value for Each Plug-in Timing

Plug-in Timing	Behavior of the Attribute Value Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

DeleteLdapOperation The server passes the Delete DN object to an ldapdelete plug-in. This is the DN to be deleted. As Table 13–7 shows, for all operations except the post-operation, the plug-in can modify the information in the Delete DN and return it to the server.

Table 13–7 Behavior of the Delete DN for Each Plug-in Timing

Plug-in Timing	Behavior of the DeleteDN Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

ModdnLdapOperation The server passes the following information to ldapmoddn plug-ins:

- New Parent DN
- New Relative DN

- Delete Old RDN
- New DN

The New Parent DN contains the new parent of the RDN that was specified in the `LdapBaseEntry` of the `PluginDetail`. As Table 13–8 shows, for all operations except the post-operation, the plug-in can modify the information in the New Parent DN and return it to the server.

Table 13–8 Behavior of New Parent DN Information for Each Plug-in Timing

Plug-in Timing	Behavior of the New Parent DN Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The New Relative DN is the new RDN that is to replace the RDN that was specified in the `LdapBaseEntry` of the `PluginDetail`. As Table 13–9 shows, for all operations except the post-operation, the plug-in can modify the information in the New Relative DN and return it to the server.

Table 13–9 Behavior of New Relative Dn Information for Each Plug-in Timing

Plug-in Timing	Behavior of the New Relative Dn Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The Delete Old RDN value specifies whether the old RDN specified in the `LdapBaseEntry` of the `PluginDetail` is to be retained after it is replaced by the new relative DN. As Table 13–10 shows, for all operations except the post-operation, the plug-in can modify the value in Delete Old RDN and return it to the server.

Table 13–10 Behavior of Delete Old RDN Information for Each Plug-in Timing

Plug-in Timing	Behavior of the Delete Old RDN Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The New DN specifies the target DN in of the ldapmoddn operation. This information is only an input from the server to the plug-in. The plug-in cannot modify this information and return it to the server.

ModifyLdapOperation The server passes an `LdapModification` object to ldapmodify plug-ins. The `LdapModification` object contains Modification Items, which are JNDI modification items. As Table 13–11 shows, for all operations except the post-operation, the plug-in can modify the information in the `LdapModification` and return it to the server.

Table 13–11 Behavior of LdapModification Information for Each Plug-in Timing

Plug-in Timing	Behavior of the LdapModification Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

SearchLdapOperation

The `SearchLdapOperation` object contains the following information:

- Filter
- Required Attributes
- Scope
- `SearchResultSet`

The Filter, Required Attributes, and Scope are passed by the server.

The Filter contains the LDAP search filter specified for the ldapsearch operation. This is only an input to the plug-in. The plug-in cannot modify this information and return it to the server.

The Required Attributes contains the required attributes specified for the ldapsearch operation. As Table 13–12 shows, for all operations except the post-operation, the plug-in can modify the information in the Required Attributes and return it to the server.

Table 13–12 Behavior of the Required Attributes for Each Plug-in Timing

Plug-in Timing	Behavior of the Required Attributes Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The Scope contains the scope of the search to be performed by the ldapsearch operation. As Table 13–13 shows, for all operations except the post-operation, the plug-in can modify the information in the Scope and return it to the server.

Table 13–13 Behavior of the Scope for Each Plug-in Timing

Plug-in Timing	Behavior of the Scope Information
Pre When When_replace	Both input and output. The plug-in can modify the information and return it to the server.
Post	Input only.

The `SearchResultSet` defines search results returned from the Java plug-in to the server. A plug-in performing an ldapsearch operation can construct this object. As

Table 13–14 shows, only the when and when_replace plug-ins can return a SearchResult Set to the server.

Table 13–14 Behavior of the SearchResultSet for Each Plug-in Timing

Plug-in Timing	Behavior of the SearchResultSet Information
Pre	The plug-in cannot return the object.
When When_replace	The plug-in can return this object to the server.
Post	The plug-in cannot return the object.

PluginFlexfield

When you register a plug-in, you can store custom information in the plug-in configuration entry. When the server invokes the plug-in, it passes this information to the plug-in in the `PluginFlexfield`.

There are three schema attributes for storing custom information in the configuration entry. You can store text information in the `orclPluginFlexfield` attribute. You can use sub-types to provide more meaning to the kind of custom information being stored. For example, you could use the subtype `orclPluginFlexfield;ad-host` to store the host name of an Active Directory server that the plug-in must connect to.

You can store a binary value in the attribute `orclPluginBinaryFlexfield` attribute. You can only store one value in `orclPluginBinaryFlexfield` for a plug-in because the server does not support attribute subtypes for binary attributes.

You can use `orclPluginSecuredFlexfield` to store custom text information that must never be displayed in clear text. The value is stored and displayed in encrypted form. Be sure that Oracle Internet Directory has privacy mode enabled to ensure that users cannot retrieve this attribute in clear text. See "Privacy of Retrieved Sensitive Attributes" in *Oracle Internet Directory Administrator's Guide*. You can use sub-types to provide more meaning to the kind of custom information being stored. Use the same subtype format as for `orclPluginFlexfield`.

When the server invokes the plug-in, it passes the information from the `orclPluginFlexfield`, `orclPluginBinaryFlexfield`, and `orclPluginSecuredFlexfield` to the plug-in in the `PluginFlexfield` object. The plug-in can interpret the information and use it. It cannot return the `PluginFlexfield` to the server.

In the following configuration entry example, subtypes of `orclPluginFlexfield` specify that the minimum password length is 8 characters, that the password must contain a digit, and that the password cannot contain repeated characters:

```
dn: cn=pre_add replace,cn=plugin,cn=subconfigsubentry
orclPluginFlexfield;minPwdLength: 8
orclPluginFlexfield;isDigitPwd: 1
orclPluginFlexfield;isRepeatCharsPwd: 0
objectclass: orclPluginConfig
objectclass: top
orclpluginname: MyJavaPwdCheckPlugin
orclplugintype: operational
orclplugintiming: pre
orclpluginldapoperation: ldapadd
orclpluginenable: 1
orclpluginsubscriberdnlist: cn=users,dc=us,dc=oracle,dc=com
orclpluginattributelist: userpassword
orclPluginKind: Java
```

PluginResult

To return the results of its execution to the server, a Java plug-in constructs a `PluginResult` object and passes it back to the server. The `PluginResult` contains one object: an `LdapOperation` or one of its operation-specific subclasses. These objects were described in the section "LdapOperation" on page 13-5. As explained in that section, for some operations and timings, the plug-in can modify the information in the "LdapOperation" subclass object it received in the `PluginDetail` and send that object back to the server in the `PluginResult`.

ServerPlugin Interface

All Java plug-ins use the `ServerPlugin` interface. The interface has pre-defined methods to communicate with the server. It has one method for each LDAP operation and timing. Each method takes a `PluginDetail` object as input and returns a `PluginResult` object back to the Oracle Internet Directory Server.

The `ServerPluginAdapter` class implements the `ServerPlugin` interface. The `ServerPluginAdapter` class has default (NULL) implementations of the `ServerPlugin` methods. This class enables you to code a Java plug-in without having to implement every method.

The rest of this section lists the `ServerPlugin` methods for each LDAP operation. It includes:

-
- ServerPlugin Methods for Ldapbind
- ServerPlugin Methods for Ldapcompare
- ServerPlugin Methods for Ldapadd
- ServerPlugin Methods for Ldapmodify
- ServerPlugin Methods for Ldapmoddn
- ServerPlugin Methods for Ldapsearch
- ServerPlugin Methods for Ldapdelete

ServerPlugin Methods for Ldapbind

```
public PluginResult pre_bind(PluginDetail pc) throws Exception;
public PluginResult when_bind_replace(PluginDetail pc) throws Exception;
public PluginResult post_bind(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapcompare

```
public PluginResult pre_compare(PluginDetail pc) throws Exception;
public PluginResult when_compare_replace(PluginDetail pc) throws Exception;
public PluginResult post_compare(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapadd

```
public PluginResult pre_add(PluginDetail pc) throws Exception;
public PluginResult when_add(PluginDetail pc) throws Exception;
public PluginResult when_add_replace(PluginDetail pc) throws Exception;
public PluginResult post_add(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapmodify

```
public PluginResult pre_modify(PluginDetail pc) throws Exception;
public PluginResult when_modify(PluginDetail pc) throws Exception;
public PluginResult when_modify_replace(PluginDetail pc) throws Exception;
public PluginResult post_modify(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapmoddn

```
public PluginResult pre_moddn(PluginDetail pc) throws Exception;
public PluginResult when_moddn(PluginDetail pc) throws Exception;
public PluginResult when_moddn_replace(PluginDetail pc) throws Exception;
public PluginResult post_moddn(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapsearch

```
public PluginResult pre_search(PluginDetail pc) throws Exception;
public PluginResult when_search(PluginDetail pc) throws Exception;
public PluginResult when_search_replace(PluginDetail pc) throws Exception;
public PluginResult post_search(PluginDetail pc) throws Exception;
```

ServerPlugin Methods for Ldapdelete

```
public PluginResult pre_delete(PluginDetail pc) throws Exception;
public PluginResult when_delete(PluginDetail pc) throws Exception;
public PluginResult when_delete_replace(PluginDetail pc) throws Exception;
public PluginResult post_delete(PluginDetail pc) throws Exception;Java plug-in AP
```

Java Plug-in Error and Exception Handling

The Oracle Internet Directory server catches all unhandled exceptions during the execution of the plug-in. The exception stack trace and message for each exception is logged in the server log file. These exceptions fall into three categories:

- Runtime errors and exceptions occur due to faulty plug-in code or logic. The server catches all runtime errors and exceptions, including `NullPointerExceptions`, raised during the execution of the Java plug-in. These errors and exceptions are logged in the server log file.
- Expected exceptions thrown by the plug-in are logged in the Oracle Internet Directory server log file. In addition, a plug-in can catch an exception and throw it back to the server to log it in the server log file.
- A plug-in can use the `PluginException` class to raise an error. The error message passed to the server with the `PluginException` object or its subclasses is passed on to the LDAP client. The server also logs this message in the server log file along with the exception stack trace and message.

This section includes three examples. They are:

- Runtime Exception Example
- Runtime Error Example
- PluginException Example

Runtime Exception Example

The log entry for a typical exception raised during execution of a plug-in looks something like this:

```
….
```

```
06:17:03 *
    ERROR * gslpg_exceptionHndlr * Exception Message : Error
    ERROR * gslpg_exceptionHndlr * Exception Stack Trace :
              MyCompareJavaPlugin.post_compare(Prog2.java:75)
END

BEGIN
2004/10/19:01:52:13 *
    ServerWorker (REG):4 * ConnID:0 * OpID:1 * OpName:compare
    ERROR * gslpg_exceptionHndlr * Exception Stack Trace :
               java.lang.NullPointerException
              java.util.Hashtable.put(Hashtable.java:393)
               oracle.ldap.ospf.PluginDetail.put(PluginDetail.java:41)
END
```

Runtime Error Example

The error occured because the plug-in `MyJavaPlugin` did not exist in the `$ORACLE_HOME/ldap/server/plugin` directory. The log file entry looks like this:

```
BEGIN
2004/10/19:01:52:13 *
    ServerWorker (REG):4 * ConnID:0 * OpID:1 * OpName:compare
    ERROR * gslpg_exceptionHndlr * Exception Stack Trace :
               java.lang.NoClassDefFoundError: MyJavaPlugin
END
```

PluginException Example

The Oracle Internet Directory server returns the standard plug-in error message to the LDAP client along with the additional error message if a `PluginException` object is thrown back to the server. The error displayed by the LDAP client looks something like this:

```
ldap_compare: UnKnown Error Encountered
ldap_compare: additional info: Error Message returned by the Java Plug-in
```

Java Plug-in Debugging and Logging

A plug-in can maintain its own log file and log to it in real time. In addition, a plug-in can log debug messages in the Oracle Internet Directory server log file during execution by using the `ServerLog` class. The method for logging messages in the `ServerLog` class is:

```
public static void log(String message);
```

Messages logged by the `ServerLog.log()` method are preceded by the string:

```
* Server Java Plug-in *
```

For example:

```
2006/05/11:01:11:28 * ServerWorker (REG):7
  ConnID:241 * mesgID:2 * OpID:1 * OpName:bind
01:11:28 * Server Java Plug-in * MESSAGE FROM PLUGIN
01:11:28 * Server Java Plug-in * Bind DN :
 cn=ad_user,cn=oiddvusers,cn=oraclecontext,dc=us,dc=oracle,dc=com
```

To log plug-in debug messages to the server log, you must start the Oracle Internet Directory server using one of the following debug levels:

Table 13–15 Debug Levels for Java Plug-in Logging

Oracle Internet Directory Server Debug Level	Debug Level Meaning
134217728	All Java plug-in debug messages and internal server messages related to the Java plug-in framework
268435456	All messages passed by a Java plug-in using the `ServerLog` object.
402653184	Both of the above

The `ServerLog.log()` method is thread safe. Execution of this method can degrade performance.

Java Plug-in Examples

This sections includes two examples. They are:

- Example 1: Password Validation Plug-in
- Example 2: External Authentication Plug-in for Active Directory

---

Note: Do not use System.exit() in a Java plug-in. Doing so might lead to unpredictable behavior by the Oracle directory server.

Example 1: Password Validation Plug-in

This example illustrates a Java plug-in that validates a `userPassword` prior to the ldapmodify operation. A `pre` Java plug-in is registered with the Oracle Internet Directory server. The plug-in configuration includes the minimum password length to be checked for in the plug-in. This information is registered in the plug-in configuration entry using an `orclPluginFlexfield` attribute. The subtype `minPwdLength` specifies the minimum length. This information is passed to the plug-in using the `PluginFlexfield`. The `orclPluginName` specifies the name of the Java Plug-in to be invoked by the Oracle Internet Directory server.

The input to the plug-in is a `PluginDetail` and the output from the plug-in is a `PluginResult`.

Password Validation Plug-in Configuration Entry

```
dn: cn=checkuserpassword,cn=plugin,cn=subconfigsubentry
orclPluginFlexfield;minPwdLength: 8
objectclass: orclPluginConfig
objectclass: top
orclpluginname: CheckPassword
orclplugintype: operational
orclplugintiming: pre
orclpluginldapoperation: ldapmodify
orclpluginenable: 1
orclpluginsubscriberdnlist: cn=users,dc=us,dc=oracle,dc=com
orclpluginattributelist: userPassword
orclPluginKind: Java
```

Password Validation Plug-in Code Example

```
import java.io.*;
import java.lang.*;
import java.util.*;
import javax.naming.*;
import javax.naming.directory.*;
import oracle.ldap.ospf.*;
/**
 * This PRE modify plug-in will check whether the "userPassword"
 * is greater than 8 characters in length
 */
public class CheckPassword extends ServerPluginAdapter {

    // This PRE modify plug-in takes in a PluginDetail Object
    // and returns a PluginResult Object
    public PluginResult pre_modify(PluginDetail plgObj)
       throws Exception
    {
       try {
         // Retrieve the LdapOperation Object from the PluginDetail
         ModifyLdapOperation opObj = (ModifyLdapOperation)
plgObj.getLdapOperation();


         // Retrieve the LdapModification Object from the LdapOperation
            LdapModification modObj = opObj.getLdapModification();



         // Retrieve the PluginFlexfield Object from the PluginDetail
         PluginFlexfield flxFldObj = plgObj.getPluginFlexfield();

         // Retrieve the custom information from the PluginFlexfield
         // Get the minimum password length
 String passwdlength =
            flxFldObj.getFlexfield("minPwdLength");

        // Create a Result Object to return to the OID server
           PluginResult plgResObj = new PluginResult();

         // Check if the LdapModification Object is a NULL
         // set the appropriate error and error message
         if (modObj==null)
         {
            throw new PluginException("CheckPassword Plug-in Execution
Error");
         }

          // Retrieve the "userPassword" Attribute Value
         ModificationItem modItem = modObj.getModificationItemAt(0);
         BasicAttribute attr = (BasicAttribute)modItem.getAttribute();
         String attrval = null;
          if ((attr.getID()).equals("userpassword"))
     attrval = attr.get(0);

         // Check for the password length and set appropriate error
         // and error message
          if (attrval.length() < Integer.parseInt(passwdlength))
         {
             throw new PluginException("userPassword is less than 8
```

```
characters");
         }

        // Return the PluginResult Object to the OID Server
        return plgResObj;
    }
    // Catch any unexpected exception which may occur and throw
    // it back to the OID server to log it
    catch (Exception e)
    {
        throw e;
    }
  }
}
```

Example 2: External Authentication Plug-in for Active Directory

This example illustrates an external authentication plug-in for Active Directory. When a client requests an ldapcompare operation for `userPassword`, the server invokes this Java plug-in to authenticate the user against Active Directory.

External Authentication Plug-in Configuration Entry

```
dn: cn=when_rep_comp,cn=plugin,cn=subconfigsubentry
orclpluginsubscriberdnlist: cn=users,dc=us,dc=oracle,dc=com;
orclpluginflexfield;ad-host: dlin-pc2.us.oracle.com
orclpluginflexfield;ad-port: 389
orclpluginflexfield;ad-su-dn: administrator@dlin.net
orclpluginflexfield;ad-su-passwd: welcome1
objectclass: orclPluginConfig
objectclass: top
orclpluginname: ExtAuthAD
orclplugintype: operational
orclplugintiming: when
orclpluginisreplace: 1
orclpluginldapoperation: ldapcompare
orclpluginversion: 1.0.1
cn: when_rep_comp
orclpluginkind: Java
orclpluginenable: 1
```

External Authentication Plug-in Code

```
public class ExtAuthAD extends ServerPluginAdapter {

public PluginResult when_compare_replace(PluginDetail plgObj)
   throws Exception {
   try {

       // Retrieve the LdapOperation from the PluginDetail
      LdapOperation opObj = (CompareLdapOperation) plgObj.getLdapOperation();


       // Retrieve the Base DN, Attribute and Attribute Value
      String bdn = opObj.getBaseDN().substring(0,
             opObj.getBaseDN().lastIndexOf("cn=users,dc=us,dc=oracle,dc=com")-1)
             +",cn=users,dc=dlin,dc=net";
       String ban = opObj.getAttributeName();
       String bav = opObj.getAttributeValue();
```

```
        // Retrieve the AD Information from the PluginFlexfield
        PluginFlexfield flxObj = plgObj.getPluginFlexfield();
        String adhost = flxObj.getFlexfield("ad-host");
        String adport = flxObj.getFlexfield("ad-port");
        String adsudn = flxObj.getFlexfield("ad-su-dn");
        String adsupasswd = flxObj.getFlexfield("ad-su-passwd");


        // Create a PluginResult Object to return to the OID server
        PluginResult plgResObj = new PluginResult();


        // Create a Hashtable with values required to connect to AD
        Hashtable env = new Hashtable();

        env.put(Context.INITIAL_CONTEXT_FACTORY,
                "com.sun.jndi.ldap.LdapCtxFactory");
        env.put(Context.PROVIDER_URL, "ldap://"+adhost+":"+adport);
        env.put(Context.SECURITY_AUTHENTICATION, "simple");
        env.put(Context.SECURITY_PRINCIPAL, bdn);
        env.put(Context.SECURITY_CREDENTIALS, bav);

        // Try to connect to AD
        DirContext dirContext = null;
        try {
          dirContext = new InitialDirContext(env);
          if (dirContext != null) {
              // User has been successfully authenticated, add the appropriate
              // result code to the LdapOperation
              opObj.setOperationResultCode(6);
          }
        }
        catch(NamingException ne) {
         // Unable to connect to the AD directory server with the given
         // credentials, add the appropriate result code to the LdapOperation
          opObj.setOperationResultCode(5);
        }

        // Add the LdapOperation to the PluginResult
        plgResObj.addLdapOperation(opObj);

        // Return the PluginResult
        return plgResObj;

   } catch(Exception e) {
      // In case of any unexpected errors in the plug-in, throw the Exception
      // back to the OID server to log it
      throw e;
    }
   }
  }
```

Part III

Oracle Internet Directory Programming Reference

Part III presents the standard APIs and the Oracle extensions to these APIs. It contains these chapters:

14

C API Reference

This chapter introduces the Oracle Internet Directory C API and provides examples of how to use it.

The chapter contains these topics:

- About the Oracle Internet Directory C API
- Functions in the C API
- Sample C API Usage
- Required Header Files and Libraries for the C API
- Dependencies and Limitations of the C API

About the Oracle Internet Directory C API

The Oracle Internet Directory SDK C API is based on LDAP Version 3 C API and Oracle extensions to support SSL.

You can use the Oracle Internet Directory API 10*g* (10.1.4.0.1) in the following modes:

- SSL—All communication secured by using SSL
- Non-SSL—Client/server communication not secure

The API uses TCP/IP to connect to a directory server. When it does this, it uses, by default, an unencrypted channel. To use the SSL mode, you must use the Oracle SSL call interface. You determine which mode you are using by the presence or absence of the SSL calls in the API usage. You can easily switch between SSL and non-SSL modes.

> **See Also:** "Sample C API Usage" on page 14-40 for more details on how to use the two modes.

This section contains these topics:

- Oracle Internet Directory SDK C API SSL Extensions
- The Functions at a Glance

Oracle Internet Directory SDK C API SSL Extensions

Oracle SSL extensions to the LDAP API are based on standard SSL protocol. The SSL extensions provide encryption and decryption of data over the wire and authentication.

There are three modes of authentication:

- None—Neither client nor server is authenticated, and only SSL encryption is used
- One-way—Only the server is authenticated by the client
- Two-way—Both the server and the client are authenticated by each other

The type of authentication is indicated by a parameter in the SSL interface call.

SSL Interface Calls

There is only one call required to enable SSL:

```
int ldap_init_SSL(Sockbuf *sb, char *sslwallet, char *sslwalletpasswd, int
sslauthmode)
```

The `ldap_init_SSL` call performs the necessary handshake between client and server using the standard SSL protocol. If the call is successful, then all subsequent communication happens over a secure connection.

Table 14–1 Arguments for SSL Interface Calls

Argument	Description
`sb`	Socket buffer handle returned by the `ldap_open` call as part of LDAP handle.
`sslwallet`	Location of the user wallet.
`sslwalletpasswd`	Password required to use the wallet.
`sslauthmode`	SSL authentication mode user wants to use. Possible values are: ■ `GSLC_SSL_NO_AUTH`—No authentication required ■ `GSLC_SSL_ONEWAY_AUTH`—Only server authentication required. ■ `GSLC_SSL_TWOWAY_AUTH`—Both server and client authentication required. A return value of `0` indicates success. A nonzero return value indicates an error. The error code can be decoded by using the function `ldap_err2string`.

See Also: "Sample C API Usage" on page 14-40.

Wallet Support

depending on which authentication mode is being used, both the server and the client may require wallets to use the SSL feature. 10*g* (10.1.4.0.1) of the API supports only the Oracle Wallet. You can create wallets by using Oracle Wallet Manager.

Functions in the C API

This section examines each of the functions and procedures in the C API. It explains their purpose and syntax. It also provides tips for using them.

The section contains the following topics:

- The Functions at a Glance
- Initializing an LDAP Session
- LDAP Session Handle Options
- Authenticating to the Directory

- SASL Authentication Using Oracle Extensions
- Working With Controls
- Closing the Session
- Performing LDAP Operations
- Abandoning an Operation
- Obtaining Results and Peeking Inside LDAP Messages
- Handling Errors and Parsing Results
- Stepping Through a List of Results
- Parsing Search Results

The Functions at a Glance

Table 14–2 lists all of the functions and procedures in the C API and briefly explains their purpose.

Table 14–2 Functions and Procedures in the C API

Function or Procedure	Description
ber_free	Free the memory allocated for a BerElement structure
ldap_abandon_ext ldap_abandon	Cancel an asynchronous operation
ldap_add_ext ldap_add_ext_s ldap_add ldap_add_s	Add a new entry to the directory
ldap_compare_ext ldap_compare_ext_s ldap_compare ldap_compare_s	Compare entries in the directory
ldap_count_entries	Count the number of entries in a chain of search results
ldap_count_values	Count the string values of an attribute
ldap_count_values_len	Count the binary values of an attribute
ora_ldap_create_clientctx	Create a client context and returns a handle to it.
ora_ldap_create_cred_hdl	Create a credential handle.
ldap_delete_ext ldap_delete_ext_s ldap_delete ldap_delete_s	Delete an entry from the directory
ora_ldap_destroy_clientctx	Destroy the client context.
ora_ldap_free_cred_hdl	Destroy the credential handle.
ldap_dn2ufn	Converts the name into a more user friendly format
ldap_err2string	Get the error message for a specific error code
ldap_explode_dn ldap_explode_rdn	Split up a distinguished name into its components
ldap_first_attribute	Get the name of the first attribute in an entry

Table 14–2 (Cont.) Functions and Procedures in the C API

Function or Procedure	Description
`ldap_first_entry`	Get the first entry in a chain of search results
`ora_ldap_get_cred_props`	Retrieve properties associated with credential handle.
`ldap_get_dn`	Get the distinguished name for an entry
`ldap_get_option`	Access the current value of various session-wide parameters
`ldap_get_values`	Get the string values of an attribute
`ldap_get_values_len`	Get the binary values of an attribute
`ldap_init` `ldap_open`	Open a connection to an LDAP server
`ora_ldap_init_SASL`	Perform SASL authentication
`ldap_memfree`	Free memory allocated by an LDAP API function call

`ldap_modify_ext`
`ldap_modify_ext_s`
`ldap_modify`
`ldap_modify_s`
	Modify an entry in the directory

`ldap_msgfree`	Free the memory allocated for search results or other LDAP operation results
`ldap_first_attribute` `ldap_next_attribute`	Get the name of the next attribute in an entry
`ldap_next_entry`	Get the next entry in a chain of search results
`ldap_perror` (Deprecated)	Prints the message supplied in message.
`ldap_rename` `ldap_rename_s`	Modify the RDN of an entry in the directory
`ldap_result2error` (Deprecated)	Return the error code from result message.

`ldap_result`
`ldap_msgfree`
`ldap_msgtype`
`ldap_msgid`
	Check the results of an asynchronous operation

`ldap_sasl_bind` `ldap_sasl_bind_s`	General authentication to an LDAP server

`ldap_search_ext`
`ldap_search_ext_s`
`ldap_search`
`ldap_search_s`
	Search the directory

`ldap_search_st`	Search the directory with a timeout value
`ldap_get_option` `ldap_set_option`	Set the value of these parameters
`ora_ldap_set_clientctx`	Add properties to the client context handle.
`ora_ldap_set_cred_props`	Add properties to credential handle.

Table 14–2 (Cont.) Functions and Procedures in the C API

Function or Procedure	Description
ldap_simple_bind ldap_simple_bind_s ldap_sasl_bind ldap_sasl_bind_s	Simple authentication to an LDAP server
ldap_unbind_ext ldap_unbind ldap_unbind_s	End an LDAP session
ldap_value_free	Free the memory allocated for the string values of an attribute
ldap_value_free ldap_value_free_len	Free the memory allocated for the binary values of an attribute

This section lists all the calls available in the LDAP C API found in RFC 1823.

> **See Also:** The following URL for a more detailed explanation of these calls:
>
> http://www.ietf.org

Initializing an LDAP Session

The calls in this section initialize a session with an LDAP server.

ldap_init and ldap_open

`ldap_init()` initializes a session with an LDAP server, but does not open a connection. The server is not actually contacted until an operation is performed that requires it, allowing various options to be set after initialization. `ldap_open()` initializes a session and opens a connection. The two fulfill the same purpose and have the same syntax, but the first is preferred.

Syntax

```
LDAP *ldap_init
(
    const char      *hostname,
    int             portno
)
;
```

Parameters

Table 14–3 Parameters for Initializing an LDAP Session

Parameter	Description
hostname	Contains a space-separated list of host names or dotted strings representing the IP address of hosts running an LDAP server to connect to. Each host name in the list may include a port number. The two must be separated by a colon. The hosts are tried in the order listed until a successful connection occurs. Note: A suitable representation for including a literal IPv6[10] address in the host name parameter is desired, but has not yet been determined or implemented in practice.

Table 14–3 (Cont.) Parameters for Initializing an LDAP Session

Parameter	Description
portno	Contains the TCP port number to connect to. The default LDAP port of 389 can be obtained by supplying the constant LDAP_PORT. If hostname includes a port number, portno is ignored.

Usage Notes

`ldap_init()` and `ldap_open()` both return a session handle. This is a pointer to an opaque structure that must be passed to subsequent calls pertaining to the session. These routines return `NULL` if the session cannot be initialized. If the session cannot be initialized, check the error reporting mechanism for the operating system to see why the call failed.

Note that if you connect to an LDAPv2 server, one of the LDAP bind calls described later SHOULD be completed before other operations can be performed on the session. LDAPv3 does not require that a bind operation be completed before other operations are performed.

The calling program can set various attributes of the session by calling the routines described in the next section.

LDAP Session Handle Options

The LDAP session handle returned by `ldap_init()` is a pointer to an opaque data type representing an LDAP session. In RFC 1823 this data type was a structure exposed to the caller, and various fields in the structure could be set to control aspects of the session, such as size and time limits on searches.

In the interest of insulating callers from inevitable changes to this structure, these aspects of the session are now accessed through a pair of accessor functions, described in this section.

ldap_get_option and ldap_set_option

`ldap_get_option()` is used to access the current value of various session-wide parameters. `ldap_set_option()` is used to set the value of these parameters. Note that some options are read only and cannot be set; it is an error to call `ldap_set_option()` and attempt to set a read only option.

Note that if automatic referral following is enabled (the default), any connections created during the course of following referrals will inherit the options associated with the session that sent the original request that caused the referrals to be returned.

Syntax

```
int ldap_get_option
(
LDAP            *ld,
int             option,
void            *outvalue
)
;

int ldap_set_option
(
LDAP            *ld,
int             option,
const void      *invalue
```

```
)
;

#define LDAP_OPT_ON     ((void *)1)
#define LDAP_OPT_OFF    ((void *)0)
```

Parameters

Table 14–4 lists and describes the parameters for LDAP session handle options.

Table 14–4 Parameters for LDAP Session Handle Options

Parameters	Description
ld	The session handle. If this is NULL, a set of global defaults is accessed. New LDAP session handles created with ldap_init() or ldap_open() inherit their characteristics from these global defaults.
option	The name of the option being accessed or set. This parameter should be one of the constants listed and described in Table 14–5 on page 14-7. The hexadecimal value of the constant is listed in parentheses after the constant.
outvalue	The address of a place to put the value of the option. The actual type of this parameter depends on the setting of the option parameter. For outvalues of type char ** and LDAPControl **, a copy of the data that is associated with the LDAP session ld is returned. Callers should dispose of the memory by calling ldap_memfree() or ldap_controls_free(), depending on the type of data returned.
invalue	A pointer to the value the option is to be given. The actual type of this parameter depends on the setting of the option parameter. The data associated with invalue is copied by the API implementation to allow callers of the API to dispose of or otherwise change their copy of the data after a successful call to ldap_set_option(). If a value passed for invalue is invalid or cannot be accepted by the implementation, ldap_set_option() should return -1 to indicate an error.

Constants

Table 14–5 on page 14-7 lists and describes the constants for LDAP session handle options.

Table 14–5 Constants

Constant	Type for invalue parameter	Type for outvalue parameter	Description
LDAP_OPT_API_INFO(0x00)	Not applicable. Option is read only.	LDAPAPIInfo*	Used to retrieve some basic information about the LDAP API implementation at execution time. Applications need to be able to determine information about the particular API implementation they are using both at compile time and during execution. This option is read only and cannot be set.
ORA_LDAP_OPT_RFRL_CACHE	void* (LDAP_OPT_ON void* (LDAP_OPT_OFF)	int *	This option determines whether referral cache is enabled or not. If this option is set to LDAP_OPT_ON, the cache is enabled; otherwise, the cache is disabled.
ORA_LDAP_OPT_RFRL_CACHE_SZ	int *	int *	This option sets the size of referral cache. The size is maximum size in terms of number of bytes the cache can grow to. It is set to 1MB by default.

Table 14–5 (Cont.) Constants

Constant	Type for invalue parameter	Type for outvalue parameter	Description
LDAP_OPT_DEREF(0x02)	int *	int *	Determines how aliases are handled during search. It should have one of the following values: LDAP_DEREF_NEVER (0x00), LDAP_DEREF SEARCHING (0x01), LDAP_DEREF_FINDING (0x02), or LDAP_DEREF_ALWAYS (0x03). The LDAP_DEREF_SEARCHING value means aliases are dereferenced during the search but not when locating the base object of the search. The LDAP_DEREF_FINDING value means aliases are dereferenced when locating the base object but not during the search. The default value for this option is LDAP_DEREF_NEVER.
LDAP_OPT_SIZELIMIT(0x03)	int *	int *	A limit on the number of entries to return from a search. A value of LDAP_NO_LIMIT (0) means no limit. The default value for this option is LDAP_NO_LIMIT.
LDAP_OPT_TIMELIMIT(0x04)	int *	int *	A limit on the number of seconds to spend on a search. A value of LDAP_NO_LIMIT (0) means no limit. This value is passed to the server in the search request only; it does not affect how long the C LDAP API implementation itself will wait locally for search results. The timeout parameter passed to ldap_search_ext_s() or ldap_result()—both of which are described later in this document—can be used to specify both a local and server side time limit. The default value for this option is LDAP_NO_LIMIT.
LDAP_OPT_REFERRALS(0x08)	void *(LDAP_OPT_ON) void *(LDAP_OPT_OFF)	int *	Determines whether the LDAP library automatically follows referrals returned by LDAP servers or not. It may be set to one of the constants LDAP_OPT_ON or LDAP_OPT_OFF. Any non-null pointer value passed to ldap_set_option() enables this option. When the current setting is read using ldap_get_option(), a zero value means off and any nonzero value means on. By default, this option is turned on.
LDAP_OPT_RESTART(0X09)	void * (LDAP_OPT_ON) void * (LDAP_OPT_OFF)	int *	Determines whether LDAP input and output operations are automatically restarted if they stop prematurely. It may be set to either LDAP_OPT_ON or LDAP_OPT_OFF. Any non-null pointer value passed to ldap_set_option() enables this option. When the current setting is read using ldap_get_option(), a zero value means off and any nonzero value means on. This option is useful if an input or output operation can be interrupted prematurely—by a timer going off, for example. By default, this option is turned off.

Table 14–5 (Cont.) Constants

Constant	Type for invalue parameter	Type for outvalue parameter	Description
LDAP_OPT_PROTOCOL_ VERSION(0x11)	int *	int *	This option indicates the version of the LDAP protocol used when communicating with the primary LDAP server. The option should be either LDAP_VERSION2 (2) or LDAP_VERSION3 (3). If no version is set, the default is LDAP_VERSION2 (2).
LDAP_OPT_SERVER_ CONTROLS(0x12)	LDAPControl**	LDAPControl***	A default list of LDAP server controls to be sent with each request. **See Also:** "Working With Controls" on page 14-14.
LDAP_OPT_CLIENT_ CONTROLS(0x13)	LDAPControl**	LDAPControl***	A default list of client controls that affect the LDAP session. **See Also:** "Working With Controls" on page 14-14.
LDAP_OPT_API_ FEATURE_INFO(0x15)	Not applicable. Option is read only.	LDAPAPIFeatureInfo *	Used to retrieve version information about LDAP API extended features at execution time. Applications need to be able to determine information about the particular API implementation they are using both at compile time and during execution. This option is read only. It cannot be set.
LDAP_OPT_HOST_ NAME(0x30)	char *	char **	The host name (or list of hosts) for the primary LDAP server. See the definition of the hostname parameter for ldap_ init() to determine the syntax.
LDAP_OPT_ERROR_ NUMBER(0x31)	int *	int *	The code of the most recent LDAP error during this session.
LDAP_OPT_ERROR_ STRING(0x32)	char *	-	The message returned with the most recent LDAP error during this session.
LDAP_OPT_MATCHED_ DN(0x33)	char *	char **	The matched DN value returned with the most recent LDAP error during this session.

Usage Notes

Both ldap_get_option() and ldap_set_option() return 0 if successful and -1 if an error occurs. If -1 is returned by either function, a specific error code may be retrieved by calling ldap_get_option() with an option value of LDAP_OPT_ERROR_NUMBER. Note that there is no way to retrieve a more specific error code if a call to ldap_get_option() with an option value of LDAP_OPT_ERROR_NUMBER fails.

When a call to ldap_get_option() succeeds, the API implementation MUST NOT change the state of the LDAP session handle or the state of the underlying implementation in a way that affects the behavior of future LDAP API calls. When a call to ldap_get_option() fails, the only session handle change permitted is setting the LDAP error code (as returned by the LDAP_OPT_ERROR_NUMBER option).

When a call to ldap_set_option() fails, it must not change the state of the LDAP session handle or the state of the underlying implementation in a way that affects the behavior of future LDAP API calls.

Standards track documents that extend this specification and specify new options should use values for option macros that are between 0x1000 and 0x3FFF inclusive. Private and experimental extensions should use values for the option macros that are between 0x4000 and 0x7FFF inclusive. All values less than 0x1000 and greater than 0x7FFF that are not defined in this document are reserved and should not be used. The following macro must be defined by C LDAP API implementations to aid extension implementers:

```
#define LDAP_OPT_PRIVATE_EXTENSION_BASE 0x4000  /* to 0x7FFF inclusive */
```

Authenticating to the Directory

The functions in this section are used to authenticate an LDAP client to an LDAP directory server.

ldap_sasl_bind, ldap_sasl_bind_s, ldap_simple_bind, and ldap_simple_bind_s

The `ldap_sasl_bind()` and `ldap_sasl_bind_s()` functions can be used to do general and extensible authentication over LDAP through the use of the Simple Authentication Security Layer. The routines both take the DN to bind as, the method to use, as a dotted-string representation of an object identifier (OID) identifying the method, and a `struct berval` holding the credentials. The special constant value `LDAP_SASL_SIMPLE (NULL)` can be passed to request simple authentication, or the simplified routines `ldap_simple_bind()` or `ldap_simple_bind_s()` can be used.

Syntax

```
int ldap_sasl_bind
(
LDAP                    *ld,
const char              *dn,
const char              *mechanism,
const struct berval     *cred,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls,
int                     *msgidp
);

int ldap_sasl_bind_s(
LDAP                    *ld,
const char              *dn,
const char              *mechanism,
const struct berval     *cred,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls,
struct berval           **servercredp
);


int ldap_simple_bind(
LDAP                    *ld,
const char              *dn,
const char              *passwd
);


int ldap_simple_bind_s(
LDAP                    *ld,
const char              *dn,
```

```
const char              *passwd
);
```

The use of the following routines is deprecated and more complete descriptions can be found in RFC 1823:

- `int ldap_bind( LDAP *ld, const char *dn, const char *cred, int method );`
- `int ldap_bind_s( LDAP *ld, const char *dn, const char *cred, int method );`
- `int ldap_kerberos_bind( LDAP *ld, const char *dn );`
- `int ldap_kerberos_bind_s( LDAP *ld, const char *dn );`

Parameters

Table 14–6 lists and describes the parameters for authenticating to the directory.

Table 14–6 Parameters for Authenticating to the Directory

Parameter	Description
`ld`	The session handle
`dn`	The name of the entry to bind as
`mechanism`	Either `LDAP_SASL_SIMPLE (NULL)` to get simple authentication, or a text string identifying the SASL method
`cred`	The credentials with which to authenticate. Arbitrary credentials can be passed using this parameter. The format and content of the credentials depends on the setting of the mechanism parameter.
`passwd`	For `ldap_simple_bind()`, the password to compare to the entry's userPassword attribute
`serverctrls`	List of LDAP server controls
`clientctrls`	List of client controls
`msgidp`	This result parameter will be set to the message id of the request if the `ldap_sasl_bind()` call succeeds
`servercredp`	This result parameter will be filled in with the credentials passed back by the server for mutual authentication, if given. An allocated `berval` structure is returned that should be disposed of by calling `ber_bvfree()`. `NULL` should be passed to ignore this field.

Usage Notes

Additional parameters for the deprecated routines are not described. Interested readers are referred to RFC 1823.

The `ldap_sasl_bind()` function initiates an asynchronous bind operation and returns the constant `LDAP_SUCCESS` if the request was successfully sent, or another LDAP error code if not. If successful, `ldap_sasl_bind()` places the message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the result of the bind.

The `ldap_simple_bind()` function initiates a simple asynchronous bind operation and returns the message id of the operation initiated. A subsequent call to `ldap_result()`, described in, can be used to obtain the result of the bind. In case of error, `ldap_simple_bind()` will return `-1`, setting the session error parameters in the LDAP structure appropriately.

The synchronous `ldap_sasl_bind_s()` and `ldap_simple_bind_s()` functions both return the result of the operation, either the constant `LDAP_SUCCESS` if the operation was successful, or another LDAP error code if it was not.

Note that if an LDAPv2 server is contacted, no other operations over the connection can be attempted before a bind call has successfully completed.

Subsequent bind calls can be used to re-authenticate over the same connection, and multistep SASL sequences can be accomplished through a sequence of calls to `ldap_sasl_bind()` or `ldap_sasl_bind_s()`.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

SASL Authentication Using Oracle Extensions

This section contains the following topics:

- **ora_ldap_init_SASL**
- **ora_ldap_create_cred_hdl, ora_ldap_set_cred_props, ora_ldap_get_cred_props, and ora_ldap_free_cred_hdl**

ora_ldap_init_SASL

The function `ora_ldap_init_SASL()` can be used for SASL based authentication. It performs authentication based on the mechanism specified as one of its input arguments.

This function encapsulates the SASL handshake between the client and the directory server for various standard SASL mechanisms thereby reducing the coding effort involved in establishing a SASL-based connection to the directory server.

Syntax

```
int ora_ldap_init_SASL
(
OraLdapClientCtx * clientCtx,
LDAP*ld,
char* dn,
char* mechanism,
OraLdapHandle cred,
LDAPControl**serverctrls,
LDAPControl**clientctrls
);
```

Parameters

Table 14–7 Parameters passed to ora_ldap_init_sasl()

Parameter	Description
`clientCtx`	C API Client context. This can be managed using `ora_ldap_init_clientctx()` and `ora_ldap_free_clientctx()` functions.
`ld`	Ldap session handle.
`dn`	User DN to be authenticated.
`mechanism`	SASL mechanism.

Table 14–7 (Cont.) Parameters passed to ora_ldap_init_sasl()

Parameter	Description
`cred`	Credentials needed for SASL authentication.
`serverctrls`	List of LDAP server controls
`clientctrls`	List of client controls

The cred parameter is a SASL credential handle for the user. This handle can be managed using `ora_ldap_create_cred_hdl()`, `ora_ldap_set_cred_props()` and `ora_ldap_free_cred_hdl()` functions.

Supported SASL mechanisms:

- DIGEST-MD5

  The Oracle Internet Directory SASL API supports the authentication-only mode of DIGEST-MD5. The other two authentication modes addressing data privacy and data integrity are yet to be supported.

  While authenticating against Oracle Internet Directory, the DN of the user has to be normalized before it is sent across to the server. This can be done either outside the SASL API using the `ora_ldap_normalize_dn()` function before the DN is passed on to the SASL API or with the SASL API by setting the `ORA_LDAP_CRED_SASL_NORM_AUTHDN` option in SASL credentials handle using `ora_ldap_set_cred_handle()`.

- EXTERNAL:

  The SASL API and SASL implementation in Oracle Internet Directory use SSL authentication as one of the external authentication mechanisms.

  Using this mechanism requires that the SSL connection (mutual authentication mode) be established to the directory server by using the `ora_ldap_init_SSL()` function. The `ora_ldap_init_SASL()` function can then be invoked with the `mechanism` argument as `EXTERNAL`. The directory server would then authenticate the user based on the user credentials in SSL connection.

ora_ldap_create_cred_hdl, ora_ldap_set_cred_props, ora_ldap_get_cred_props, and ora_ldap_free_cred_hdl

Use these functions to create and manage SASL credential handles. The `ora_ldap_create_cred_hdl` function should be used to create a SASL credential handle of certain type based on the type of mechanism used for SASL authentication. The `ora_ldap_set_cred_props()` function can be used to add relevant credentials to the handle needed for SASL authentication. The `ora_ldap_get_cred_props()` function can be used for retrieving the properties stored in the credential handle, and the `ora_ldap_free_cred_hdl()` function should be used to destroy the handle after its use.

Syntax

```
OraLdapHandle ora_ldap_create_cred_hdl
(
        OraLdapClientCtx * clientCtx,
        int                credType
);

OraLdapHandle ora_ldap_set_cred_props
(
```

```
        OraLdapClientCtx *   clientCtx,
        OraLdapHandle        cred,
        int                  String[],
        void             *   inProperty
);
OraLdapHandle ora_ldap_get_cred_props
(
        OraLdapClientCtx *   clientCtx,
        OraLdapHandle   cred,
        int                     String[],
        void                  *   outProperty
);

OraLdapHandle ora_ldap_free_cred_hdl
(
        OraLdapClientCtx *   clientCtx,
        OraLdapHandle   cred
);
```

Parameters

Table 14–8 Parameters for Managing SASL Credentials

Parameter	Description
clientCtx	C API Client context. This can be managed using `ora_ldap_init_clientctx()` and `ora_ldap_free_clientctx()` functions.
credType	Type of credential handle specific to SASL mechanism.
cred	Credential handle containing SASL credentials needed for a specific SASL mechanism for SASL authentication.
String[]	Type of credential, which needs to be added to credential handle.
inProperty	One of the SASL Credentials to be stored in credential handle.
outProperty	One of the SASL credentials stored in credential handle.

Working With Controls

LDAPv3 operations can be extended through the use of controls. Controls can be sent to a server or returned to the client with any LDAP message. These controls are referred to as server controls.

The LDAP API also supports a client-side extension mechanism through the use of client controls. These controls affect the behavior of the LDAP API only and are never sent to a server. A common data structure is used to represent both types of controls:

```
typedef struct ldapcontrol
{
char            *ldctl_oid;
struct berval   ldctl_value;
char            ldctl_iscritical;
} LDAPControl;
```

The fields in the `ldapcontrol` structure are described in Table 14–9.

Table 14–9 Fields in ldapcontrol Structure

Field	Description
ldctl_oid	The control type, represented as a string.
ldctl_value	The data associated with the control (if any). To specify a zero-length value, set ldctl_value.bv_len to zero and ldctl_value.bv_val to a zero-length string. To indicate that no data is associated with the control, set ldctl_value.bv_val to NULL.
ldctl_iscritical	Indicates whether the control is critical of not. If this field is nonzero, the operation will only be carried out if the control is recognized by the server or the client. Note that the LDAP unbind and abandon operations have no server response. Clients should not mark server controls critical when used with these two operations.

See Also: Chapter 3, "Extensions to the LDAP Protocol" for more information about controls.

Some LDAP API calls allocate an ldapcontrol structure or a NULL-terminated array of ldapcontrol structures. The following routines can be used to dispose of a single control or an array of controls:

```
void ldap_control_free( LDAPControl *ctrl );
void ldap_controls_free( LDAPControl **ctrls );
```

If the ctrl or ctrls parameter is NULL, these calls do nothing.

A set of controls that affect the entire session can be set using the ldap_set_option() function described in "ldap_get_option and ldap_set_option" on page 14-6. A list of controls can also be passed directly to some LDAP API calls such as ldap_search_ext(), in which case any controls set for the session through the use of ldap_set_option() are ignored. Control lists are represented as a NULL-terminated array of pointers to ldapcontrol structures.

Server controls are defined by LDAPv3 protocol extension documents; for example, a control has been proposed to support server-side sorting of search results.

One client control is defined in this chapter (described in the following section).

Client-Controlled Referral Processing As described previously in "LDAP Session Handle Options" on page 14-6, applications can enable and disable automatic chasing of referrals on a session-wide basic by using the ldap_set_option() function with the LDAP_OPT_REFERRALS option. It is also useful to govern automatic referral chasing on per-request basis. A client control with an object identifier (OID) of 1.2.840.113556.1.4.616 exists to provide this functionality.

```
/* OID for referrals client control */
#define LDAP_CONTROL_REFERRALS              "1.2.840.113556.1.4.616"

/* Flags for referrals client control value */
#define LDAP_CHASE_SUBORDINATE_REFERRALS    0x00000020U
#define LDAP_CHASE_EXTERNAL_REFERRALS       0x00000040U
```

To create a referrals client control, the ldctl_oid field of an LDAPControl structure must be set to LDAP_CONTROL_REFERRALS ("1.2.840.113556.1.4.616") and the ldctl_value field must be set to a four-octet value that contains a set of flags. The ldctl_value.bv_len field must always be set to 4. The ldctl_value.bv_val field must point to a four-octet integer flags value. This flags value can be set to zero to disable automatic chasing of referrals and LDAPv3 references altogether. Alternatively, the flags value can be set to the value `LDAP_CHASE_SUBORDINATE_REFERRALS (0x00000020U)` to indicate that only LDAPv3 search continuation references are to be automatically chased by the API implementation, to the value `LDAP_CHASE_EXTERNAL_REFERRALS (0x00000040U)` to indicate that only LDAPv3 referrals are to be automatically chased, or the logical OR of the two flag values `(0x00000060U)` to indicate that both referrals and references are to be automatically chased.

> **See Also:** "Directory Schema Administration" in *Oracle Internet Directory Administrator's Guide* for more information about object identifiers.

Closing the Session

Use the functions in this section to unbind from the directory, to close open connections, and to dispose of the session handle.

ldap_unbind, ldap_unbind_ext, and ldap_unbind_s

`ldap_unbind_ext()`, `ldap_unbind()`, and `ldap_unbind_s()` all work synchronously in the sense that they send an unbind request to the server, close all open connections associated with the LDAP session handle, and dispose of all resources associated with the session handle before returning. Note, however, that there is no server response to an LDAP unbind operation. All three of the unbind functions return `LDAP_SUCCESS` (or another LDAP error code if the request cannot be sent to the LDAP server). After a call to one of the unbind functions, the session handle `ld` is invalid and it is illegal to make any further LDAP API calls using `ld`.

The `ldap_unbind()` and `ldap_unbind_s()` functions behave identically. The `ldap_unbind_ext()` function allows server and client controls to be included explicitly, but note that since there is no server response to an unbind request there is no way to receive a response to a server control sent with an unbind request.

Syntax

```
int ldap_unbind_ext( LDAP *ld, LDAPControl **serverctrls,
LDAPControl **clientctrls );
int ldap_unbind( LDAP *ld );
int ldap_unbind_s( LDAP *ld );
```

Parameters

Table 14–10 Parameters for Closing the Session

Parameter	Description
`ld`	The session handle
`serverctrls`	List of LDAP server controls
`clientctrls`	List of client controls

Performing LDAP Operations

Use the functions in this section to search the LDAP directory and to return a requested set of attributes for each entry matched.

ldap_search_ext, ldap_search_ext_s, ldap_search, and ldap_search_s

The `ldap_search_ext()` function initiates an asynchronous search operation and returns the constant `LDAP_SUCCESS` if the request was successfully sent, or another LDAP error code if not. If successful, `ldap_search_ext()` places the message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the results from the search. These results can be parsed using the result parsing routines described in detail later.

Similar to `ldap_search_ext()`, the `ldap_search()` function initiates an asynchronous search operation and returns the message id of the operation initiated. As for `ldap_search_ext()`, a subsequent call to `ldap_result()` can be used to obtain the result of the bind. In case of error, `ldap_search()` will return `-1`, setting the session error parameters in the LDAP structure appropriately.

The synchronous `ldap_search_ext_s()`, `ldap_search_s()`, and `ldap_search_st()` functions all return the result of the operation, either the constant `LDAP_SUCCESS` if the operation was successful, or another LDAP error code if it was not. Entries returned from the search, if any, are contained in the `res` parameter. This parameter is opaque to the caller. Entries, attributes, values, and so on, can be extracted by calling the parsing routines described in this section. The results contained in `res` should be freed when no longer in use by calling `ldap_msgfree()`, which is described later.

The `ldap_search_ext()` and `ldap_search_ext_s()` functions support LDAPv3 server controls, client controls, and allow varying size and time limits to be easily specified for each search operation. The `ldap_search_st()` function is identical to `ldap_search_s()` except that it takes an additional parameter specifying a local timeout for the search. The local search timeout is used to limit the amount of time the API implementation will wait for a search to complete. After the local search timeout expires, the API implementation will send an abandon operation to stop the search operation.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_search_ext
(
LDAP            *ld,
const char      *base,
int             scope,
const char      *filter,
char            **attrs,
int             attrsonly,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls,
struct timeval  *timeout,
int             sizelimit,
int             *msgidp
);

int ldap_search_ext_s
(
LDAP            *ld,
const char      *base,
int             scope,
const char      *filter,
char            **attrs,
```

```
int             attrsonly,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls,
struct timeval  *timeout,
int             sizelimit,
LDAPMessage     **res
);

int ldap_search
(
LDAP            *ld,
const char      *base,
int             scope,
const char      *filter,
char            **attrs,
int             attrsonly
);

int ldap_search_s
(
LDAP            *ld,
const char      *base,
int             scope,
const char      *filter,
char            **attrs,
int             attrsonly,
LDAPMessage     **res
);

int ldap_search_st
);

LDAP            *ld,
const char      *base,
int             scope,
const char      *filter,
char            **attrs,
int             attrsonly,
struct timeval  *timeout,
LDAPMessage     **res
);
```

Parameters

Table 14–11 lists and describes the parameters for search operations.

Table 14–11 Parameters for Search Operations

Parameter	Description
ld	The session handle.
base	The DN of the entry at which to start the search.
scope	One of LDAP_SCOPE_BASE (0x00), LDAP_SCOPE_ONELEVEL (0x01), or LDAP_SCOPE_SUBTREE (0x02), indicating the scope of the search.
filter	A character string representing the search filter. The value NULL can be passed to indicate that the filter "(objectclass=*)" which matches all entries is to be used. Note that if the caller of the API is using LDAPv2, only a subset of the filter functionality can be successfully used.

Table 14–11 (Cont.) Parameters for Search Operations

Parameter	Description
attrs	A NULL-terminated array of strings indicating which attributes to return for each matching entry. Passing NULL for this parameter causes all available user attributes to be retrieved. The special constant string LDAP_NO_ATTRS ("1.1") may be used as the only string in the array to indicate that no attribute types are to be returned by the server. The special constant string LDAP_ALL_USER_ATTRS ("*") can be used in the attrs array along with the names of some operational attributes to indicate that all user attributes plus the listed operational attributes are to be returned.
attrsonly	A boolean value that must be zero if both attribute types and values are to be returned, and nonzero if only types are wanted.
timeout	For the ldap_search_st() function, this specifies the local search timeout value (if it is NULL, the timeout is infinite). If a zero timeout (where tv_sec and tv_usec are both zero) is passed, API implementations should return LDAP_PARAM_ERROR. For the ldap_search_ext() and ldap_search_ext_s() functions, the timeout parameter specifies both the local search timeout value and the operation time limit that is sent to the server within the search request. Passing a NULL value for timeout causes the global default timeout stored in the LDAP session handle (set by using ldap_set_option() with the LDAP_OPT_TIMELIMIT parameter) to be sent to the server with the request but an infinite local search timeout to be used. If a zero timeout (where tv_sec and tv_usec are both zero) is passed in, API implementations should return LDAP_PARAM_ERROR. If a zero value for tv_sec is used but tv_usec is nonzero, an operation time limit of 1 should be passed to the LDAP server as the operation time limit. For other values of tv_sec, the tv_sec value itself should be passed to the LDAP server.
sizelimit	For the ldap_search_ext() and ldap_search_ext_s() calls, this is a limit on the number of entries to return from the search. A value of LDAP_NO_LIMIT (0) means no limit.
res	For the synchronous calls, this is a result parameter which will contain the results of the search upon completion of the call. If no results are returned, *res is set to NULL.
serverctrls	List of LDAP server controls.
clientctrls	List of client controls.
msgidp	This result parameter will be set to the message id of the request if the ldap_search_ext() call succeeds.There are three options in the session handle ld which potentially affect how the search is performed. They are: ■ LDAP_OPT_SIZELIMIT—A limit on the number of entries to return from the search. A value of LDAP_NO_LIMIT (0) means no limit. Note that the value from the session handle is ignored when using the ldap_search_ext() or ldap_search_ext_s() functions. ■ LDAP_OPT_TIMELIMIT—A limit on the number of seconds to spend on the search. A value of LDAP_NO_LIMIT (0) means no limit. Note that the value from the session handle is ignored when using the ldap_search_ext() or ldap_search_ext_s() functions. ■ LDAP_OPT_DEREF—One of LDAP_DEREF_NEVER (0x00), LDAP_DEREF_SEARCHING (0x01), LDAP_DEREF_FINDING (0x02), or LDAP_DEREF_ALWAYS (0x03), specifying how aliases are handled during the search. The LDAP_DEREF_SEARCHING value means aliases are dereferenced during the search but not when locating the base object of the search. The LDAP_DEREF_FINDING value means aliases are dereferenced when locating the base object but not during the search.

Reading an Entry

LDAP does not support a read operation directly. Instead, this operation is emulated by a search with base set to the DN of the entry to read, scope set to LDAP_SCOPE_

BASE, and filter set to "(objectclass=*)" or NULL. The attrs parameter contains the list of attributes to return.

Listing the Children of an Entry

LDAP does not support a list operation directly. Instead, this operation is emulated by a search with base set to the DN of the entry to list, scope set to LDAP_SCOPE_ONELEVEL, and filter set to "(objectclass=*)" or NULL. The parameter attrs contains the list of attributes to return for each child entry.

ldap_compare_ext, ldap_compare_ext_s, ldap_compare, and ldap_compare_s

Use these routines to compare an attribute value assertion against an LDAP entry.

The ldap_compare_ext() function initiates an asynchronous compare operation and returns the constant LDAP_SUCCESS if the request was successfully sent, or another LDAP error code if not. If successful, ldap_compare_ext() places the message id of the request in *msgidp. A subsequent call to ldap_result() can be used to obtain the result of the compare.

Similar to ldap_compare_ext(), the ldap_compare() function initiates an asynchronous compare operation and returns the message id of the operation initiated. As for ldap_compare_ext(), a subsequent call to ldap_result() can be used to obtain the result of the bind. In case of error, ldap_compare() will return -1, setting the session error parameters in the LDAP structure appropriately.

The synchronous ldap_compare_ext_s() and ldap_compare_s() functions both return the result of the operation, either the constant LDAP_SUCCESS if the operation was successful, or another LDAP error code if it was not.

The ldap_compare_ext() and ldap_compare_ext_s() functions support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_compare_ext
(
LDAP                    *ld,
const char              *dn,
const char              *attr,
const struct berval     *bvalue,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls,
int                     *msgidp
);

int ldap_compare_ext_s
(
LDAP                    *ld,
const char              *dn,
const char              *attr,
const struct berval     *bvalue,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls
);

int ldap_compare
(
```

```
LDAP                    *ld,
const char              *dn,
const char              *attr,
const char              *value
);
int ldap_compare_s
(
LDAP                    *ld,
const char              *dn,
const char              *attr,
const char              *value
);
```

Parameters

Table 14–12 lists and describes the parameters for compare operations.

Table 14–12 Parameters for Compare Operations

Parameter	Description
ld	The session handle.
dn	The name of the entry to compare against.
attr	The attribute to compare against.
bvalue	The attribute value to compare against those found in the given entry. This parameter is used in the extended routines and is a pointer to a struct berval so it is possible to compare binary values.
value	A string attribute value to compare against, used by the ldap_compare() and ldap_compare_s() functions. Use ldap_compare_ext() or ldap_compare_ext_s() if you need to compare binary values.
serverctrls	List of LDAP server controls.
clientctrls	List of client controls.
msgidp	This result parameter will be set to the message id of the request if the ldap_compare_ext() call succeeds.

ldap_modify_ext, ldap_modify_ext_s, ldap_modify, and ldap_modify_s

Use these routines to modify an existing LDAP entry.

The ldap_modify_ext() function initiates an asynchronous modify operation and returns the constant LDAP_SUCCESS if the request was successfully sent, or another LDAP error code if not. If successful, ldap_modify_ext() places the message id of the request in *msgidp. A subsequent call to ldap_result() can be used to obtain the result of the modify.

Similar to ldap_modify_ext(), the ldap_modify() function initiates an asynchronous modify operation and returns the message id of the operation initiated. As for ldap_modify_ext(), a subsequent call to ldap_result() can be used to obtain the result of the modify. In case of error, ldap_modify() will return -1, setting the session error parameters in the LDAP structure appropriately.

The synchronous ldap_modify_ext_s() and ldap_modify_s() functions both return the result of the operation, either the constant LDAP_SUCCESS if the operation was successful, or another LDAP error code if it was not.

The ldap_modify_ext() and ldap_modify_ext_s() functions support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
typedef struct ldapmod
{
int             mod_op;
char            *mod_type;
union mod_vals_u
  {
  char            **modv_strvals;
  struct berval   **modv_bvals;
  } mod_vals;
} LDAPMod;
#define mod_values      mod_vals.modv_strvals
#define mod_bvalues     mod_vals.modv_bvals

int ldap_modify_ext
(
LDAP            *ld,
const char      *dn,
LDAPMod         **mods,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls,
int             *msgidp
);

int ldap_modify_ext_s
(
LDAP            *ld,
const char      *dn,
LDAPMod         **mods,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls
);

int ldap_modify
(
LDAP            *ld,
const char      *dn,
LDAPMod         **mods
);

int ldap_modify_s
(
LDAP            *ld,
const char      *dn,
LDAPMod         **mods
);
```

Parameters

Table 14–13 lists and describes the parameters for modify operations.

Table 14–13 Parameters for Modify Operations

Parameter	Description
ld	The session handle
dn	The name of the entry to modify

Table 14–13 (Cont.) Parameters for Modify Operations

Parameter	Description
mods	A NULL-terminated array of modifications to make to the entry
serverctrls	List of LDAP server controls
clientctrls	List of client controls
msgidp	This result parameter will be set to the message id of the request if the `ldap_modify_ext()` call succeeds

Table 14–14 lists and describes the fields in the LDAPMod structure.

Table 14–14 Fields in LDAPMod Structure

Field	Description
mod_op	The modification operation to perform. It must be one of LDAP_MOD_ADD (0x00), LDAP_MOD_DELETE (0x01), or LDAP_MOD_REPLACE (0x02). This field also indicates the type of values included in the mod_vals union. It is logically ORed with LDAP_MOD_BVALUES (0x80) to select the `mod_bvalues` form. Otherwise, the `mod_values` form is used.
mod_type	The type of the attribute to modify.
mod_vals	The values (if any) to add, delete, or replace. Only one of the `mod_values` or `mod_bvalues` variants can be used, selected by ORing the `mod_op` field with the constant LDAP_MOD_BVALUES. `mod_values` is a NULL-terminated array of zero-terminated strings and mod_bvalues is a NULL-terminated array of `berval` structures that can be used to pass binary values such as images.

Usage Notes

For LDAP_MOD_ADD modifications, the given values are added to the entry, creating the attribute if necessary.

For LDAP_MOD_DELETE modifications, the given values are deleted from the entry, removing the attribute if no values remain. If the entire attribute is to be deleted, the mod_vals field can be set to NULL.

For LDAP_MOD_REPLACE modifications, the attribute will have the listed values after the modification, having been created if necessary, or removed if the `mod_vals` field is NULL. All modifications are performed in the order in which they are listed.

ldap_rename and ldap_rename_s

Use these routines to change the name of an entry.

The `ldap_rename()` function initiates an asynchronous modify DN operation and returns the constant LDAP_SUCCESS if the request was successfully sent, or another LDAP error code if not. If successful, `ldap_rename()` places the DN message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the result of the rename.

The synchronous `ldap_rename_s()` returns the result of the operation, either the constant LDAP_SUCCESS if the operation was successful, or another LDAP error code if it was not.

The `ldap_rename()` and `ldap_rename_s()` functions both support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_rename
(
LDAP            *ld,
const char      *dn,
const char      *newrdn,
const char      *newparent,
int             deleteoldrdn,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls,
int             *msgidp
);

int ldap_rename_s
(
LDAP            *ld,
const char      *dn,
const char      *newrdn,
const char      *newparent,
int             deleteoldrdn,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls
);
```

The use of the following routines is deprecated and more complete descriptions can be found in RFC 1823:

```
int ldap_modrdn
(
LDAP            *ld,
const char      *dn,
const char      *newrdn
);

int ldap_modrdn_s
(
LDAP            *ld,
const char      *dn,
const char      *newrdn
);

int ldap_modrdn2
(
LDAP            *ld,
const char      *dn,
const char      *newrdn,
int             deleteoldrdn
);

int ldap_modrdn2_s
(
LDAP            *ld,
const char      *dn,
const char      *newrdn,
int             deleteoldrdn
);
```

Parameters

Table 14–15 lists and describes the parameters for rename operations.

Table 14–15 Parameters for Rename Operations

Parameter	Description
`ld`	The session handle.
`dn`	The name of the entry whose DN is to be changed.
`newrdn`	The new RDN to give the entry.
`newparent`	The new parent, or superior entry. If this parameter is `NULL`, only the RDN of the entry is changed. The root DN should be specified by passing a zero length string, `""`. The newparent parameter should always be `NULL` when using version 2 of the LDAP protocol; otherwise the server's behavior is undefined.
`deleteoldrdn`	This parameter only has meaning on the rename routines if newrdn is different than the old RDN. It is a boolean value, if nonzero indicating that the old RDN value is to be removed, if zero indicating that the old RDN value is to be retained as non-distinguished values of the entry.
`serverctrls`	List of LDAP server controls.
`clientctrls`	List of client controls.
`msgidp`	This result parameter will be set to the message id of the request if the `ldap_rename()` call succeeds.

ldap_add_ext, ldap_add_ext_s, ldap_add, and ldap_add_s

Use these functions to add entries to the LDAP directory.

The `ldap_add_ext()` function initiates an asynchronous add operation and returns the constant `LDAP_SUCCESS` if the request was successfully sent, or another LDAP error code if not. If successful, `ldap_add_ext()` places the message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the result of the add.

Similar to `ldap_add_ext()`, the `ldap_add()` function initiates an asynchronous add operation and returns the message id of the operation initiated. As for `ldap_add_ext()`, a subsequent call to `ldap_result()` can be used to obtain the result of the add. In case of error, `ldap_add()` will return `-1`, setting the session error parameters in the LDAP structure appropriately.

The synchronous `ldap_add_ext_s()` and `ldap_add_s()` functions both return the result of the operation, either the constant `LDAP_SUCCESS` if the operation was successful, or another LDAP error code if it was not.

The `ldap_add_ext()` and `ldap_add_ext_s()` functions support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_add_ext
(
LDAP             *ld,
const char       *dn,
LDAPMod          **attrs,
LDAPControl      **serverctrls,
```

```
LDAPControl     **clientctrls,
int             *msgidp
);

int ldap_add_ext_s
(
LDAP            *ld,
const char      *dn,
LDAPMod         **attrs,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls
);

int ldap_add
(
LDAP            *ld,
const char      *dn,
LDAPMod         **attrs
);

int ldap_add_s
(
LDAP            *ld,
const char      *dn,
LDAPMod         **attrs
);
```

Parameters

Table 14–16 lists and describes the parameters for add operations.

Table 14–16 Parameters for Add Operations

Parameter	Description
ld	The session handle.
dn	The name of the entry to add.
attrs	The entry attributes, specified using the LDAPMod structure defined for ldap_modify(). The mod_type and mod_vals fields must be filled in. The mod_op field is ignored unless ORed with the constant LDAP_MOD_BVALUES, used to select the mod_bvalues case of the mod_vals union.
serverctrls	List of LDAP server controls.
clientctrls	List of client controls.
msgidp	This result parameter will be set to the message id of the request if the ldap_add_ext() call succeeds.

Usage Notes

Note that the parent of the entry being added must already exist or the parent must be empty—that is, equal to the root DN—for an add to succeed.

ldap_delete_ext, ldap_delete_ext_s, ldap_delete, and ldap_delete_s

Use these functions to delete a leaf entry from the LDAP directory.

The ldap_delete_ext() function initiates an asynchronous delete operation and returns the constant LDAP_SUCCESS if the request was successfully sent, or another LDAP error code if not. If successful, ldap_delete_ext() places the message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the result of the delete.

Similar to `ldap_delete_ext()`, the `ldap_delete()` function initiates an asynchronous delete operation and returns the message id of the operation initiated. As for `ldap_delete_ext()`, a subsequent call to `ldap_result()` can be used to obtain the result of the delete. In case of error, `ldap_delete()` will return `-1`, setting the session error parameters in the LDAP structure appropriately.

The synchronous `ldap_delete_ext_s()` and `ldap_delete_s()` functions both return the result of the operation, either the constant `LDAP_SUCCESS` if the operation was successful, or another LDAP error code if it was not.

The `ldap_delete_ext()` and `ldap_delete_ext_s()` functions support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_delete_ext
(
LDAP            *ld,
const char      *dn,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls,
int             *msgidp
);

int ldap_delete_ext_s
(
LDAP            *ld,
const char      *dn,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls
);
```

int ldap_delete

```
(
LDAP            *ld,
const char      *dn
);

int ldap_delete_s
(
LDAP            *ld,
const char      *dn
);
```

Parameters

Table 14–17 lists and describes the parameters for delete operations.

Table 14–17 Parameters for Delete Operations

Parameter	Description
`ld`	The session handle.
`dn`	The name of the entry to delete.

Table 14–17 (Cont.) Parameters for Delete Operations

Parameter	Description
serverctrls	List of LDAP server controls.
clientctrls	List of client controls.
msgidp	This result parameter will be set to the message id of the request if the `ldap_delete_ext()` call succeeds.

Usage Notes

Note that the entry to delete must be a leaf entry—that is, it must have no children. Deletion of entire subtrees in a single operation is not supported by LDAP.

ldap_extended_operation and ldap_extended_operation_s

These routines enable extended LDAP operations to be passed to the server, providing a general protocol extensibility mechanism.

The `ldap_extended_operation()`function initiates an asynchronous extended operation and returns the constant LDAP_SUCCESS if the request was successfully sent, or another LDAP error code if not. If successful, `ldap_extended_operation()` places the message id of the request in `*msgidp`. A subsequent call to `ldap_result()` can be used to obtain the result of the extended operation which can be passed to `ldap_parse_extended_result()` to obtain the object identifier (OID) and data contained in the response.

The synchronous `ldap_extended_operation_s()` function returns the result of the operation, either the constant LDAP_SUCCESS if the operation was successful, or another LDAP error code if it was not. The `retoid` and `retdata` parameters are filled in with the OID and data from the response. If no OID or data was returned, these parameters are set to NULL.

The `ldap_extended_operation()` and `ldap_extended_operation_s()` functions both support LDAPv3 server controls and client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Syntax

```
int ldap_extended_operation
(
LDAP                    *ld,
const char              *requestoid,
const struct berval     *requestdata,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls,
int                     *msgidp
);

int ldap_extended_operation_s
(
LDAP                    *ld,
const char              *requestoid,
const struct berval     *requestdata,
LDAPControl             **serverctrls,
LDAPControl             **clientctrls,
char                    **retoidp,
struct berval           **retdatap
```

```
);
```

Parameters

Table 14–18 lists and describes the parameters for extended operations.

Table 14–18 Parameters for Extended Operations

Parameter	Description
ld	The session handle
requestoid	The dotted-OID text string naming the request
requestdata	The arbitrary data needed by the operation (if NULL, no data is sent to the server)
serverctrls	List of LDAP server controls
clientctrls	List of client controls
msgidp	This result parameter will be set to the message id of the request if the ldap_extended_operation() call succeeds.
retoidp	Pointer to a character string that will be set to an allocated, dotted-OID text string returned by the server. This string should be disposed of using the ldap_memfree() function. If no OID was returned, *retoidp is set to NULL.
retdatap	Pointer to a berval structure pointer that will be set an allocated copy of the data returned by the server. This struct berval should be disposed of using ber_bvfree(). If no data is returned, *retdatap is set to NULL.

Abandoning an Operation

Use the functions in this section to abandon an operation in progress:

ldap_abandon_ext and ldap_abandon

ldap_abandon_ext() abandons the operation with message id msgid and returns the constant LDAP_SUCCESS if the abandon was successful or another LDAP error code if not.

ldap_abandon() is identical to ldap_abandon_ext() except that it does not accept client or server controls and it returns zero if the abandon was successful, -1 otherwise.

After a successful call to ldap_abandon() or ldap_abandon_ext(), results with the given message id are never returned from a subsequent call to ldap_result(). There is no server response to LDAP abandon operations.

Syntax

```
int ldap_abandon_ext
(
LDAP            *ld,
int             msgid,
LDAPControl     **serverctrls,
LDAPControl     **clientctrls
);

int ldap_abandon
(
LDAP            *ld,
int             msgid
);
```

Parameters

Table 14–19 lists and describes the parameters for abandoning an operation.

Table 14–19 Parameters for Abandoning an Operation

Parameter	Description
`ld`	The session handle.
`msgid`	The message id of the request to be abandoned.
`serverctrls`	List of LDAP server controls.
`clientctrls`	List of client controls.

> **See Also:** "Handling Errors and Parsing Results" for more information about possible errors and how to interpret them.

Obtaining Results and Peeking Inside LDAP Messages

Use the functions in this section to return the result of an operation initiated asynchronously. They identify messages by type and by ID.

ldap_result, ldap_msgtype, and ldap_msgid

`ldap_result()` is used to obtain the result of a previous asynchronously initiated operation. Note that depending on how it is called, `ldap_result()` can actually return a list or "chain" of result messages. The `ldap_result()` function only returns messages for a single request, so for all LDAP operations other than search only one result message is expected; that is, the only time the "result chain" can contain more than one message is if results from a search operation are returned.

Once a chain of messages has been returned to the caller, it is no longer tied in any caller-visible way to the LDAP request that produced it. Therefore, a chain of messages returned by calling `ldap_result()` or by calling a synchronous search routine will never be affected by subsequent LDAP API calls (except for `ldap_msgfree()` which is used to dispose of a chain of messages).

`ldap_msgfree()` frees the result messages (possibly an entire chain of messages) obtained from a previous call to `ldap_result()` or from a call to a synchronous search routine.

`ldap_msgtype()` returns the type of an LDAP message. `ldap_msgid()` returns the message ID of an LDAP message.

Syntax

```
int ldap_result
(
LDAP            *ld,
int             msgid,
int             all,
struct timeval  *timeout,
LDAPMessage     **res
);
int ldap_msgfree( LDAPMessage *res );
int ldap_msgtype( LDAPMessage *res );
int ldap_msgid( LDAPMessage *res );
```

Parameters

Table 14–20 on page 14-31 lists and describes the parameters for obtaining results and peeling inside LDAP messages.

Table 14–20 Parameters for Obtaining Results and Peeking Inside LDAP Messages

Parameter	Description
ld	The session handle.
msgid	The message id of the operation whose results are to be returned, the constant LDAP_RES_UNSOLICITED (0) if an unsolicited result is desired, or the constant LDAP_RES_ANY (-1) if any result is desired.
all	Specifies how many messages will be retrieved in a single call to ldap_result(). This parameter only has meaning for search results. Pass the constant LDAP_MSG_ONE (0x00) to retrieve one message at a time. Pass LDAP_MSG_ALL (0x01) to request that all results of a search be received before returning all results in a single chain. Pass LDAP_MSG_RECEIVED (0x02) to indicate that all messages retrieved so far are to be returned in the result chain.
timeout	A timeout specifying how long to wait for results to be returned. A NULL value causes ldap_result() to block until results are available. A timeout value of zero seconds specifies a polling behavior.
res	For ldap_result(), a result parameter that will contain the result of the operation. If no results are returned, *res is set to NULL. For ldap_msgfree(), the result chain to be freed, obtained from a previous call to ldap_result(), ldap_search_s(), or ldap_search_st(). If res is NULL, nothing is done and ldap_msgfree() returns zero.

Usage Notes

Upon successful completion, ldap_result() returns the type of the first result returned in the res parameter. This will be one of the following constants.

LDAP_RES_BIND (0x61)

LDAP_RES_SEARCH_ENTRY (0x64)

LDAP_RES_SEARCH_REFERENCE (0x73)-- new in LDAPv3

LDAP_RES_SEARCH_RESULT (0x65)

LDAP_RES_MODIFY (0x67)

LDAP_RES_ADD (0x69)

LDAP_RES_DELETE (0x6B)

LDAP_RES_MODDN (0x6D)

LDAP_RES_COMPARE (0x6F)

LDAP_RES_EXTENDED (0x78) -- new in LDAPv3

ldap_result() returns 0 if the timeout expired and -1 if an error occurs, in which case the error parameters of the LDAP session handle will be set accordingly.

ldap_msgfree() frees each message in the result chain pointed to by res and returns the type of the last message in the chain. If res is NULL, then nothing is done and the value zero is returned.

ldap_msgtype() returns the type of the LDAP message it is passed as a parameter. The type will be one of the types listed previously, or -1 on error.

`ldap_msgid()` returns the message ID associated with the LDAP message passed as a parameter, or `-1` on error.

Handling Errors and Parsing Results

Use the functions in this section to extract information from results and to handle errors returned by other LDAP API routines.

ldap_parse_result, ldap_parse_sasl_bind_result, ldap_parse_extended_result, and ldap_err2string

Note that `ldap_parse_sasl_bind_result()` and `ldap_parse_extended_result()` must typically be used in addition to `ldap_parse_result()` to retrieve all the result information from SASL Bind and Extended Operations respectively.

The `ldap_parse_result()`, `ldap_parse_sasl_bind_result()`, and `ldap_parse_extended_result()` functions all skip over messages of type LDAP_RES_SEARCH_ENTRY and LDAP_RES_SEARCH_REFERENCE when looking for a result message to parse. They return the constant LDAP_SUCCESS if the result was successfully parsed and another LDAP error code if not. Note that the LDAP error code that indicates the outcome of the operation performed by the server is placed in the errcodep `ldap_parse_result()` parameter. If a chain of messages that contains more than one result message is passed to these routines they always operate on the first result in the chain.

`ldap_err2string()` is used to convert a numeric LDAP error code, as returned by `ldap_parse_result()`, `ldap_parse_sasl_bind_result()`, `ldap_parse_extended_result()` or one of the synchronous API operation calls, into an informative zero-terminated character string message describing the error. It returns a pointer to static data.

Syntax

```
int ldap_parse_result
(
LDAP            *ld,
LDAPMessage     *res,
int             *errcodep,
char            **matcheddnp,
char            **errmsgp,
char            ***referralsp,
LDAPControl     ***serverctrlsp,
int             freeit
);


int ldap_parse_sasl_bind_result
(
LDAP            *ld,
LDAPMessage     *res,
struct berval   **servercredp,
int             freeit
);


int ldap_parse_extended_result
(
LDAP            *ld,
LDAPMessage     *res,
char            **retoidp,
```

```
struct berval   **retdatap,
int             freeit
);
#define LDAP_NOTICE_OF_DISCONNECTION    "1.3.6.1.4.1.1466.20036"
char *ldap_err2string( int err );
```

The routines immediately following are deprecated. To learn more about them, see RFC 1823.

```
int ldap_result2error
(
LDAP            *ld,
LDAPMessage     *res,
int             freeit
);
void ldap_perror( LDAP *ld, const char *msg );
```

Parameters

Table 14–21 lists and describes parameters for handling errors and parsing results.

Table 14–21 Parameters for Handling Errors and Parsing Results

Parameter	Description
ld	The session handle.
res	The result of an LDAP operation as returned by `ldap_result()` or one of the synchronous API operation calls.
errcodep	This result parameter will be filled in with the LDAP error code field from the `LDAPMessage` message. This is the indication from the server of the outcome of the operation. `NULL` should be passed to ignore this field.
matcheddnp	In the case of a return of `LDAP_NO_SUCH_OBJECT`, this result parameter will be filled in with a DN indicating how much of the name in the request was recognized. `NULL` should be passed to ignore this field. The matched DN string should be freed by calling `ldap_memfree()` which is described later in this document.
errmsgp	This result parameter will be filled in with the contents of the error message field from the `LDAPMessage` message. The error message string should be freed by calling `ldap_memfree()` which is described later in this document. `NULL` should be passed to ignore this field.
referralsp	This result parameter will be filled in with the contents of the referrals field from the `LDAPMessage` message, indicating zero or more alternate LDAP servers where the request is to be retried. The referrals array should be freed by calling `ldap_value_free()` which is described later in this document. `NULL` should be passed to ignore this field.
serverctrlsp	This result parameter will be filled in with an allocated array of controls copied out of the `LDAPMessage` message. The control array should be freed by calling `ldap_controls_free()` which was described earlier.
freeit	A Boolean that determines whether the `res` parameter is disposed of or not. Pass any nonzero value to have these routines free `res` after extracting the requested information. This is provided as a convenience; you can also use `ldap_msgfree()` to free the result later. If `freeit` is nonzero, the entire chain of messages represented by res is disposed of.
servercredp	For SASL bind results, this result parameter will be filled in with the credentials passed back by the server for mutual authentication, if given. An allocated `berval` structure is returned that should be disposed of by calling `ber_bvfree()`. `NULL` should be passed to ignore this field.

Table 14–21 (Cont.) Parameters for Handling Errors and Parsing Results

Parameter	Description
retoidp	For extended results, this result parameter will be filled in with the dotted-OID text representation of the name of the extended operation response. This string should be disposed of by calling `ldap_memfree()`. `NULL` should be passed to ignore this field. The `LDAP_NOTICE_OF_DISCONNECTION` macro is defined as a convenience for clients that wish to check an OID to see if it matches the one used for the unsolicited Notice of Disconnection (defined in RFC 2251[2] section 4.4.1).
retdatap	For extended results, this result parameter will be filled in with a pointer to a `struct berval` containing the data in the extended operation response. It should be disposed of by calling `ber_bvfree()`. `NULL` should be passed to ignore this field.
err	For `ldap_err2string()`, an LDAP error code, as returned by `ldap_parse_result()` or another LDAP API call.

Usage Notes

See RFC 1823 for a description of parameters peculiar to the deprecated routines.

Stepping Through a List of Results

Use the routines in this section to step through the list of messages in a result chain returned by `ldap_result()`.

ldap_first_message and ldap_next_message

The result chain for search operations can include referral messages, entry messages, and result messages.

`ldap_count_messages()` is used to count the number of messages returned. The `ldap_msgtype()` function, described previously, can be used to distinguish between the different message types.

```
LDAPMessage *ldap_first_message( LDAP *ld, LDAPMessage *res );
LDAPMessage *ldap_next_message( LDAP *ld, LDAPMessage *msg );
int ldap_count_messages( LDAP *ld, LDAPMessage *res );
```

Parameters

Table 14–22 lists and describes the parameters for stepping through a list of results.

Table 14–22 Parameters for Stepping Through a List of Results

Parameter	Description
ld	The session handle.
res	The result chain, as obtained by a call to one of the synchronous search routines or `ldap_result()`.
msg	The message returned by a previous call to `ldap_first_message()` or `ldap_next_message()`.

Usage Notes

`ldap_first_message()` and `ldap_next_message()` will return `NULL` when no more messages exist in the result set to be returned. `NULL` is also returned if an error occurs while stepping through the entries, in which case the error parameters in the session handle ld will be set to indicate the error.

If successful, ldap_count_messages() returns the number of messages contained in a chain of results; if an error occurs such as the res parameter being invalid, -1 is returned. The ldap_count_messages() call can also be used to count the number of messages that remain in a chain if called with a message, entry, or reference returned by ldap_first_message(), ldap_next_message(), ldap_first_entry(), ldap_next_entry(), ldap_first_reference(), ldap_next_reference().

Parsing Search Results

Use the functions in this section to parse the entries and references returned by ldap_search functions. These results are returned in an opaque structure that may be accessed by calling the routines described in this section. Routines are provided to step through the entries and references returned, step through the attributes of an entry, retrieve the name of an entry, and retrieve the values associated with a given attribute in an entry.

ldap_first_entry, ldap_next_entry, ldap_first_reference, ldap_next_reference, ldap_count_entries, and ldap_count_references

The ldap_first_entry() and ldap_next_entry() routines are used to step through and retrieve the list of entries from a search result chain. The ldap_first_reference() and ldap_next_reference() routines are used to step through and retrieve the list of continuation references from a search result chain. ldap_count_entries() is used to count the number of entries returned. ldap_count_references() is used to count the number of references returned.

```
LDAPMessage *ldap_first_entry( LDAP *ld, LDAPMessage *res );
LDAPMessage *ldap_next_entry( LDAP *ld, LDAPMessage *entry );
LDAPMessage *ldap_first_reference( LDAP *ld, LDAPMessage *res );
LDAPMessage *ldap_next_reference( LDAP *ld, LDAPMessage *ref );
int ldap_count_entries( LDAP *ld, LDAPMessage *res );
int ldap_count_references( LDAP *ld, LDAPMessage *res );
```

Parameters

Table 14–23 lists and describes the parameters or retrieving entries and continuation references from a search result chain, and for counting entries returned.

Table 14–23 Parameters for Retrieving Entries and Continuation References from a Search Result Chain, and for Counting Entries Returned

Parameter	Description
ld	The session handle.
res	The search result, as obtained by a call to one of the synchronous search routines or ldap_result().
entry	The entry returned by a previous call to ldap_first_entry() or ldap_next_entry().
ref	The reference returned by a previous call to ldap_first_reference() or ldap_next_reference().

Usage Notes

ldap_first_entry(), ldap_next_entry(), ldap_first_reference(), and ldap_next_reference() all return NULL when no more entries or references exist in the result set to be returned. NULL is also returned if an error occurs while stepping through the entries or references, in which case the error parameters in the session handle `ld` will be set to indicate the error.

`ldap_count_entries()` returns the number of entries contained in a chain of entries; if an error occurs such as the `res` parameter being invalid, `-1` is returned. The `ldap_count_entries()` call can also be used to count the number of entries that remain in a chain if called with a message, entry or reference returned by `ldap_first_message()`, `ldap_next_message()`, `ldap_first_entry()`, `ldap_next_entry()`, `ldap_first_reference()`, `ldap_next_reference()`.

`ldap_count_references()` returns the number of references contained in a chain of search results; if an error occurs such as the `res` parameter being invalid, `-1` is returned. The `ldap_count_references()` call can also be used to count the number of references that remain in a chain.

ldap_first_attribute and ldap_next_attribute

Use the functions in this section to step through the list of attribute types returned with an entry.

Syntax

```
char *ldap_first_attribute
(
LDAP            *ld,
LDAPMessage     *entry,
BerElement      **ptr
);

char *ldap_next_attribute
(
LDAP            *ld,
LDAPMessage     *entry,
BerElement      *ptr
);
void ldap_memfree( char *mem );
```

Parameters

Table 14–24 lists and describes the parameters for stepping through attribute types returned with an entry.

Table 14–24 Parameters for Stepping Through Attribute Types Returned with an Entry

Parameter	Description
`ld`	The session handle.
`entry`	The entry whose attributes are to be stepped through, as returned by `ldap_first_entry()` or `ldap_next_entry()`.
`ptr`	In `ldap_first_attribute()`, the address of a pointer used internally to keep track of the current position in the entry. In `ldap_next_attribute()`, the pointer returned by a previous call to `ldap_first_attribute()`. The `BerElement` type itself is an opaque structure.
`mem`	A pointer to memory allocated by the LDAP library, such as the attribute type names returned by `ldap_first_attribute()` and `ldap_next_attribute`, or the DN returned by `ldap_get_dn()`. If `mem` is `NULL`, the `ldap_memfree()` call does nothing.

Usage Notes

`ldap_first_attribute()` and `ldap_next_attribute()` returns `NULL` when the end of the attributes is reached, or if there is an error. In the latter case, the error parameters in the session handle `ld` are set to indicate the error.

Both routines return a pointer to an allocated buffer containing the current attribute name. This should be freed when no longer in use by calling `ldap_memfree()`.

`ldap_first_attribute()` will allocate and return in `ptr` a pointer to a `BerElement` used to keep track of the current position. This pointer may be passed in subsequent calls to `ldap_next_attribute()` to step through the entry's attributes. After a set of calls to `ldap_first_attribute()` and `ldap_next_attribute()`, if `ptr` is non-null, it should be freed by calling `ber_free(ptr, 0)`. Note that it is very important to pass the second parameter as `0` (zero) in this call, since the buffer associated with the `BerElement` does not point to separately allocated memory.

The attribute type names returned are suitable for passing in a call to `ldap_get_values()` and friends to retrieve the associated values.

ldap_get_values, ldap_get_values_len, ldap_count_values, ldap_count_values_len, ldap_value_free, and ldap_value_free_len

`ldap_get_values()` and `ldap_get_values_len()` are used to retrieve the values of a given attribute from an entry. `ldap_count_values()` and `ldap_count_values_len()` are used to count the returned values.

`ldap_value_free()` and `ldap_value_free_len()` are used to free the values.

Syntax

```
char **ldap_get_values
(
LDAP            *ld,
LDAPMessage     *entry,
const char      *attr
);

struct berval **ldap_get_values_len
(
LDAP            *ld,
LDAPMessage     *entry,
const char      *attr
);

int ldap_count_values( char **vals );
int ldap_count_values_len( struct berval **vals );
void ldap_value_free( char **vals );
void ldap_value_free_len( struct berval **vals );
```

Parameters

Table 14–25 lists and describes the parameters for retrieving and counting attribute values.

Table 14–25 Parameters for Retrieving and Counting Attribute Values

Parameter	Description
`ld`	The session handle.
`entry`	The entry from which to retrieve values, as returned by `ldap_first_entry()` or `ldap_next_entry()`.

Table 14–25 (Cont.) Parameters for Retrieving and Counting Attribute Values

Parameter	Description
attr	The attribute whose values are to be retrieved, as returned by ldap_first_attribute() or ldap_next_attribute(), or a caller-supplied string (for example, "mail").
vals	The values returned by a previous call to ldap_get_values() or ldap_get_values_len().

Usage Notes

Two forms of the various calls are provided. The first form is only suitable for use with non-binary character string data. The second _len form is used with any kind of data.

ldap_get_values() and ldap_get_values_len() return NULL if no values are found for attr or if an error occurs.

ldap_count_values() and ldap_count_values_len() return -1 if an error occurs such as the vals parameter being invalid.

If a NULL vals parameter is passed to ldap_value_free() or ldap_value_free_len(), nothing is done.

Note that the values returned are dynamically allocated and should be freed by calling either ldap_value_free() or ldap_value_free_len() when no longer in use.

ldap_get_dn, ldap_explode_dn, ldap_explode_rdn, and ldap_dn2ufn

ldap_get_dn() is used to retrieve the name of an entry. ldap_explode_dn() and ldap_explode_rdn() are used to break up a name into its component parts. ldap_dn2ufn() is used to convert the name into a more user friendly format.

Syntax

```
char *ldap_get_dn( LDAP *ld, LDAPMessage *entry );
char **ldap_explode_dn( const char *dn, int notypes );
char **ldap_explode_rdn( const char *rdn, int notypes );
char *ldap_dn2ufn( const char *dn );
```

Parameters

Table 14–26 lists and describes the parameters for retrieving, exploding, and converting entry names.

Table 14–26 Parameters for Retrieving, Exploding, and Converting Entry Names

Parameter	Description
ld	The session handle.
entry	The entry whose name is to be retrieved, as returned by ldap_first_entry() or ldap_next_entry().
dn	The DN to explode, such as returned by ldap_get_dn().
rdn	The RDN to explode, such as returned in the components of the array returned by ldap_explode_dn().
notypes	A Boolean parameter, if nonzero indicating that the DN or RDN components are to have their type information stripped off: cn=Babs would become Babs.

Usage Notes

`ldap_get_dn()` returns `NULL` if a DN parsing error occurs. The function sets error parameters in the session handle `ld` to indicate the error. It returns a pointer to newly allocated space that the caller should free by calling `ldap_memfree()` when it is no longer in use.

`ldap_explode_dn()` returns a `NULL`-terminated `char *` array containing the RDN components of the DN supplied, with or without types as indicated by the `notypes` parameter. The components are returned in the order they appear in the DN. The array returned should be freed when it is no longer in use by calling `ldap_value_free()`.

`ldap_explode_rdn()` returns a `NULL`-terminated `char *` array containing the components of the RDN supplied, with or without types as indicated by the `notypes` parameter. The components are returned in the order they appear in the rdn. The array returned should be freed when it is no longer in use by calling `ldap_value_free()`.

`ldap_dn2ufn()` converts the DN into a user friendly format. The UFN returned is newly allocated space that should be freed by a call to `ldap_memfree()` when no longer in use.

ldap_get_entry_controls

`ldap_get_entry_controls()` is used to extract LDAP controls from an entry.

Syntax

```
int ldap_get_entry_controls
(
LDAP            *ld,
LDAPMessage     *entry,
LDAPControl     ***serverctrlsp
);
```

Parameters

Table 14–27 lists and describes the parameters for extracting LDAP control from an entry.

Table 14–27 Parameters for Extracting LDAP Controls from an Entry

Parameters	Description
`ld`	The session handle.
`entry`	The entry to extract controls from, as returned by `ldap_first_entry()` or `ldap_next_entry()`.
`serverctrlsp`	This result parameter will be filled in with an allocated array of controls copied out of entry. The control array should be freed by calling `ldap_controls_free()`. If `serverctrlsp` is `NULL`, no controls are returned.

Usage Notes

`ldap_get_entry_controls()` returns an LDAP error code that indicates whether the reference could be successfully parsed (`LDAP_SUCCESS` if all goes well).

ldap_parse_reference

Use `ldap_parse_reference()` to extract referrals and controls from a `SearchResultReference` message.

Syntax

```
int ldap_parse_reference
(
LDAP            *ld,
LDAPMessage     *ref,
char            ***referralsp,
LDAPControl     ***serverctrlsp,
int             freeit
);
```

Parameters

Table 14–28 lists and describes parameters for extracting referrals and controls from a `SearchResultReference` message.

Table 14–28 Parameters for Extracting Referrals and Controls from a SearchResultReference Message

Parameter	Description
`ld`	The session handle.
`ref`	The reference to parse, as returned by `ldap_result()`, `ldap_first_reference()`, or `ldap_next_reference()`.
`referralsp`	This result parameter will be filled in with an allocated array of character strings. The elements of the array are the referrals (typically LDAP URLs) contained in ref. The array should be freed when no longer in used by calling `ldap_value_free()`. If `referralsp` is `NULL`, the referral URLs are not returned.
`serverctrlsp`	This result parameter will be filled in with an allocated array of controls copied out of `ref`. The control array shouldbe freed by calling `ldap_controls_free()`. If `serverctrlsp` is `NULL`, no controls are returned.
`freeit`	A Boolean that determines whether the `ref` parameter is disposed of or not. Pass any nonzero value to have this routine free `ref` after extracting the requested information. This is provided as a convenience. You can also use `ldap_msgfree()` to free the result later.

Usage Notes

`ldap_parse_reference()` returns an LDAP error code that indicates whether the reference could be successfully parsed (`LDAP_SUCCESS` if all goes well).

Sample C API Usage

The following examples show how to use the C API both with and without SSL and for SASL authentication. More complete examples are given in RFC 1823. The sample code for the command-line tool to perform an LDAP search also demonstrates use of the API in both the SSL and the non-SSL mode.

This section contains these topics:

- C API Usage with SSL
- C API Usage Without SSL
- C API Usage for SASL-Based DIGEST-MD5 Authentication

C API Usage with SSL

```
#include <stdio.h>
#include <ldap.h>
```

```
main()
{
LDAP          *ld;
int           ret = 0;
….
/* open a connection */
if ((ld = ldap_open("MyHost", 636)) == NULL)
     exit( 1 );

/* SSL initialization */
ret = ldap_init_SSL(&ld->ld_sb, "file:/sslwallet", "welcome",
                                        GSLC_SSL_ONEWAY_AUTH );
if(ret != 0)
{
printf(" %s \n", ldap_err2string(ret));
exit(1);
}

/* authenticate as nobody */
if ( ldap_bind_s( ld, NULL, NULL ) != LDAP_SUCCESS ) {
     ldap_perror( ld, "ldap_bind_s" );
     exit( 1 );
}

.
.
.
}
```

Because the user is making the `ldap_init_SSL` call, the client/server communication in the previous example is secured by using SSL.

C API Usage Without SSL

```
#include <stdio.h>
#include <ldap.h>

main()
{
LDAP          *ld;
int           ret = 0;
.
.
.
/* open a connection */
if ( (ld = ldap_open( "MyHost", LDAP_PORT
 )) == NULL )
     exit( 1 );

/* authenticate as nobody */
if ( ldap_bind_s( ld, NULL, NULL ) != LDAP_SUCCESS ) {
     ldap_perror( ld, "ldap_bind_s" );
      exit( 1 );
}
.
.
.
}
```

In the previous example, the user is not making the `ldap_init_SSL` call, and the client-to-server communication is therefore not secure.

C API Usage for SASL-Based DIGEST-MD5 Authentication

This sample program illustrates the usage of LDAP SASL C-API for SASL-based DIGEST-MD5 authentication to a directory server.

```
/*
   EXPORT FUNCTION(S)
     NONE

   INTERNAL FUNCTION(S)
     NONE

   STATIC FUNCTION(S)
     NONE

   NOTES
     Usage:
      saslbind -h ldap_host -p ldap_port -D authentication_identity_dn \
               -w password
      options
       -h     LDAP host
       -p     LDAP port
       -D     DN of the identity for authentication
       -p     Password

       Default SASL authentication parameters used by the demo program
       SASL Security Property :    Currently only "auth" security property
                                   is supported by the C-API. This demo
                                   program uses this security property.
       SASL Mechanism         :    Supported mechanisms by OID
                                   "DIGEST-MD5" - This demo program
                                                  illustrates it's usage.
                                   "EXTERNAL" - SSL authentication is used.
                                                (This demo program does
                                                 not illustrate it's usage.)
       Authorization identity :    This demo program does not use any
                                    authorization identity.

   MODIFIED   (MM/DD/YY)
   ******      06/12/03 - Creation

*/

/*---------------------------------------------------------------------------
                     PRIVATE TYPES AND CONSTANTS
  ---------------------------------------------------------------------------*/

/*---------------------------------------------------------------------------
                     STATIC FUNCTION DECLARATIONS
  ---------------------------------------------------------------------------*/

#include <stdio.h>
#include <stdlib.h>
#include <ldap.h>


static int ldap_version = LDAP_VERSION3;
```

```
main (int argc, char **argv)
{
  LDAP*           ld;
  extern char*    optarg;
  char*           ldap_host = NULL;
  char*           ldap_bind_dn = NULL;
  char*           ldap_bind_pw = NULL;
  int             authmethod = 0;
  char            ldap_local_host[256] = "localhost";
  int             ldap_port = 389;
  char*           authcid = (char *)NULL;
  char*           mech = "DIGEST-MD5"; /* SASL mechanism */
  char*           authzid = (char *)NULL;
  char*           sasl_secprops = "auth";
  char*           realm = (char *)NULL;
  int             status = LDAP_SUCCESS;
  OraLdapHandle   sasl_cred = (OraLdapHandle )NULL;
  OraLdapClientCtx *cctx = (OraLdapClientCtx *)NULL;
  int              i = 0;


    while (( i = getopt( argc, argv,
    "D:h:p:w:E:P:U:V:W:O:R:X:Y:Z"
    )) != EOF ) {
switch( i ) {

case 'h':/* ldap host */
    ldap_host = (char *)strdup( optarg );
    break;
case 'D':/* bind DN */
    authcid = (char *)strdup( optarg );
    break;

case 'p':/* ldap port */
    ldap_port = atoi( optarg );
    break;
case 'w':/* Password */
    ldap_bind_pw = (char *)strdup( optarg );
    break;

    default:
    printf("Invalid Arguments passed\n" );
}
    }


  /* Get the connection to the LDAP server */
  if (ldap_host == NULL)
    ldap_host = ldap_local_host;

  if ((ld = ldap_open (ldap_host, ldap_port)) == NULL)
  {
    ldap_perror (ld, "ldap_init");
    exit (1);
  }

  /* Create the client context needed by LDAP C-API Oracle Extension functions*/
  status = ora_ldap_init_clientctx(&cctx);
```

```
  if(LDAP_SUCCESS != status) {
     printf("Failed during creation of client context \n");
     exit(1);
  }

  /* Create SASL credentials */
  sasl_cred = ora_ldap_create_cred_hdl(cctx, ORA_LDAP_CRED_HANDLE_SASL_MD5);

  ora_ldap_set_cred_props(cctx, sasl_cred, ORA_LDAP_CRED_SASL_REALM,
      (void *)realm);
  ora_ldap_set_cred_props(cctx, sasl_cred, ORA_LDAP_CRED_SASL_AUTH_PASSWORD,
      (void *)ldap_bind_pw);
  ora_ldap_set_cred_props(cctx, sasl_cred, ORA_LDAP_CRED_SASL_AUTHORIZATION_ID,
      (void *)authzid);
  ora_ldap_set_cred_props(cctx, sasl_cred, ORA_LDAP_CRED_SASL_SECURITY_PROPERTIES,
      (void *)sasl_secprops);

  /* If connecting to the directory using SASL DIGEST-MD5, the Authentication ID
     has to be normalized before it's sent to the server,
     the LDAP C-API does this normalization based on the following flag set in
     SASL credential properties */
  ora_ldap_set_cred_props(cctx, sasl_cred, ORA_LDAP_CRED_SASL_NORM_AUTHDN, (void
*)NULL);

  /* SASL Authetication to LDAP Server */
  status = (int)ora_ldap_init_SASL(cctx, ld, (char *)authcid, (char *)ORA_LDAP_
SASL_MECH_DIGEST_MD5,
     sasl_cred, NULL, NULL);

  if(LDAP_SUCCESS == status) {
     printf("SASL bind successful \n" );
  }else {
     printf("SASL bind failed with status :  %d\n", status);
  }

  /* Free SASL Credentials */
  ora_ldap_free_cred_hdl(cctx, sasl_cred);

  status = ora_ldap_free_clientctx(cctx);

  /* Unbind from LDAP server */
  ldap_unbind (ld);

  return (0);
}


/* end of file saslbind.c */
```

Required Header Files and Libraries for the C API

To build applications with the C API, you need to:

- Include the header file located at `$ORACLE_HOME/ldap/public/ldap.h`.
- Dynamically link to the library located at
  - `$ORACLE_HOME/lib/libclntsh.so.10.1` on UNIX operating systems
  - `%ORACLE_HOME%\bin\oraldapclnt10.dll` on Windows operating systems

Dependencies and Limitations of the C API

This API can work against any release of Oracle Internet Directory. It requires either an Oracle environment or, at minimum, globalization support and other core libraries.

To use the different authentication modes in SSL, the directory server requires corresponding configuration settings.

> **See Also:** *Oracle Internet Directory Administrator's Guide* for details about how to set the directory server in various SSL authentication modes.

Oracle Wallet Manager is required for creating wallets if you are using the C API in SSL mode.

TCP/IP Socket Library is required.

The following Oracle libraries are required:

- Oracle SSL-related libraries
- Oracle system libraries

Sample libraries are included in the release for the sample command line tool. You should replace these libraries with your own versions of the libraries.

The product supports only those authentication mechanisms described in LDAP SDK specifications (RFC 1823).

All strings input to the C API must be in UTF-8 format. If the strings are not in the UTF-8 format, you can use the OCI function `OCINlsCharSetConvert` to perform the conversion. Please see the *Oracle Call Interface Programmer's Guide* in the Oracle Database Library at `http://www.oracle.com/technology/documentation`.

15

DBMS_LDAP PL/SQL Reference

DBMS_LDAP contains the functions and procedures that enable PL/SQL programmers to access data from LDAP servers. This chapter examines all of the API functions in detail.

The chapter contains these topics:

- Summary of Subprograms
- Exception Summary
- Data Type Summary
- Subprograms

Note: Sample code for the DBMS_LDAP package is available at this URL:

http://www.oracle.com/technology/sample_code/

Look for the Oracle Identity Management link under Sample Applications—Fusion Middleware.

Summary of Subprograms

Table 15–1 DBMS_LDAP API Subprograms

Function or Procedure	Description
FUNCTION init	init() initializes a session with an LDAP server. This actually establishes a connection with the LDAP server.
FUNCTION simple_bind_s	The function simple_bind_s() can be used to perform simple user name and password authentication to the directory server.
FUNCTION bind_s	The function bind_s() can be used to perform complex authentication to the directory server.
FUNCTION unbind_s	The function unbind_s() is used for closing an active LDAP session.
FUNCTION compare_s	The function compare_s() can be used to test if a particular attribute in a particular entry has a particular value.
FUNCTION search_s	The function search_s() performs a synchronous search in the LDAP server. It returns control to the PL/SQL environment only after all of the search results have been sent by the server or if the search request is 'timed-out by the server.

Table 15–1 (Cont.) DBMS_LDAP API Subprograms

Function or Procedure	Description
FUNCTION search_st	The function `search_st()` performs a synchronous search in the LDAP server with a client side time out. It returns control to the PL/SQL environment only after all of the search results have been sent by the server or if the search request is 'timed-out' by the client or the server.
FUNCTION first_entry	The function first_entry is used to retrieve the first entry in the result set returned by either `search_s()` or search_st.
FUNCTION next_entry	The function `next_entry()` is used to iterate to the next entry in the result set of a search operation.
FUNCTION count_entries	This function is used to count the number of entries in the result set. It can also be used to count the number of entries remaining during a traversal of the result set using a combination of the functions `first_entry()` and `next_entry`.
FUNCTION first_attribute	The function `first_attribute()` fetches the first attribute of a given entry in the result set.
FUNCTION next_attribute	The function `next_attribute()`fetches the next attribute of a given entry in the result set.
FUNCTION get_dn	The function `get_dn()` retrieves the X.500 distinguished name of a given entry in the result set.
FUNCTION get_values	The function `get_values()`can be used to retrieve all of the values associated with a given attribute in a given entry.
FUNCTION get_values_len	The function `get_values_len()` can be used to retrieve values of attributes that have a 'Binary' syntax.
FUNCTION delete_s	This function can be used to remove a leaf entry in the LDAP Directory Information Tree.
FUNCTION modrdn2_s	The function `modrdn2_s()` can be used to rename the relative distinguished name of an entry.
FUNCTION err2string	The function `err2string()` can be used to convert an LDAP error code to a string in the local language in which the API is operating.
FUNCTION create_mod_array	The function `create_mod_array()` allocates memory for array modification entries that will be applied to an entry using the `modify_s()` functions.
PROCEDURE populate_mod_array (String Version)	Populates one set of attribute information for add or modify operations. This procedure call has to happen after `DBMS_LDAP.create_mod_array()` is called.
PROCEDURE populate_mod_array (Binary Version)	Populates one set of attribute information for add or modify operations. This procedure call has to occur after `DBMS_LDAP.create_mod_array()` is called.
PROCEDURE populate_mod_array (Binary Version. Uses BLOB Data Type)	Populates one set of attribute information for add or modify operations. This procedure call has to happen after `DBMS_LDAP.create_mod_array()` is called.
FUNCTION get_values_blob	The function `get_values_blob()` can be used to retrieve larger values of attributes that have a binary syntax.
FUNCTION count_values_blob	Counts the number of values returned by `DBMS_LDAP.get_values_blob()`.
FUNCTION value_free_blob	Frees the memory associated with the `BLOB_COLLECTION` returned by `DBMS_LDAP.get_values_blob()`.

Table 15–1 (Cont.) DBMS_LDAP API Subprograms

Function or Procedure	Description
FUNCTION modify_s	Performs a synchronous modification of an existing LDAP directory entry. Before calling `add_s`, you must call `DBMS_LDAP.creat_mod_array()` and `DBMS_LDAP.populate_mod_array()`.
FUNCTION add_s	Adds a new entry to the LDAP directory synchronously. Before calling `add_s`, you must call `DBMS_LDAP.creat_mod_array()` and `DBMS_LDAP.populate_mod_array()`.
PROCEDURE free_mod_array	Frees the memory allocated by `DBMS_LDAP.create_mod_array()`.
FUNCTION count_values	Counts the number of values returned by `DBMS_LDAP.get_values()`.
FUNCTION count_values_len	Counts the number of values returned by `DBMS_LDAP.get_values_len ()`.
FUNCTION rename_s	Renames an LDAP entry synchronously.
FUNCTION explode_dn	Breaks a DN up into its components.
FUNCTION open_ssl	Establishes an SSL (Secure Sockets Layer) connection over an existing LDAP connection.
FUNCTION msgfree	This function frees the chain of messages associated with the message handle returned by synchronous search functions.
FUNCTION ber_free	This function frees the memory associated with a handle to `BER_ELEMENT`.
FUNCTION nls_convert_to_utf8	The `nls_convert_to_utf8` function converts the input string containing database character set data to UTF-8 character set data and returns it.
FUNCTION nls_convert_from_utf8	The `nls_convert_from_utf8` function converts the input string containing UTF-8 character set data to database character set data and returns it.
FUNCTION nls_get_dbcharset_name	The `nls_get_dbcharset_name` function returns a string containing the database character set name.

See Also:

- "Searching the Directory" in Chapter 3 for more about `DBMS_LDAP.search_s()` and `DBMS_LDAP.search_st()`.
- "Terminating the Session by Using DBMS_LDAP" in Chapter 3 for more about `DBMS_LDAP.unbind_s()`.

Exception Summary

`DBMS_LDAP` can generate the exceptions described in Table 15–2 on page 15-3.

Table 15–2 DBMS_LDAP Exception Summary

Exception Name	Oracle Error Number	Cause of Exception
`general_error`	31202	Raised anytime an error is encountered that does not have a specific PL/SQL exception associated with it. The error string contains the description of the problem in the user's language.

Table 15–2 (Cont.) DBMS_LDAP Exception Summary

Exception Name	Oracle Error Number	Cause of Exception
init_failed	31203	Raised by DBMS_LDAP.init() if there are problems.
invalid_session	31204	Raised by all functions and procedures in the DBMS_LDAP package if they are passed an invalid session handle.
invalid_auth_method	31205	Raised by DBMS_LDAP.bind_s()if the authentication method requested is not supported.
invalid_search_scope	31206	Raised by all search functions if the scope of the search is invalid.
invalid_search_time_val	31207	Raised by DBMS_LDAP.search_st()if it is given an invalid value for a time limit.
invalid_message	31208	Raised by all functions that iterate through a result-set for getting entries from a search operation if the message handle given to them is invalid.
count_entry_error	31209	Raised by DBMS_LDAP.count_entries if it cannot count the entries in a given result set.
get_dn_error	31210	Raised by DBMS_LDAP.get_dn if the DN of the entry it is retrieving is NULL.
invalid_entry_dn	31211	Raised by all functions that modify, add, or rename an entry if they are presented with an invalid entry DN.
invalid_mod_array	31212	Raised by all functions that take a modification array as an argument if they are given an invalid modification array.
invalid_mod_option	31213	Raised by DBMS_LDAP.populate_mod_array if the modification option given is anything other than MOD_ADD, MOD_DELETE or MOD_REPLACE.
invalid_mod_type	31214	Raised by DBMS_LDAP.populate_mod_array if the attribute type that is being modified is NULL.
invalid_mod_value	31215	Raised by DBMS_LDAP.populate_mod_array if the modification value parameter for a given attribute is NULL.
invalid_rdn	31216	Raised by all functions and procedures that expect a valid RDN and are provided with an invalid one.
invalid_newparent	31217	Raised by DBMS_LDAP.rename_s if the new parent of an entry being renamed is NULL.
invalid_deleteoldrdn	31218	Raised by DBMS_LDAP.rename_s if the deleteoldrdn parameter is invalid.
invalid_notypes	31219	Raised by DBMS_LDAP.explode_dn if the notypes parameter is invalid.
invalid_ssl_wallet_loc	31220	Raised by DBMS_LDAP.open_ssl if the wallet location is NULL but the SSL authentication mode requires a valid wallet.
invalid_ssl_wallet_password	31221	Raised by DBMS_LDAP.open_ssl if the wallet password given is NULL.
invalid_ssl_auth_mode	31222	Raised by DBMS_LDAP.open_ssl if the SSL authentication mode is not 1, 2 or 3.

Data Type Summary

The DBMS_LDAP package uses the data types described in Table 15–3.

Table 15–3 DBMS_LDAP Data Type Summary

Data-Type	Purpose
SESSION	Used to hold the handle of the LDAP session. Nearly all of the functions in the API require a valid LDAP session to work.
MESSAGE	Used to hold a handle to the message retrieved from the result set. This is used by all functions that work with entry attributes and values.
MOD_ARRAY	Used to hold a handle to the array of modifications being passed to either modify_s() or add_s().
TIMEVAL	Used to pass time limit information to the LDAP API functions that require a time limit.
BER_ELEMENT	Used to hold a handle to a BER structure used for decoding incoming messages.
STRING_COLLECTION	Used to hold a list of VARCHAR2 strings that can be passed on to the LDAP server.
BINVAL_COLLECTION	Used to hold a list of RAW data, which represent binary data.
BERVAL_COLLECTION	Used to hold a list of BERVAL values that are used for populating a modification array.
BLOB_COLLECTION	Used to hold a list of BLOB data, which represent binary data.

Subprograms

This section takes a closer look at each of the DBMS_LDAP subprograms.

FUNCTION init

init() initializes a session with an LDAP server. This actually establishes a connection with the LDAP server.

Syntax

```
FUNCTION init
(
hostname IN VARCHAR2,
portnum  IN PLS_INTEGER
)
RETURN SESSION;
```

Parameters

Table 15–4 INIT Function Parameters

Parameter	Description
hostname	Contains a space-separated list of host names or dotted strings representing the IP address of hosts running an LDAP server to connect to. Each host name in the list may include a port number, which is separated from the host by a colon. The hosts are tried in the order listed, stopping with the first one to which a successful connection is made.

Table 15–4 (Cont.) INIT Function Parameters

Parameter	Description
portnum	Contains the TCP port number to connect to. If the port number is included with the host name, this parameter is ignored. If the parameter is not specified, and the host name does not contain the port number, a default port number of 389 is assumed.

Return Values

Table 15–5 INIT Function Return Values

Value	Description
SESSION	A handle to an LDAP session that can be used for further calls to the API.

Exceptions

Table 15–6 INIT Function Exceptions

Exception	Description
init_failed	Raised when there is a problem contacting the LDAP server.
general_error	For all other errors. The error string associated with the exception describes the error in detail.

Usage Notes

`DBMS_LDAP.init()` is the first function that should be called because it establishes a session with the LDAP server. Function `DBMS_LDAP.init()` returns a session handle, a pointer to an opaque structure that must be passed to subsequent calls pertaining to the session. This routine will return `NULL` and raise the `INIT_FAILED` exception if the session cannot be initialized. After `init()` has been called, the connection has to be authenticated using `DBMS_LDAP.bind_s` or `DBMS_LDAP.simple_bind_s()`.

See Also

`DBMS_LDAP.simple_bind_s()`, `DBMS_LDAP.bind_s()`.

FUNCTION simple_bind_s

The function `simple_bind_s` can be used to perform simple user name and password authentication to the directory server.

Syntax

```
FUNCTION simple_bind_s
(
ld     IN SESSION,
dn     IN VARCHAR2,
passwd IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–7 SIMPLE_BIND_S Function Parameters

Parameter	Description
`ld`	A valid LDAP session handle.
`dn`	The Distinguished Name of the User that we are trying to login as.
`passwd`	A text string containing the password.

Return Values

Table 15–8 SIMPLE_BIND_S Function Return Values

Value	Description
`PLS_INTEGER`	`DBMS_LDAP.SUCCESS` on a successful completion. If there was a problem, one of the following exceptions will be raised.

Exceptions

Table 15–9 SIMPLE_BIND_S Function Exceptions

Exception	Description
`invalid_session`	Raised if the session handle `ld` is invalid.
`general_error`	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

`DBMS_LDAP.simple_bind_s()` can be used to authenticate a user whose directory distinguished name and directory password are known. It can be called only after a valid LDAP session handle is obtained from a call to `DBMS_LDAP.init()`.

FUNCTION bind_s

The function `bind_s` can be used to perform complex authentication to the directory server.

Syntax

```
FUNCTION  bind_s
(
ld     IN SESSION,
dn     IN VARCHAR2,
cred IN VARCHAR2,
meth IN PLS_INTEGER
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–10 BIND_S Function Parameters

Parameter	Description
`ld`	A valid LDAP session handle.
`dn`	The distinguished name of the user.

Table 15–10 (Cont.) BIND_S Function Parameters

Parameter	Description
cred	A text string containing the credentials used for authentication.
meth	The authentication method. The only valid value is DBMS_LDAP_UTL.AUTH_SIMPLE.

Return Values

Table 15–11 BIND_S Function Return Values

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS upon successful completion. One of the following exceptions is raised if there is a problem.

Exceptions

Table 15–12 BIND_S Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_auth_method	Raised if the authentication method requested is not supported.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

`DBMS_LDAP.bind_s()` can be used to authenticate a user. It can be called only after a valid LDAP session handle is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP.simple_bind_s()`.

FUNCTION unbind_s

The function `unbind_s` is used for closing an active LDAP session.

Syntax

```
FUNCTION unbind_s
(
ld IN OUT SESSION
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–13 UNBIND_S Function Parameters

Parameter	Description
ld	A valid LDAP session handle.

Return Values

Table 15–14 UNBIND_S Function Return Values

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS on proper completion. One of the following exceptions is raised otherwise.

Exceptions

Table 15–15 UNBIND_S Function Exceptions

Exception	Description
invalid_session	Raised if the sessions handle ld is invalid.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

The unbind_s() function sends an unbind request to the server, closes all open connections associated with the LDAP session, and disposes of all resources associated with the session handle before returning. After a call to this function, the session handle ld is invalid.

See Also

DBMS_LDAP.bind_s(), DBMS_LDAP.simple_bind_s().

FUNCTION compare_s

The function compare_s can be used to test if a particular attribute in a particular entry has a particular value.

Syntax

```
FUNCTION compare_s
(
ld    IN SESSION,
dn    IN VARCHAR2,
attr  IN VARCHAR2,
value IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–16 COMPARE_S Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
dn	The name of the entry to compare against.
attr	The attribute to compare against.
value	A string attribute value to compare against.

Return Values

Table 15–17 COMPARE_S Function Return Values

Value	Description
PLS_INTEGER	COMPARE_TRUE if the given attribute has a matching value. COMPARE_FALSE if the given attribute does not have a matching value.

Exceptions

Table 15–18 COMPARE_S Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

The function compare_s can be used to assert that an attribute in the directory has a certain value. This operation can be performed only on attributes whose syntax enables them to be compared. The compare_s function can be called only after a valid LDAP session handle has been obtained from the init() function and authenticated by the bind_s() or simple_bind_s() functions.

See Also

DBMS_LDAP.bind_s().

FUNCTION search_s

The function search_s performs a synchronous search in the directory. It returns control to the PL/SQL environment only after all of the search results have been sent by the server or if the search request is timed out by the server.

Syntax

```
FUNCTION search_s
(
ld       IN  SESSION,
base     IN  VARCHAR2,
scope    IN  PLS_INTEGER,
filter   IN  VARCHAR2,
attrs    IN  STRING_COLLECTION,
attronly IN  PLS_INTEGER,
res      OUT MESSAGE
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–19 SEARCH_S Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
base	The DN of the entry at which to start the search.

Table 15–19 (Cont.) SEARCH_S Function Parameters

Parameter	Description
scope	One of SCOPE_BASE (0x00), SCOPE_ONELEVEL (0x01), or SCOPE_SUBTREE (0x02), indicating the scope of the search.
filter	A character string representing the search filter. The value NULL can be passed to indicate that the filter "(objectclass=*)", which matches all entries, is to be used.
attrs	A collection of strings indicating which attributes to return for each matching entry. Passing NULL for this parameter causes all available user attributes to be retrieved. The special constant string NO_ATTRS ("1.1") may be used as the only string in the array to indicate that no attribute types are to be returned by the server. The special constant string ALL_USER_ATTRS ("*") can be used in the attrs array along with the names of some operational attributes to indicate that all user attributes plus the listed operational attributes are to be returned.
attrsonly	A boolean value that must be zero if both attribute types and values are to be returned, and nonzero if only types are wanted.
res	This is a result parameter that contains the results of the search upon completion of the call. If no results are returned, *res is set to NULL.

Return Values

Table 15–20 SEARCH_S Function Return Value

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS if the search operation succeeded. An exception is raised in all other cases.
res	If the search succeeded and there are entries, this parameter is set to a non-null value which can be used to iterate through the result set.

Exceptions

Table 15–21 SEARCH_S Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_search_scope	Raised if the search scope is not one of SCOPE_BASE, SCOPE_ONELEVEL, or SCOPE_SUBTREE.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

The function search_s() issues a search operation and does not return control to the user environment until all of the results have been returned from the server. Entries returned from the search, if any, are contained in the res parameter. This parameter is opaque to the caller. Entries, attributes, and values can be extracted by calling the parsing routines described in this chapter.

See Also

DBMS_LDAP.search_st(), DBMS_LDAP.first_entry(), DBMS_LDAP.next_entry.

FUNCTION search_st

The function `search_st()` performs a synchronous search in the LDAP server with a client-side time out. It returns control to the PL/SQL environment only after all of the search results have been sent by the server or if the search request is timed out by the client or the server.

Syntax

```
FUNCTION search_st
(
ld       IN  SESSION,
base     IN  VARCHAR2,
scope    IN  PLS_INTEGER,
filter   IN  VARCHAR2,
attrs    IN  STRING_COLLECTION,
attronly IN  PLS_INTEGER,
tv       IN  TIMEVAL,
res      OUT MESSAGE
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–22 SEARCH_ST Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
base	The DN of the entry at which to start the search.
scope	One of SCOPE_BASE (0x00), SCOPE_ONELEVEL (0x01), or SCOPE_SUBTREE (0x02), indicating the scope of the search.
filter	A character string representing the search filter. The value NULL can be passed to indicate that the filter "(objectclass=*)", which matches all entries, is to be used.
attrs	A collection of strings indicating which attributes to return for each matching entry. Passing NULL for this parameter causes all available user attributes to be retrieved. The special constant string NO_ATTRS ("1.1") may be used as the only string in the array to indicate that no attribute types are to be returned by the server. The special constant string ALL_USER_ATTRS ("*") can be used in the attrs array along with the names of some operational attributes to indicate that all user attributes plus the listed operational attributes are to be returned.
attrsonly	A boolean value that must be zero if both attribute types and values are to be returned, and nonzero if only types are wanted.
tv	The time out value, expressed in seconds and microseconds, that should be used for this search.
res	This is a result parameter which will contain the results of the search upon completion of the call. If no results are returned, *res is set to NULL.

Return Values

Table 15–23 SEARCH_ST Function Return Values

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS if the search operation succeeded. An exception is raised in all other cases.
res	If the search succeeded and there are entries, this parameter is set to a non-null value which can be used to iterate through the result set.

Exceptions

Table 15–24 SEARCH_ST Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_search_scope	Raised if the search scope is not one of SCOPE_BASE, SCOPE_ONELEVEL or SCOPE_SUBTREE.
invalid_search_time_value	Raised if the time value specified for the time out is invalid.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

This function is very similar to DBMS_LDAP.search_s() except that it requires a time out value to be given.

See Also

DBMS_LDAP.search_s(), DBML_LDAP.first_entry(), DBMS_LDAP.next_entry.

FUNCTION first_entry

The function first_entry() is used to retrieve the first entry in the result set returned by either search_s() or search_st().

Syntax

```
FUNCTION first_entry
(
ld  IN SESSION,
msg IN MESSAGE
)
RETURN MESSAGE;
```

Parameters

Table 15–25 FIRST_ENTRY Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
msg	The search result, as obtained by a call to one of the synchronous search routines.

Return Values

Table 15–26 FIRST_ENTRY Return Values

Value	Description
MESSAGE	A handle to the first entry in the list of entries returned from the LDAP server. It is set to NULL if there was an error and an exception is raised.

Exceptions

Table 15–27 FIRST_ENTRY Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming msg handle is invalid.

Usage Notes

The function `first_entry()` should always be the first function used to retrieve the results from a search operation.

See Also

`DBMS_LDAP.next_entry()`, `DBMS_LDAP.search_s()`, `DBMS_LDAP.search_st()`.

FUNCTION next_entry

The function `next_entry()` is used to iterate to the next entry in the result set of a search operation.

Syntax

```
FUNCTION next_entry
(
ld  IN SESSION,
msg IN MESSAGE
)
RETURN MESSAGE;
```

Parameters

Table 15–28 NEXT_ENTRY Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
msg	The search result, as obtained by a call to one of the synchronous search routines.

Return Values

Table 15–29 NEXT_ENTRY Function Return Values

Value	Description
MESSAGE	A handle to the next entry in the list of entries returned from the LDAP server. It is set to null if there was an error and an exception is raised.

Exceptions

Table 15–30 NEXT_ENTRY Function Exceptions

Exception	Description
invalid_session	Raised if the session handle, `ld` is invalid.
invalid_message	Raised if the incoming `msg` handle is invalid.

Usage Notes

The function `next_entry()` should always be called after a call to the function `first_entry()`. Also, the return value of a successful call to `next_entry()` should be used as `msg` argument used in a subsequent call to the function `next_entry()` to fetch the next entry in the list.

See Also

`DBMS_LDAP.first_entry()`, `DBMS_LDAP.search_s()`, `DBMS_LDAP.search_st()`.

FUNCTION count_entries

This function is used to count the number of entries in the result set. It can also be used to count the number of entries remaining during a traversal of the result set using a combination of the functions `first_entry()` and `next_entry()`.

Syntax

```
FUNCTION count_entries
(
ld  IN SESSION,
msg IN MESSAGE
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–31 COUNT_ENTRY Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
msg	The search result, as obtained by a call to one of the synchronous search routines.

Return Values

Table 15–32 COUNT_ENTRY Function Return Values

Value	Description
PLS_INTEGER	Nonzero if there are entries in the result set. -1 if there was a problem.

Exceptions

Table 15–33 COUNT_ENTRY Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming msg handle is invalid.
count_entry_error	Raised if there was a problem in counting the entries.

Usage Notes

count_entries() returns the number of entries contained in a chain of entries; if an error occurs such as the res parameter being invalid, -1 is returned. The count_entries() call can also be used to count the number of entries that remain in a chain if called with a message, entry, or reference returned by first_message(), next_message(), first_entry(), next_entry(), first_reference(), next_reference().

See Also

DBMS_LDAP.first_entry(), DBMS_LDAP.next_entry().

FUNCTION first_attribute

The function first_attribute() fetches the first attribute of a given entry in the result set.

Syntax

```
FUNCTION first_attribute
(
ld          IN  SESSION,
ldapentry   IN  MESSAGE,
ber_elem    OUT BER_ELEMENT
)
RETURN VARCHAR2;
```

Parameters

Table 15–34 FIRST_ATTRIBUTE Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
ldapentry	The entry whose attributes are to be stepped through, as returned by first_entry() or next_entry().
ber_elem	A handle to a BER_ELEMENT that is used to keep track of attributes in the entry that have already been read.

Return Values

Table 15–35 FIRST_ATTRIBUTE Function Return Values

Value	Description
VARCHAR2	The name of the attribute if it exists. NULL if no attribute exists or if an error occurred.
ber_elem	A handle used by DBMS_LDAP.next_attribute() to iterate over all of the attributes

Exceptions

Table 15–36 FIRST_ATTRIBUTE Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming msg handle is invalid.

Usage Notes

The handle to the BER_ELEMENT returned as a function parameter to first_attribute() should be used in the next call to next_attribute() to iterate through the various attributes of an entry. The name of the attribute returned from a call to first_attribute() can in turn be used in calls to the functions get_values() or get_values_len() to get the values of that particular attribute.

See Also

DBMS_LDAP.next_attribute(), DBMS_LDAP.get_values(), DBMS_LDAP.get_values_len(), DBMS_LDAP.first_entry(), DBMS_LDAP.next_entry().

FUNCTION next_attribute

The function next_attribute() retrieves the next attribute of a given entry in the result set.

Syntax

```
FUNCTION next_attribute
(
ld       IN SESSION,
ldapentry      IN MESSAGE,
ber_elem IN BER_ELEMENT
)
RETURN VARCHAR2;
```

Parameters

Table 15–37 NEXT_ATTRIBUTE Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
ldapentry	The entry whose attributes are to be stepped through, as returned by first_entry() or next_entry().
ber_elem	A handle to a BER_ELEMENT that is used to keep track of attributes in the entry that have been read.

Return Values

Table 15–38 NEXT_ATTRIBUTE Function Return Values

Value	Description
`VARCHAR2` (function return)	The name of the attribute if it exists.

Exceptions

Table 15–39 NEXT_ATTRIBUTE Function Exceptions

Exception	Description
`invalid_session`	Raised if the session handle `ld` is invalid.
`invalid_message`	Raised if the incoming `msg` handle is invalid.

Usage Notes

The handle to the `BER_ELEMENT` returned as a function parameter to `first_attribute()` should be used in the next call to `next_attribute()` to iterate through the various attributes of an entry. The name of the attribute returned from a call to `next_attribute()` can in turn be used in calls to the functions `get_values()` or `get_values_len()` to get the values of that particular attribute.

See Also

`DBMS_LDAP.first_attribute()`, `DBMS_LDAP.get_values()`, `DBMS_LDAP.get_values_len()`, `DBMS_LDAP.first_entry()`, `DBMS_LDAP.next_entry()`.

FUNCTION get_dn

The function `get_dn()` retrieves the X.500 distinguished name of given entry in the result set.

Syntax

```
FUNCTION get_dn
(
ld  IN SESSION,
ldapentrymsg IN MESSAGE
)
RETURN VARCHAR2;
```

Parameters

Table 15–40 GET_DN Function Parameters

Parameter	Description
`ld`	A valid LDAP session handle.
`ldapentry`	The entry whose DN is to be returned.

Return Values

Table 15–41 GET_DN Function Return Values

Value	Description
VARCHAR2	The X.500 Distinguished name of the entry as a PL/SQL string. NULL if there was a problem.

Exceptions

Table 15–42 GET_DN Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming msg handle is invalid.
get_dn_error	Raised if there was a problem in determining the DN.

Usage Notes

The function `get_dn()` can be used to retrieve the DN of an entry as the program logic is iterating through the result set. This can in turn be used as an input to `explode_dn()` to retrieve the individual components of the DN.

See Also

`DBMS_LDAP.explode_dn()`.

FUNCTION get_values

The function `get_values()` can be used to retrieve all of the values associated with a given attribute in a given entry.

Syntax

```
FUNCTION get_values
(
ld   IN SESSION,
ldapentry IN MESSAGE,
attr IN VARCHAR2
)
RETURN STRING_COLLECTION;
```

Parameters

Table 15–43 GET_VALUES Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
ldapentry	A valid handle to an entry returned from a search result.
attr	The name of the attribute for which values are being sought.

Return Values

Table 15–44 GET_VALUES Function Return Values

Value	Description
STRING_COLLECTION	A PL/SQL string collection containing all of the values of the given attribute. NULL if there are no values associated with the given attribute.

Exceptions

Table 15–45 GET_VALUES Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming entry handle is invalid.

Usage Notes

The function `get_values()` can only be called after the handle to entry has been first retrieved by call to either `first_entry()` or `next_entry()`. The name of the attribute may be known beforehand or can be determined by a call to `first_attribute()` or `next_attribute()`.The function `get_values()` always assumes that the data type of the attribute it is retrieving is a string. For retrieving binary data types, `get_values_len()` should be used.

See Also

`DBMS_LDAP.first_entry()`, `DBMS_LDAP.next_entry()`, `DBMS_LDAP.count_values()`, `DBMS_LDAP.get_values_len()`.

FUNCTION get_values_len

The function `get_values_len()` can be used to retrieve values of attributes that have a binary syntax.

Syntax

```
FUNCTION get_values_len
(
ld   IN SESSION,
ldapentry IN MESSAGE,
attr IN VARCHAR2
)
RETURN BINVAL_COLLECTION;
```

Parameters

Table 15–46 GET_VALUES_LEN Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
ldapentrymsg	A valid handle to an entry returned from a search result.
attr	The string name of the attribute for which values are being sought.

Return Values

Table 15–47 GET_VALUES_LEN Function Return Values

Value	Description
BINVAL_COLLECTION	A PL/SQL 'Raw' collection containing all the values of the given attribute. NULL if there are no values associated with the given attribute.

Exceptions

Table 15–48 GET_VALUES_LEN Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_message	Raised if the incoming entry handle is invalid.

Usage Notes

The function get_values_len() can only be called after the handle to an entry has been retrieved by a call to either first_entry() or next_entry().The name of the attribute may be known beforehand or can also be determined by a call to first_attribute() or next_attribute().This function can be used to retrieve both binary and non-binary attribute values.

See Also

DBMS_LDAP.first_entry(), DBMS_LDAP.next_entry(), DBMS_LDAP.count_values_len(), DBMS_LDAP.get_values().

FUNCTION delete_s

The function delete_s() can be used to remove a leaf entry in the DIT.

Syntax

```
FUNCTION delete_s
(
ld      IN SESSION,
entrydn IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–49 DELETE_S Function Parameters

Parameter Name	Description
ld	A valid LDAP session.
entrydn	The X.500 distinguished name of the entry to delete.

Return Values

Table 15–50 DELETE_S Function Return Values

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS if the delete operation was successful. An exception is raised otherwise.

Exceptions

Table 15–51 DELETE_S Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_entry_dn	Raised if the distinguished name of the entry is invalid.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

The function delete_s() can be used to remove only leaf entries in the DIT. A leaf entry is an entry that does not have any entries under it. This function cannot be used to delete non-leaf entries.

See Also

DBMS_LDAP.modrdn2_s().

FUNCTION modrdn2_s

The function modrdn2_s() can be used to rename the relative distinguished name of an entry.

Syntax

```
FUNCTION modrdn2_s
(
ld IN SESSION,
entrydn in VARCHAR2
newrdn in VARCHAR2
deleteoldrdn IN PLS_INTEGER
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–52 MODRDN2_S Function Parameters

Parameter	Description
ld	A valid LDAP session handle.
entrydn	The distinguished name of the entry (This entry must be a leaf node in the DIT.).
newrdn	The new relative distinguished name of the entry.
deleteoldrdn	A boolean value that, if nonzero, indicates that the attribute values from the old name should be removed from the entry.

Return Values

Table 15–53 MODRDN2_S Function Return Values

Value	Description
PLS_INTEGER	DBMS_LDAP.SUCCESS if the operation was successful. An exception is raised otherwise.

Exceptions

Table 15–54 MODRDN2_S Function Exceptions

Exception	Description
invalid_session	Raised if the session handle ld is invalid.
invalid_entry_dn	Raised if the distinguished name of the entry is invalid.
invalid_rdn	Invalid LDAP RDN.
invalid_deleteoldrdn	Invalid LDAP deleteoldrdn.
general_error	For all other errors. The error string associated with this exception will explain the error in detail.

Usage Notes

The function `nodrdn2_s()` can be used to rename the leaf nodes of a DIT. It simply changes the relative distinguished name by which they are known. The use of this function is being deprecated in the LDAP v3 standard. Please use `rename_s()`, which fulfills the same purpose.

See Also

`DBMS_LDAP.rename_s()`.

FUNCTION err2string

The function `err2string()` can be used to convert an LDAP error code to a string in the local language in which the API is operating.

Syntax

```
FUNCTION err2string
(
ldap_err IN PLS_INTEGER
)
RETURN VARCHAR2;
```

Parameters

Table 15–55 ERR2STRING Function Parameters

Parameter	Description
ldap_err	An error number returned from one of the API calls.

Return Values

Table 15–56 ERR2STRING Function Return Values

Value	Description
VARCHAR2	A character string translated to the local language. The string describes the error in detail.

Exceptions

`err2string()` raises no exceptions.

Usage Notes

In this release, the exception handling mechanism automatically invokes this function if any of the API calls encounter an error.

FUNCTION create_mod_array

The function `create_mod_array()` allocates memory for array modification entries that are applied to an entry using the `modify_s()` or `add_s()` functions.

Syntax

```
FUNCTION create_mod_array
(
num IN PLS_INTEGER
)
RETURN MOD_ARRAY;
```

Parameters

Table 15–57 CREATE_MOD_ARRAY Function Parameters

Parameter	Description
num	The number of the attributes that you want to add or modify.

Return Values

Table 15–58 CREATE_MOD_ARRAY Function Return Values

Value	Description
MOD_ARRAY	The data structure holds a pointer to an LDAP mod array. Returns NULL if there was a problem.

Exceptions

`create_mod_array()` raises no exceptions.

Usage Notes

This function is one of the preparation steps for `DBMS_LDAP.add_s` and `DBMS_LDAP.modify_s`. It calls `DBMS_LDAP.free_mod_array` to free memory after the calls to `add_s` or `modify_s` have completed.

See Also

`DBMS_LDAP.populate_mod_array()`, `DBMS_LDAP.modify_s()`, `DBMS_LDAP.add_s()`, and `DBMS_LDAP.free_mod_array()`.

PROCEDURE populate_mod_array (String Version)

Populates one set of attribute information for add or modify operations.

Syntax

```
PROCEDURE populate_mod_array
(
modptr   IN DBMS_LDAP.MOD_ARRAY,
mod_op   IN PLS_INTEGER,
mod_type IN VARCHAR2,
modval   IN DBMS_LDAP.STRING_COLLECTION
);
```

Parameters

Table 15–59 POPULATE_MOD_ARRAY (String Version) Procedure Parameters

Parameter	Description
modptr	The data structure holds a pointer to an LDAP mod array.
mod_op	This field specifies the type of modification to perform.
mod_type	This field indicates the name of the attribute type to which the modification applies.
modval	This field specifies the attribute values to add, delete, or replace. It is for string values only.

Exceptions

Table 15–60 POPULATE_MOD_ARRAY (String Version) Procedure Exceptions

Exception	Description
invalid_mod_array	Invalid LDAP mod array
invalid_mod_option	Invalid LDAP mod option
invalid_mod_type	Invalid LDAP mod type
invalid_mod_value	Invalid LDAP mod value

Usage Notes

This function is one of the preparation steps for `DBMS_LDAP.add_s` and `DBMS_LDAP.modify_s`. It has to happen after `DBMS_LDAP.create_mod_array` is called.

See Also

`DBMS_LDAP.create_mod_array()`, `DBMS_LDAP.modify_s()`, `DBMS_LDAP.add_s()`, and `DBMS_LDAP.free_mod_array()`.

PROCEDURE populate_mod_array (Binary Version)

Populates one set of attribute information for add or modify operations. This procedure call occurs after `DBMS_LDAP.create_mod_array()` is called.

Syntax

```
PROCEDURE populate_mod_array
(
modptr   IN DBMS_LDAP.MOD_ARRAY,
mod_op   IN PLS_INTEGER,
```

```
mod_type IN VARCHAR2,
modbval  IN DBMS_LDAP.BERVAL_COLLECTION
);
```

Parameters

Table 15–61 POPULATE_MOD_ARRAY (Binary Version) Procedure Parameters

Parameter	Description
modptr	This data structure holds a pointer to an LDAP mod array.
mod_op	This field specifies the type of modification to perform.
mod_type	This field indicates the name of the attribute type to which the modification applies.
modbval	This field specifies the attribute values to add, delete, or replace. It is for the binary values.

Exceptions

Table 15–62 POPULATE_MOD_ARRAY (Binary Version) Procedure Exceptions

Exception	Description
invalid_mod_array	Invalid LDAP mod array.
invalid_mod_option	Invalid LDAP mod option.
invalid_mod_type	Invalid LDAP mod type.
invalid_mod_value	Invalid LDAP mod value.

Usage Notes

This function is one of the preparation steps for `DBMS_LDAP.add_s` and `DBMS_LDAP.modify_s`. It is invoked after `DBMS_LDAP.create_mod_array` is called.

See Also

`DBMS_LDAP.create_mod_array()`, `DBMS_LDAP.modify_s()`, `DBMS_LDAP.add_s()`, and `DBMS_LDAP.free_mod_array()`.

PROCEDURE populate_mod_array (Binary Version. Uses BLOB Data Type)

Populates one set of attribute information for add or modify operations. This procedure call occurs after `DBMS_LDAP.create_mod_array()` is called.

Syntax

```
PROCEDURE populate_mod_array
(
modptr IN DBMS_LDAP.MOD_ARRAY,
mod_op IN PLS_INTEGER,
mod_type IN VARCHAR2,
modbval IN DBMS_LDAP.BLOB_COLLECTION
);
```

Parameters

Table 15–63 POPULATE_MOD_ARRAY (Binary) Parameters

Parameter	Description
modptr	This data structure holds a pointer to an LDAP mod array.
mod_op	This field specifies the type of modification to perform.
mod_type	This field indicates the name of the attribute type to which the modification applies.
modbval	This field specifies the binary attribute values to add, delete, or replace.

Exceptions

Table 15–64 POPULATE_MOD_ARRAY (Binary) Exceptions

Exception	Description
invalid_mod_array	Invalid LDAP mod array.
invalid_mod_option	Invalid LDAP mod option.
invalid_mod_type	Invalid LDAP mod type.
invalid_mod_value	Invalid LDAP mod value.

Usage Notes

This function is one of the preparation steps for `DBMS_LDAP.add_s` and `DBMS_LDAP.modify_s`. It is invoked after `DBMS_LDAP.create_mod_array` is called.

See Also

`DBMS_LDAP.create_mod_array()`, `DBMS_LDAP.modify_s()`, `DBMS_LDAP.add_s()`, and `DBMS_LDAP.free_mod_array()`.

FUNCTION get_values_blob

The function `get_values_blob()` can be used to retrieve larger values of attributes that have a binary syntax.

Syntax

```
Syntax
FUNCTION get_values_blob
(
ld IN SESSION,
ldapentry IN MESSAGE,
attr IN VARCHAR2
)
RETURN BLOB_COLLECTION;
```

Parameters

Table 15–65 GET_VALUES_BLOB Parameters

Parameter	Description
ld	A valid LDAP session handle.
ldapentrymsg	A valid handle to an entry returned from a search result.

Table 15–65 (Cont.) GET_VALUES_BLOB Parameters

Parameter	Description
attr	The string name of the attribute for which values are being sought.

Return Values

Table 15–66 get_values_blob Return Values

Value	Description
BLOB_COLLECTION	A PL/SQL BLOB collection containing all the values of the given attribute.
NULL	No values are associated with the given attribute.

Exceptions

Table 15–67 get_values_blob Exceptions

Exception	Description
invalid_session	Raised if the session handle `ld` is invalid.
invalid message	Raised if the incoming entry handle is invalid.

Usage Notes

The function `get_values_blob()` can only be called after the handle to an entry has been retrieved by a call to either `first_entry()` or `next_entry()`. The name of the attribute may be known beforehand or can also be determined by a call to `first_attribute()` or `next_attribute()`. This function can be used to retrieve both binary and nonbinary attribute values.

See Also

`DBMS_LDAP.first_entry()`, `DBMS_LDAP.next_entry()`, `DBMS_LDAP.count_values_blob()`, `DBMS_LDAP.get_values()`.

FUNCTION count_values_blob

Counts the number of values returned by `DBMS_LDAP.get_values_blob()`.

Syntax

```
FUNCTION count_values_blob
(
values IN DBMS_LDAP.BLOB_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–68 COUNT_VALUES_BLOB Parameters

Parameter	Description
values	The collection of large binary values.

Return Values

Table 15–69 COUNT_VALUES_BLOB Return Values

Values	Description
PLS_INTEGER	Indicates the success or failure of the operation.

Exceptions

The function `count_values_blob()` raises no exceptions.

See Also

`DBMS_LDAP.count_values()`, `DBMS_LDAP.get_values_blob()`.

FUNCTION value_free_blob

Frees the memory associated with `BLOB_COLLECTION` returned by `DBMS_LDAP.get_values_blob()`.

Syntax

```
PROCEDURE value_free_blob
(
vals IN OUT DBMS_LDAP.BLOB_COLLECTION
);
```

Parameters

Table 15–70 VALUE_FREE_BLOB Parameters

Parameter	Description
vals	The collection of large binary values returned by `DBMS_LDAP.get_values_blob()`.

Exceptions

`value_free_blob()` raises no exceptions.

See Also

`DBMS_LDAP.get_values_blob()`.

FUNCTION modify_s

Performs a synchronous modification of an existing LDAP directory entry.

Syntax

```
FUNCTION modify_s
(
ld      IN DBMS_LDAP.SESSION,
entrydn IN VARCHAR2,
modptr  IN DBMS_LDAP.MOD_ARRAY
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–71 MODIFY_S Function Parameters

Parameter	Description
ld	This parameter is a handle to an LDAP session returned by a successful call to DBMS_LDAP.init().
entrydn	This parameter specifies the name of the directory entry whose contents are to be modified.
modptr	This parameter is the handle to an LDAP mod structure, as returned by successful call to DBMS_LDAP.create_mod_array().

Return Values

Table 15–72 MODIFY_S Function Return Values

Value	Description
PLS_INTEGER	Indicates the success or failure of the modification operation.

Exceptions

Table 15–73 MODIFY_S Function Exceptions

Exception	Description
invalid_session	Invalid LDAP session.
invalid_entry_dn	Invalid LDAP entry dn.
invalid_mod_array	Invalid LDAP mod array.

Usage Notes

This function call has to follow successful calls of DBMS_LDAP.create_mod_array() and DBMS_LDAP.populate_mod_array().

See Also

DBMS_LDAP.create_mod_array(),DBMS_LDAP.populate_mod_array(), DBMS_LDAP.add_s(), and DBMS_LDAP.free_mod_array().

FUNCTION add_s

Adds a new entry to the LDAP directory synchronously. Before calling add_s, DBMS_LDAP.create_mod_array() and DBMS_LDAP.populate_mod_array() must be called.

Syntax

```
FUNCTION add_s
(
ld      IN DBMS_LDAP.SESSION,
entrydn IN VARCHAR2,
modptr  IN DBMS_LDAP.MOD_ARRAY
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–74 ADD_S Function Parameters

Parameter	Description
ld	This parameter is a handle to an LDAP session, as returned by a successful call to DBMS_LDAP.init().
entrydn	This parameter specifies the name of the directory entry to be created.
modptr	This parameter is the handle to an LDAP mod structure, as returned by successful call to DBMS_LDAP.create_mod_array().

Return Values

Table 15–75 ADD_S Function Return Values

Value	Description
PLS_INTEGER	Indicates the success or failure of the modification operation.

Exceptions

Table 15–76 ADD_S Function Exceptions

Exception	Description
invalid_session	Invalid LDAP session.
invalid_entry_dn	Invalid LDAP entry dn.
invalid_mod_array	Invalid LDAP mod array.

Usage Notes

The parent entry of the entry to be added must already exist in the directory. This function call has to follow successful calls to DBMS_LDAP.create_mod_array() and DBMS_LDAP.populate_mod_array().

See Also

DBMS_LDAP.create_mod_array(), DBMS_LDAP.populate_mod_array(), DBMS_LDAP.modify_s(), and DBMS_LDAP.free_mod_array().

PROCEDURE free_mod_array

Frees the memory allocated by DBMS_LDAP.create_mod_array().

Syntax

```
PROCEDURE free_mod_array
(
modptr IN DBMS_LDAP.MOD_ARRAY
);
```

Parameters

Table 15–77 FREE_MOD_ARRAY Procedure Parameters

Parameter	Description
modptr	This parameter is the handle to an LDAP mod structure returned by a successful call to DBMS_LDAP.create_mod_array().

Exceptions

free_mod_array raises no exceptions.

See Also

DBMS_LDAP.populate_mod_array(), DBMS_LDAP.modify_s(), DBMS_LDAP.add_s(), and DBMS_LDAP.create_mod_array().

FUNCTION count_values

Counts the number of values returned by DBMS_LDAP.get_values().

Syntax

```
FUNCTION count_values
(
values IN DBMS_LDAP.STRING_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–78 COUNT_VALUES Function Parameters

Parameter	Description
values	The collection of string values.

Return Values

Table 15–79 COUNT_VALUES Function Return Values

Value	Description
PLS_INTEGER	Indicates the success or failure of the operation.

Exceptions

count_values raises no exceptions.

See Also

DBMS_LDAP.count_values_len(), DBMS_LDAP.get_values().

FUNCTION count_values_len

Counts the number of values returned by DBMS_LDAP.get_values_len().

Syntax

```
FUNCTION count_values_len
(
```

```
values IN DBMS_LDAP.BINVAL_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–80 COUNT_VALUES_LEN Function Parameters

Parameter	Description
`values`	The collection of binary values.

Return Values

Table 15–81 COUNT_VALUES_LEN Function Return Values

Value	Description
`PLS_INTEGER`	Indicates the success or failure of the operation.

Exceptions

`count_values_len` raises no exceptions.

See Also

`DBMS_LDAP.count_values()`, `DBMS_LDAP.get_values_len()`.

FUNCTION rename_s

Renames an LDAP entry synchronously.

Syntax

```
FUNCTION rename_s
(
ld           IN SESSION,
dn           IN VARCHAR2,
newrdn       IN VARCHAR2,
newparent    IN VARCHAR2,
deleteoldrdn IN PLS_INTEGER,
serverctrls  IN LDAPCONTROL,
clientctrls  IN LDAPCONTROL
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–82 RENAME_S Function Parameters

Parameter	Description
`ld`	This parameter is a handle to an LDAP session returned by a successful call to `DBMS_LDAP.init()`.
`dn`	This parameter specifies the name of the directory entry to be renamed or moved.
`newrdn`	This parameter specifies the new RDN.
`newparent`	This parameter specifies the DN of the new parent.
`deleteoldrdn`	This parameter specifies whether the old RDN should be retained. If this value is `1`, the old RDN is removed.

Table 15–82 (Cont.) RENAME_S Function Parameters

Parameter	Description
serverctrls	Currently not supported.
clientctrls	Currently not supported.

Return Values

Table 15–83 RENAME_S Function Return Values

Value	Description
PLS_INTEGER	The indication of the success or failure of the operation.

Exceptions

Table 15–84 RENAME_S Function Exceptions

Exception	Description
invalid_session	Invalid LDAP Session.
invalid_entry_dn	Invalid LDAP DN.
invalid_rdn	Invalid LDAP RDN.
invalid_newparent	Invalid LDAP newparent.
invalid_deleteoldrdn	Invalid LDAP deleteoldrdn.

See Also

`DBMS_LDAP.modrdn2_s()`.

FUNCTION explode_dn

Breaks a DN up into its components.

Syntax

```
FUNCTION explode_dn
(
dn      IN VARCHAR2,
notypes IN PLS_INTEGER
)
RETURN STRING_COLLECTION;
```

Parameters

Table 15–85 EXPLODE_DN Function Parameters

Parameter	Description
dn	This parameter specifies the name of the directory entry to be broken up.
notypes	This parameter specifies whether the attribute tags will be returned. If this value is not `0`, no attribute tags are returned.

Return Values

Table 15–86 EXPLODE_DN Function Return Values

Value	Description
STRING_COLLECTION	An array of strings. If the DN cannot be broken up, NULL will be returned.

Exceptions

Table 15–87 EXPLODE_DN Function Exceptions

Exception	Description
invalid_entry_dn	Invalid LDAP DN.
invalid_notypes	Invalid LDAP notypes value.

See Also

DBMS_LDAP.get_dn().

FUNCTION open_ssl

Establishes an SSL (Secure Sockets Layer) connection over an existing LDAP connection.

Syntax

```
FUNCTION open_ssl
(
ld              IN SESSION,
sslwrl          IN VARCHAR2,
sslwalletpasswd IN VARCHAR2,
sslauth         IN PLS_INTEGER
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–88 OPEN_SSL Function Parameters

Parameter	Description
ld	This parameter is a handle to an LDAP session that is returned by a successful call to DBMS_LDAP.init().
sslwrl	This parameter specifies the wallet location. Required for one-way or two-way SSL connections.
sslwalletpasswd	This parameter specifies the wallet password. Required for one-way or two-way SSL connections.
sslauth	This parameter specifies the SSL Authentication Mode. (1 for no authentication, 2 for one-way authentication required, 3 for two-way authentication).

Return Values

Table 15–89 OPEN_SSL Function Return Values

Value	Description
PLS_INTEGER	Indicates the success or failure of the operation.

Exceptions

Table 15–90 OPEN_SSL Function Exceptions

Exception	Description
invalid_session	Invalid LDAP Session.
invalid_ssl_wallet_loc	Invalid LDAP SSL wallet location.
invalid_ssl_wallet_passwd	Invalid LDAP SSL wallet password.
invalid_ssl_auth_mode	Invalid LDAP SSL authentication mode.

Usage Notes

Need to call `DBMS_LDAP.init()` first to acquire a valid ldap session.

See Also

`DBMS_LDAP.init()`.

FUNCTION msgfree

This function frees the chain of messages associated with the message handle returned by synchronous search functions.

Syntax

```
FUNCTION msgfree
(
res             IN MESSAGE
)
RETURN PLS_INTEGER;
```

Parameters

Table 15–91 MSGFREE Function Parameters

Parameter	Description
res	The message handle obtained by a call to one of the synchronous search routines.

Return Values

Table 15–92 MSGFREE Return Values

Value	Description
PLS_INTEGER	Indicates the type of the last message in the chain. The function might return any of the following values: ■ DBMS_LDAP.LDAP_RES_BIND ■ DBMS_LDAP.LDAP_RES_SEARCH_ENTRY ■ DBMS_LDAP.LDAP_RES_SEARCH_REFERENCE ■ DBMS_LDAP.LDAP_RES_SEARCH_RESULT ■ DBMS_LDAP.LDAP_RES_MODIFY ■ DBMS_LDAP.LDAP_RES_ADD ■ DBMS_LDAP.LDAP_RES_DELETE ■ DBMS_LDAP.LDAP_RES_MODDN ■ DBMS_LDAP.LDAP_RES_COMPARE ■ DBMS_LDAP.LDAP_RES_EXTENDED

Exceptions

`msgfree` raises no exceptions.

See Also

`DBMS_LDAP.search_s()`, `DBMS_LDAP.search_st()`.

FUNCTION ber_free

This function frees the memory associated with a handle to `BER ELEMENT`.

Syntax

```
FUNCTION ber_free
(
ber_elem IN BER_ELEMENT,
freebuf  IN PLS_INTEGER
)
```

Parameters

Table 15–93 BER_FREE Function Parameters

Parameter	Description
ber_elem	A handle to `BER ELEMENT`.
freebuf	The value of this flag should be `0` while the `BER ELEMENT` returned from `DBMS_LDAP.first_attribute()` is being freed. For any other case, the value of this flag should be `1`. The default value of this parameter is zero.

Return Values

`ber_free` returns no values.

Exceptions

`ber_free` raises no exceptions.

See Also

DBMS_LDAP.first_attribute(),DBMS_LDAP.next_attribute().

FUNCTION nls_convert_to_utf8

The nls_convert_to_utf8() function converts the input string containing database character set data to UTF-8 character set data and returns it.

Syntax

```
Function nls_convert_to_utf8
(
data_local IN VARCHAR2
)
RETURN VARCHAR2;
```

Parameters

Table 15–94 Parameters for nls_convert_to_utf8

Parameter	Description
data_local	Contains the database character set data.

Return Values

Table 15–95 Return Values for nls_convert_to_utf8

Value	Description
VARCHAR2	UTF-8 character set data string.

Usage Notes

The functions in DBMS_LDAP package expect the input data to be UTF-8 character set data if the UTF8_CONVERSION package variable is set to FALSE. The nls_convert_to_utf8() function converts database character set data to UTF-8 character set data.

If the UTF8_CONVERSION package variable of the DBMS_LDAP package is set to TRUE, functions in the DBMS_LDAP package expect input data to be database character set data.

See Also

DBMS_LDAP.nls_convert_from_utf8(), DBMS_LDAP.nls_get_dbcharset_name().

FUNCTION nls_convert_to_utf8

The nls_convert_to_utf8() function converts the input string collection containing database character set data to UTF-8 character set data. It then returns the converted data.

Syntax

```
Function nls_convert_to_utf8
(
data_local IN STRING_COLLECTION
)
RETURN STRING_COLLECTION;
```

Parameters

Table 15–96 Parameters for nls_convert_to_utf8

Parameter	Description
data_local	Collection of strings containing database character set data.

Return Values

Table 15–97 Return Values for nls_convert_to_utf8

Value	Description
STRING_COLLECTION	Collection of strings containing UTF-8 character set data.

Usage Notes

The functions in the DBMS_LDAP package expect the input data to be in the UTF-8 character set if the UTF8_CONVERSION package variable is set to FALSE. The nls_convert_to_utf8() function converts the input data from the database character set to the UTF-8 character set.

If the UTF8_CONVERSION package variable of the DBMS_LDAP package is set to TRUE, functions in the DBMS_LDAP package expect the input data to be in the database character set.

See Also

DBMS_LDAP.nls_convert_from_utf8(), DBMS_LDAP.nls_get_dbcharset_name().

FUNCTION nls_convert_from_utf8

The nls_convert_from_utf8() function converts the input string containing UTF-8 character set to database character set data. It then returns this data.

Syntax

```
Function nls_convert_from_utf8
(
data_utf8 IN VARCHAR2
)
RETURN VARCHAR2;
```

Parameters

Table 15–98 Parameter for nls_convert_from_utf8

Parameter	Description
data_utf8	Contains UTF-8 character set data.

Return Values

Table 15–99 Return Value for nls_convert_from_utf8

Value	Description
VARCHAR2	Data string in the database character set.

Usage Notes

The functions in the DBMS_LDAP package return UTF-8 character set data if the UTF8_CONVERSION package variable is set to FALSE. The nls_convert_from_utf8() function converts the output data from the UTF-8 character set to the database character set.

If the UTF8_CONVERSION package variable of the DBMS_LDAP package is set to TRUE, functions in the DBMS_LDAP package return database character set data.

See Also

DBMS_LDAP.nls_convert_to_utf8(), DBMS_LDAP.nls_get_dbcharset_name().

FUNCTION nls_convert_from_utf8

The nls_convert_from_utf8() function converts the input string collection containing UTF-8 character set data to database character set data. It then returns this data.

Syntax

```
Function nls_convert_from_utf8
(
data_utf8 IN STRING_COLLECTION
)
RETURN STRING_COLLECTION;
```

Parameters

Table 15–100 Parameter for nls_convert_from_utf8

Parameter	Description
data_utf8	Collection of strings containing UTF-8 character set data.

Return Values

Table 15–101 Return Value for nls_convert_from_utf8

Value	Description
VARCHAR2	Collection of strings containing database character set data.

Usage Notes

The functions in the DBMS_LDAP package return UTF-8 character set data if the UTF8_CONVERSION package variable is set to FALSE. nls_convert_from_utf8() converts the output data from the UTF-8 character set to the database character set. If the UTF8_CONVERSION package variable of the DBMS_LDAP package is set to TRUE, functions in the DBMS_LDAP package return database character set data.

See Also

DBMS_LDAP.nls_convert_to_utf8(), DBMS_LDAP.nls_get_dbcharset_name().

FUNCTION nls_get_dbcharset_name

The `nls_get_dbcharset_name()` function returns a string containing the database character set name.

Syntax

```
Function nls_get_dbcharset_name

RETURN VARCHAR2;
```

Parameters

None.

Return Values

Table 15–102 Return Value for nls_get_dbcharset_name

Value	Description
VARCHAR2	String containing the database character set name.

See Also

`DBMS_LDAP.nls_convert_to_utf8()`, `DBMS_LDAP.nls_convert_from_utf8()`.

16

Java API Reference

The standard Java APIs for Oracle Internet Directory are available as the Java Naming and Directory Interface (JNDI) from Sun Microsystems. The JNDI is found at this link:

http://java.sun.com/products/jndi

The Oracle extensions to the standard APIs are found in *Oracle Internet Directory API Reference*.

Sample code for the Java APIs is available at this URL:

http://www.oracle.com/technology/sample_code/

Look for the Oracle Identity Management link under Sample Applications–Oracle Application Server.

17

DBMS_LDAP_UTL PL/SQL Reference

This chapter contains reference material for the DBMS_LDAP_UTL package, which contains Oracle Extension utility functions. The chapter contains these topics:

- Summary of Subprograms
- Subprograms
- Function Return Code Summary
- Data Type Summary

Note: Sample code for the DBMS_LDAP_UTL package is available at this URL:

http://www.oracle.com/technology/sample_code/

Look for the Oracle Identity Management link under Sample Applications—Fusion Middleware.

Summary of Subprograms

Table 17–1 DBMS_LDAP_UTL User-Related Subprograms

Function or Procedure	Purpose
Function authenticate_user	Authenticates a user against an LDAP server.
Function create_user_handle	Creates a user handle.
Function set_user_handle_properties	Associates the given properties to the user handle.
Function get_user_properties	Retrieves user properties from an LDAP server.
Function set_user_properties	Modifies the properties of a user.
Function get_user_extended_properties	Retrieves user extended properties.
Function get_user_dn	Retrieves a user DN.
Function check_group_membership	Checks whether a user is member of a given group.
Function locate_subscriber_for_user	Retrieves the subscriber for the given user.
Function get_group_membership	Retrieves a list of groups of which the user is a member.

Table 17–2 DBMS_LDAP_UTL Group-Related Subprograms

Function or Procedure	Purpose
Function create_group_handle	Creates a group handle.
Function set_group_handle_properties	Associates the given properties with the group handle.
Function get_group_properties	Retrieves group properties from an LDAP server.
Function get_group_dn	Retrieves a group DN.

Table 17–3 DBMS_LDAP_UTL Subscriber-Related Subprograms

Function or Procedure	Purpose
Function create_subscriber_handle	Creates a subscriber handle.
Function get_subscriber_properties	Retrieves subscriber properties from an LDAP server.
Function get_subscriber_dn	Retrieves a subscriber DN.

Table 17–4 DBMS_LDAP_UTL Miscellaneous Subprograms

Function or Procedure	Purpose
Function normalize_dn_with_case	Normalizes the DN string.
Function get_property_names	Retrieves a list of property names in a `PROPERTY_SET`.
Function get_property_values	Retrieves a list of values for a property name.
Function get_property_values_blob	Retrieves a list of large binary values for a property name.
Procedure property_value_free_blob	Frees the memory associated with `BLOB_COLLECTION` returned by `DBMS_LDAP_UTL.get_property_values_blob()`.
Function get_property_values_len	Retrieves a list of binary values for a property name.
Procedure free_propertyset_collection	Frees `PROPERTY_SET_COLLECTION`.
Function create_mod_propertyset	Creates a `MOD_PROPERTY_SET`.
Function populate_mod_propertyset	Populates a `MOD_PROPERTY_SET` structure.
Procedure free_mod_propertyset	Frees a `MOD_PROPERTY_SET`.
Procedure free_handle	Frees handles.
Function check_interface_version	Checks for support of the interface version.

Subprograms

This section contains the following topics:

- User-Related Subprograms
- Group-Related Subprograms
- Subscriber-Related Subprograms
- Property-Related Subprograms
- Miscellaneous Subprograms

User-Related Subprograms

A user is represented by the DBMS_LDAP_UTL.HANDLE data type. You can create a user handle by using a DN, GUID, or simple name, along with the appropriate subscriber handle. When a simple name is used, additional information from the root Oracle Context and the subscriber Oracle Context is used to identify the user. This example shows a user handle being created:

```
retval := DBMS_LDAP_UTL.create_user_handle(
user_handle,
DBMS_LDAP_UTL.TYPE_DN,
"cn=user1,cn=users,o=acme,dc=com"
);
```

This user handle must be associated with an appropriate subscriber handle. If, for example, subscriber_handle is o=acme,dc=com, the subscriber handle can be associated in the following way:

```
retval := DBMS_LDAP_UTL.set_user_handle_properties(
user_handle,
DBMS_LDAP_UTL.SUBSCRIBER_HANDLE,
subscriber_handle
);
```

Common uses of user handles include setting and getting user properties and authenticating the user. Here is a handle that authenticates a user:

```
retval := DBMS_LDAP_UTL.authenticate_user(
my_session
user_handle
DBMS_LDAP_UTL.AUTH_SIMPLE,
"welcome"
NULL
);
```

In this example, the user is authenticated using a clear text password welcome.

Here is a handle that retrieves a user's telephone number:

```
--my_attrs is of type DBMS_LDAP.STRING_COLLECTION
my_attrs(1) :='telephonenumber';
retval := DBMS_LDAP_UTL.get_user_properties(
my_session,
my_attrs,
DBMS_LDAP_UTL.ENTRY_PROPERTIES,
my_pset_coll
);
```

Function authenticate_user

The function authenticate_user() authenticates the user against Oracle Internet Directory.

Syntax

```
FUNCTION authenticate_user
(
ld IN SESSION,
user_handle IN HANDLE,
auth_type IN PLS_INTEGER,
credentials IN VARCHAR2,
binary_credentials IN RAW
```

```
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–5 authenticate_user Function Parameters

Parameter Name	Parameter Type	Parameter Description
`ld`	`SESSION`	A valid LDAP session handle.
`user_handle`	`HANDLE`	The user handle.
`auth_type`	`PLS_INTEGER`	Type of authentication. The only valid value is `DBMS_LDAP_UTL.AUTH_SIMPLE`
`credentials`	`VARCHAR2`	The user credentials.
`binary_credentials`	`RAW`	The binary credentials. This parameter is optional. It can be `NULL` by default.

Return Values

Table 17–6 authenticate_user Function Return Values

Value	Description
`DBMS_LDAP_UTL.SUCCESS`	On a successful completion.
`DBMS_LDAP_UTL.PARAM_ERROR`	Invalid input parameters.
`DBMS_LDAP_UTL.GENERAL_ERROR`	Authentication failed.
`DBMS_LDAP_UTL.NO_SUCH_USER`	User does not exist.
`DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES`	The user has multiple DN entries.
`DBMS_LDAP_UTL.INVALID_SUBSCRIBER_ORCL_CTX`	Invalid Subscriber Oracle Context.
`DBMS_LDAP_UTL.NO_SUCH_SUBSCRIBER`	Subscriber doesn't exist.
`DBMS_LDAP_UTL.MULTIPLE_SUBSCRIBER_ENTRIES`	The subscriber has multiple DN entries.
`DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX`	Invalid Root Oracle Context.
`DBMS_LDAP_UTL.ACCT_TOTALLY_LOCKED_EXCP`	User account is locked.
`DBMS_LDAP_UTL.AUTH_PASSWD_CHANGE_WARN`	This return value is deprecated.
`DBMS_LDAP_UTL.AUTH_FAILURE_EXCP`	Authentication failed.
`DBMS_LDAP_UTL.PWD_EXPIRED_EXCP`	User password has expired.
`DBMS_LDAP_UTL.PWD_GRACELOGIN_WARN`	Grace login for user.
DBMS_LDAP error codes	Return proper `DBMS_LDAP` error codes for unconditional failures that occurred when LDAP operations were carried out.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP_UTL.create_user_handle()`.

Function create_user_handle

The function `create_user_handle()` creates a user handle.

Syntax

```
FUNCTION create_user_handle
(
user_hd OUT HANDLE,
user_type IN PLS_INTEGER,
user_id IN VARCHAR2,
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–7 CREATE_USER_HANDLE Function Parameters

Parameter Name	Parameter Type	Parameter Description
user_hd	HANDLE	A pointer to a handle to a user.
user_type	PLS_INTEGER	The type of user ID that is passed. Valid values for this argument are as follows: ■ DBMS_LDAP_UTL.TYPE_DN ■ DBMS_LDAP_UTL.TYPE_GUID ■ DBMS_LDAP_UTL.TYPE_NICKNAME
user_id	VARCHAR2	The user ID representing the user entry.

Return Values

Table 17–8 CREATE_USER_HANDLE Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

See Also

`DBMS_LDAP_UTL.get_user_properties()`, `DBMS_LDAP_UTL.set_user_handle_properties()`.

Function set_user_handle_properties

The function `set_user_handle_properties()` configures the user handle properties.

Syntax

```
FUNCTION set_user_handle_properties
(
user_hd IN HANDLE,
property_type IN PLS_INTEGER,
property IN HANDLE
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–9 SET_USER_HANDLE_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
user_hd	HANDLE	A pointer to a handle to a user.
property_type	PLS_INTEGER	The type of property that is passed. Valid values for this argument are as follows: - DBMS_LDAP_UTL.SUBSCRIBER_HANDLE.
property	HANDLE	The property describing the user entry.

Return Values

Table 17–10 SET_USER_HANDLE_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.RESET_HANDLE	When a caller tries to reset the existing handle properties.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

Usage Notes

The subscriber handle does not have to be set in User Handle Properties if the user handle is created with `TYPE_DN` or `TYPE_GUID` as the user type.

See Also

`DBMS_LDAP_UTL.get_user_properties()`.

Function get_user_properties

The function `get_user_properties()` retrieves the user properties.

Syntax

```
FUNCTION get_user_properties
(
ld IN SESSION,
user_handle IN HANDLE,
attrs IN STRING_COLLECTION,
ptype IN PLS_INTEGER,
ret_pset_coll OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–11 GET_USER_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
attrs	STRING_COLLECTION	The list of user attributes to retrieve.

Table 17–11 (Cont.) GET_USER_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
ptype	PLS_INTEGER	Type of properties to return. These are valid values: ■ DBMS_LDAP_UTL.ENTRY_PROPERTIES ■ DBMS_LDAP_UTL.NICKNAME_PROPERTY
ret-pset_collection	PROPERTY_SET_COLLECTION	User details contained in attributes requested by the caller.

Return Values

Table 17–12 GET_USER_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.NO_SUCH_USER	User does not exist.
DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES	The user has multiple DN entries.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid root Oracle Context.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures that occur when LDAP operations are carried out.

Usage Notes

This function requires the following:

- A valid LDAP session handle, which must be obtained from the DBMS_LDAP.init() function.
- A valid subscriber handle to be set in the group handle properties if the user type is of DBMS_LDAP_UTL.TYPE_NICKNAME.

This function does not identify a NULL subscriber handle as a default subscriber. The default subscriber can be obtained from DBMS_LDAP_UTL.create_subscriber_handle(), where a NULL subscriber_id is passed as an argument.

If the group type is either DBMS_LDAP_UTL.TYPE_GUID or DBMS_LDAP_UTL.TYPE_DN, the subscriber handle need not be set in the user handle properties. If the subscriber handle is set, it is ignored.

See Also

DBMS_LDAP.init(), DBMS_LDAP_UTL.create_user_handle().

Function set_user_properties

The function set_user_properties() modifies the properties of a user.

Syntax

```
FUNCTION set_user_properties
(
```

```
ld IN SESSION,
user_handle IN HANDLE,
pset_type IN PLS_INTEGER,
mod_pset IN PROPERTY_SET,
mod_op IN PLS_INTEGER
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–13 SET_USER_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Description
`ld`	`SESSION`	A valid LDAP session handle.
`user_handle`	`HANDLE`	The user handle.
`pset_type`	`PLS_INTEGER`	The type of property set being modified. A valid value is `ENTRY_PROPERTIES`.
`mod_pset`	`PROPERTY_SET`	Data structure containing modify operations to perform on the property set.
`mod_op`	`PLS_INTEGER`	The type of modify operation to be performed on the property set. Here are valid values: ■ `ADD_PROPERTYSET` ■ `MODIFY_PROPERTYSET` ■ `DELETE_PROPERTYSET`

Return Values

Table 17–14 SET_USER_PROPERTIES Function Return Values

Value	Description
`DBMS_LDAP_UTL.SUCCESS`	On a successful completion.
`DBMS_LDAP_UTL.NO_SUCH_USER`	User does not exist.
`DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES`	The user has multiple DN entries.
`DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX`	Invalid root Oracle Context.
`DBMS_LDAP_UTL.PWD_MIN_LENGTH_ERROR`	Password length is less than the minimum required length.
`DBMS_LDAP_UTL.PWD_NUMERIC_ERROR`	Password must contain numeric characters.
`DBMS_LDAP_UTL.PWD_NULL_ERROR`	Password cannot be NULL.
`DBMS_LDAP_UTL.PWD_INHISTORY_ERROR`	Password cannot be the same as the one that is being replaced.
`DBMS_LDAP_UTL.PWD_ILLEGALVALUE_ERROR`	Password contains illegal characters.
`DBMS_LDAP_UTL.GENERAL_ERROR`	Other error.
DBMS_LDAP error codes	Return proper `DBMS_LDAP` error codes for unconditional failures while carrying out LDAP operations by the LDAP server.

Usage Notes

This function can only be called after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP_UTL.get_user_properties()`.

Function get_user_extended_properties

The function `get_user_extended_properties()` retrieves user extended properties.

Syntax

```
FUNCTION get_user_extended_properties
(
ld IN SESSION,
user_handle IN HANDLE,
attrs IN STRING_COLLECTION
ptype IN PLS_INTEGER,
filter IN VARCHAR2,
rep_pset_coll OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–15 GET_USER_EXTENDED_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
attrs	STRING_COLLECTION	A list of attributes to fetch for the user.
ptype	PLS_INTEGER	The type of properties to return. Here is a valid value: - DBMS_LDAP_UTL.EXTPROPTYPE_RAD
filter	VARCHAR2	An LDAP filter to further refine the user properties returned by the function.
ret_pset_collection	PROPERTY_SET_COLLECTION	The user details containing the attributes requested by the caller.

Return Values

Table 17–16 GET_USER_EXTENDED_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.NO_SUCH_USER	User does not exist.
DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES	The user has multiple DN entries.
USER_PROPERTY_NOT_FOUND	User extended property does not exist.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid root Oracle Context.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

Table 17–16 (Cont.) GET_USER_EXTENDED_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures that occur when LDAP operations are carried out.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP_UTL.get_user_properties()`.

Function get_user_dn

The `function get_user_dn()` returns the user DN.

Syntax

```
FUNCTION get_user_dn
(
ld IN SESSION,
user_handle IN HANDLE,
dn OUT VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–17 GET_USER_DN Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
dn	VARCHAR2	The user DN.

Return Values

Table 17–18 GET_USER_DN Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	Authentication failed.
DBMS_LDAP_UTL.NO_SUCH_USER	User does not exist.
DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES	The user has multiple DN entries.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid root Oracle Context.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures that occur when LDAP operations are carried out.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to DBMS_LDAP.init().

See Also

DBMS_LDAP.init().

Function check_group_membership

The function check_group_membership() checks whether the user belongs to a group.

Syntax

```
FUNCTION check_group_membership
(
ld IN SESSION,
user_handle IN HANDLE,
group_handle IN HANDLE,
nested IN PLS_INTEGER
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–19 CHECK_GROUP_MEMBERSHIP Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
group_handle	HANDLE	The group handle.
nested	PLS_INTEGER	The type of membership the user holds in groups. Here are valid values: ■ DBMS_LDAP_UTL.NESTED_MEMBERSHIP ■ DBMS_LDAP_UTL.DIRECT_MEMBERSHIP

Return Values

Table 17–20 CHECK_GROUP_MEMBERSHIP Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	If user is a member.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GROUP_MEMBERSHIP	If user is not a member.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to DBMS_LDAP.init().

See Also

DBMS_LDAP.get_group_membership().

Function locate_subscriber_for_user

The function `locate_subscriber_for_user()` retrieves the subscriber for the given user and returns a handle to it.

Syntax

```
FUNCTION locate_subscriber_for_user
(
ld IN SESSION,
user_handle IN HANDLE,
subscriber_handle OUT HANDLE
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–21 LOCATE_SUBSCRIBER_FOR_USER Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
subscriber_handle	HANDLE	The subscriber handle.

Return Values

Table 17–22 LOCATE SUBSCRIBER FOR USER Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.NO_SUCH_SUBSCRIBER	Subscriber doesn't exist.
DBMS_LDAP_UTL.MULTIPLE_SUBSCRIBER_ENTRIES	Multiple number of subscriber DN entries exist in the directory for the given subscriber.
DBMS_LDAP_UTL.NO_SUCH_USER	User doesn't exist.
DBMS_LDAP_UTL.MULTIPLE_USER_ENTRIES	Multiple number of user DN entries exist in the directory for the given user.
DBMS_LDAP_UTL.SUBSCRIBER_NOT_FOUND	Unable to locate subscriber for the given user.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid Root Oracle Context.
DBMS_LDAP_UTL.ACCT_TOTALLY_LOCKED_EXCP	User account is locked.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures while carrying out LDAP operations by the LDAP server.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP_UTL.create_user_handle()`.

Function get_group_membership

The function `get_group_membership()` returns the list of groups to which the user is a member.

Syntax

```
FUNCTION get_group_membership
(
user_handle IN HANDLE,
nested IN PLS_INTEGER,
attr_list IN STRING_COLLECTION,
ret_groups OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–23 GET_GROUP_MEMBERSHIP Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
user_handle	HANDLE	The user handle.
nested	PLS_INTEGER	The type of membership the user holds in groups. Here are valid values: ▪ DBMS_LDAP_UTL.NESTED_ MEMBERSHIP ▪ DBMS_LDAP_UTL.DIRECT_ MEMBERSHIP
attr_list	STRING_COLLECTION	A list of attributes to be returned.
ret_groups	PROPERTY_SET_COLLECTION	A pointer to a pointer to an array of group entries.

Return Values

Table 17–24 GET_GROUP_MEMBERSHIP Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`.

Group-Related Subprograms

A group is represented using by using the `DBMS_LDAP_UTL.HANDLE` data type. A group handle represents a valid group entry. You can create a group handle by using a DN, GUID or a simple name, along with the appropriate subscriber handle. When a simple name is used, additional information from the Root Oracle Context and the Subscriber Oracle Context is used to identify the group. Here is an example of a group handle creation:

```
retval := DBMS_LDAP_UTL.create_group_handle(
group_handle,
DBMS_LDAP_UTL.TYPE_DN,
"cn=group1,cn=Groups,o=acme,dc=com"
);
```

This group handle has to be associated with an appropriate subscriber handle. For example, given a subscriber handle: `subscriber_handle` representing `o=acme,dc=com`, the subscriber handle can be associated in the following way:

```
retval := DBMS_LDAP_UTL.set_group_handle_properties(
group_handle,
DBMS_LDAP_UTL.SUBSCRIBER_HANDLE,
subscriber_handle
);
```

A sample use of group handle is getting group properties. Here is an example:

```
my_attrs is of type DBMS_LDAP.STRING_COLLECTION
my_attrs(1) :='uniquemember';
retval := DBMS_LDAP_UTL.get_group_properties(
my_session,
my_attrs,
DBMS_LDAP_UTL.ENTRY_PROPERTIES,
my_pset_coll
);
```

The group-related subprograms also support membership-related functionality. Given a user handle, you can find out if it is a direct or a nested member of a group by using the `DBMS_LDAP_UTL.check_group_membership()` function. Here is an example:

```
retval := DBMS_LDAP_UTL.check_group_membership(
session,
user_handle,
group_handle,
DBMS_LDAP_UTL.DIRECT_MEMBERSHIP
```

You can also obtain a list of groups that a particular group belongs to, using the `DBMS_LDAP_UTL.get_group_membership()` function. For example:

```
my_attrs is of type DBMS_LDAP.STRING_COLLECTION
my_attrs(1) :='cn';
retval := DBMS_LDAP_UTL.get_group_membership(
my_session,
user_handle,
DBMS_LDAP_UTL.DIRECT_MEMBERSHIP,
my_attrs
my_pset_coll
);
```

Function create_group_handle

The function `create_group_handle()` creates a group handle.

Syntax

```
FUNCTION create_group_handle
(
```

```
group_hd OUT HANDLE,
group_type IN PLS_INTEGER,
group_id IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–25 CREATE_GROUP_HANDLE Function Parameters

Parameter Name	Parameter Type	Parameter Description
group_hd	HANDLE	A pointer to a handle to a group.
group_type	PLS_INTEGER	The type of group ID that is passed. Valid values for this argument are as follows: ■ DBMS_LDAP_UTL.TYPE_DN ■ DBMS_LDAP_UTL.TYPE_GUID ■ DBMS_LDAP_UTL.TYPE_NICKNAME
group_id	VARCHAR2	The group ID representing the group entry.

Return Values

Table 17–26 CREATE_GROUP_HANDLE Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

See Also

DBMS_LDAP_UTL.get_group_properties(), DBMS_LDAP_UTL.set_group_handle_properties().

Function set_group_handle_properties

The function set_group_handle_properties() configures the group handle properties.

Syntax

```
FUNCTION set_group_handle_properties
(
group_hd IN HANDLE,
property_type IN PLS_INTEGER,
property IN HANDLE
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–27 SET_GROUP_HANDLE_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
group_hd	HANDLE	A pointer to the handle to the group.

Table 17–27 (Cont.) SET_GROUP_HANDLE_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
property_type	PLS_INTEGER	The type of property that is passed. Valid values for this argument are as follows: DBMS_LDAP_UTL.GROUP_HANDLE
property	HANDLE	The property describing the group entry.

Return Values

Table 17–28 SET_GROUP_HANDLE_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.RESET_HANDLE	When a caller tries to reset the existing handle properties.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

Usage Notes

The subscriber handle doesn't need to be set in Group Handle Properties if the group handle is created with `TYPE_DN` or `TYPE_GUID` as the group type.

See Also

`DBMS_LDAP_UTL.get_group_properties()`.

Function get_group_properties

The `function get_group_properties()` retrieves the group properties.

Syntax

```
FUNCTION get_group_properties
(
ld IN SESSION,
group_handle IN HANDLE,
attrs IN STRING_COLLECTION,
ptype IN PLS_INTEGER,
ret_pset_coll OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–29 GET_GROUP_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
group_handle	HANDLE	The group handle.
attrs	STRING_COLLECTION	A list of attributes that must be fetched for the group.
ptype	PLS_INTEGER	The type of properties to be returned. The valid value is DBMS_LDAP_UTL.ENTRY_PROPERTIES

Table 17–29 (Cont.) GET_GROUP_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
`ret_pset_coll`	`PROPERTY_SET_COLLECTION`	The group details containing the attributes requested by the caller.

Return Values

Table 17–30 GET_GROUP_PROPERTIES Function Return Values

Value	Description
`DBMS_LDAP_UTL.SUCCESS`	On a successful completion.
`DBMS_LDAP_UTL.PARAM_ERROR`	Invalid input parameters.
`DBMS_LDAP_UTL.NO_SUCH_GROUP`	Group doesn't exist.
`DBMS_LDAP_UTL.MULTIPLE_GROUP_ENTRIES`	Multiple number of group DN entries exist in the directory for the given group.
`DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX`	Invalid Root Oracle Context.
`DBMS_LDAP_UTL.GENERAL_ERROR`	Other error.
DBMS_LDAP error codes	Return proper `DBMS_LDAP` error codes for unconditional failures while carrying out LDAP operations by the LDAP server.

Usage Notes

This function requires the following:

- A valid LDAP session handle which must be obtained from the `DBMS_LDAP.init()` function.
- A valid subscriber handle to be set in the group handle properties if the group type is of: `DBMS_LDAP_UTL.TYPE_NICKNAME`.

This function does not identify a `NULL` subscriber handle as a default subscriber. The default subscriber can be obtained from `DBMS_LDAP_UTL.create_subscriber_handle()`, where a `NULL` subscriber_id is passed as an argument.

If the group type is either `DBMS_LDAP_UTL.TYPE_GUID` or `DBMS_LDAP_UTL.TYPE_DN`, the subscriber handle does not have to be set in the group handle properties. If the subscriber handle is set, it is ignored.

See Also

`DBMS_LDAP.init()`, `DBMS_LDAP_UTL.create_group_handle()`.

Function get_group_dn

The function `get_group_dn()`returns the group DN.

Syntax

```
FUNCTION get_group_dn
(
ld IN SESSION,
group_handle IN HANDLE
dn OUT VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–31 GET_GROUP_DN Function Parameters

Parameter Name	Parameter Type	Parameter Description
`ld`	`SESSION`	A valid LDAP session handle.
`group_handle`	`HANDLE`	The group handle.
`dn`	`VARCHAR2`	The group DN.

Return Values

Table 17–32 GET_GROUP_DN Function Return Values

Value	Description
`DBMS_LDAP_UTL.SUCCESS`	On a successful completion.
`DBMS_LDAP_UTL.PARAM_ERROR`	Invalid input parameters.
`DBMS_LDAP_UTL.NO_SUCH_GROUP`	Group doesn't exist.
`DBMS_LDAP_UTL.MULTIPLE_GROUP_ENTRIES`	Multiple number of group DN entries exist in the directory for the given group.
`DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX`	Invalid Root Oracle Context.
`DBMS_LDAP_UTL.GENERAL_ERROR`	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures that are encountered when LDAP operations are carried out.

Usage Notes

This function can only be called after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also

`DBMS_LDAP.init()`.

Subscriber-Related Subprograms

A subscriber is represented by using `dbms_ldap_utl.handle` data type. You can create a subscriber handle by using a DN, GUID or simple name. When a simple name is used, additional information from the root Oracle Context is used to identify the subscriber. This example shows a subscriber handle being created:

```
retval := DBMS_LDAP_UTL.create_subscriber_handle(
subscriber_handle,
DBMS_LDAP_UTL.TYPE_DN,
"o=acme,dc=com"
);
```

`subscriber_handle` is created by it's DN: `o=oracle,dc=com`.

Getting subscriber properties is one common use of a subscriber handle. Here is an example:

```
my_attrs is of type DBMS_LDAP.STRING_COLLECTION
       my_attrs(1) :='orclguid';
```

```
      retval := DBMS_LDAP_UTL.get_subscriber_properties(
my_session,
my_attrs,
DBMS_LDAP_UTL.ENTRY_PROPERTIES,
my_pset_coll
);
```

Function create_subscriber_handle

The function `create_subscriber_handle()` creates a subscriber handle.

Syntax

```
FUNCTION create_subscriber_handle
(
subscriber_hd OUT HANDLE,
subscriber_type IN PLS_INTEGER,
subscriber_id IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–33 CREATE_SUBSCRIBER_HANDLE Function Parameters

Parameter Name	Parameter Type	Parameter Description
subscriber_hd	HANDLE	A pointer to a handle to a subscriber.
subscriber_type	PLS_INTEGER	The type of subscriber ID that is passed. Valid values for this argument are: ■ DBMS_LDAP_UTL.TYPE_DN ■ DBMS_LDAP_UTL.TYPE_GUID ■ DBMS_LDAP_UTL.TYPE_NICKNAME ■ DBMS_LDAP_UTL.TYPE_DEFAULT
subscriber_id	VARCHAR2	The subscriber ID representing the subscriber entry. This can be `NULL` if `subscriber_type` is `DBMS_LDAP_UTL.TYPE_DEFAULT`. In this case, the default subscriber is retrieved from the root Oracle Context.

Return Values

Table 17–34 CREATE_SUBSCRIBER_HANDLE Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

See Also

`DBMS_LDAP_UTL.get_subscriber_properties()`.

Function get_subscriber_properties

The function `get_subscriber_properties()` retrieves the subscriber properties for the given subscriber handle.

Syntax

```
FUNCTION get_subscriber_properties
(
ld IN SESSION,
subscriber_handle IN HANDLE,
attrs IN STRING_COLLECTION,
ptype IN PLS_INTEGER,
ret_pset_coll OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–35 GET_SUBSCRIBER_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
subscriber_handle	HANDLE	The subscriber handle.
attrs	STRING_COLLECTION	A list of attributes that must be retrieved for the subscriber.
ptype	PLS_INTEGER	Properties of the subscriber's Oracle Context to return. These are valid values: ■ DBMS_LDAP_UTL.ENTRY_PROPERTIES ■ DBMS_LDAP_UTL.COMMON_PROPERTIES
ret_pset_coll	PROPERTY_SET_COLLECTION	The subscriber details containing the attributes requested by the caller.

Return Values

Table 17–36 GET_SUBSCRIBER_PROPERTIES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.NO_SUCH_SUBSCRIBER	Subscriber doesn't exist.
DBMS_LDAP_UTL.MULTIPLE_SUBSCRIBER_ENTRIES	Subscriber has a multiple number of DN entries.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid root Oracle Context.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures encountered while LDAP operations are carried out.

Usage Notes

This function can only be called after a valid LDAP session is obtained from a call to DBMS_LDAP.init().

See Also

DBMS_LDAP.init(), DBMS_LDAP_UTL.create_subscriber_handle().

Function get_subscriber_dn

The function get_subscriber_dn() returns the subscriber DN.

Syntax

```
FUNCTION get_subscriber_dn
(
ld IN SESSION,
subscriber_handle IN HANDLE,
dn OUT VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–37 GET_SUBSCRIBER_DN Function Parameters

Parameter Name	Parameter Type	Parameter Description
ld	SESSION	A valid LDAP session handle.
subscriber_handle	HANDLE	The subscriber handle.
dn	VARCHAR2	The subscriber DN.

Return Values

Table 17–38 GET_SUBSCRIBER_DN Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.NO_SUCH_SUBSCRIBER	Subscriber doesn't exist.
DBMS_LDAP_UTL.MULTIPLE_SUBSCRIBER_ENTRIES	Multiple number of subscriber DN entries exist in the directory for the given subscriber.
DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX	Invalid root Oracle Context.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.
DBMS_LDAP error codes	Return proper DBMS_LDAP error codes for unconditional failures encountered when LDAP operations are carried out.

Usage Notes

This function can only be called after a valid LDAP session is obtained from a call to DBMS_LDAP.init().

See Also

DBMS_LDAP.init().

Function get_subscriber_ext_properties

The function `get_subscriber_ext_properties()` retrieves the subscriber extended properties. Currently this can be used to retrieve the subscriber-wide default Resource Access Descriptors.

Syntax

```
FUNCTION get_subscriber_ext_properties
(
ld IN SESSION,
subscriber_handle IN HANDLE,
attrs IN STRING_COLLECTION,
ptype IN PLS_INTEGER,
filter IN VARCHAR2,
rep_pset_coll OUT PROPERTY_SET_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–39 GET_SUBSCRIBER_EXT_PROPERTIES Function Parameters

Parameter Name	Parameter Type	Parameter Description
`ld`	`SESSION`	A valid LDAP session handle.
`subscriber_handle`	`HANDLE`	The subscriber handle.
`attrs`	`STRING_COLLECTION`	A list of subscriber attributes to retrieve.
`ptype`	`PLS_INTEGER`	The type of properties to return. A valid value is `DBMS_LDAP_UTL.DEFAULT_RAD_PROPERTIES`
`filter`	`VARCHAR2`	An LDAP filter to further refine the subscriber properties returned by the function.
`ret_pset_collection`	`PROPERTY_SET_COLLECTION`	The subscriber details containing the attributes requested by the caller.

Return Values

Table 17–40 GET_USER_EXTENDED_PROPERTIES Function Return Values

Value	Description
`DBMS_LDAP_UTL.SUCCESS`	On a successful completion.
`DBMS_LDAP_UTL.PARAM_ERROR`	Invalid input parameters.
`DBMS_LDAP_UTL.NO_SUCH_USER`	User does not exist.
`DBMS_LDAP_UTL.INVALID_ROOT_ORCL_CTX`	Invalid root Oracle Context.
`DBMS_LDAP_UTL.GENERAL_ERROR`	Other error.
`DBMS_LDAP error codes`	Return proper `DBMS_LDAP` error codes for unconditional failures encountered when LDAP operations are carried out.

Usage Notes

This function can be called only after a valid LDAP session is obtained from a call to `DBMS_LDAP.init()`.

See Also `DBMS_LDAP.init()`, `DBMS_LDAP_UTL.get_subscriber_properties()`.

Property-Related Subprograms

Many of the user-related, subscriber-related, and group-related subprograms return `DBMS_LDAP_UTL.PROPERTY_SET_COLLECTION`, which is a collection of one or more LDAP entries representing results. Each of these entries is represented by a `DBMS_LDAP_UTL.PROPERTY_SET`. A `PROPERTY_SET` may contain attributes—that is, properties—and its values. Here is an example that illustrates the retrieval of properties from `DBMS_LDAP_UTL.PROPERTY_SET_COLLECTION`:

```
my_attrs is of type DBMS_LDAP.STRING_COLLECTION
my_attrs(1) :='cn';

retval := DBMS_LDAP_UTL.get_group_membership(
my_session,
user_handle,
DBMS_LDAP_UTL.DIRECT_MEMBERSHIP,
my_attrs,
my_pset_coll
);

IF my_pset_coll.count > 0 THEN
      FOR i in my_pset_coll.first .. my_pset_coll.last LOOP
--    my_property_names is of type DBMS_LDAP.STRING_COLLECTION
       retval := DBMS_LDAP_UTL.get_property_names(
pset_coll(i),
property_names
       IF my_property_names.count > 0 THEN
           FOR j in my_property_names.first .. my_property_names.last LOOP
             retval := DBMS_LDAP_UTL.get_property_values(
pset_coll(i),
property_names(j),
property_values
             if my_property_values.COUNT > 0 then
              FOR k in my_property_values.FIRST..my_property_values.LAST LOOP
                     DBMS_OUTPUT.PUT_LINE(my_property_names(j)  || ':'
                        ||my_property_values(k));
                    END LOOP; -- For each value
             else
                DBMS_OUTPUT.PUT_LINE('NO VALUES FOR' || my_property_names(j));
             end if;
           END LOOP; -- For each property name
         END IF; -- IF my_property_names.count > 0
      END LOOP; -- For each propertyset
  END IF; -- If my_pset_coll.count > 0
```

`use_handle` is a user handle. `my_pset_coll` contains all the nested groups that `user_handle` belongs to. The code loops through the resulting entries and prints out the `cn` of each entry.

Miscellaneous Subprograms

The miscellaneous subprograms in the DBMS_LDAP_UTL package perform a variety of different functions.

Function normalize_dn_with_case

The function normalize_dn_with_case() removes unnecessary white space characters from a DN and converts all characters to lower case based on a flag.

Syntax

```
FUNCTION normalize_dn_with_case
(
dn IN VARCHAR2,
lower_case IN PLS_INTEGER,
norm_dn OUT VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–41 NORMALIZE_DN_WITH_CASE Function Parameters

Parameter Name	Parameter Type	Parameter Description
dn	VARCHAR2	The DN.
lower_case	PLS_INTEGER	If set to 1: The normalized DN returns in lower case. If set to 0: The case is preserved in the normalized DN string.
norm_dn	VARCHAR2	The normalized DN.

Return Values

Table 17–42 NORMALIZE_DN_WITH_CASE Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	On failure.

Usage Notes

This function can be used while comparing two DNs.

Function get_property_names

The function get_property_names() retrieves the list of property names in the property set.

Syntax

```
FUNCTION get_property_names
(
pset IN PROPERTY_SET,
property_names OUT STRING_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–43 GET_PROPERTY_NAMES Function Parameters

Parameter Name	Parameter Type	Parameter Description
pset	PROPERTY_SET	The property set in the property set collection returned from any of the following functions: ■ DBMS_LDAP_UTL.get_group_membership() ■ DBMS_LDAP_UTL.get_subscriber_properties() ■ DBMS_LDAP_UTL.get_user_properties() ■ DBMS_LDAP_UTL.get_group_properties()
property_names	STRING_COLLECTION	A list of property names associated with the property set.

Return Values

Table 17–44 GET_PROPERTY_NAMES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	On error.

See Also

DBMS_LDAP_UTL.get_property values().

Function get_property_values

The function get_property_values() retrieves the property values (the strings) for a given property name and property.

Syntax

```
FUNCTION get_property_values
(
pset IN PROPERTY_SET,
property_name IN VARCHAR2,
property_values OUT STRING_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–45 GET_PROPERTY_VALUES Function Parameters

Parameter Name	Parameter Type	Parameter Description
property_name	VARCHAR2	The property name.

Table 17–45 (Cont.) GET_PROPERTY_VALUES Function Parameters

Parameter Name	Parameter Type	Parameter Description
pset	PROPERTY_SET	The property set in the property set collection obtained from any of the following function returns: ■ DBMS_LDAP_UTL.get_group_membership() ■ DBMS_LDAP_UTL.get_subscriber_properties() ■ DBMS_LDAP_UTL.get_user_properties() ■ DBMS_LDAP_UTL.get_group_properties()
property_values	STRING_COLLECTION	A list of property values (strings).

Return Values

Table 17–46 GET_PROPERTY_VALUES Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	On failure.

See Also

`DBMS_LDAP_UTL.get_property_values_len()`.

Function get_property_values_len

The function `get_property_values_len()` retrieves the binary property values for a given property name and property.

Syntax

```
FUNCTION get_property_values_len
(
pset IN PROPERTY_SET,
property_name IN VARCHAR2,
auth_type IN PLS_INTEGER,
property_values OUT BINVAL_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–47 GET_PROPERTY_VALUES_LEN Function Parameters

Parameter Name	Parameter Type	Parameter Description
property_name	VARCHAR2	A property name.

Table 17–47 (Cont.) GET_PROPERTY_VALUES_LEN Function Parameters

Parameter Name	Parameter Type	Parameter Description
pset	PROPERTY_SET	The property set in the property set collection obtained from any of the following function returns: ■ DBMS_LDAP_UTL.get_group_membership() ■ DBMS_LDAP_UTL.get_subscriber_properties() ■ DBMS_LDAP_UTL.get_user_properties() ■ DBMS_LDAP_UTL.get_group_properties()
property_values	BINVAL_COLLECTION	A list of binary property values.

Return Values

Table 17–48 GET_PROPERTY_VALUES_LEN Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	On failure.

See Also

`DBMS_LDAP_UTL.get_property_values()`.

Procedure free_propertyset_collection

The procedure `free_propertyset_collection()` frees the memory associated with property set collection.

Syntax

```
PROCEDURE free_propertyset_collection
(
pset_collection IN OUT PROPERTY_SET_COLLECTION
);
```

Parameters

Table 17–49 FREE_PROPERTYSET_COLLECTION Procedure Parameters

Parameter Name	Parameter Type	Parameter Description
pset_collection	PROPERTY_SET_COLLECTION	The property set collection returned from one of the following functions: ■ DBMS_LDAP_UTL.get_group_membership() ■ DBMS_LDAP_UTL.get_subscriber_properties() ■ DBMS_LDAP_UTL.get_user_properties() ■ DBMS_LDAP_UTL.get_group_properties()

See Also

DBMS_LDAP_UTL.get_group_membership(), DBMS_LDAP_UTL.get_subscriber_properties(), DBMS_LDAP_UTL.get_user_properties(), DBMS_LDAP_UTL.get_group_properties().

Function create_mod_propertyset

The function create_mod_propertyset() creates a MOD_PROPERTY_SET data structure.

Syntax

```
FUNCTION create_mod_propertyset
(
pset_type IN PLS_INTEGER,
pset_name IN VARCHAR2,
mod_pset OUT MOD_PROPERTY_SET
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–50 CREATE_MOD_PROPERTYSET Function Parameters

Parameter Name	Parameter Type	Parameter Description
pset_type	PLS_INTEGER	The type of property set being modified. Here is a valid value: ENTRY_PROPERTIES
pset_name	VARCHAR2	The name of the property set. This can be NULL if ENTRY_PROPERTIES are being modified.
mod_pset	MOD_PROPERTY_SET	The data structure to contain modify operations to be performed on the property set.

Return Values

Table 17–51 CREATE_MOD_PROPERTYSET Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.GENERAL_ERROR	Other error.

See Also

DBMS_LDAP_UTL.populate_mod_propertyset().

Function populate_mod_propertyset

The function populate_mod_propertyset() populates the MOD_PROPERTY_SET data structure.

Syntax

```
FUNCTION populate_mod_propertyset
(
mod_pset IN MOD_PROPERTY_SET,
property_mod_op IN PLS_INTEGER,
property_name IN VARCHAR2,
property_values IN STRING_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–52 POPULATE_MOD_PROPERTYSET Function Parameters

Parameter Name	Parameter Type	Parameter Description
mod_pset	MOD_PROPERTY_SET	Mod-PropertySet data structure.
property_mod_op	PLS_INTEGER	The type of modify operation to perform on a property. These are valid values: ■ ADD_PROPERTY ■ REPLACE_PROPERTY ■ DELETE_PROPERTY
property_name	VARCHAR2	The name of the property
property_values	STRING_COLLECTION	Values associated with the property.

Return Values

Table 17–53 POPULATE_MOD_PROPERTYSET Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.GENERAL_ERROR	Authentication failed.
DBMS_LDAP_UTL.PWD_GRACELOGIN_WARN	Grace login for user.

See Also

DBMS_LDAP_UTL.create_mod_propertyset().

Procedure free_mod_propertyset

The procedure free_mod_propertyset() frees the MOD_PROPERTY_SET data structure.

Syntax

```
PROCEDURE free_mod_propertyset
(
mod_pset IN MOD_PROPERTY_SET
```

```
);
```

Parameters

Table 17–54 FREE_MOD_PROPERTYSET Procedure Parameters

Parameter Name	Parameter Type	Parameter Description
mod_pset	PROPERTY_SET	Mod_PropertySet data structure.

See Also

DBMS_LDAP_UTL.create_mod_propertyset().

Procedure free_handle

The procedure free_handle() frees the memory associated with the handle.

Syntax

```
PROCEDURE free_handle
(
handle IN OUT HANDLE
);
```

Parameters

Table 17–55 FREE_HANDLE Procedure Parameters

Parameter Name	Parameter Type	Parameter Description
handle	HANDLE	A pointer to a handle.

See Also

DBMS_LDAP_UTL.create_user_handle(), DBMS_LDAP_UTL.create_subscriber_handle(), DBMS_LDAP_UTL.create_group_handle().

Function check_interface_version

The function check_interface_version() checks the interface version.

Syntax

```
FUNCTION check_interface_version
(
interface_version IN VARCHAR2
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–56 CHECK_INTERFACE_VERSION Function Parameters

Parameter Name	Parameter Type	Parameter Description
interface_version	VARCHAR2	Version of the interface.

Return Values

Table 17–57 CHECK_VERSION_INTERFACE Function Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	Interface version is supported.
DBMS_LDAP_UTL.GENERAL_ERROR	Interface version is not supported.

Function get_property_values_blob

The function `get_property_values_blob()` retrieves large binary property values for a given property name and property.

Syntax

```
FUNCTION get_property_values_blob
(
pset IN PROPERTY_SET,
property_name IN VARCHAR2,
auth_type IN PLS_INTEGER,
property_values OUT BLOB_COLLECTION
)
RETURN PLS_INTEGER;
```

Parameters

Table 17–58 GET_PROPERTY_VALUES_BLOB Function Parameters

Parameters	Parameter Type	Description
property_name	VARCHAR2	A property name.
pset	PROPERTY_SET	The property set in the property set collection obtained from any of the following function returns: ▪ DBMS_LDAP_UTL.get_group_membership() ▪ DBMS_LDAP_UTL.get_subscriber_properties() ▪ DBMS_LDAP_UTL.get_user_properties() ▪ DBMS_LDAP_UTL.get_group_properties()
property_values	BLOB_COLLECTION	A list of binary property values.

Return Values

Table 17–59 GET_PROPERTY_VALUES_BLOB Return Values

Value	Description
DBMS_LDAP_UTL.SUCCESS	On a successful completion.
DBMS_LDAP_UTL.PARAM_ERROR	Invalid input parameters.
DBMS_LDAP_UTL.GENERAL_ERROR	On failure.

See Also

`DBMS_LDAP_UTL.get_property_values()`.

Procedure property_value_free_blob

Frees the memory associated with BLOB_COLLECTION returned by DBMS_LDAP.get_property_values_blob().

Syntax

```
Syntax
PROCEDURE property_value_free_blob
(
vals IN OUT DBMS_LDAP.BLOB_COLLECTION
);
```

Parameters

Table 17–60 PROPERTY_VALUE_FREE_BLOB Function Parameters

Parameter	Description
vals	The collection of large binary values returned by DBMS_LDAP.get_property_values_blob().

See Also

DBMS_LDAP.get_property_values_blob().

Function Return Code Summary

The DBMS_LDAP_UTL functions can return the values in the following table

Table 17–61 Function Return Codes

Name	Return Code	Description
SUCCESS	0	Operation successful.
GENERAL_ERROR	-1	This error code is returned on failure conditions other than those conditions listed here.
PARAM_ERROR	-2	Returned by all functions when an invalid input parameter is encountered.
NO_GROUP_MEMBERSHIP	-3	Returned by user-related functions and group functions when the user is not a member of a group.
NO_SUCH_SUBSCRIBER	-4	Returned by subscriber-related functions when the subscriber does not exist in the directory.
NO_SUCH_USER	-5	Returned by user-related functions when the user does not exist in the directory.
NO_ROOT_ORCL_CTX	-6	Returned by most functions when the root oracle context does not exist in the directory.
MULTIPLE_SUBSCRIBER_ENTRIES	-7	Returned by subscriber-related functions when multiple subscriber entries are found for the given subscriber nickname.
INVALID_ROOT_ORCL_CTX	-8	Root Oracle Context does not contain all the required information needed by the function.
NO_SUBSCRIBER_ORCL_CTX	-9	Oracle Context does not exist for the subscriber.
INVALID_SUBSCRIBER_ORCL_CTX	-10	Oracle Context for the subscriber is invalid.
MULTIPLE_USER_ENTRIES	-11	Returned by user-related functions when multiple user entries exist for the given user nickname.

Table 17–61 (Cont.) Function Return Codes

Name	Return Code	Description
NO_SUCH_GROUP	-12	Returned by group related functions when a group does not exist in the directory.
MULTIPLE_GROUP_ENTRIES	-13	Multiple group entries exist for the given group nickname in the directory.
ACCT_TOTALLY_LOCKED_EXCEPTION	-14	Returned by `DBMS_LDAP_UTL.authenticate_user()` function when a user account is locked. This error is based on the password policy set in the subscriber oracle context.
AUTH_PASSWD_CHANGE_WARN	-15	This return code is deprecated.
AUTH_FAILURE_EXCEPTION	-16	Returned by `DBMS_LDAP_UTL.authenticate_user()` function when user authentication fails.
PWD_EXPIRED_EXCEPTION	-17	Returned by `DBMS_LDAP_UTL.authenticate_user()` function when the user password has expired. This is a password policy error.
RESET_HANDLE	-18	Returned when entity handle properties are being reset by the caller.
SUBSCRIBER_NOT_FOUND	-19	Returned by `DBMS_LDAP-UTL.locate_subscriber_for_user()` function when it is unable to locate the subscriber.
PWD_EXPIRE_WARN	-20	Returned by `DBMS_LDAP_UTL.authenticate_user()` function when the user password is about to expire. This is a password policy error.
PWD_MINLENGTH_ERROR	-21	Returned by `DBMS_LDAP_UTL.set_user_properties()` function while changing the user password and the new user password is less than the minimum required length. This is a password policy error.
PWD_NUMERIC_ERROR	-22	Returned by `DBMS_LDAP_UTL.set_user_properties()` function while changing the user password and the new user password does not contain at least one numeric character. This is a password policy error.
PWD_NULL_ERROR	-23	Returned by `DBMS_LDAP_UTL.set_user_properties()` function while changing the user password and the new user password is an empty password. This is a password policy error.
PWD_INHISTORY_ERROR	-24	Returned by `DBMS_LDAP_UTL.set_user_properties()` function while changing the user password and the new user password is the same as the previous password. This is a password policy error.
PWD_ILLEGALVALUE_ERROR	-25	Returned by `DBMS_LDAP_UTL.set_user_properties()` function while changing the user password and the new user password has an illegal character. This is a password policy error.
PWD_GRACELOGIN_WARN	-26	Returned by `DBMS_LDAP_UTL.authenticate_user()` function to indicate that the user password has expired and the user has been given a grace login. This is a password policy error.

Table 17–61 (Cont.) Function Return Codes

Name	Return Code	Description
PWD_MUSTCHANGE_ERROR	-27	Returned by DBMS_LDAP_UTL.authenticate_user() function when user password needs to be changed. This is a password policy error.
USER_ACCT_DISABLED_ERROR	-29	Returned by DBMS_LDAP_UTL.authenticate_user() function when user account has been disabled. This is a password policy error.
PROPERTY_NOT_FOUND	-30	Returned by user-related functions while searching for a user property in the directory.

Data Type Summary

The DBMS_LDAP_UTL package uses the data types in the following table

Table 17–62 DBMS_LDAP_UTL Data Types

Data Type	Purpose
HANDLE	Used to hold the entity.
PROPERTY_SET	Used to hold the properties of an entity.
PROPERTY_SET_COLLECTION	List of PROPERTY_SET structures.
MOD_PROPERTY_SET	Structure to hold modify operations on an entity.

18

DAS_URL Interface Reference

This chapter describes the Oracle extensions to the DAS_URL Service Interface. It contains these sections:

- Directory Entries for the Service Units
- Service Units and Corresponding URL Parameters
- DAS URL API Parameter Descriptions
- Search-and-Select Service Units for Users or Groups

Directory Entries for the Service Units

Table 18–1 lists the Oracle Delegated Administration Services units and the directory entries that store relative URLs for these units.

Table 18–1 Service Units and Corresponding Entries

Service Unit	Entry
Create User	cn=Create User,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext
Edit User	cn=Edit User,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext
Edit User when GUID is passed as a parameter	cn=Edit UserGivenGUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Delete User	cn=DeleteUser,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext
Delete User when GUID of the user to be deleted is passed as a parameter	cn=DeleteUserGivenGUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Create Group	cn=Create Group,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Edit Group	cn=Edit Group,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext
Edit the group whose GUID is passed through a parameter	cn=Edit GroupGivenGUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Delete Group	cn=DeleteGroup,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Delete group with the GUID passed through a parameter	cn=DeleteGroupGivenGUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext

Table 18–1 (Cont.) Service Units and Corresponding Entries

Service Unit	Entry
Assign privileges to a user	cn=User Privilege,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Assign privileges to a user with the GUID passed through a parameter	cn=User Privilege Given GUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Assign privilege to a group	cn=Group Privilege,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Assign privilege to a group with the given GUID	cn=Group Privilege Given GUID,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
View User account information / Profile	cn=Account Info,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Edit User account Information / Profile	cn=Edit My Profile,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Change Password	cn=Password Change,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Search User	cn=User Search,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Search Group	cn=Group Search,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Search User LOV	cn=User LOV,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Search Group LOV	cn=Group LOV,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
EUS Console	cn=EUS Console,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext"
Delegation Console	cn=Delegation Console,cn=OperationURLs,cn=DAS,cn=Products, cn=OracleContext
Password Reset	cn=Reset Password,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContex
View User Profile	cn=View User Profile,cn=OperationURLs,cn=DAS,cn=Products,cn=OracleContext

Service Units and Corresponding URL Parameters

Table 18–2 lists the service units and the URL parameters that can be passed to these units.

Table 18–2 Service Units and Corresponding URL Parameters

Service Unit	Parameter	Return Values
Create User	doneURL homeURL cancelURL enablePA parentDN enableHomeURL enableHelpURL	returnGUID

Table 18–2 (Cont.) Service Units and Corresponding URL Parameters

Service Unit	Parameter	Return Values
Edit User	homeURL doneURL cancelURL enablePA enableHomeURL enableHelpURL	-
Edit UserGivenGUID	homeURL doneURL cancelURL enablePA userGUID enableHomeURL enableHelpURL	-
Edit My Profile	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
Delegation Console	-	-
DeleteUser	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
DeleteUserGivenGUID	homeURL doneURL cancelURL userGUID enableHomeURL enableHelpURL	-
User Privilege	homeURL doneURL cancelURL enableHomeURL enableHelpURL	
User Privilege Given GUID	homeURL doneURL cancelURL userGUID enableHomeURL enableHelpURL	-
Create Group	homeURL doneURL cancelURL enablePA parentDN enableHomeURL enableHelpURL	returnGUID

Table 18–2 (Cont.) Service Units and Corresponding URL Parameters

Service Unit	Parameter	Return Values
Edit Group	homeURL doneURL cancelURL enablePA enableHomeURL enableHelpURL	-
Edit GroupGivenGUID	homeURL doneURL cancelURL enablePA groupGUID enableHomeURL enableHelpURL	-
DeleteGroup	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
DeleteGroupGivenGUID	homeURL doneURL cancelURL groupGUID enableHomeURL enableHelpURL	-
Group Privilege	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
Group Privilege Given GUID	homeURL doneURL cancelURL groupGUID enableHomeURL enableHelpURL	-
Account Info	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
Password Change	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
User Search	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-

Table 18–2 (Cont.) Service Units and Corresponding URL Parameters

Service Unit	Parameter	Return Values
Group Search	homeURL doneURL cancelURL enableHomeURL enableHelpURL	-
Password Reset	cancelURL doneURL enableHomeURL enableHelpURL	-
View User Profile	userGuid doneURL homeURL nableHomeURL enableHelpURL	-
User LOV	base cfilter title dasdomain callbackURL	userDn userGuid userName nickName userEmail
Group LOV	otype base cfilter title dasdomain callbackURL	groupDN groupGuid groupName groupDescription

DAS URL API Parameter Descriptions

The parameters described in Table 18–3 are used with DAS units.

Table 18–3 DAS URL Parameter Descriptions

Parameter	Description
homeURL	The URL that is linked to the global button Home. When the calling application specifies this value, clicking Home redirects the DAS unit to the URL specified by this parameter.
doneURL	This URL is used by DAS to redirect the DAS page at the end of each operation. In the case of Create User, once the user is created, clicking OK redirects the URL to this location.
callbackURL	DAS uses this URL to send return values to the invoking application. For UserLOV and GroupLOV units, the return values are submitted as HTML form parameters through the HTTP POST method.
cancelURL	This URL is linked with all the Cancel buttons shown in the DAS units. Any time the user clicks Cancel, the page is redirected to the URL specified by this parameter.
enablePA	This parameter takes a Boolean value of true or false. Set to true, the parameter enables the Assign Privileges in User or Group operation. If the enablePA is passed with value of true in the Create User page, the Assign Privileges to User section also appears in the Create User page.
userGUID	This is the GUID of the user to be edited or deleted. This corresponds to the orclguid attribute. Specifying the GUID causes the search for the user step in either editUser or deleteUser units to be skipped.

Table 18–3 (Cont.) DAS URL Parameter Descriptions

Parameter	Description
`GroupGUID`	This is the GUID of the group to be edited or deleted. This corresponds to the orclguid attribute. Specifying the GUID causes the search for the group step in either editGroup or deleteGroup units to be skipped.
`parentDN`	When this parameter is specified in CreateGroup, the group is created under this container. If the parameter is not specified, group creation defaults to the group search base.
`base`	This parameter represents the search base in the case of search operations.
`cfilter`	This parameter represents the filter to be used for the search. This filter is LDAP compliant.
`title`	This parameter represents the title to be shown in the Search and Select LOV page.
`otype`	This parameter represents the object type used for search. Values supported are `Select`, `Edit`, and `Assign`.
`returnGUID`	This parameter is appended to the done URL in case of a create operation. The value will be the orclguid of the new object.
`dasdomain`	This parameter is needed only when the browser is Internet Explorer and the calling URL and the DAS URL are on different hosts and in the same domain. An example value is us.oracle.com. Note the calling application also needs to set the `document.domain` parameter on the formload. For more details, refer to Microsoft support at: `http://support.microsoft.com/`
`enableHomeUR`	When this parameter is passed with a value of false, the service unit will be rendered without the home button and home link. By default, the parameter is set to true.
`enableHelpURL`	When this parameter is passed with a value of false, the service unit will be rendered without the help button and help link. By default, the parameter is set to true.

Search-and-Select Service Units for Users or Groups

DAS provides service units for searching and selecting users or groups. These service units are sometimes referred to as user or group List Of Values (LOV).

Invoking Search-and-Select Service Units for Users or Groups

A custom application can open a popup window and populate its contents by supplying a search-and-select URL for a user or group by using a URL of the form:

```
http://das_host:das_port/oiddas/ui/oracle/ldap/das/search/LOVUserSearch
?title=User&callbackurl=http://app_host:app_port/custapp/Callback
```

or

```
http://das_host:das_port/oiddas/ui/oracle/ldap/das/search/LOVGroupSearch
?title=User&callbackurl=http://app_host:app_port/custapp/Callback
```

respectively. For example:

```
http://server02.example.com:7777/oiddas/ui/oracle/ldap/das/search/LOVUserSearch?
Mary.Smith=User&callbackurl=http://server04.example.com:7778/custapp/Callback
```

In this example, `server02.example.com:7777` is the host name and port of the Oracle Internet Directory DAS application server. `server04.example.com:7778` is the host name and port of the custom application server. `Mary.Smith` is a string that appears in the title of the Search and Select page. `http://server04.example.com:7778/custapp/Callback` is a URL of the custom application server that receives the selected parameters for users or groups.

Note: To avoid popup blocking, the custom application may open the popup window with a URL on the local custom application server and immediately redirect to the Oracle Internet Directory DAS User or Group Search-and-Select URL.

Receiving Data from the User or Group Search-and-Select Service Units

After a User or Group has been selected through the Oracle Internet Directory DAS User or Group Search-and-Select Service Unit, an HTTP form will be submitted to the callbackurl page using the POST method. The parameters defined in Table 18–4 and Table 18–5 are available to the callbackurl page:

Table 18–4 User Search and Select

Parameter	Description
`userDn`	User's distinguished name.
`userGuid`	User's global unique ID.
`userName`	User's name.
`nickName`	User's nickname
`userEmail`	User's email.

Table 18–5 Group Search and Select

Parameter	Description
`groupDn`	Group's distinguished name.
`groupGuid`	Group's global unique ID.
`groupName`	Group's name.
`groupDescription`	Group's description.

The callbackurl page in the popup window may transfer the form parameters to the invoking page in the opener window using JavaScript. It may then close the popup window.

Note: To avoid JavaScript security problems, the custom application may supply the callbackurl page on the same server as the invoking page. This enables the callbackurl page in the popup window and the invoking page in the opener window to communicate directly through JavaScript.

19

Oracle Directory Integration Platform User Provisioning Java API Reference

As of 10*g* (10.1.4.0.1), Oracle offers two complementary provisioning products, optimized for different use cases.

- Oracle Identity Manager, formerly known as Oracle Xellerate IP, is an enterprise provisioning platform designed to manage complex environments with highly heterogeneous technologies that can include directories, databases, mainframes, proprietary technologies, and flat files. Oracle Identity Manager offers full-functioned workflow and policy capabilities along with a rich set of audit and compliance features.
- Oracle Directory Integration Platform, a component of the Identity Management infrastructure, is a meta-directory technology designed to perform directory synchronization as well as provisioning tasks in a directory-centric environment. Oracle Directory Integration Platform is designed to manage a more homogeneous environment consisting of directories and compatible Oracle products. Oracle Directory Integration Platform performs provisioning tasks by using data synchronization. Oracle Directory Integration Platform offers a small deployment footprint when workflow and a full feature policy engine are not required.

The Oracle Internet Directory SDK includes an Oracle Directory Integration Platform user provisioning API, which enables you to manage users and their application properties in the Oracle Identity Management infrastructure. This chapter describes the main features of the API and explains how to use them.

This chapter contains the following sections:

Application Configuration

Applications must register with the provisioning system in order to be recognized as provisionable. They must also create their own configuration in Oracle Internet Directory using the command-line interface. Java classes exist for viewing application configurations.

This section contains the following topics:

- Application Configuration Classes

Application Registration and Provisioning Configuration

In order to register with the provisioning system, an application must create a provisioning configuration. Once the provisioning configuration exists, the provisioning system identifies the application as directory-enabled and provisionable.

The application must perform the following steps to create a provisioning configuration:

1. Application Registration
2. Provisioning Configuration

Application Registration

Oracle applications typically register themselves by using the repository APIs in the `repository.jar` file under `$ORACLE_HOME/jlib`. This file is provided during installation specifically for application registration. In addition to creating an application entry in Oracle Internet Directory, repository APIs can be used to add the application to privileged groups.

Applications written by customers, however, cannot use the `repository.jar` APIs to perform application registration. So application developers must use LDIF templates and create application entries in Oracle Internet Directory using LDAP commands.

An application must create a container for itself under one of these containers:

- `"cn=Products,cn=OracleContext"`—for applications that service users in multiple realms
- `"cn=Products,cn=OracleContext,`*`RealmDN`*`"`—for applications that service users in a specific realm

If an application is configured for a specific realm, then that application cannot manage users in other realms. In most cases, you should create the application outside any identity management realm so that the application is not tied to a specific realm in Oracle Internet Directory.

Whenever a new instance of the application installs, a separate entry for the application instance is created under the application's container. Some of the provisioning configuration is common to all the instances of a particular type and some is specific to the instance. When multiple instances of an application are deployed in an enterprise, each instance is independent of the others. Each instance is defined as a separate provisionable application. Users can be provisioned for one or more instances of this application, so that the user can get access to one or more instances of this application.

The examples in this section are for a sample application similar to Oracle Files. When the first instance of this application installs, specific entries must be created in Oracle Internet Directory. In the following example, the name of this application, chosen at run time, is `Files-App1` and the type of the application is `FILES`. The application can have LDIF templates that can be instantiated if required and then uploaded to Oracle Internet Directory. In this example, the application identity is outside any realm. That is, it is under the `"cn=Products,cn=OracleContext"` container.

```
dn: cn=FILES,cn=Products,cn=OracleContext
changetype: add
objectclass: orclContainer
```

```
dn: orclApplicationCommonName=Files-App1,cn=FILES,cn=Products,cn=OracleContext
changetype: add
orclappfullname: Files Application Instance 1
userpassword: welcome123
description: This is a test Appliction instance.
protocolInformation: xxxxx
orclVersion: 1.0
orclaci: access to entry by group="cn=odisgroup,cn=DIPAdmins,
 cn=Directory Integration  Platform,cn=Products,
 cn=OracleContext" (browse,proxy) by group="cn=User Provisioning Admins,
 cn=Groups,cn=OracleContext" (browse,proxy)
orclaci: access to attr=(*) by group="cn=odisgroup,cn=DIPAdmins,
 cn=Directory Integration Platform,cn=Products,
 cn=OracleContext" (search,read,write,compare)
 by group="cn=User Provisioning Admins,
 cn=Groups,cn=OracleContext" (search,read,write,compare)
```

The ACLs shown in the example are discussed in the "Application User Data Location" section.

The application is expected to grant certain privileges to some provisioning services as well as provisioning administrators.

When the second instance of this application installs, the following entries must be created in Oracle Directory Integration Platform, assuming the name of this application, decided at run time, is `Files-App2`.

```
dn: orclApplicationCommonName=Files-App2,cn=FILES,cn=Products,cn=OracleContext
changetype: add
orclappfullname: Files Application Instance 2
userpassword: welcome123
description: This is a test Appliction instance.
orclVersion: 1.0
orclaci: access to entry by group="cn=odisgroup,
 cn=DIPAdmins,cn=Directory Integration Platform,cn=Products,
 cn=OracleContext" (browse,proxy) by group="cn=User Provisioning Admins,
 cn=Groups,cn=OracleContext" (browse,proxy)
orclaci: access to attr=(*) by group="cn=odisgroup,cn=DIPAdmins,
 cn=Directory Integration Platform,cn=Products,
 cn=OracleContext" (search,read,write,compare) by
 group="cn=User Provisioning Admins,cn=Groups,cn=OracleContext"
 (search,read,write,compare)
```

Once the application creates its entries successfully, the application's identity is registered in Oracle Internet Directory. At this point, the application can add itself to certain privileged groups in Oracle Internet Directory, if it needs specific privileges. Table 19–1, " Some Useful Privilege Groups" shows some of the privileged groups that an application can add itself to. Each of these groups exists in every realm and also in the RootOracleContext. The RootOracleContext Group is a member of the group in all the realms

Table 19–1 Some Useful Privilege Groups

Group Name	Privilege
OracleDASCreateUser	Create a public user
OracleDASEditUser	Edit a public user
OracleDASDeleteUser	Delete a public user
OracleDASCreateGroup	Create a new public group

Table 19–1 (Cont.) Some Useful Privilege Groups

Group Name	Privilege
OracleDASEditGroup	Edit a public group
OracleDASDeleteGroup	Delete a public group

For example, the following LDIF file adds the `Files-App1` application to `cn=OracleCreateUser`, which gives it the privilege to create users in all realms.

```
dn:cn=OracleCreateUser,cn=Groups,cn=OracleContext
changetype: modify
add: uniquemember
uniquemember:
orclApplicationCommonName=Files-App1,cn=FILES,cn=Products,cn=OracleContext
```

Provisioning Configuration

An application's provisioning configuration is maintained in its provisioning profile. The provisioning system supports three different provisioning profile versions: Versions 1.1, 2.0 and 3.0. The provisioning service provides different service for the different profile version. Some generic configuration details are common to all applications, regardless of version.

Differences Between Provisioning Configuration Versions

The differences between the Version 3.0 profile and the Version 2.0 and Version 1.1 profiles are as follows:

- The new provisioning framework recognizes only Version 3.0 applications. Therefore, only applications with provisioning profile Version 3.0 show up as target applications to be provisioned in Oracle Provisioning Console. Applications with Version 2.0 and Version 1.1 profiles do not show them up as applications to be provisioned in the Provisioning Console. Still, the applications are notified about the events that the applications have configured for.
- Creating the provisioning configuration of an application is a multi step process for Version 3.0 profiles. For the earlier version profiles, provisioning registration requires only a single step, running the `oidprovtool` command.
- Applications can subscribe for provisioning events using different interfaces. Two of the interfaces, Java and OID-LDAP, are available only for interface Version 3.0, which is coupled with provisioning configuration Version 3.0. See Table 19–2, " Interfaces and Their Configuration".
- An application can specify its application-specific user attributes configuration in an LDIF file. This is supported only for interface Version 3.0, which is coupled with provisioning configuration Version 3.0. See "Application User Attribute and Defaults Configuration" on page 19-9
- The provisioning status of the user, discussed in the *Oracle Identity Management Integration Guide*, is maintained only for Version 3.0 applications. It is not maintained for applications having profiles earlier than Version 3.0.
- Event propagation configuration parameters vary from one version to another. See Table 19–5, " Event propagation parameters".

Version 3.0-Specific Provisioning Configuration

Unless otherwise stated, the remainder of this section describes the Version 3.0-specific provisioning configuration. Figure 19–1 shows the DIT in Oracle Internet Directory used to store the provisioning configuration. All the provisioning configuration information is located under the following container:

```
cn=Provisioning,cn=Directory Integration Platform,cn=Products,cn=OracleContext
```

Common provisioning configuration information is stored in entries under the container:

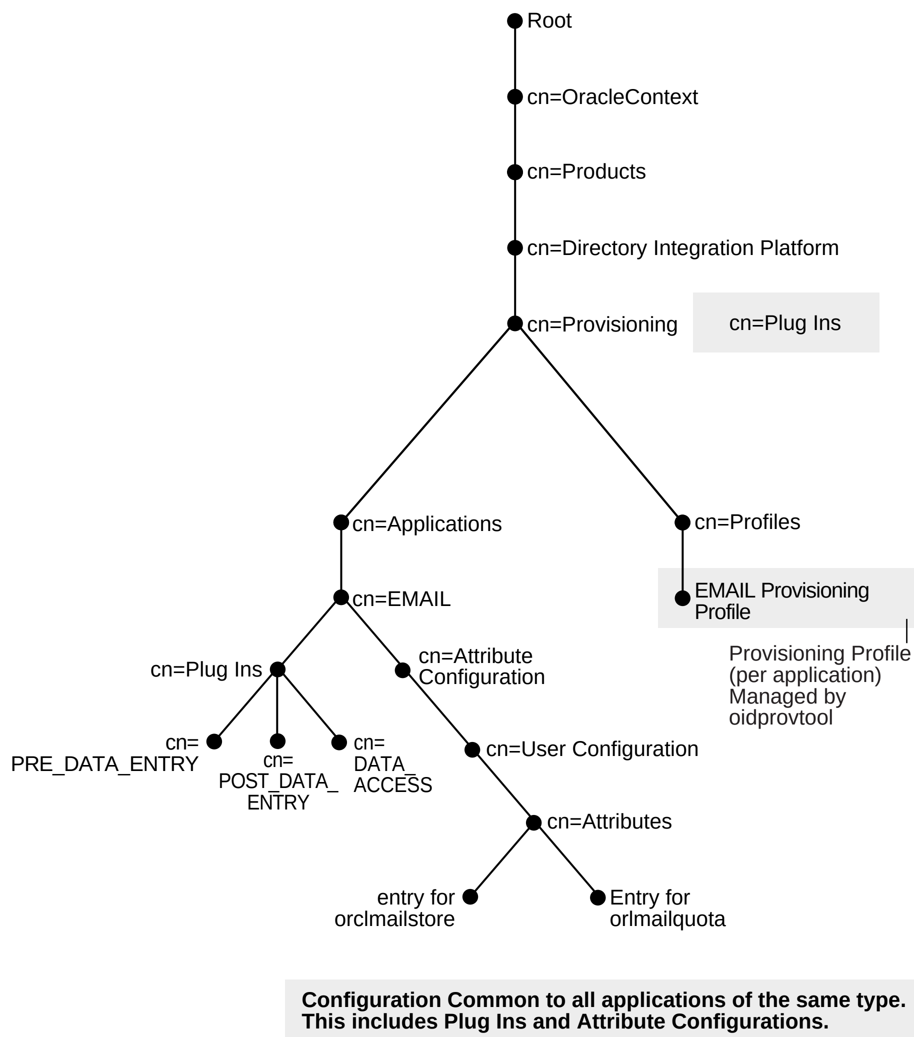
```
cn=Profiles,cn=Provisioning,cn=Directory Integration Platform,
 cn=Products,cn=OracleContext
```

The rest of the provisioning configuration for an application is located under:

```
cn=ApplicationType,cn=Applications,cn=Provisioning,
 cn=Directory Integration Platform,cn=Products,cn=OracleContext
```

All the instances of a specific application type share the configuration under this container. That is, whenever a second instance of an existing application type creates a provisioning profile, all the configuration information under the "`cn=`*`ApplicationType`*" container is shared.

Figure 19–1 The Directory Information Tree for Provisioning Configuration Data



The `Profiles` container contains the following types of configuration information:

- Application Identity Information
- Application Identity Realm Information
- Application Provisioning and Default Policy
- Application User Data Location
- Event Interface Configuration
- Application User Attribute and Defaults Configuration
- Application Provisioning Plug-in Configuration
- Application Propagation Configuration
- Application Event Propagation Run Time Status

Whenever an instance of an application creates a profile, the new profile is stored as a separate entry under the `Profiles` container in the following naming format:

orclODIPProfileName=*GUID_of_the_Realm_Entry_GUID_of_the_Application_Identity*,….

An application must specify the following information when creating a provisioning configuration:

Application Identity Information An instance of an application is uniquely identified by the following parameters:

- Application DN—A unique DN in the Oracle Internet Directory representing the application. This is a mandatory parameter.
- Application Type— A parameter that is common to all instances of the same application. Multiple instances of a particular type can share some configuration. This is a mandatory parameter.
- Application Name—This can be separately specified. If not specified, it is extracted from the DN. This is an optional parameter.
- Application Display Name—A user-friendly name for the application. This shows up on the Provisioning Console as a target provisionable application. This is an optional parameter.

You provide these application identity parameters while creating the provisioning profile by using the following arguments to the `$ORACLE_HOME/bin/oidprovtool` command line utility, respectively:

- `application_type`
- `application_dn`
- `application_name`
- `application_display_name`

> **See Also:** The `oidprovtool` command-line tool reference in *Oracle Identity Management User Reference*.

Application Identity Realm Information An application registers for a specific realm in order to provide services to the users of that realm only. An application must create a separate provisioning profile for each of the realms it provides services for. In a multi realm scenario, such as a hosted OracleAS Portal scenario, applications must register for individual realms.

Whenever a provisioning administrator for a realm accesses the Provisioning Console, only the applications that are registered for that realm are shown as provisionable target applications.

The application specifies realm information while creating the provisioning profile by using the `$ORACLE_HOME/bin/oidprovtool` command line utility with the argument `organization_dn`.

> **See Also:** The `oidprovtool` command-line tool reference in *Oracle Identity Management User Reference*.

Application Provisioning and Default Policy While creating a provisioning profile, an application can specify whether the Provisioning Console should manage provisioning to that application or not. If not, the application does not show up on the Provisioning Console as an application to be provisioned. However, Oracle Directory Integration Platform still processes this profile and propagates the events as expected.

An application specifies this information while creating the provisioning profile by using the `application_isdasvisible` argument to the `$ORACLE_HOME/bin/oidprovtool` command line utility. The default value is `TRUE`.

An application can configure a default policy determining whether all the users in that realm should be provisioned for that application by default or no users should be provisioned by default. The valid values are

- `PROVISIONING_REQUIRED`—all users will be provisioned by default
- `PROVISIONING_NOT_REQUIRED`—no users will be provisioned by default

The default is set to `PROVISIONING_REQUIRED`

You can override the default policy with application-provided policy plug-ins at run time. In addition, an administrator can override both the default policy and the decision of the policy plug-in.

An application provides the default policy information by using the `default_provisioning_policy` argument to the `$ORACLE_HOME/bin/oidprovtool` command line utility.

Application User Data Location Application-specific user information is stored in the application-specific containers. If this data is to be managed by the provisioning system, the application must specify the location of these containers during provisioning registration. An application specifies its user data location by using the `user_data_location` argument to the `$ORACLE_HOME/bin/oidprovtool` command line utility. The application must ensure that the ACLs on this container allow Oracle Delegated Administration Services and Oracle Directory Integration Platform to manage the information in this container.

Event Interface Configuration Applications can subscribe for provisioning events using different interfaces: PLSQL, Java, and OID-LDAP. Table 19–2, " Interfaces and Their Configuration" lists the supported interfaces and their associated configuration. Note that `INTERFACE_VERSION` is coupled with provisioning profile version.

Table 19–2 Interfaces and Their Configuration

Configuration Parameter	PLSQL	Java	OID-LDAP
INTERFACE_VERSION	1.1, 2.0, 3.0	3.0	3.0

Table 19–2 (Cont.) Interfaces and Their Configuration

Configuration Parameter	PLSQL	Java	OID-LDAP
INTERFACE_NAME	The name of the PLSQL package that implements the Interface	Not used	Not used
INTERFACE_CONNECT_INFO	The Database Connect String. Multiple formats supported for all versions.	Not used	Not used
INTERFACE_ADDITIONAL_INFO	Not used	Not used	Not used
Plugin types	PRE_DATA_ENTRY, POST_DATA_ENTRY, DATA_ACCESS	PRE_DATA_ENTRY, POST_DATA_ENTRY, DATA_ACCESS, EVENT_DELIVERY (MUST)	PRE_DATA_ENTRY, POST_DATA_ENTRY, DATA_ACCESS
Description	Mainly for applications that have an Oracle Database backend. The DIP Server pushes the event to the remote Database by invoking the PLSQL procedure.	If the Interface Type is JAVA, an event delivering plug-in must be configured or the server will give errors. The plug-in configuration determines the rest of the configuration. See Application Provisioning Plug-in Configuration.	Mainly used in cases where the application is very tightly bound to Oracle Internet Directory and event delivery through the PLSQL interface or the JAVA Event Delivery Plug-in is unnecessary. This interface will be deprecated in future. Please use the JAVA Interface instead.

Applications can use the following arguments to `$ORACLE_HOME/bin/oidprovtool` when specifying an event interface configuration:

- `interface_type` (Default is PLSQL)
- `interface_version` (Default is 2.0)
- `interface_name`
- `interface_connect_info`
- `interface_additional_info`

Table 19–3, " Information Formats Supported by the PLSQL Interface" lists the interface connection information formats that the PL/SQL interface supports when it connects to a remote database. All the formats are supported for all interface versions.

Table 19–3 Information Formats Supported by the PLSQL Interface

Format	Description
dbHost:*dbPort*:*dbSID*:*username*:*password*	Old format, not recommended. Oracle Directory Integration Platform passes this to the thin JDBC Driver.
dbHost:*dbPort*:*dbServiceName*:*username*:*password*	Newer format. Not Recommended for High Availability implementations, as the database host and port might change in such scenarios. DIP passes this to the thin JDBC Driver.

Table 19–3 (Cont.) Information Formats Supported by the PLSQL Interface

Format	Description
DBSVC=*DB_TNS_Connect_Sring_ Alias*:*username*:*password*	Used by JDBC thick OCI Driver. The local `tnsnames.ora` file must contain this alias on the node where DIP is running.
DBURL=ldap://*LDAP_host*:*LDAP_ port*/*ServiceName*,cn=OracleContext	Recommended format, as it takes care of High Availability requirements. DIP passes this to the thin JDBC Driver and the driver looks up the Database Registration entry in Oracle Internet Directory to get the actual Database connection information.

Some examples of supported formats are:

```
localhost:1521:iasdb:scott:tiger

localhost:1521:iasdbsvc:scott:tiger

DBSVC=TNSALIAS:scott:tiger

DBURL=ldap://acme.com:389/samplegdbname:scott:tiger
```

Application User Attribute and Defaults Configuration An application can specify its application-specific user attributes configuration in an LDIF file. This is supported only for interface version 3.0.

As shown in Figure 19–1, "The Directory Information Tree for Provisioning Configuration Data", the configuration for a particular attribute is stored as a separate entry under the container:

```
"cn=Attributes,cn=User Configuration,cn=Attribute configuration,
 cn=Application_Type,cn=Applications,cn=Provisioning,
 cn=Directory Integration Platform,cn=Products,cn=OracleContext"
```

There is no argument to `oidprovtool` for uploading this information. The application must use an LDAP file and command-line tools to upload its attribute configuration information to Oracle Internet Directory.

Each application-specific attribute is represented as a separate entry. The following example is for the attribute `orclFilesDomain`:

```
dn: cn=orclFilesDomain,cn=Attributes,cn=User configuration,cn=Attribute
configuration,……
changetype: add
orcldasadminmodifiable: 1
orcldasviewable: 1
displayname: Files Domain
orcldasismandatory: 1
orcldasuitype: LOV
orcldaslov: us.oracle.com
orcldaslov: oraclecorp.com
orclDASAttrIsUIField: 1
orclDASAttrIsFieldForCreate: 1
orclDASAttrIsFieldForEdit: 1
orclDASAttrToDisplayByDefault: 1
orclDASSelfModifiable: 1
orclDASAttrDisplayOrder: 1
orclDASAttrDefaultValue: oraclecorp.com
orclDASAttrObjectClass: orclFILESUser
objectclass: orclDASConfigAttr
```

Table 19–4, " Properties Stored as Attributes in the Attribute Configuration Entry" explains the significance of each of the properties that are stored as attributes in the attribute configuration entry.

Table 19–4 Properties Stored as Attributes in the Attribute Configuration Entry

Property Name	Description	Comments
orclDASIsUIField	Whether this property is to be shown in the DAS Console or not	Not Used in 10*g* (10.1.4.0.1). All attributes are shown.
orclDASUIType	The Type of the UI Field: singletext, multitext, LOV, DATE, Number, password	Used by Oracle Internet Directory Self-Service Console only
orclDASAdminModifiable	Whether the field is modifiable by the administrator or not	Not Used in 10*g* (10.1.4.0.1). All attributes are modifiable by administrator.
orclDASViewAble	Whether this attribute is a read-only attribute in the Oracle Internet Directory Self-Service Console	Not Used in 10*g* (10.1.4.0.1)
displayName	The Localized Name of the attribute as it shows on the Oracle Internet Directory Self-Service Console	
orclDASIsMandatory	Whether this attribute is mandatory or not	If a mandatory attribute is not populated, the Oracle Internet Directory Self-Service Console complains
orclDASAttrIsFieldForCreate	Whether to expose this attribute only during user creation	Not Used in 10*g* (10.1.4.0.1)
orclDASAttrIsFieldForEdit	Whether to expose this attribute only during user editing	Not Used in 10*g* (10.1.4.0.1)
orclDASAttrToDisplayByDefault	Whether to hide the attribute by default under a collapsed section	Not Used in 10*g* (10.1.4.0.1)
orclDASSelfModifiable	Whether this attribute is modifiable by the user or not	Not Used in 10*g* (10.1.4.0.1), as Oracle Internet Directory Self-Service Console is only for application-specific attributes. Users cannot change their user preferences from the Oracle Internet Directory Self-Service Console.
OrclDASAttrDisplayOrder	The order is which the attribute is to be displayed in the application-specific section	Not Used in 10*g* (10.1.4.0.1)
OrclDASAttrDefaultValue	The initial default value for the attribute that is used by the provisioning components: Oracle Internet Directory Self-Service Console, Oracle Directory Integration Platform, Bulk Provisioning Tool	Can be changed using the Oracle Internet Directory Self-Service Console *Application Management* Page. The Plug-ins or the administrator can override the initial default values.
OrclDASAttrObjectClass	The LDAP object class that the attribute belongs to.	Used to create the application-specific user entries that the provisioning system maintains.

If an application has application-specific attributes, you can specify that the provisioning system manage its attributes defaults. You do that by using the `manage_` application_defaults argument to $ORACLE_HOME/bin/oidprovtool. This argument is TRUE by default.

Application Provisioning Plug-in Configuration Application provisioning plug-ins are discussed in

Appendix A, "Java Plug-ins for User Provisioning".

Application Propagation Configuration Event propagation configuration parameters vary from one profile version to another. Table 19–5, " Event propagation parameters" lists and describes configuration parameters for event propagation.

Table 19–5 Event propagation parameters

Parameter	Supported Provisioning Profile Version	Description
profile_mode	2.0,.3.0	Whether the application is to receive outbound provisioning events from Oracle Internet Directory, to send inbound events, or both. Values are OUTBOUND (default), INBOUND, and BOTH.
Schedule	1.1, 2.0, 3.0	The scheduling interval after which pending events are propagated
enable_bootstrap	3.0	Enables events for application bootstrapping. This specifies that the application should be notified of users that existed in Oracle Internet Directory before the application created its provisioning profile.
enable_upgrade	3.0	Enables events for application user upgrade. This specifies that the application should be notified of users that existed in Oracle Internet Directory before the upgrade. If the application was present before the upgrade, users might already exist in the application. For such users, Oracle Directory Integration Platform sends an Upgrade Event to the application so that the user is handled differently from a normal new user.
lastchangenumber	3.0	The change number in Oracle Internet Directoryfrom which the events need to be sent to the application.
max_prov_failure_limit	3.0	The maximum number of retries that the Oracle Directory Integration Platform server attempts when provisioning a user for that application.
max_events_per_invocation	2.0, 3.0	For bulk event propagation, this specifies the maximum number of events that can be packaged and sent during one invocation of the event interface.
max_events_per_schedule	2.0	Maximum number of events that Oracle Directory Integration Platform sends to an application in one execution of the profile. The default is 25. In deployments with many profiles and applications, this enables Oracle Directory Integration Platform, which is multithreaded, to execute threads for multiple profiles.

Table 19–5 (Cont.) Event propagation parameters

Parameter	Supported Provisioning Profile Version	Description

event_subscription	1.1, 2.0, 3.0	Defines the types of OUTBOUND events an application is to receive from the event propagation service. The format is:
		`Object_Type:Domain:Operation(Attributes,…)`
		For example:
		`USER:cn=users,dc=acme,dc=com:ADD(*)`
		specifies that USER_ADD event should be sent if the user that was created is under the specified domain and that all attributes should also be sent.
		`USER:cn=users,dc=acme,dc=com:MODIFY(cn,sn.mail,telephonenumber)`
		specifies that USER_MODIFY event should be sent if the user that was modified is under the specified domain and any of the listed attributes were modified
		`USER:cn=users,dc=acme,dc=com:DELETE`
		specifies that USER_DELETE event should be sent if a user under the specified domain was deleted

event_permitted_ operations	2.0	Defines the types of INBOUND events an application is privileged to send to the Oracle Directory Integration Platform server. The format is:
		`Object_Type:Domain:Operation(Attributes,…)`
		For example:
		`IDENTITY:cn=users,dc=acme,dc=com:ADD(*)`
		specifies that IDENTITY_ADD event is allowed for the specified domain and all attributes are also allowed. This means that the application is allowed to create users in Oracle Internet Directory.
		`IDENTITY:cn=users,dc=acme,dc=com:MODIFY(cn,sn.mail,telephonenumber)`
		Specifies that IDENTITY_MODIFY is allowed for only the attributes in the list. Other attributes are silently ignored. This means that the application is allowed to modify the listed attributes of the users in Oracle Internet Directory.
		`IDENTITY:cn=users,dc=acme,dc=com:DELETE`
		Specifies that the application is allowed to delete users in Oracle Internet Directory

Table 19–5 (Cont.) Event propagation parameters

Parameter	Supported Provisioning Profile Version	Description
event_mapping_ rules	2.0	For INBOUND profiles, this specifies the type of object received from an application and a qualifying filter condition to determine the domain of interest for this event. Multiple rules are allowed. The format is: `Object_Type`: `Filter_condition`: `Domain_Of_Interest` For example: `EMP::cn=users,dc=acme,dc=com` specifies that if the object type received is `EMP`, the event is meant for the domain `"cn=users,dc=acme,dc=com"`. `EMP:l=AMERICA:l=AMER,cn=users,dc=acme,dc=com` specifies that if the object type received is `EMP`, and the event has the attribute `l` (locality) and its value is `AMERICA`, the event is meant for the domain `"l=AMER,cn=users,dc=acme,dc=com"`.

Application Event Propagation Run Time Status The Oracle Provisioning Service records a user's provisioning status in Oracle Internet Directory for each provisioning-integrated application. This is described in the Deploying and Configuring Provisioning chapter of *Oracle Identity Management Integration Guide*.

Application Configuration Classes

The `oracle.idm.user.provisioning.configuration.Configuration` class enables you to obtain provisioning schema information. The `oracle.idm.user.provisioning.configuration.Application` class enables you to obtain metadata for registered applications. These classes are documented under the package `oracle.idm.provisioning.configuration`.

The `Configuration` class provides access to application configurations. To construct, a `Configuration` object, you must specify the realm. For example:

```
Configuration cfg = new Configuration ("us");
```

Then you use `Configuration` class methods to get one or all application configurations in a realm. You must supply the LDAP context of the realm.

The `Configuration` object is a fairly heavy weight object, as its creation requires access to the Oracle Internet Directory metadata. Best practice is to create a `Configuration` object once during initialization of an application, then to reuse it for all operations that require it.

The `Application` object represents an application instance. Its methods provide metadata about a registered application in the infrastructure.

User Management

When Oracle Directory Integration Platform or Oracle Delegated Administration Services invokes a provisioning plugin, it passes information about the user being provisioned. A deployed application can use the user object to modify the user.

The user management provisioning classes provide the following operations:

- Create, modify, and delete a base user

- Create, modify, and delete application-specific user information
- Search base users
- Retrieve user provisioning status for applications

This section includes the following topics:

- Creating a User
- Modifying a User
- Deleting a User
- Looking Up a User

Creating a User

Creating a user in the Oracle Identity Management repository consists of two steps:

1. Creating basic user information in the specified realm. This information is referred to as the base user.
2. Creating the application-specific user attributes, or footprint. This information is referred to as the application user.

The combination of the base user and application user in the repository is referred to as the Oracle Identity Management user. Some methods create only the base user and other create both components of the Oracle Identity Management user.

The minimum information required to create a user is a set of attributes representing the base user. The attributes are in the form of name-value pairs. These user attributes are represented as Java objects using the class `oracle.ldap.util.ModPropertySet`.

Some user creation methods require you to specify the DN of the entry that you want to create in the Oracle Identity Management user repository. Other methods do not require the DN. Instead, they construct the Oracle Identity Management user using the metadata configuration information from the Realm in which the user is created.

If the creation of the base user and application user succeeds, then the creation method returns an `IdmUser` object. You use this object to manage the attributes of the base user and application user.

Modifying a User

Modifying a base user in the Oracle Identity Management repository results in

- Modifying the base user information
- Creating or modifying application user information

You must supply the following information in order to modify an Oracle Identity Management user:

1. The user's DN, GUID, or `IdmUser` object reference
2. The desired changes to the base user attributes, represented as an `oracle.ldap.util.ModPropertySet`

Some user modification methods modify only the base user attributes. Others modify the application user attributes as well.

Deleting a User

Deleting a base user in the Oracle Identity Management repository produces the following results:

- Deleting the base user information
- Deleting the application user information

To modify an Oracle Identity Management user, you must supply the DN, GUID, or IdmUser object reference.

As result of this operation, the base user and the application user attributes are deleted.

Looking Up a User

The lookup methods provide two lookup options:

- Look up a specific Oracle Identity Management user using GUID or DN
- Look up a set of Oracle Identity Management users using a search filter

In order to look up Oracle Identity Management users, you must provide the DN or GUID.

The output of a lookup method is one of the following:

- A single IdmUser object
- A list of IdmUser objects

Debugging

Set `UtilDebug.MODE_PROVISIONING_API` mode to enable debugging and trace information. If you do not specify an output stream for the log messages, they are written to standard output.

The following snippet shows how to set `UtilDebug.MODE_PROVISIONING_API` mode and specify an output stream:

```
Import oracle.ldap.util.UtilDebug;
FileOutputStream logStream = new FileOutputStream("ProvAPI.log")
…
UtilDebug.setDebugMode(UtilDebug.MODE_PROVISIONING_API);
UtilDebug.setPrintStream(logStream);
```

Sample Code

The following code example shows how to create, modify, and look up a user and how to get user provisioning status for an application.

```
UtilDebug.setDebugMode(UtilDebug.MODE_PROVISIONING_API);
…
Configuration cfg = new Configuration(realm);
    try {
      debug("Connecting...");
      InitialLdapContext ctx =
          ConnectionUtil.getDefaultDirCtx(hostName, port, bindDn, passwd);
      debug("Connected...");
      UserFactory factory = UserFactoryBuilder.createUserFactory(ctx, cfg);
```

```
        // Create
        ModPropertySet mpSet = new ModPropertySet();
        mpSet.addProperty("cn","Heman");
        mpSet.addProperty("sn","The Master");
        mpSet.addProperty("uid","Heman");
        IdmUser idmUser = factory.createUser(mpSet);

        // Modify
        mpSet = new ModPropertySet();
        mpSet.addProperty(LDIF.ATTRIBUTE_CHANGE_TYPE_REPLACE,"sn",
              "Heman The Master");
        mpSet.addProperty("givenName","Master of the Universe");
        factory.modifyUser(idmUser, mpSet);

        // Lookup
        List users = factory.searchUsers(Util.IDTYPE_SIMPLE, "Hema*", null);
….

        // Get user provisioning status for an application.
        Application app = cfg.getApplication(lCtx, "Files", "FilesInstace");
        String  status = idmUser.getProvisioningStatus(app);


        // Another way to get user provisioning status
        String userDn = idmUser.getDNn();
        String  status = ProvUtil.getUserProvisioningStatus(dirctx,
              Util.IDTYPE_DN, userDn, app.getType(), app.getName());
      } catch (Exception ex) {
        ex.printStackTrace();
         //
     }
```

20

Oracle Directory Integration Platform PL/SQL API Reference

This chapter describes the registration API for the Directory Integration Platform. It contains the following sections:

Versioning of Provisioning Files and Interfaces

In release 9.0.2, the default interface version was version 1.1. In releases 9.0.4 and 10.1.2.0.0, the interface version defaults to version 2.0. Release 10.1.2.0.1 adds yet a third version. The administrator can use any one of these.

Extensible Event Definition Configuration

This feature is only for outbound events. It addresses the ability to define a new event at run time so that the provisioning integration service can interpret a change in Oracle Internet Directory and determine whether an appropriate event is to be generated and propagated to an application. The following events will be the only configured events at installation time.

An event definition (entry) consists of the following attributes.

- Event object type (`orclODIPProvEventObjectType`): This specifies the type of object the event is associated with. For example, the object could be a `USER`, `GROUP`, or `IDENTITY`.
- LDAP change type (`orclODIPProvEventChangeType`): This indicates that all kinds of LDAP operations can generate an event for this type of object. (e.g `ADD`, `MODIFY`, `DELETE`)
- Event criteria (`orclODIPProvEventCriteria`): The additional selection criteria that qualify an LDAP entry to be of a specific object type. For example, `Objectclass=orclUserV2` means that any LDAP entry that satisfies this criteria can be qualified as this Object Type and any change to this entry can generate appropriate events.

The object class that holds these attributes is `orclODIPProvEventTypeConfig`. The container `cn=ProvisioningEventTypeConfig,cn=odi,cn=oracle internet directory` is used to store all the event type configurations.

Table 20–1 lists the event definitions predefined as a part of the installation.

Table 20–1 Predefined Event Definitions

Event Object Type	LDAP Change Type	Event Criteria
ENTRY	ADD MODIFY DELETE	objectclass=*
USER	ADD MODIFY DELETE	objectclass=interorgperson objectclass=orcluserv2
IDENTITY	ADD MODIFY DELETE	objectclass=interorgperson objectclass=orcluserv2
GROUP	ADD MODIFY DELETE	objectclass=orclgroup objectclass=groupofuniquenames
SUBSCRPTION	ADD MODIFY DELETE	objectclass=orclservicerecepient
SUBSCRIBER	ADD MODIFY DELETE	objectclass=orclsubscriber

The container `cn=ProvisioningEventTypeConfig,cn=odi,cn=oracle internet directory` is used to store all the event definition configurations. LDAP configuration of the predefined event definitions is as follows:

```
dn: orclODIPProvEventObjectType=ENTRY,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: ENTRY
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=*
objectclass: orclODIPProvEventTypeConfig

dn:
orclODIPProvEventObjectType=USER,cn=ProvisioningEventTypeConfig,cn=odi,cn=oracle
internet directory
orclODIPProvEventObjectType: USER
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=InetOrgPerson
orclODIPProvEventCriteria: objectclass=orcluserv2
objectclass: orclODIPProvEventTypeConfig

dn: orclODIPProvEventObjectType=IDENTITY,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: IDENTITY
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
```

```
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=inetorgperson
orclODIPProvEventCriteria: objectclass=orcluserv2
objectclass: orclODIPProvEventTypeConfig

dn: orclODIPProvEventObjectType=GROUP,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: GROUP
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=orclgroup
orclODIPProvEventCriteria: objectclass=groupofuniquenames
objectclass: orclODIPProvEventTypeConfig

dn:
orclODIPProvEventObjectType=SUBSCRIPTION,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: SUBSCRIPTION
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=orclservicerecepient
objectclass: orclODIPProvEventTypeConfig

dn: orclODIPProvEventObjectType=SUBSCRIBER,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: SUBSCRIBER
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=orclsubscriber
objectclass: orclODIPProvEventTypeConfig
```

To define a new event of Object type XYZ (which is qualified with the object class `objXYZ`), create the following entry in Oracle Internet Directory. The DIP server recognizes this new event definition and propagates events if necessary to applications that subscribe to this event.

```
dn: orclODIPProvEventObjectType=XYZ,cn=ProvisioningEventTypeConfig,cn=odi,
cn=oracle internet directory
orclODIPProvEventObjectType: XYZ
orclODIPProvEventLDAPChangeType: Add
orclODIPProvEventLDAPChangeType: Modify
orclODIPProvEventLDAPChangeType: Delete
orclODIPProvEventCriteria: objectclass=objXYZ
objectclass: orclODIPProvEventTypeConfig
```

This means that if an LDAP entry with the object class `objXYZ` is added, modified, or deleted, DIP will propagate the `XYZ_ADD`, `XYZ_MODIFY`, or `XYZ_DELETE` event to any application concerned.

Inbound and Outbound Events

An application can register as a supplier as well as a consumer of events. The provisioning subscription profile has the attributes described in Table 20–2 on page 20-4.

Table 20–2 Attributes of the Provisioning Subscription Profile

Attribute	Description
`EventSubscriptions`	Outbound events only (multivalued). Events for which DIP should send notification to this application. The format of this string is `[USER]GROUP]:[`*`domain_of_interest`*`]:[DELETE|ADD|MODIFY(`*`list_of_attributes_separated_by_comma`*`)]` Multiple values may be specified by listing the string multiple times, each time with different values. If parameters are not specified, the following defaults are assumed: `USER:`*`organization_DN`*`:DELETEGROUP:`*`organization_DN`*`:DELETE`—that is, send user and group delete notifications under the organization DN.
`MappingRules`	Inbound events Only (multivalued). This attribute is used to map the type of object received from an application and a qualifying filter condition to determine the domain of interest for this event. The mapping takes this form: *`OBJECT_TYPE`*`:` *`Filter_condition`*`:` *`domain_of_interest`* Multiple rules are allowed. In the mapping `EMP:cn=users,dc=acme,dc=com`, the object type received is `EMP`. The event is meant for the domain `cn=users,dc=acme,dc=com`. In the mapping `EMP:l=AMERICA:l=AMER,cn=users,dc=acme,dc=com`, the object type received is `EMP`. The event is meant for the domain `l=AMER,cn=users,dc=acme,dc=com`.
`permittedOperations`	Inbound events only (multi valued). This attribute is used to define the types of events an application is privileged to send to the provisioning integration service. The mapping takes this form: *`Event_Object`*`:` *`affected_domain`*`:`*`operation`*`(`*`attributes`*`, . . . )` In the mapping `IDENTITY:cn=users,dc=acme,dc=com:ADD(*)` the `IDENTITY_ADD` event is allowed for the specified domain and all attributes are also allowed. In the mapping `IDENTITY:cn=users,dc=acme,dc=com:MODIFY(cn,sn.mail,telephonenumber)`, the `IDENTITY_MODIFY` event is allowed only for the attributes in the list. Any extra attributes are silently ignored.

PL/SQL Bidirectional Interface (Version 3.0)

Before attempting to use Version 3.0 of the PL/SQL interface, please refer to:

- Appendix A, "Java Plug-ins for User Provisioning"
- The Oracle Provisioning Service Concepts chapter in *Oracle Identity Management Integration Guide*
- The Deploying Provisioning-Integrated Applications chapter in *Oracle Identity Management Integration Guide*

The PL/SQL callback interface requires you to develop a PL/SQL package that Oracle Directory Provisioning Integration Service invokes in the application specific database. Choose any name for the package, but be sure to use the same name when you register the package at subscription time. Implement the package by using the following PL/SQL package specification:

```
DROP TYPE LDAP_EVENT_LIST_V3;
DROP TYPE LDAP_EVENT_V3;
DROP TYPE LDAP_EVENT_STATUS_LIST_V3;
DROP TYPE LDAP_ATTR_LIST_V3;
DROP TYPE LDAP_ATTR_V3;
```

```
DROP TYPE LDAP_ATTR_VALUE_LIST_V3;
DROP TYPE LDAP_ATTR_VALUE_V3;
---------------------------------------------------------------------------------
----------------
-- Name: LDAP_ATTR_VALUE_V3
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains values of an attribute. A list of one or
more of this object is passed in any event.
---------------------------------------------------------------------------------
-----------------

CREATE TYPE LDAP_ATTR_VALUES_V3 AS OBJECT (
     attr_value       VARCHAR2(4000),
     attr_bvalue      RAW(2048),
     attr_value_len   INTEGER
);

GRANT EXECUTE ON LDAP_ATTR_VALUE_V3 to public;

CREATE TYPE LDAP_ATTR_VALUE_LIST_V3 AS TABLE OF LDAP_ATTR_VALUE_V3;
/
GRANT EXECUTE ON LDAP_ATTR_VALUE_LIST_V3 to public;
---------------------------------------------------------------------------------
----------------
-- Name: LDAP_ATTR_V3
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains details regarding an attribute. A list of
one or more of this object is passed in any event.
---------------------------------------------------------------------------------
-----------------
CREATE TYPE LDAP_ATTR_V3 AS OBJECT (
     attr_name        VARCHAR2(256),
     attr_type        INTEGER ,
     attr_mod_op      INTEGER,
     attr_values      LDAP_ATTR_VALUE_LIST_V3
);

GRANT EXECUTE ON LDAP_ATTR_V3 to public;

CREATE TYPE LDAP_ATTR_LIST_V3 AS TABLE OF LDAP_ATTR_V3;
/
GRANT EXECUTE ON LDAP_ATTR_LIST_V3 to public;
---------------------------------------------------------------------------------
-----------------
-- Name: LDAP_EVENT_V3
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains event information plus the attribute List.
---------------------------------------------------------------------------------
-----------------

CREATE TYPE LDAP_EVENT_V3 AS OBJECT (
          event_type  VARCHAR2(32),
          event_id    VARCHAR2(32),
          event_src   VARCHAR2(1024),
          event_time  VARCHAR2(32),
          object_name VARCHAR2(1024),
          object_type VARCHAR2(32),
          object_guid VARCHAR2(32),
          object_dn   VARCHAR2(1024),
          profile_id  VARCHAR2(1024),
```

```
          attr_list   LDAP_ATTR_LIST_V3 ) ;
/

GRANT EXECUTE ON LDAP_EVENT_V3 to public;
CREATE TYPE LDAP_EVENT_LIST_V3 AS TABLE OF LDAP_EVENT_V3;
/
GRANT EXECUTE ON LDAP_EVENT_LIST_V3 to public;
----------------------------------------------------------------------------------
-----------------
-- Name: LDAP_EVENT_STATUS_V3
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains information that is sent by the consumer
of an event to the supplier in response to the actual event.

----------------------------------------------------------------------------------
-----------------

CREATE TYPE LDAP_EVENT_STATUS_V3 AS OBJECT (
          event_id     VARCHAR2(32),
          status       VARCHAR2(32),
          status_msg   VARCHAR2(2048),
          object_guid  VARCHAR(32)
) ;
/

GRANT EXECUTE ON LDAP_EVENT_STATUS_V3 to public;
CREATE TYPE LDAP_EVENT_STATUS_LIST_V3 AS TABLE OF LDAP_EVENT_STATUS_V3;
/
GRANT EXECUTE ON LDAP_EVENT_STATUS_LIST_V3 to public;
----------------------------------------------------------------------------------
-----------------
-- Name: LDAP_NTFY
-- DESCRIPTION: This is the interface to be implemented by provisioning integrated
applications to send information to and receive information from the directory.
The name of the package can be customized as needed. The function and procedure
names within this package should not be changed.

----------------------------------------------------------------------------------
-----------------

CREATE OR REPLACE PACKAGE LDAP_NTFY AS

    -- The Predefined Event Types

    ENTRY_ADD     CONSTANT VARCHAR2 (32) :='ENTRY_ADD';
    ENTRY_DELETE  CONSTANT VARCHAR2 (32) :='ENTRY_DELETE';
    ENTRY_MODIFY  CONSTANT VARCHAR2 (32) :='ENTRY_MODIFY';

    USER_ADD     CONSTANT VARCHAR2 (32) :='USER_ADD';
    USER_DELETE  CONSTANT VARCHAR2 (32) :='USER_DELETE';
    USER_MODIFY  CONSTANT VARCHAR2 (32) :='USER_MODIFY';

    IDENTITY_ADD     CONSTANT VARCHAR2 (32) :='IDENTITY_ADD';
    IDENTITY_DELETE  CONSTANT VARCHAR2 (32) :='IDENTITY_DELETE';
    IDENTITY_MODIFY  CONSTANT VARCHAR2 (32) :='IDENTITY_MODIFY';

    GROUP_ADD     CONSTANT VARCHAR2 (32) :='GROUP_ADD';
    GROUP_DELETE  CONSTANT VARCHAR2 (32) :='GROUP_DELETE';
    GROUP_MODIFY  CONSTANT VARCHAR2 (32) :='GROUP_MODIFY';
```

```
SUBSCRIPTION_ADD     CONSTANT VARCHAR2(32) :='SUBSCRIPTION_ADD';
SUBSCRIPTION_DELETE  CONSTANT VARCHAR2(32) :='SUBSCRIPTION_DELETE';
SUBSCRIPTION_MODI    CONSTANT VARCHAR2(32) :='SUBSCRIPTION_MODIFY';

SUBSCRIBER_ADD     CONSTANT VARCHAR2(32) :='SUBSCRIBER_ADD';
SUBSCRIBER_DELETE  CONSTANT VARCHAR2(32) :='SUBSCRIBER_DELETE';
SUBSCRIBER_MODIFY  CONSTANT VARCHAR2(32) :='SUBSCRIBER_MODIFY';

-- The Attribute Type

ATTR_TYPE_STRING            CONSTANT NUMBER  := 0;
ATTR_TYPE_BINARY            CONSTANT NUMBER  := 1;
ATTR_TYPE_ENCRYPTED_STRING  CONSTANT NUMBER  := 2;

-- The Attribute Modification Type

MOD_ADD      CONSTANT NUMBER  := 0;
MOD_DELETE   CONSTANT NUMBER  := 1;
MOD_REPLACE  CONSTANT NUMBER  := 2;

-- The Event dispostions constants

EVENT_SUCCESS            CONSTANT VARCHAR2(32)  :='EVENT_SUCCESS';
EVENT_IN_PROGRESS        CONSTANT VARCHAR2(32)  :='EVENT_IN_PROGRESS’;
EVENT_USER_NOT_REQUIRED  CONSTANT VARCHAR2(32)  :='EVENT_USER_NOT_REQUIRED’;
EVENT_ERROR              CONSTANT VARCHAR2(32)  :='EVENT_ERROR';
EVENT_ERROR_ALERT        CONSTANT VARCHAR2(32)  :='EVENT_ERROR_ALERT';
EVENT_ERROR_ABORT        CONSTANT VARCHAR2(32)  :='EVENT_ERROR_ABORT';

-- The Actual Callbacks

FUNCTION GetAppEvents (events OUT LDAP_EVENT_LIST_V3)
RETURN NUMBER;

-- Return CONSTANTS
EVENT_FOUND      CONSTANT NUMBER:= 0;
EVENT_NOT_FOUND  CONSTANT NUMBER:= 1403;
```

If the provisioning server is unable to process an inbound event, it triggers an EVENT_ERROR_ALERT status, which generates a trigger in Oracle Enterprise Manager.

If the provisioning server is able to process the event, but finds that the event cannot be processed—for example, the user to be modified, subscribed, or deleted does not exist—it responds with EVENT_ERROR to indicate to the application that something is wrong. It is again up to the application to handle the status event.

EVENT_ERROR means no errors in directory operations. The event cannot be processed for other reasons.

```
-- PutAppEventStatus() : DIP Server invokes this callback in the remote Data
base after processing an event it had received using the GetAppEvents()
callback.  For every event received, the DIP server sends the status event
back after processing the event.  This API will NOT be required by the
Oracle Collaboration Suite release 3.0 components.

PROCEDURE PutAppEventStatus (event_status IN LDAP_EVENT_STATUS_LIST_V3);

-- PutOIDEvents() : DIP Server invokes this API in the remote Database. DIP
server sends event to applications using this callback. It also expects a status
event object in response as an OUT parameter. This API needs to be implemented
by all the Oracle Collaboration Suite release 3.0 components.
```

```
PROCEDURE PutOIDEvents (event         IN  LDAP_EVENT_LIST_V3,
                       event_status  OUT LDAP_EVENT_STATUS_LIST_V3);

END LDAP_NTFY;
/
```

PL/SQL Bidirectional Interface (Version 2.0)

The PL/SQL callback interface requires that you develop a PL/SQL package that the provisioning integration service invokes in the application-specific database. Choose any name for the package, but be sure to use the same name when you register the package at subscription time. Implement the package using the following PL/SQL package specification:

```
DROP TYPE LDAP_EVENT;
DROP TYPE LDAP_EVENT_STATUS;
DROP TYPE LDAP_ATTR_LIST;
DROP TYPE LDAP_ATTR;
--------------------------------------------------------------------------------
-- Name: LDAP_ATTR
-- Data Type: OBJECT

DESCRIPTION: This structure contains details regarding an attribute. A list of one
--           or more of this object is passed in any event.
---------------------------------------------------------------------------------
-----------------
CREATE TYPE LDAP_ATTR AS OBJECT (
     attr_name        VARCHAR2(256),
     attr_value       VARCHAR2(4000),
     attr_bvalue      RAW(2048),
     attr_value_len   INTEGER,
     attr_type        INTEGER ,
     attr_mod_op      INTEGER
);

GRANT EXECUTE ON LDAP_ATTR to public;

CREATE TYPE LDAP_ATTR_LIST AS TABLE OF LDAP_ATTR;
/
GRANT EXECUTE ON LDAP_ATTR_LIST to public;

---------------------------------------------------------------------------------
-----------------
-- Name: LDAP_EVENT
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains event information plus the attribute
--              list.
---------------------------------------------------------------------------------
-----------------

CREATE TYPE LDAP_EVENT AS OBJECT (
          event_type  VARCHAR2(32),
          event_id    VARCHAR2(32),
          event_src   VARCHAR2(1024),
          event_time  VARCHAR2(32),
          object_name VARCHAR2(1024),
          object_type VARCHAR2(32),
          object_guid VARCHAR2(32),
          object_dn   VARCHAR2(1024),
```

```
          profile_id  VARCHAR2(1024),
          attr_list   LDAP_ATTR_LIST ) ;
/

GRANT EXECUTE ON LDAP_EVENT to public;

---------------------------------------------------------------------------------
-----------------
-- Name: LDAP_EVENT_STATUS
-- Data Type: OBJECT
-- DESCRIPTION: This structure contains information that is sent by the
--              consumer of an event to the supplier in response to the
--              actual event.

---------------------------------------------------------------------------------
-----------------

CREATE TYPE LDAP_EVENT_STATUS AS OBJECT (
          event_id          VARCHAR2(32),
          orclguid          VARCHAR(32),
          error_code        INTEGER,
          error_String      VARCHAR2(1024),
          error_disposition VARCHAR2(32)) ;
/

GRANT EXECUTE ON LDAP_EVENT_STATUS to public;
```

Provisioning Event Interface (Version 1.1)

You must develop logic to consume events generated by the provisioning integration service. The interface between the application and the provisioning integration service can be table-based, or it can use PL/SQL callbacks.

The PL/SQL callback interface requires that you develop a PL/SQL package that the provisioning integration service invokes in the application-specific database. Choose any name for the package, but be sure to use the same name when you register the package at subscription time. Implement the package using the following PL/SQL package specification:

```
Rem
Rem      NAME
Rem         ldap_ntfy.pks - Provisioning Notification Package Specification.
Rem

DROP TYPE LDAP_ATTR_LIST;
DROP TYPE LDAP_ATTR;

-- LDAP ATTR
----------------------------------------------------------------
--
--  Name        : LDAP_ATTR
--  Data Type   : OBJECT
--  DESCRIPTION : This structure contains details regarding
--                an attribute.
--
----------------------------------------------------------------
CREATE TYPE LDAP_ATTR AS OBJECT (
     attr_name        VARCHAR2(255),
     attr_value       VARCHAR2(2048),
     attr_bvalue      RAW(2048),
```

```
     attr_value_len   INTEGER,
     attr_type        INTEGER  -- (0 - String, 1 - Binary)
     attr_mod_op      INTEGER
);
/
 GRANT EXECUTE ON LDAP_ATTR to public;

-------------------------------------------------------------
--
--  Name        : LDAP_ATTR_LIST
--  Data Type   : COLLECTION
--  DESCRIPTION : This structure contains collection
--                of attributes.
--
-------------------------------------------------------------
CREATE TYPE LDAP_ATTR_LIST AS TABLE OF LDAP_ATTR;
/
 GRANT EXECUTE ON LDAP_ATTR_LIST to public;

-------------------------------------------------------------------------------
--
--  NAME        : LDAP_NTFY
--  DESCRIPTION : This is a notifier interface implemented by Provisioning System
--                clients to receive information about changes in Oracle Internet
--                Directory. The name of package can be customized as needed.
--                The function names within this package should not be changed.
--
--
-------------------------------------------------------------------------------
CREATE OR REPLACE PACKAGE LDAP_NTFY AS

--
-- LDAP_NTFY data type definitions
--


-- Event Types
USER_DELETE               CONSTANT VARCHAR2(256) := 'USER_DELETE';
USER_MODIFY               CONSTANT VARCHAR2(256) := 'USER_MODIFY';
GROUP_DELETE              CONSTANT VARCHAR2(256) := 'GROUP_DELETE';
GROUP_MODIFY              CONSTANT VARCHAR2(256) := 'GROUP_MODIFY';

-- Return Codes (Boolean)
SUCCESS                   CONSTANT NUMBER  := 1;
FAILURE                   CONSTANT NUMBER  := 0;

-- Values for attr_mod_op in LDAP_ATTR object.
MOD_ADD                   CONSTANT NUMBER  := 0;
MOD_DELETE                CONSTANT NUMBER  := 1;
MOD_REPLACE               CONSTANT NUMBER  := 2;
----------------------------------------------------------------------------------
-----------------
-- Name: LDAP_NTFY
-- DESCRIPTION: This is the interface to be implemented by Provisioning System
--              clients to send information to and receive information from
--              Oracle Internet Directory. The name of the package can be
--              customized as needed. The function names within this package
--              should not be changed.

----------------------------------------------------------------------------------
```

```
----------------

CREATE OR REPLACE PACKAGE LDAP_NTFY AS
```

Predefined Event Types

```
ENTRY_ADD            CONSTANT VARCHAR2 (32)    := 'ENTRY_ADD';
ENTRY_DELETE         CONSTANT VARCHAR2 (32)    := 'ENTRY_DELETE';
ENTRY_MODIFY         CONSTANT VARCHAR2 (32)    := 'ENTRY_MODIFY';

USER_ADD             CONSTANT VARCHAR2 (32)    := 'USER_ADD';
USER_DELETE          CONSTANT VARCHAR2 (32)    := 'USER_DELETE';
USER_MODIFY CONSTANT VARCHAR2(32)              := 'USER_MODIFY';

IDENTITY_ADD         CONSTANT VARCHAR2 (32)    := 'IDENTITY_ADD';
IDENTITY_DELETE      CONSTANT VARCHAR2 (32)    := 'IDENTITY_DELETE';
IDENTITY_MODIFY      CONSTANT VARCHAR2 (32)    := 'IDENTITY_MODIFY';

GROUP_ADD            CONSTANT VARCHAR2 (32)    := 'GROUP_ADD';
GROUP_DELETE         CONSTANT VARCHAR2 (32)    := 'GROUP_DELETE';
GROUP_MODIFY         CONSTANT VARCHAR2 (32)    := 'GROUP_MODIFY';

SUBSCRIPTION_ADD     CONSTANT VARCHAR2(32)     := 'SUBSCRIPTION_ADD';
SUBSCRIPTION_DELETE  CONSTANT VARCHAR2(32)     := 'SUBSCRIPTION_DELETE';
SUBSCRIPTION_MODI    CONSTANT VARCHAR2(32)     := 'SUBSCRIPTION_MODIFY';

SUBSCRIBER_ADD       CONSTANT VARCHAR2(32)     := 'SUBSCRIBER_ADD';
SUBSCRIBER_DELETE    CONSTANT VARCHAR2(32)     := 'SUBSCRIBER_DELETE';
SUBSCRIBER_MODIFY    CONSTANT VARCHAR2(32)     := 'SUBSCRIBER_MODIFY';
```

Attribute Type

```
ATTR_TYPE_STRING              CONSTANT NUMBER    := 0;
ATTR_TYPE_BINARY              CONSTANT NUMBER    := 1;
ATTR_TYPE_ENCRYPTED_STRING    CONSTANT NUMBER    := 2;
```

Attribute Modification Type

```
MOD_ADD        CONSTANT NUMBER    := 0;
MOD_DELETE     CONSTANT NUMBER    := 1;
MOD_REPLACE    CONSTANT NUMBER    := 2;
```

Event Dispositions Constants

```
EVENT_SUCCESS    CONSTANT VARCHAR2(32)    := 'EVENT_SUCCESS';
EVENT_ERROR      CONSTANT VARCHAR2(32)    := 'EVENT_ERROR';
EVENT_RESEND     CONSTANT VARCHAR2(32)    := 'EVENT_RESEND';
```

Callbacks

A callback is a function invoked by the provisioning integration service to send or receive notification events. While transferring events for an object, the related attributes can also be sent along with other details. The attributes are delivered as a collection (array) of attribute containers, which are in unnormalized form: if an attribute has two values, two rows are sent in the collection.

GetAppEvent()

The Oracle Directory Integration Platform server invokes this API in the remote database. It is up to the application to respond with an event. The Oracle Directory Integration Platform processes the event and sends the status back using the `PutAppEventStatus()` callback. The return value of `GetAppEvent()` indicates whether an event is returned or not.

```
FUNCTION GetAppEvent (event OUT LDAP_EVENT)
RETURN NUMBER;

-- Return CONSTANTS
EVENT_FOUND          CONSTANT NUMBER  := 0;
EVENT_NOT_FOUND      CONSTANT NUMBER  := 1403;
```

If the provisioning server is not able to process the event—that is, it runs into some type of LDAP error—it responds with `EVENT_RESEND`. The application is expected to resend that event when `GetAppEvent()` is invoked again.

If the provisioning server is able to process the event, but finds that the event cannot be processed—for example, the user to be modified does not exist, or the user to be subscribed does not exist, or the user to be deleted does not exist—then it responds with `EVENT_ERROR` to indicate to the application that something was wrong. Resending the event is not required. It is up to the application to handle the event.

Note the difference between `EVENT_RESEND` and `EVENT_ERROR` in the previous discussion. `EVENT_RESEND` means that it was possible to apply the event but the server could not. If it gets the event again, it might succeed.

`EVENT_ERROR` means there is no error in performing directory operations, but the event could not be processed due to other reasons.

PutAppEventStatus()

The Oracle Directory Integration Platform server invokes this callback in the remote database after processing an event it has received using the `GetAppEvent()` callback. For every event received, the Oracle Directory Integration Platform server sends the status event back after processing the event.

```
PROCEDURE PutAppEventStatus (event_status IN LDAP_EVENT_STATUS);
```

PutOIDEvent()

The Oracle Directory Integration Platform server invokes this API in the remote database. It sends event to applications using this callback. It also expects a status event object in response as an `OUT` parameter. If a valid event status object is not sent back, or it indicates a `RESEND`, the Oracle Directory Integration Platform server resends the event. In case of `EVENT_ERROR`, the server does not resend the event.

```
PROCEDURE PutOIDEvent (event  IN  LDAP_EVENT,   event_status  OUT LDAP_EVENT_
STATUS);
END LDAP_NTFY;
/
```

Part IV

Appendixes

Part IV presents plug-ins that can be used to customize provisioning in Oracle Collaboration Suite. In addition, this section contains an appendix about DSML syntax and usage.

- Appendix A, "Java Plug-ins for User Provisioning"
- Appendix B, "DSML Syntax"

A

Java Plug-ins for User Provisioning

This appendix explains how to use plug-ins to customize provisioning policy evaluation, data validation, data manipulation, and event delivery in typical deployments of Oracle Directory Integration Platform Provisioning Service version 3.0.

The Oracle provisioning server cannot support all of the provisioning needs of a deployment. Hence, hooks are provided at various stages of user creation, modification, and deletion. These hooks enable an enterprise to incorporate its own business rules and to tailor information creation to its needs. The hooks take the form of Java plug-ins.

This appendix contains these topics:

Provisioning Plug-in Types and Their Purpose

There are three types of provisioning plug-ins:

- Data entry plug-ins
- Data manipulation and data access plug-ins
- Event Delivery plug-ins

The data entry plug-ins can be used by applications that integrate with the provisioning framework using either synchronous or asynchronous provisioning. The data access plug-ins are used only by applications that are integrated with the provisioning framework for synchronous provisioning. The event delivery plug-ins are used only by applications that integrate with the provisioning framework using asynchronous provisioning.

Oracle Provisioning Console, Oracle Directory Integration Platform server, and other mechanisms that affect the base user information in the directory invoke these plug-ins when the information is created. By configuring a data entry plug-in, a deployment can do any of the following:

- Validate attribute values for application users
- Validate attribute values for base users
- Enhance attribute values for application users
- Enhance attribute values for base users
- Evaluate provisioning policies

If you want the deployed application to maintain application user information you must configure a data access plug-in for it. This type of plug-in enables you to maintain the application information either outside of the directory or within it as several entries.

Data entry and data access plug-ins are typically invoked from one of these environments:

- User provisioning console for Oracle Delegated Administration Services
- Oracle Directory Integration Platform server
- Provisioning API
- Bulk Provisioning Tools

The event delivery plug-ins are required by applications that have the JAVA interface type and that subscribe for provisioning events. Applications that have synchronous provisioning should not implement event delivery plug-ins.

Provisioning Plug-in Requirements

All of the plug-ins that you provide for an application must be in a JAR file that can be uploaded to the directory with the standard LDIF template. See the section "Configuration Template for Provisioning Plug-ins" for an example. The plug-in interface definitions are found in `$ORACLE_HOME/jlib/ldapjclnt10.jar`. Refer to *Oracle Internet Directory API Reference* and the public interfaces for a more detailed description. If the application requires additional jar files, you can upload them too.

Data Entry Provisioning Plug-in

Data entry plug-ins take two forms:

- Pre–data-entry plug-ins
- Post–data-entry plug-ins

If you want to use either of these plug-ins, you must implement the `oracle.idm.provisioning.plugin.IdataEntryPlugin` interface. This interface has three methods. Here it is:

```
/**
   * The applications can perform a post data entry operation by
   * implementing this method.
   *
   * @param appCtx the application context
   * @param idmUser the IdmUser object
   * @param baseUserAttr Base user properties
   * @param appUserAttr App user properties
   * @throws PluginException when an exception occurs.
   */
  public PluginStatus process(ApplicationContext appCtx,
     IdmUser idmUser, ModPropertySet baseUserAttr,
```

```
        ModPropertySet appUserAttr)throws PluginException;
    /**
     * Returns the Modified Base User properties
     *
     * @return ModPropertySet modified base user properties.
     */
    public ModPropertySet getBaseAttrMods();

    /**
     * Returns the Modified App User properties
     *
     * @return ModPropertySet modified app user properties.
     */
    public ModPropertySet getAppAttrMods();
```

Typically the plug-in implementer uses these methods for data validation or policy evaluation. In the latter case, a base user attribute is used to make the decision.

The application context object contains this information:

- LDAP directory context

  If you want the application to perform a directory operation, you can have it obtain the LDAP context from the application object. Note that this LDAP context should not be closed in the plug-in.

- Plug-in call mode

  The plug-in is called from Oracle Provisioning Console, Oracle Directory Integration Platform server, or another environment that invokes the provisioning API. If the calling environment is Oracle Directory Integration Platform, the provisioning service calls the plug-in. The two possible values are `INTERACTIVE_MODE` and `AUTOMATIC_MODE`. The first indicates that the plug-in was invoked through interaction between Oracle Delegated Administration Services and a client application. The second indicates that the plug-in was invoked by Oracle Directory Integration Platform, where user intervention does not occur.

- Client locale

  The plug-in may want to know what the client locale is, especially if it is invoked from Oracle Delegated Administration Services.

- Plug-in call operation

  You may decide to have data entry plug-ins for both create and modify user operations. You may even implement these plug-ins in the same class. Under these conditions, the plug-in must determine which operation is invoked. The application context object uses the values `OP_CREATE` and `OP_MODIFY` to identify the operation.

- Plug-in invocation point

  The data entry plug-in is typically used to determine whether a user needs to be provisioned for an application. The policy evaluation and data validation that occurs can be performed in either a pre–data-entry plug-in or a post–data-entry plug-in. You may choose either or both. If you choose both, you can implement them in the same class. The application context object specifies which one is actually invoked. It uses the values `PRE_DATA_ENTRY` and `POST_DATA_ENTY` to do this.

- Callback context

If you decide to have both pre and post plug-ins for an operation and you want the pre plug-in to share information with the post plug-in, you can set the callback context in the application context object of the pre–data-entry plug-in. The post–data-entry plug-in can then obtain and use this callback context.

- Logging

  You can use the log methods provided in the application context object to log information for the plug-in.

  The calling sequence looks like this:

  1. Download and instantiate a plug-in object based on the configuration information object in Oracle Internet Directory
  2. Construct an application context object that will be passed to the plug-in.
  3. Call `process method()`
  4. Call `getBaseAttrMods()` to obtain base user attributes that are modified in `process()`.
  5. Merge the base user attributes returned by `getBaseAttrMods()` with the base user attributes, depending on the plug-in execution status. The execution status can be either `success` or `failure`. The plug-in implementer must return a valid plug-in execution status object. If null is returned, the execution status is considered a failure.
  6. Merging of the base user will only be done if the plug-in execution status is successful.
  7. Call `getAppAttrMods()` for the plug-in. This method obtains application user attributes that are modified in `process()`.
  8. Merge the application user attributes returned by `getAppAttrMods()` with the application user attributes, depending on the user provisioning status returned by the plug-in.

Pre–Data-Entry Provisioning Plug-in

The pre–data-entry plug-in generates values for application attributes. The attribute defaults specified during application registration are passed to this plug in along with the current base user attributes. The returned values are displayed in the UI if the invocation environment is interactive like Oracle Delegated Administration Services.

The pre–data-entry plug-in can decide whether the user should be provisioned for an application. The plug-in examines base user attributes to make the decision. It is invoked during create and modify operations. You can support both operations with one plug-in class, or you can assign one class to each.

If the application decides to have pre–data- entry plug-ins for create and modify operations, two configuration entries must be created in Oracle Internet Directory under the application container. The first entry is for the create operation:

```
dn: cn=PRE_DATA_ENTRY_CREATE, cn=Plugins, cn=FILES, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: oracle.myapp.provisioning.UserCreatePlugin
orclODIPPluginAddInfo: Pre Data Entry Plugin for CREATE operation
```

The second entry is for the modify operation:

```
dn: cn=PRE_DATA_ENTRY_MODIFY, cn=Plugins, cn=FILES, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: oracle.myapp.provisioning.UserModifyPlugin
orclODIPPluginAddInfo: Pre Data Entry Plugin for MODIFY operation
```

In this example, separate classes for create and modify plug-ins are shown.

Post–Data-Entry Provisioning Plug-in

The post–data-entry plug-in validates data entered by the user in the UI. In addition, it generates derived attribute values. If the plug in fails for any one application, the UI does not proceed. All applications must successfully validate the data before a user entry can be created in the directory. However, in the case of non-UI environment or automatic route, the plug-in implementer can decide to raise an error or continue, based on the plug-in call mode (`INTERACTIVE_MODE` or `AUTOMATIC_MODE`).

Like the pre–data-entry plug-in, the post–data-entry plug-in is invoked during create and modify operations. The application can decide to implement one plug-in class for both operations or a separate class for each.

If you decide to have post–data-entry plug-ins for create and modify operations, create two configuration entries in Oracle Internet Directory under the application container. The first entry is for the create operation:

```
dn: cn=POST_DATA_ENTRY_CREATE, cn=Plugins, cn=FILES, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: oracle.myapp.provisioning.UserMgmtPlugin
orclODIPPluginAddInfo: Post Data Entry Plugin for CREATE and MODIFY
 operations
```

The second entry is for the modify operation:

```
dn: cn=POST_DATA_ENTRY_MODIFY, cn=Plugins, cn=FILES, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: oracle.myapp.provisioning.UserMgmtPlugin
orclODIPPluginAddInfo: Post Data Entry Plugin for MODIFY and CREATE operation
```

In this example, too, separate classes for create and modify plug-ins are shown.

Data Access Provisioning Plug-in

The primary purpose of the data access plug in is to manage the application-specific information of the user in the directory. You can use this plug-in to create and retrieve the information.

The data access plug-in is invoked whenever a user is created and is requesting provisioning for an application—whether by Oracle Delegated Administration Services, by Oracle Directory Integration Platform, or by bulk provisioning tools.

The data access plug-in is invoked during modify and delete operations as well. It can update the application information or remove it.

If you want to use the data access plug-in, implement the interface `oracle.idm.provisioning.plugin.IDataAccessPlugin`. Here is the interface:

```
/**
 * The applications can create/modify/delete the user footprint by
 * implementing this method.
 *
 * @param appCtx the application context
 * @param idmUser IdmUser object
 * @param baseUserAttr Base user properties
 * @param appUserAttr App user properties
 *
 * @return PluginStatus a plugin status object, which must contain
 * the either <codE>IdmUser.PROVISION_SUCCESS</CODE> or
 * <codE>IdmUser.PROVISION_FAILURE</CODE> provisioning status
 *
 * @throws PluginException when an exception occurs.
 */
public PluginStatus process(ApplicationContext appCtx,
 IdmUser idmUser, ModPropertySet baseUserAttr,
 ModPropertySet ppUserAttr) throws PluginException;

/**
 * The applications can return their user footprint by
 * implementing this method. Use <CODE>
 * oracle.ldap.util.VarPropertySet </CODE>
 * as the return object
 *
 * <PRE>
 *  For Ex.
 *   PropertySet retPropertySet =  null;
 *   retPropertySet = new VarPropertySet();
 *
 *   //Fetch the App data and add it to retPropertySet
 *   retPropertySet.addProperty("name", "value");
 *   ..
 *   return retPropertySet;
 * </PRE>
 *
 * @throws PluginException when an exception occurs.
 */
public PropertySet getAppUserData(ApplicationContext appCtx,
      IdmUser user, String reqAttrs[]) throws PluginException;
```

If you want to manage the user information for an application, create a plug-in configuration entry in the directory under the application container. The example that follows shows what this entry looks like:

```
dn: cn=DATA_ACCESS, cn=Plugins, cn=FILES, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
```

```
orclODIPPluginExecName: oracle.myapp.provisioning.UserDataAccPlugin
orclODIPPluginAddInfo: Data Access Plugin
```

Event Delivery Provisioning Plug-in

The primary purpose of the event delivery plug-in is to use the events notified by the Oracle Directory Integration Platform server. Events are delivered to the plug-in by the Oracle Directory Integration Platform server. Based on the event type and the action to be performed in the application repository, the plug-in performs the required operations. The interface definitions for this plug-in are as follows:

```
/* $Header: IEventPlugin.java 09-jun-2005.12:45:53  *
/* Copyright (c) 2004, 2005, Oracle. All rights reserved.  */
/*
   DESCRIPTION
    All of the plug-in interfaces must extend this common interface.
   PRIVATE CLASSES
    None
   NOTES
    None
*/
package oracle.idm.provisioning.plugin;
/**
 * This is the base interface
 */
public interface IEventPlugin
{
   /**
    * The applications can perform the initialization logic in this method.
    *
    * @param Object For now it is the provisioning Profile that will be passed.
    *        look at oracle.ldap.odip.engine.ProvProfile for more details.
    *
    *
    * @throws PluginException when an exception occurs.
    */
   public void initialize(Object profile) throws PluginException;
   /**
    * The applications can perform the termination logic in this method.
    *
    * @param void Provisioning Profile Object will be sent.
    *             refer to oracle.ldap.odip.engine.ProvProfile for more details
    * @throws PluginException when an exception occurs.
    */
   public void terminate(Object profile) throws PluginException;
   /**
    * Set Additional Info.
    * Since we pass on the complete profile, there is no requirement to set
    * the additiona
    * @param addInfo Plugin additional info
    */
   //public void setAddInfo(Object addInfo);
}

/* $Header: IEventsFromOID.java 09-jun-2005.12:45:53  */
/* Copyright (c) 2004, 2005, Oracle. All rights reserved.  */
/*
   DESCRIPTION
   Applications interested in receiving changes from OID should
implement this
```

```
   interface.
   PRIVATE CLASSES
    <None>
   NOTES
*/
package oracle.idm.provisioning.plugin;
import oracle.idm.provisioning.event.Event;
import oracle.idm.provisioning.event.EventStatus;

/**
 * Applications interested in receiving changes from OID should implement this
 * interface.  The applications register with the OID for the changes occurring
 * at OID. The DIP engine would instantiate an object of this class and invoke
 * the initialize(), sendEventsToApp(), and truncate() method in the same
 * sequence. The initialize method would provide the appropriate information
 * from the profile in the form of a java.util.Hashtable object.
 * The property names, that is, the hash table key that could be used by the
 * interface implementer will be defined as constants in this interface.
 *
 * @version $Header: IEventsFromOID.java 09-jun-2005.12:45:53  $
 */
public interface IEventsFromOID extends IEventPlugin
{

   /**
    * Initialize. The application would provide any initialization logic
    * through method. The DIP engine after instantiating a class that
    * implements this interface will first invoke this method.
    *
    * @param prop A HashMap that would contain necessary information exposed
    * to the applications
    * @throws EventInitializationException the applications must throw this
    * exception in case of error.
    */
   public void initialize(Object provProfile)
                           throws EventPluginInitException;

   /**
    * OID Events are deliverd to the application through this method.
    *
    * @param evts an array of LDAPEvent objects returned by the DIP engine
    * @return the application logc must process these events and return the
    * status of the processed events
    * @throws EventDeliveryException the applications must throw this exception
    * in case of any error.
    */
   public EventStatus[] sendEventsToApp(Event [] evts)
                        throws EventDeliveryException;
}

/* $Header: IEventsToOID.java 09-jun-2005.12:45:53 $ */
/* Copyright (c) 2004, 2005, Oracle. All rights reserved.  */

/*
   DESCRIPTION
   Applications interested in sending changes to OID should implement this
   interface.
*/
package oracle.idm.provisioning.plugin;
import oracle.idm.provisioning.event.Event;
```

```
import oracle.idm.provisioning.event.EventStatus;

/**
 * Applications interested in sending changes to OID should implement this
 * interface.  The applications must register with the OID for the sending
 * changes at their  end to DIP. The DIP engine would instantiate an object
 * of this class and invoke the initialize(), sendEventsFromApp(), and
 * truncate() method in the same sequence. The initialize method would
 * provide the appropriate information from the profile in the form of
 * a java.util.Hashtable object. The property names, that is, the hash table key
 * that could be used by the interface implementer will be defined as
 * constants in this interface.
 *
 */
public interface IEventsToOID extends IEventPlugin
{
   /**
    * Initialize. The application would provide any initialization logic
    * through method. The DIP engine after instantiating a class that
    * implements this interface will first invoke this method.
    *
    * @param  prop ProvProfile
    *              oracle.ldap.odip.engine.ProvProfile
    * @throws EventPluginInitException the applications must throw this
    * exception in case of error.
    */
   public void initialize(Object profile) throws EventPluginInitException;

   /**
    * Application Events are deliverd to OID through this method.
    *
    * @return an array of Event objects returned to be processed by the
    * DIP engine.
    * @throws EventDeliveryException the applications must throw this exception
    * in case of any error.
    */
   public Event[] receiveEventsFromApp()
                     throws EventDeliveryException;

   /**
    * Application can let the DIP engine know whether there are more event to
    * follow through this method
    *
    * @return ture if there are more events to be returned and false otherwise
    * @throws PluginException the applications must throw this exception
    * in case of any error.
    */
   public boolean hasMore() throws PluginException;

   /**
    * The status of the application events are intimated through this method.
    * i.e the DIP engine after processing the events calls this method to set
    * the event status.
    *
    * @param an array of Event status objects describing the processed event
    * status by the DIP engine.
    * @throws EventDeliveryException the applications must throw this exception
    * in case of any error.
    */
   public void setAppEventStatus(EventStatus[] evtStatus)
```

```
                        throws EventDeliveryException;
}
```

To perform directory operations from a plug-in, you need the application context. You can use `ProvProfile.getApplicationContext()` in the event delivery plug-in `initialize()` method to get an instance of `oracle.idm.provisioning.plugin.ApplicationContext`.You can use this `applicationContext` to perform any directory operation in any plug-in method.

Provisioning Plug-in Return Status

Each of the provisioning plug-ins must return an object of the class `oracle.idm.provisioning.plugin.PluginStatus` This object indicates the execution status, which is either `success` or `failure`. The object can return the user provisioning status as well.

Configuration Template for Provisioning Plug-ins

The LDIF template provided here is used in Oracle Internet Directory 10*g* (10.1.4.0.1) to specify the application plug-in. You must create a directory entry for the application and upload the JAR file that contains the classes that implement the plug-in.

```
dn: cn=Plugins, cn=APPTYPE, cn=Applications, cn=Provisioning,
 cn=Directory Integration Platform,cn=Products,cn=OracleContext
changetype: add
add: orclODIPPluginExecData
orclODIPPluginExecData: full_path_name_of_the_JAR_file
objectclass: orclODIPPluginContainer

dn: cn=PRE_DATA_ENTRY_CREATE, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning, cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Pre Data Entry Plugin for CREATE operation

dn: cn=PRE_DATA_ENTRY_MODIFY, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Pre Data Entry Plugin for MODIFY operation

dn: cn=POST_DATA_ENTRY_CREATE, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Post Data Entry Plugin for CREATE and modify operations
```

```
dn: cn=POST_DATA_ENTRY_MODIFY, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Post Data Entry Plugin for MODIFY and CREATE operation

dn: cn=DATA_ACCESS, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning,  cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Data Access Plugin

dn: cn=EVENT_DELIVERY_OUT, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning, cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Event Delivery Plugin for Outbound

dn: cn=EVENT_DELIVERY_IN, cn=Plugins, cn=APPTYPE, cn=Applications,
 cn=Provisioning, cn=Directory Integration Platform, cn=Products,
 cn=OracleContext
changetype: add
objectClass: orclODIPPlugin
orclStatus: ENABLE
orclODIPPluginExecName: Name_of_the_class_that_implements_the_plug-in
orclODIPPluginAddInfo: Event Delivery Plugin for Inbound
```

Sample Code for a Provisioning Plug-in

```
/* Copyright (c) 2004, Oracle. All rights reserved. */
/**
 DESCRIPTION
 Sample PRE DATA Entry Plugin for CREATE operation that
 validates the attribute.
 PRIVATE CLASSES
 None.
 NOTES
 This class implements the PRE_DATA_ENTRY_CREATE plugin ONLY
 MODIFIED (MM/DD/YY)
 12/15/04 \226 Creation
*/
package oracle.ldap.idm;

import java.util.*;
import javax.naming.*;
import javax.naming.ldap.*;
import javax.naming.directory.*;
import oracle.ldap.util.*;
import oracle.idm.provisioning.plugin.*;
/**
 * This class implements the PRE_DATA_ENTRY_CREATE plugin ONLY
```

```
 *
 */
public class SamplePreDataEntryCreatePlugin implements IDataEntryPlugin
{
   public ModPropertySet mpBaseUser = null;
   public ModPropertySet mpAppUser = null;

   public PluginStatus process(ApplicationContext appCtx,IdmUser idmuser,
    ModPropertySet baseUserAttr, ModPropertySet appUserAttr)
          throws PluginException
   {
     PluginStatus retPluginStatus = null;
     String retProvStatus = null;
     String retProvStatusMsg = null;

     LDIFRecord lRec = null;
     LDIFAttribute lAttr = null;
     String val = null;
     if(null == baseUserAttr.getModPropertyValue(\223departmentNumber\224))
     {
        mpBaseUser = new ModPropertySet();
        mpBaseUser.addProperty("departmentNumber","ST");
        appCtx.log(\223Base user attribute \226 departmentNumber missing\224 +
               \223Setting default - ST\224);
     }
     else if ( baseUserAttr.getModPropertyValue(\223departmentNumber\224)
                .notIn(\223ST\224, \223APPS\224, \224CRM\224) )
     {
        throw new PluginException(\223Invalid department Number\224);
     }
     if((null == appUserAttr) ||
               null == appUserAttr.getModPropertyValue(\223emailQouta\224))
     {
        mpAppUser = new ModPropertySet();
        mpAppUser.addProperty("emailQouta","50M");
        appCtx.log(\223Application user attribute - email Qouta missing \224 +
            \223Setting default - 50M\224);
     }
     return new PluginStatus(PluginStatus.SUCCESS, null, null);
  }

  public ModPropertySet getBaseAttrMods()
  {
    return mpBaseUser;
  }

  public ModPropertySet getAppAttrMods()
  {
    return mpAppUser;
  }
}

/* Copyright (c) 2004, Oracle. All rights reserved. */
/**
 DESCRIPTION
 Sample POST DATA Entry Plugin for CREATE operation. Implementing a
 policy check to provision only those users who belong to \223SALES\224.
 PRIVATE CLASSES
 None.
 NOTES
```

```
 This class implements the POST_DATA_ENTRY_CREATE plugin ONLY
 MODIFIED (MM/DD/YY)
 12/15/04 \226 Creation
*/
package oracle.ldap.idm;

import java.util.*;
import javax.naming.*;
import javax.naming.ldap.*;
import javax.naming.directory.*;
import oracle.ldap.util.*;
import oracle.idm.provisioning.plugin.*;
/**
 * This class implements the POST_DATA_ENTRY_CREATE plugin ONLY
 *
 */
public class SamplePostDataEntryCreatePlugin
{
   public ModPropertySet mpBaseUser = null;
   public ModPropertySet mpAppUser = null;

   public PluginStatus process(ApplicationContext appCtx,IdmUser idmuser,
    ModPropertySet baseUserAttr, ModPropertySet appUserAttr)
          throws PluginException
   {
     PluginStatus retPluginStatus = null;
     String retProvStatus = null;
     String retProvStatusMsg = null;

     if(null == baseUserAttr.getModPropertyValue(\223deptartmentNumber\224))
     {
        mpBaseUser = new ModPropertySet();
        mpBaseUser.addProperty("deptartmentNumber ","SALES");
        appCtx.log("Base user attribute \221c\222 is missing");

        retProvStatus = IdmUser.PROVISION_ REQUIRED;
        retProvStatusMsg =  "Provision policy: Only \221SALES\222\224.
     }
     else if (baseUserAttr.getModPropertyValue(\223deptartmentNumber\224)
             .equals(\223SALES\224))
     {
        retProvStatus = IdmUser.PROVISION_ REQUIRED;
        retProvStatusMsg =  "Provision policy: Only \221SALES\222\224.
     }
     else
     {
        // do not provision those users who do not belong to SALES.
        retProvStatus = IdmUser.PROVISION_NOT_REQUIRED;
        retProvStatusMsg =
                "Do not provision the person who is not from \221SALES\222";
      }

      return new PluginStatus(PluginStatus. SUCCESS, retProvStatusMsg,
                             retProvStatus);
  }

  public ModPropertySet getBaseAttrMods()
  {
    return mpBaseUser;
  }
```

```
  public ModPropertySet getAppAttrMods()
  {
    return mpAppUser;
  }
}

/* Copyright (c) 2004, Oracle. All rights reserved. */
/**
 DESCRIPTION
 Sample DATA Access Plugin.
 NOTES
 This class implements the DATA_ACCESS plugin
 MODIFIED (MM/DD/YY)
 12/15/04 \226 Creation
*/
package oracle.ldap.idm;

import javax.naming.*;
import javax.naming.ldap.*;
import javax.naming.directory.*;
import oracle.ldap.util.*;
import oracle.idm.provisioning.plugin.*;
/**
 * This class implements the DATA_ACCESS plugin ONLY
 *
 */
public class SampleDataAccessPlugin
{
   public PluginStatus process(ApplicationContext appCtx,IdmUser idmuser,
        ModPropertySet baseUserAttr,ModPropertySet appUserAttr)
            throws PluginException
   {
      try {
          DirContext dirCtx = appCtx.getDirCtx();
          if ( appCtx.getCallOp().equals(ApplicationContext.OP_CREATE )
          {
            // Use the directory context and create the entry.
          }
          elseif ( appCtx.getCallOp().equals(ApplicationContext.OP_MODIFY)
          {
            // Use the directory context and modify the entry.
          }
      } catch (Exception e) {
         throw new PluginException(e);
      }
      return new PluginStatus(PluginStatus.SUCCESS, null, null);
   }

   public PropertySet getAppUserData(ApplicationContext appCtx,
          IdmUser idmuser, String [] reqAttrs) throws PluginException
   {
      VarPropertySet vpSet = null;
      DirContext dirCtx = appCtx.getDirCtx();

      try {
        Attributes attrs= dirCtx.getAttributes(\223myAppContainer\224);
        vpSet = new VarPropertySet(); // Populate the VarPropertySet from attrs
      } catch(Exception ne) {
        throw new PluginException(e);
```

```
        }
        return vpSet;   }
}
```

B

DSML Syntax

This appendix contains the following sections:

- Capabilities of DSML
- Benefits of DSML
- DSML Syntax
- Tools Enabled for DSML

Capabilities of DSML

Directory services form a core part of distributed computing. XML is becoming the standard markup language for Internet applications. As directory services are brought to the Internet, there is a pressing and urgent need to express the directory information as XML data. This caters to the growing breed of applications that are not LDAP-aware yet require information exchange with a LDAP directory server.

Directory Services Mark-up Language (DSML) defines the XML representation of LDAP information and operations. The LDAP Data Interchange Format (LDIF) is used to convey directory information, or a set of changes to be applied to directory entries. The former is called Attribute Value Record and the latter is called Change Record.

Benefits of DSML

Using DSML with Oracle Internet Directory and Internet applications makes it easier to flexibly integrate data from disparate sources. Also, DSML enables applications that do not use LDAP to communicate with LDAP-based applications, easily operating on data generated by an Oracle Internet Directory client tool or accessing the directory through a firewall.

DSML is based on XML, which is optimized for delivery over the Web. Structured data in XML will be uniform and independent of application or vendors, thus making possible numerous new flat file type synchronization connectors. Once in XML format, the directory data can be made available in the middle tier and have more meaningful searches performed on it.

DSML Syntax

A DSML version 1 document describes either directory entries, a directory schema or both. Each directory entry has a unique name called a distinguished name (DN). A directory entry has a number of property-value pairs called directory attributes. Every directory entry is a member of a number of object classes. An entry's object classes constrain the directory attributes the entry can take. Such constraints are described in a directory schema, which may be included in the same DSML document or may be in a separate document.

The following subsections briefly explain the top-level structure of DSML and how to represent the directory and schema entries.

Top-Level Structure

The top-level document element of DSML is of the type `dsml`, which may have child elements of the following types:

```
directory-entries
directory-schema
```

The child element directory-entries may in turn have child elements of the type entry. Similarly the child element directory-schema may in turn have child elements of the types class and attribute-type.

At the top level, the structure of a DSML document looks like this:

```
<!- a document with directory & schema entries -->
  <dsml:directory-entries>
    <dsml:entry dn="...">...</dsml:entry>
    .
    .
    .
  </dsml:directory-entries>
  .
  .
  .
  <dsml:directory-schema>
    <dsml:class id="..." ...>...</dsml:class>
    <dsml:attribute-type id="..." ...>...</dsml:attribute-type>
    .
    .
    .
  </dsml:directory-schema>
</dsml:dsml>
```

Directory Entries

The element type `entry` represents a directory entry in a DSML document. The `entry` element contains elements representing the entry's directory attributes. The distinguished name of the entry is indicated by the XML attribute `dn`.

Here is an XML entry to describe the directory entry:

```
<dsml:entry dn="uid=Heman, c=in, dc=oracle, dc=com">
<dsml:objectclass>
  <dsml:oc-value>top</dsml:oc-value>
  <dsml:oc-value ref="#person">person</dsml:oc-value>
  <dsml:oc-value>organizationalPerson</dsml:oc-value>
  <dsml:oc-value>inetOrgPerson</dsml:oc-value>
</dsml:objectclass>
<dsml:attr name="sn">
<dsml:value>Siva</dsml:value></dsml:attr>
<dsml:attr name="uid">
<dsml:value>Heman</dsml:value></dsml:attr>
<dsml:attr name="mail">
```

```
<dsml:attr name="givenname">
<dsml:value>Siva V. Kumar</dsml:value></dsml:attr>
<dsml:attr name="cn">
<dsml:value>SVK@oracle.com</dsml:value></dsml:attr>
<dsml:value>Siva Kumar</dsml:value></dsml:attr>
```

The `oc-value's ref` is a URI Reference to a class element that defines the object class. In this case it is a URI [9] Reference to the element that defines the `person` object class. The child elements `objectclass` and `attr` are used to specify the object classes and the attributes of a directory entry.

Schema Entries

The element type `class` represents a schema entry in a DSML document. The `class` element takes an XML attribute `id` to make referencing easier.

For example, the object class definition for the `person` object class might look like the following:

```
<dsml:class id="person" superior="#top"  type="structural">
  <dsml:name>person</dsml:name>
  <dsml:description>...</dsml:description>
  <dsml:object-identifier>2.5.6.6</object-identifier>
  <dsml:attribute ref="#sn" required="true"/>
  <dsml:attribute ref="#cn" required="true"/>
  <dsml:attribute ref="#userPassword" required="false"/>
  <dsml:attribute ref="#telephoneNumber" required="false"/>
  <dsml:attribute ref="#seeAlso" required="false"/>
  <dsml:attribute ref="#description" required="false"/>
</dsml:class>
```

The directory attributes are described in a similar way. For example, the attribute definition for the `cn` attribute may look like this:

```
<dsml:attribute-type id="cn">
  <dsml:name>cn</dsml:name>
  <dsml:description>...</dsml:description>
  <dsml:object-identifier>2.5.4.3</object-identifier>
  <dsml:syntax>1.3.6.1.4.1.1466.115.121.1.44</dsml:syntax>
</dsml:attribute-type>
```

Tools Enabled for DSML

With the XML framework, you can now use non-ldap applications to access directory data. The XML framework broadly defines the access points and provides the following tools:

- `ldapadd`
- `ldapaddmt`
- `ldapsearch`

> **See Also:** "Oracle Internet Directory Server Administration Tools" in *Oracle Identity Management User Reference* for information about syntax and usage.

The client tool `ldifwrite` generates directory data and schema LDIF files. If you convert these LDIF files to XML, you can store the XML file on an application server and query it. The query and response time is small compared to performing an LDAP operation against an LDAP server.

C

Migrating from Netscape LDAP SDK API to Oracle LDAP SDK API

The Oracle Internet Directory SDK C API is described in Chapter 14, "C API Reference". This Appendix outlines differences between the Netscape LDAP SDK and the Oracle Internet Directory LDAP SDK that are important when migrating code.

Features

The following features of the Oracle Internet Directory LDAP SDK are different from Netscape's SDK.

- In the Netscape SDK, a client must register an LDAP Rebind Call Back to handle a referral. This is automatically handled in the Oracle LDAP SDK.
- Access to the LDAP Structure is different. The LDAP handle in Netscape LDAP SDK is type opaque. Accessory functions are required to access individual fields within this handle. In the Oracle Internet Directory LDAP SDK, the LDAP structure is exposed and a client can modify individual fields within the structure.
- Use ldap_open() instead of ldap_init() with the Oracle LDAP SDK.
- SSL connection initialization requires different function calls and procedures in the Oracle LDAP SDK. See Chapter 14, "C API Reference"for information about Oracle Internet Directory function calls for SSL.
- The Oracle Internet Directory C API depends on the Oracle environment, including libraries and other files.You must install Oracle Application Server or Oracle Database and set the environment variable $ORACLE_HOME to an appropriate location before you build your application.
- An LDAP SDK user must use an allocation function that clears memory, such as calloc(), to allocate an LDAPMod structure().
- The Oracle Internet Directory API is not thread-safe.

Functions

The following functions are available in Netscape LDAP SDK and not in Oracle LDAP SDK:

- The Oracle LDAP SDK does not have the function ldap_ber_free(). Use ber_free() instead.
- The Oracle LDAP SDK does not have the function ldap_get_lderrno() for retrieving the ld error and matched string. You can retrieve this information

directly by accessing the field LDAP.ld_matched and LDAP.ld_error. These are the only fields of the LDAP structure that you should ever need to access.

Macros

- LDAPS_PORT is not defined in the Oracle LDAP SDK. Use LDAP_SSL_PORT instead.
- LDAP_AFFECT_MULTIPLE_DSA is not defined in the Oracle LDAP SDK. This is a Nestcape-specific macro.

Glossary

3DES

See **Triple Data Encryption Standard (3DES)**.

access control item (ACI)

Access control information represents the permissions that various entities or subjects have to perform operations on a given object in the directory. This information is stored in Oracle Internet Directory as user-modifiable operational **attribute**s, each of which is called an access control item (ACI). An ACI determines user access rights to directory data. It contains a set of rules for controlling access to entries (structural access items) and attributes (content access items). Access to both structural and content access items may be granted to one or more users or groups.

access control list (ACL)

A list of resources and the usernames of people who are permitted access to those resources within a computer system. In Oracle Internet Directory, an ACL is a list of **access control item (ACI) attribute value**s that is associated with directory objects. The attribute values on that list represent the permissions that various directory user entities (or subjects) have on a given object.

access control policy point (ACP)

A directory entry that contains access control policy information that applies downward to all entries at lower positions in the **directory information tree (DIT)**. This information affects the entry itself and all entries below it. In Oracle Internet Directory, you can create ACPs to apply an access control policy throughout a **subtree** of your directory.

account lockout

A security feature that locks a user account if repeated failed logon attempts occur within a specified amount of time, based on security policy settings. Account lockout occurs in OracleAS Single Sign-On when a user submits an account and password combination from any number of workstations more times than is permitted by Oracle Internet Directory. The default lockout period is 24 hours.

ACI

See **access control item (ACI)**.

ACL

See **access control list (ACL)**.

ACP

See **access control policy point (ACP)**.

administrative area

A **subtree** on a directory server whose entries are under the control of a single administrative authority. The designated administrator controls each **entry** in that administrative area, as well as the directory **schema**, **access control list (ACL)**, and **attribute**s for those entries.

Advanced Encryption Standard (AES)

Advanced Encryption Standard (AES) is a **symmetric cryptography** algorithm that is intended to replace **Data Encryption Standard (DES)**. AES is a Federal Information Processing Standard (FIPS) for the encryption of commercial and government data.

advanced replication

See **Oracle Database Advanced Replication**.

advanced symmetric replication (ASR)

See **Oracle Database Advanced Replication**.

AES

See **Advanced Encryption Standard (AES)**.

anonymous authentication

The process by which a directory authenticates a user without requiring a user name and password combination. Each anonymous user then exercises the privileges specified for anonymous users.

API

See **application programming interface (API)**.

application programming interface (API)

A series of software routines and development tools that comprise an interface between a computer application and lower-level services and functions (such as the operating system, device drivers, and other software applications). APIs serve as building blocks for programmers putting together software applications. For example, LDAP-enabled clients access Oracle Internet Directory information through programmatic calls available in the LDAP API.

application service provider

Application Service Providers (ASPs) are third-party entities that manage and distribute software-based services and solutions to customers across a wide area network from a central data center. In essence, ASPs are a way for companies to outsource some or almost all aspects of their information technology needs.

ASN.1

Abstract Syntax Notation One (ASN.1) is an International Telecommunication Union (ITU) notation used to define the syntax of information data. ASN.1 is used to describe structured information, typically information that is to be conveyed across some communications medium. It is widely used in the specification of Internet protocols.

ASR

See **Oracle Database Advanced Replication**.

asymmetric algorithm

A **cryptographic algorithm** that uses different **key**s for **encryption** and **decryption**.

See also: **public key cryptography**.

asymmetric cryptography

See **public key cryptography**.

attribute

Directory attributes hold a specific data element such as a name, phone number, or job title. Each directory **entry** is comprised of a set of attributes, each of which belongs to an **object class**. Moreover, each attribute has both a *type*, which describes the kind of information in the attribute, and a *value*, which contains the actual data.

attribute configuration file

In an Oracle Directory Integration Platform environment, a file that specifies attributes of interest in a connected directory.

attribute type

Attribute types specify information about a data element, such as the data type, maximum length, and whether it is single-valued or multivalued. The attribute type provides the real-world meaning for a value, and specifies the rules for creating and storing specific pieces of data, such as a name or an e-mail address.

attribute uniqueness

An Oracle Internet Directory feature that ensures that no two specified **attribute**s have the same value. It enables applications synchronizing with the enterprise directory to use attributes as unique keys.

attribute value

Attribute values are the actual data contained within an **attribute** for a particular **entry**. For example, for the attribute type `email`, an attribute value might be `sally.jones@oracle.com`.

authentication

The process of verifying the identity claimed by an entity based on its credentials. Authentication of a user is generally based on something the user knows or has (for example, a password or a certificate).

Authentication of an electronic message involves the use of some kind of system (such as **public key cryptography**) to ensure that a file or message which claims to originate from a given individual or company actually does, and a check based on the contents of a message to ensure that it was not modified in transit.

authentication level

An OracleAS Single Sign-On parameter that enables you to specify a particular authentication behavior for an application. You can link this parameter with a specific **authentication plugin**.

authentication plugin

An implementation of a specific authentication method. OracleAS Single Sign-On has Java plugins for password authentication, digital certificates, Windows native authentication, and third-party access management.

authorization

The process of granting or denying access to a service or network resource. Most security systems are based on a two step process. The first stage is authentication, in which a user proves his or her identity. The second stage is authorization, in which a user is allowed to access various resources based on his or her identity and the defined **authorization policy**.

authorization policy

Authorization policy describes how access to a protected resource is governed. Policy maps identities and objects to collections of rights according to some system model. For example, a particular authorization policy might state that users can access a sales report only if they belong to the sales group.

basic authentication

An **authentication** protocol supported by most browsers in which a Web server authenticates an entity with an encoded user name and password passed via data transmissions. Basic authentication is sometimes called plaintext authentication because the base-64 encoding can be decoded by anyone with a freely available decoding utility. Note that encoding is not the same as **encryption**.

Basic Encoding Rules (BER)

Basic Encoding Rules (BER) are the standard rules for encoding data units set forth in **ASN.1**. BER is sometimes incorrectly paired with ASN.1, which applies only to the abstract syntax description language, not the encoding technique.

BER

See **Basic Encoding Rules (BER)**.

binding

In networking, binding is the establishment of a logical connection between communicating entities.

In the case of Oracle Internet Directory, binding refers to the process of authenticating to the directory.

The formal set of rules for carrying a **SOAP** message within or on top of another protocol (underlying protocol) for the purpose of exchange is also called a binding.

block cipher

Block ciphers are a type of **symmetric algorithm**. A block cipher encrypts a message by breaking it down into fixed-size blocks (often 64 bits) and encrypting each block with a key. Some well known block ciphers include **Blowfish**, **DES**, and **AES**.

See also: **stream cipher**.

Blowfish

Blowfish is a **symmetric cryptography** algorithm developed by Bruce Schneier in 1993 as a faster replacement for **DES**. It is a **block cipher** using 64-bit blocks and keys of up to 448 bits.

CA

See **Certificate Authority (CA)**.

CA certificate

A **Certificate Authority (CA)** signs all certificates that it issues with its **private key**. The corresponding Certificate Authority's **public key** is itself contained within a certificate, called a CA Certificate (also referred to as a root certificate). A browser must contain the CA Certificate in its list of trusted root certificates in order to trust messages signed by the CA's private key.

cache

Generally refers to an amount of quickly accessible memory in your computer. However, on the Web it more commonly refers to where the browser stores downloaded files and graphics on the user's computer.

CBC

See **cipher block chaining (CBC)**.

central directory

In an Oracle Directory Integration Platform environment, the directory that acts as the central repository. In an Oracle Directory Integration Platform environment, Oracle Internet Directory is the central directory.

certificate

A certificate is a specially formatted data structure that associates a **public key** with the identity of its owner. A certificate is issued by a **Certificate Authority (CA)**. It contains the name, serial number, expiration dates, and public key of a particular entity. The certificate is digitally signed by the issuing CA so that a recipient can verify that the certificate is real. Most digital certificates conform to the **X.509** standard.

Certificate Authority (CA)

A Certificate Authority (CA) is a trusted third party that issues, renews, and revokes digital **certificate**s. The CA essentially vouches for a entity's identity, and may delegate the verification of an applicant to a **Registration Authority (RA)**. Some well known Certificate Authorities (CAs) include Digital Signature Trust, Thawte, and VeriSign.

certificate chain

An ordered list of certificates containing one or more pairs of a user **certificate** and its associated **CA certificate**.

certificate management protocol (CMP)

Certificate Management Protocol (CMP) handles all relevant aspects of certificate creation and management. CMP supports interactions between **public key infrastructure (PKI)**) components, such as the **Certificate Authority (CA)**, **Registration Authority (RA)**, and the user or application that is issued a certificate.

certificate request message format (CRMF)

Certificate Request Message Format (CRMF) is a format used for messages related to the life-cycle management of **X.509** certificates, as described in the **RFC** 2511 specification.

certificate revocation list (CRL)

A Certificate Revocation List (CRL) is a list of digital **certificate**s which have been revoked by the **Certificate Authority (CA)** that issued them.

change logs

A database that records changes made to a directory server.

cipher

See **cryptographic algorithm**.

cipher block chaining (CBC)

Cipher block chaining (CBC) is a mode of operation for a **block cipher**. CBC uses what is known as an initialization vector (IV) of a certain length. One of its key characteristics is that it uses a chaining mechanism that causes the decryption of a block of ciphertext to depend on all the preceding ciphertext blocks. As a result, the entire validity of all preceding blocks is contained in the immediately previous ciphertext block.

cipher suite

In **Secure Sockets Layer (SSL)**, a set of authentication, encryption, and data integrity algorithms used for exchanging messages between network nodes. During an SSL handshake, the two nodes negotiate to see which cipher suite they will use when transmitting messages back and forth.

ciphertext

Ciphertext is the result of applying a **cryptographic algorithm** to readable data (plaintext) in order to render the data unreadable by all entities except those in possession of the appropriate **key**.

circle of trust

A circle of trust is a **federation** of **service provider**s and **identity provider**s that have business relationships based on **Liberty Alliance** architecture and operational agreements, and with whom users can transact business in a secure and apparently seamless environment.

claim

A claim is a declaration made by an entity (for example, a name, identity, key, group, and so on).

client SSL certificates

A type of **certificate** used to identify a client machine to a server through **Secure Sockets Layer (SSL)** (client authentication).

cluster

A collection of interconnected usable whole computers that is used as a single computing resource. Hardware clusters provide high availability and scalability.

CMP

See **certificate management protocol (CMP)**.

CMS

See **Cryptographic Message Syntax (CMS)**.

code signing certificates

A type of **certificate** used to identify the entity who signed a Java program, Java Script, or other signed file.

cold backup

In Oracle Internet Directory, this refers to the procedure of adding a new **directory system agent (DSA)** node to an existing replicating system by using the database copy procedure.

concurrency

The ability to handle multiple requests simultaneously. Threads and processes are examples of concurrency mechanisms.

concurrent clients

The total number of clients that have established a session with Oracle Internet Directory.

concurrent operations

The number of operations that are being executed on Oracle Internet Directory from all of the **concurrent clients**. Note that this is not necessarily the same as the concurrent clients, because some of the clients may be keeping their sessions idle.

confidentiality

In cryptography, confidentiality (also known as privacy) is the ability to prevent unauthorized entities from reading data. This is typically achieved through **encryption**.

configset

See **configuration set entry**.

configuration set entry

An Oracle Internet Directory entry holding the configuration parameters for a specific instance of the directory server. Multiple configuration set entries can be stored and referenced at runtime. The configuration set entries are maintained in the subtree specified by the `subConfigsubEntry` attribute of the **directory-specific entry (DSE)**, which itself resides in the associated **directory information base (DIB)** against which the servers are started.

connect descriptor

A specially formatted description of the destination for a network connection. A connect descriptor contains destination service and network route information.

The destination service is indicated by using its service name for the Oracle Database or its Oracle System Identifier (SID) for Oracle release 8.0 or version 7 databases. The network route provides, at a minimum, the location of the listener through use of a network address.

connected directory

In an Oracle Directory Integration Platform environment, an information repository requiring full synchronization of data between Oracle Internet Directory and itself—for example, an Oracle human resources database.

consumer

A directory server that is the destination of replication updates. Sometimes called a slave.

contention

Competition for resources.

context prefix

The **distinguished name (DN)** of the root of a **naming context**.

CRL

See **certificate revocation list (CRL)**.

CRMF

See **certificate request message format (CRMF)**.

cryptographic algorithm

A cryptographic algorithm is a defined sequence of processes to convert readable data (plaintext) to unreadable data (ciphertext) and vice versa. These conversions require some secret knowledge, normally contained in a **key**. Examples of cryptographic algorithms include **DES**, **AES**, **Blowfish**, and **RSA**.

Cryptographic Message Syntax (CMS)

Cryptographic Message Syntax (CMS) is a syntax defined in **RFC** 3369 for signing, digesting, authenticating, and encrypting digital messages.

cryptography

The process of protecting information by transforming it into an unreadable format. The information is encrypted using a **key**, which makes the data unreadable, and is then decrypted later when the information needs to be used again. See also **public key cryptography** and **symmetric cryptography**.

dads.conf

A configuration file for Oracle HTTP Server that is used to configure a **database access descriptor (DAD)**.

DAS

See **Oracle Delegated Administration Services**. (DAS).

Data Encryption Standard (DES)

Data Encryption Standard (DES) is a widely used **symmetric cryptography** algorithm developed in 1974 by IBM. It applies a 56-bit key to each 64-bit block of data. DES and 3DES are typically used as encryption algorithms by **S/MIME**.

data integrity

The guarantee that the contents of the message received were not altered from the contents of the original message sent.

See also: **integrity**.

database access descriptor (DAD)

Database connection information for a particular Oracle Application Server component, such as the OracleAS Single Sign-On schema.

decryption

The process of converting the contents of an encrypted message (ciphertext) back into its original readable format (plaintext).

default identity management realm

In a hosted environment, one enterprise—for example, an application service provider—makes Oracle components available to multiple other enterprises and stores information for them. In such hosted environments, the enterprise performing the hosting is called the default identity management realm, and the enterprises that are hosted are each associated with their own identity management realm in the **directory information tree (DIT)**.

default knowledge reference

A **knowledge reference** that is returned when the base object is not in the directory, and the operation is performed in a **naming context** not held locally by the server. A default knowledge reference typically sends the user to a server that has more knowledge about the directory partitioning arrangement.

default realm location

An attribute in the **root Oracle Context** that identifies the root of the **default identity management realm**.

Delegated Administration Services

See **Oracle Delegated Administration Services**.

delegated administrator

In a hosted environment, one enterprise—for example, an application service provider—makes Oracle components available to multiple other enterprises and stores information for them. In such an environment, a global administrator performs activities that span the entire directory. Other administrators—called delegated administrators—may exercise roles in specific identity management realms, or for specific applications.

DER

See **Distinguished Encoding Rules (DER)**.

DES

See **Data Encryption Standard (DES)**.

DIB

See **directory information base (DIB)**.

Diffie-Hellman

Diffie-Hellman (DH) is a public key cryptography protocol that allows two parties to establish a shared secret over an unsecure communications channel. First published in 1976, it was the first workable public key cryptographic system.

See also: **symmetric algorithm**.

digest

See **message digest**.

digital certificate

See **certificate**.

digital signature

A digital signature is the result of a two-step process applied to a given block of data. First, a **hash function** is applied to the data to obtain a result. Second, that result is encrypted using the signer's **private key**. Digital signatures can be used to ensure integrity, message authentication, and non-repudiation of data. Examples of digital signature algorithms include **DSA**, **RSA**, and **ECDSA**.

Digital Signature Algorithm (DSA)

The Digital Signature Algorithm (DSA) is an **asymmetric algorithm** that is used as part of the Digital Signature Standard (DSS). It cannot be used for encryption, only for digital signatures. The algorithm produces a pair of large numbers that enable the authentication of the signatory, and consequently, the integrity of the data attached. DSA is used both in generating and verifying digital signatures.

See also: **Elliptic Curve Digital Signature Algorithm (ECDSA)**.

directory

See **Oracle Internet Directory**, **Lightweight Directory Access Protocol (LDAP)**, and **X.500**.

directory information base (DIB)

The complete set of all information held in the directory. The DIB consists of entries that are related to each other hierarchically in a **directory information tree (DIT)**.

directory information tree (DIT)

A hierarchical tree-like structure consisting of the **DN**s of the entries.

directory integration platform server

In an Oracle Directory Integration Platform environment, the server that drives the synchronization of data between Oracle Internet Directory and a **connected directory**.

directory integration profile

In an Oracle Directory Integration Platform environment, an entry in Oracle Internet Directory that describes how Oracle Directory Integration Platform communicates with external systems and what is communicated.

Directory Manager

See **Oracle Directory Manager**.

directory naming context

See **naming context**.

directory provisioning profile

A special kind of **directory integration profile** that describes the nature of provisioning-related notifications that Oracle Directory Integration Platform sends to the directory-enabled applications.

directory replication group (DRG)

The directory servers participating in a **replication agreement**.

directory server instance

A discrete invocation of a directory server. Different invocations of a directory server, each started with the same or different configuration set entries and startup flags, are said to be different directory server instances.

directory synchronization profile

A special kind of **directory integration profile** that describes how synchronization is carried out between Oracle Internet Directory and an external system.

directory system agent (DSA)

The **X.500** term for a directory server.

directory-specific entry (DSE)

An entry specific to a directory server. Different directory servers may hold the same **directory information tree (DIT)** name, but have different contents—that is, the contents can be specific to the directory holding it. A DSE is an entry with contents specific to the directory server holding it.

directory user agent (DUA)

The software that accesses a directory service on behalf of the directory user. The directory user may be a person or another software element.

DIS

See **directory integration platform server**.

Distinguished Encoding Rules (DER)

Distinguished Encoding Rules (DER) are a set of rules for encoding **ASN.1** objects in byte-sequences. DER is a special case of **Basic Encoding Rules (BER)**.

distinguished name (DN)

A **X.500** distinguished name (DN) is a unique name for a node in a directory tree. A DN is used to provide a unique name for a person or any other directory entry. A DN is a concatenation of selected **attribute**s from each node in the tree along the path from the root node to the named entry's node. For example, in LDAP notation, the DN for a person named John Smith working at Oracle's US office would be: "cn=John Smith, ou=People, o=Oracle, c=us".

DIT

See **directory information tree (DIT)**.

DN

See **distinguished name (DN)**.

Document Type Definition (DTD)

A Document Type Definition (DTD) is a document that specifies constraints on the tags and tag sequences that are valid for a given **XML** document. DTDs follow the rules of Simple Generalized Markup Language (SGML), the parent language of XML.

domain component attribute

The domain component (dc) attribute can be used in constructing a **distinguished name (DN)** from a domain name. For example, using a domain name such as "oracle.com", one could construct a DN beginning with "dc=oracle, dc=com", and then use this DN as the root of its subtree of directory information.

DRG

See **directory replication group (DRG)**.

DSA

See **Digital Signature Algorithm (DSA)** or **directory system agent (DSA)**.

DSE

See **directory-specific entry (DSE)**.

DTD

See **Document Type Definition (DTD)**.

ECC

See **Elliptic Curve Cryptography (ECC)**.

ECDSA

See **Elliptic Curve Digital Signature Algorithm (ECDSA)**.

EJB

See **Enterprise Java Bean (EJB)**.

Elliptic Curve Cryptography (ECC)

Elliptic Curve Cryptography (ECC) is an alternative to the **RSA** encryption system which is based on the difficulty of solving elliptic curve discrete logarithm problems rather than on factoring large numbers. Developed and marketed by Certicom, ECC is especially suitable for environments, such as wireless devices and PC cards, where computational power is limited and high speed is required. For any given key size (measured in bits) ECC provides more security (is harder to decrypt without the key) than RSA.

Elliptic Curve Digital Signature Algorithm (ECDSA)

The Elliptic Curve Digital Signature Algorithm (ECDSA) is the elliptic curve analog of the **Digital Signature Algorithm (DSA)** standard. The advantages of ECDSA compared to RSA-like schemes are shorter key lengths and faster signing and decryption. For example, a 160 (210) bit ECC key is expected to give the same security as a 1024 (2048) bit RSA key, and the advantage increases as level of security is raised.

encryption

Encryption is the process of converting plaintext to ciphertext by applying a **cryptographic algorithm**.

encryption certificate

An encryption certificate is a **certificate** containing a **public key** that is used to encrypt electronic messages, files, documents, or data transmission, or to establish or exchange a session key for these same purposes.

end-to-end security

This is a property of message-level security that is established when a message traverses multiple applications within and between business entities and is secure over its full route through and between the business entities.

Enterprise Java Bean (EJB)

Enterprise JavaBeans (EJBs) are a Java API developed by Sun Microsystems that defines a component architecture for multi-tier client/server systems. Because EJB systems are written in Java, they are platform independent. Being object oriented, they can be implemented into existing systems with little or no recompiling and configuring.

Enterprise Manager

See **Oracle Enterprise Manager**.

entry

An entry is a unique record in a directory that describes an object, such as a person. An entry consists of **attribute**s and their associated **attribute value**s, as dictated by the **object class** that describes that entry object. All entries in an LDAP directory structure are uniquely identified through their **distinguished name (DN)**.

export agent

In an Oracle Directory Integration Platform environment, an agent that exports data out of Oracle Internet Directory.

export data file

In an Oracle Directory Integration Platform environment, the file that contains data exported by an **export agent**.

export file

See **export data file**.

external agent

A directory integration agent that is independent of Oracle Directory Integration Platform server. Oracle Directory Integration Platform server does not provide scheduling, mapping, or error handling services for it. An external agent is typically used when a third party metadirectory solution is integrated with Oracle Directory Integration Platform.

external application

Applications that do not delegate authentication to the OracleAS Single Sign-On server. Instead, they display HTML login forms that ask for application user names and passwords. At the first login, users can choose to have the OracleAS Single Sign-On server retrieve these credentials for them. Thereafter, they are logged in to these applications transparently.

failover

The process of failure recognition and recovery. In an Oracle Application Server Cold Failover Cluster (Identity Management), an application running on one cluster node is transparently migrated to another cluster node. During this migration, clients accessing the service on the cluster see a momentary outage and may need to reconnect once the failover is complete.

fan-out replication

Also called a point-to-point replication, a type of replication in which a supplier replicates directly to a consumer. That consumer can then replicate to one or more other consumers. The replication can be either full or partial.

Federal Information Processing Standards (FIPS)

Federal Information Processing Standards (FIPS) are standards for information processing issued by the US government Department of Commerce's National Institute of Standards and Technology (NIST).

federated identity management (FIM)

The agreements, standards, and technologies that make identity and entitlements portable across autonomous domains. FIM makes it possible for an authenticated user to be recognized and take part in personalized services across multiple domains. It avoids pitfalls of centralized storage of personal information, while allowing users to link identity information between different accounts. Federated identity requires two key components: trust and standards. The trust model of federated identity management is based on **circle of trust**. The standards are defined by the **Liberty Alliance** Project.

federation

A federation is a group of entities (companies and organizations) that have a shared user base, and have agreed to provide identity and authorization tokens so that their users only have to logon once to access all of the services in their **circle of trust**. Within the federation, at least one entity serves as the **identity provider** who is responsible for authenticating users. Entities that provide services to the user are referred to as **service provider**s.

filter

A filter is an expression that defines the entries to be returned from a request or search on a directory. Filters are typically expressed as DNs, for example: `cn=susie smith,o=acme,c=us`.

FIM

See **federated identity management (FIM)**.

FIPS

See **Federal Information Processing Standards (FIPS)**.

forced authentication

The act of forcing a user to reauthenticate if he or she has been idle for a preconfigured amount of time. Oracle Application Server Single Sign-On enables you to specify a global user inactivity timeout. This feature is intended for installations that have sensitive applications.

GET

An authentication method whereby login credentials are submitted as part of the login URL.

global administrator

In a hosted environment, one enterprise—for example, an application service provider—makes Oracle components available to multiple other enterprises and stores information for them. In such an environment, a global administrator performs activities that span the entire directory.

global unique identifier (GUID)

An identifier generated by the system and inserted into an entry when the entry is added to the directory. In a multimaster replicated environment, the GUID, not the DN, uniquely identifies an entry. The GUID of an entry cannot be modified by a user.

global user inactivity timeout

An optional feature of Oracle Application Server Single Sign-On that forces users to reauthenticate if they have been idle for a preconfigured amount of time. The global user inactivity timeout is much shorter than the single sign-out session timeout.

globalization support

Multilanguage support for graphical user interfaces. Oracle Application Server Single Sign-On supports 29 languages.

globally unique user ID

A numeric string that uniquely identifies a user. A person may change or add user names, passwords, and distinguished names, but her globally unique user ID always remains the same.

grace login

A login occurring within the specified period before password expiration.

group search base

In the Oracle Internet Directory default **directory information tree (DIT)**, the node in the identity management realm under which all the groups can be found.

guest user

One who is not an anonymous user, and, at the same time, does not have a specific user entry.

GUID

See **global unique identifier (GUID)**.

handshake

A protocol two computers use to initiate a communication session.

hash

A number generated from a string of text with an algorithm. The hash value is substantially smaller than the text itself. Hash numbers are used for security and for faster access to data.

See also: **hash function**.

hash function

In cryptography, a hash function or one-way hash function is an algorithm that produces a given value when applied to a given block of data. The result of a hash function can be used to ensure the integrity of a given block of data. For a hash function to be considered secure, it must be very difficult, given a known data block and a known result, to produce another data block that produces the same result.

Hashed Message Authentication Code (HMAC)

Hashed Message Authentication Code (HMAC) is a hash function technique used to create a secret hash function output. This strengthens existing hash functions such as MD5 and SHA. It is used in transport layer security (TLS).

HMAC

See **Hashed Message Authentication Code (HMAC)**.

HTTP

The Hyper Text Transfer Protocol (HTTP) is the protocol used between a Web browser and a server to request a document and transfer its contents. The specification is maintained and developed by the World Wide Web Consortium.

HTTP Server

See **Oracle HTTP Server**.

httpd.conf

The file used to configure **Oracle HTTP Server**.

iASAdmins

The administrative group responsible for user and group management functions in Oracle Application Server. The OracleAS Single Sign-On administrator is a member of the group iASAdmins.

identity management

The process by which the complete security lifecycle for network entities is managed in an organization. It typically refers to the management of an organization's application users, where steps in the security life cycle include account creation, suspension, privilege modification, and account deletion. The network entities managed may also include devices, processes, applications, or anything else that needs to interact in a networked environment. Entities managed by an identity management process may also include users outside of the organization, for example customers, trading partners, or Web services.

identity management infrastructure database

The database that contains data for OracleAS Single Sign-On and Oracle Internet Directory.

identity management realm

A collection of identities, all of which are governed by the same administrative policies. In an enterprise, all employees having access to the intranet may belong to one realm, while all external users who access the public applications of the enterprise may belong to another realm. An identity management realm is represented in the directory by a specific **entry** with a special **object class** associated with it.

identity management realm-specific Oracle Context

An Oracle Context contained in each identity management realm. It stores the following information:

- User naming policy of the identity management realm—that is, how users are named and located.
- Mandatory authentication attributes.
- Location of groups in the identity management realm.
- Privilege assignments for the identity management realm—for example: who has privileges to add more users to the realm.
- Application specific data for that realm including authorizations.

identity provider

These are organizations recognized by the members of a **circle of trust** as the entity responsible for authenticating users and providing the digital identity information of users to other parties in a **federation**. Identity providers enter into partnerships with service providers and provide services that follow agreed-upon practices set by all parties in a federation.

import agent

In an Oracle Directory Integration Platform environment, an agent that imports data into Oracle Internet Directory.

import data file

In an Oracle Directory Integration Platform environment, the file containing the data imported by an **import agent**.

infrastructure tier

The Oracle Application Server components responsible for identity management. These components are OracleAS Single Sign-On, Oracle Delegated Administration Services, and Oracle Internet Directory.

inherit

When an **object class** has been derived from another class, it also derives, or inherits, many of the characteristics of that other class. Similarly, an attribute subtype inherits the characteristics of its supertype.

instance

See **directory server instance**.

integrity

In cryptography, integrity is the ability to detect if data has been modified by entities that are not authorized to modify it.

Internet Directory

See **Oracle Internet Directory**.

Internet Engineering Task Force (IETF)

The principal body engaged in the development of new Internet standard specifications. It is an international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

Internet Message Access Protocol (IMAP)

A protocol allowing a client to access and manipulate electronic mail messages on a server. It permits manipulation of remote message folders, also called mailboxes, in a way that is functionally equivalent to local mailboxes.

J2EE

See **Java 2 Platform, Enterprise Edition (J2EE)**.

Java 2 Platform, Enterprise Edition (J2EE)

Java 2 Platform, Enterprise Edition (J2EE) is an environment for developing and deploying enterprise applications, defined by Sun Microsystems Inc. The J2EE platform consists of a set of services, application programming interfaces (APIs), and protocols that provide the functionality for developing multitiered, Web-based applications.

Java Server Page (JSP)

JavaServer Pages (JSP), a server-side technology, are an extension to the Java servlet technology that was developed by Sun Microsystems. JSPs have dynamic scripting capability that works in tandem with HTML code, separating the page logic from the static elements (the design and display of the page). Embedded in the HTML page, the Java source code and its extensions help make the HTML more functional, being used in dynamic database queries, for example.

JSP

See **Java Server Page (JSP)**.

key

A key is a data structure that contains some secret knowledge necessary to successfully encrypt or decrypt a given block of data. The larger the key, the harder it is to crack a block of encrypted data. For example, a 256-bit key is more secure than a 128-bit key.

key pair

A **public key** and its associated **private key**.

See also: **public/private key pair**.

knowledge reference

The access information (name and address) for a remote **directory system agent (DSA)** and the name of the **directory information tree (DIT)** subtree that the remote DSA holds. Knowledge references are also called referrals.

latency

The time a client has to wait for a given directory operation to complete. Latency can be defined as wasted time. In networking discussions, latency is defined as the travel time of a packet from source to destination.

LDAP

See **Lightweight Directory Access Protocol (LDAP)**.

LDAP connection cache

To improve throughput, the OracleAS Single Sign-On server caches and then reuses connections to Oracle Internet Directory.

LDAP Data Interchange Format (LDIF)

A common, text-based format for exchanging directory data between systems. The set of standards for formatting an input file for any of the LDAP command-line utilities.

LDIF

See **LDAP Data Interchange Format (LDIF)**.

legacy application

Older application that cannot be modified to delegate authentication to the OracleAS Single Sign-On server. Also known as an **external application**.

Liberty Alliance

The Liberty Alliance Project is an alliance of more than 150 companies, non-profit, and government organizations from around the globe. The consortium is committed to developing an open standard for federated network identity that supports all current and emerging network devices. The Liberty Alliance is the only global body working to define and drive open technology standards, privacy, and business guidelines for **federated identity management (FIM)**.

Lightweight Directory Access Protocol (LDAP)

A set of protocols for accessing information in directories. LDAP supports TCP/IP, which is necessary for any type of Internet access. Its framework of design conventions supports industry-standard directory products, such as Oracle Internet Directory. Because it is a simpler version of the **X.500** standard, LDAP is sometimes called X.500 light.

load balancer

Hardware devices and software that balance connection requests between two or more servers, either due to heavy load or failover. BigIP, Alteon, or Local Director are all popular hardware devices. Oracle Application Server Web Cache is an example of load balancing software.

logical host

In an Oracle Application Server Cold Failover Cluster (Identity Management), one or more disk groups and pairs of host names and IP addresses. It is mapped to a physical host in the cluster. This physical host impersonates the host name and IP address of the logical host.

MAC

See **message authentication code (MAC)**.

man-in-the-middle

A security attack characterized by the third-party, surreptitious interception of a message. The third-party, the *man-in-the-middle*, decrypts the message, re-encrypts it (with or without alteration of the original message), and retransmits it to the originally-intended recipient—all without the knowledge of the legitimate sender and receiver. This type of security attack works only in the absence of **authentication**.

mapping rules file

In an Oracle Directory Integration Platform environment, the file that specifies mappings between Oracle Internet Directory attributes and those in a **connected directory**.

master definition site (MDS)

In replication, a master definition site is the Oracle Internet Directory database from which the administrator runs the configuration scripts.

master site

In replication, a master site is any site other than the **master definition site (MDS)** that participates in LDAP replication.

matching rule

In a search or compare operation, determines equality between the attribute value sought and the attribute value stored. For example, matching rules associated with the `telephoneNumber` attribute could cause "(650) 123-4567" to be matched with either "(650) 123-4567" or "6501234567" or both. When you create an **attribute**, you associate a matching rule with it.

MD2

Message Digest Two (MD2) is a message digest **hash function**. The algorithm processes input text and creates a 128-bit **message digest** which is unique to the message and can be used to verify data integrity. MD2 was developed by Ron Rivest for RSA Security and is intended to be used in systems with limited memory, such as smart cards.

MD4

Message Digest Four (MD4) is similar to **MD2** but designed specifically for fast processing in software.

MD5

Message Digest Five (MD5) is a message digest **hash function**. The algorithm processes input text and creates a 128-bit **message digest** which is unique to the message and can be used to verify data integrity. MD5 was developed by Ron Rivest after potential weaknesses were reported in **MD4**. MD5 is similar to MD4 but slower because more manipulation is made to the original data.

MDS

See **master definition site (MDS)**.

message authentication

The process of verifying that a particular message came from a particular entity.

See also: **authentication**.

message authentication code (MAC)

The Message Authentication Code (MAC) is a result of a two-step process applied to a given block of data. First, the result of a **hash function** is obtained. Second, that result is encrypted using a **secret key**. The MAC can be used to authenticate the source of a given block of data.

message digest

The result of a **hash function**.

See also: **hash**.

metadirectory

A directory solution that shares information between all enterprise directories, integrating them into one virtual directory. It centralizes administration, thereby reducing administrative costs. It synchronizes data between directories, thereby ensuring that it is consistent and up-to-date across the enterprise.

middle tier

That portion of a OracleAS Single Sign-On instance that consists of the Oracle HTTP Server and OC4J. The OracleAS Single Sign-On middle tier is situated between the identity management infrastructure database and the client.

mod_osso

A module on the Oracle HTTP Server that enables applications protected by OracleAS Single Sign-On to accept HTTP headers in lieu of a user name and password once the user has logged into the OracleAS Single Sign-On server. The values for these headers are stored in the **mod_osso cookie**.

mod_osso cookie

User data stored on the HTTP server. The cookie is created when a user authenticates. When the same user requests another application, the Web server uses the information in the mod_osso cookie to log the user in to the application. This feature speeds server response time.

mod_proxy

A module on the Oracle HTTP Server that makes it possible to use **mod_osso** to enable single sign-on to legacy, or **external application**s.

MTS

See **shared server**.

multimaster replication

Also called peer-to-peer or *n*-way replication, a type of replication that enables multiple sites, acting as equals, to manage groups of replicated data. In a multimaster replication environment, each node is both a supplier and a consumer node, and the entire directory is replicated on each node.

naming attribute

The attribute used to compose the RDN of a new user entry created through Oracle Delegated Administration Services or Oracle Internet Directory Java APIs. The default value for this is `cn`.

naming context

A subtree that resides entirely on one server. It must be contiguous, that is, it must begin at an entry that serves as the top of the subtree, and extend downward to either leaf entries or **knowledge reference**s (also called referrals) to subordinate naming contexts. It can range in size from a single entry to the entire **directory information tree (DIT)**.

native agent

In an Oracle Directory Integration Platform environment, an agent that runs under the control of the **directory integration platform server**. It is in contrast to an **external agent**.

net service name

A simple name for a service that resolves to a connect descriptor. Users initiate a connect request by passing a user name and password along with a net service name in a connect string for the service to which they wish to connect, for example:

```
CONNECT username/password@net_service_name
```

Depending on your needs, net service names can be stored in a variety of places, including:

- Local configuration file, `tnsnames.ora`, on each client
- Directory server
- Oracle Names server
- External naming service, such as NDS, NIS or CDS

Net Services

See **Oracle Net Services**.

nickname attribute

The attribute used to uniquely identify a user in the entire directory. The default value for this is `uid`. Applications use this to resolve a simple user name to the complete distinguished name. The user nickname attribute cannot be multi-valued—that is, a given user cannot have multiple nicknames stored under the same attribute name.

non-repudiation

In cryptography, the ability to prove that a given **digital signature** was produced with a given entity's **private key**, and that a message was sent untampered at a given point in time.

OASIS

Organization for the Advancement of Structured Information Standards. OASIS is a worldwide not-for-profit consortium that drives the development, convergence and adoption of e-business standards.

object class

In LDAP, object classes are used to group information. Typically an object class models a real-world object such as a person or a server. Each directory entry belongs to one or more object classes. The object class determines the attributes that make up an entry. One object class can be derived from another, thereby inheriting some of the characteristics of the other class.

OC4J

See **Oracle Containers for J2EE (OC4J)**.

OCA

See **Oracle Certificate Authority**.

OCI

See **Oracle Call Interface (OCI)**.

OCSP

See **Online Certificate Status Protocol (OCSP)**.

OEM

See **Oracle Enterprise Manager**.

OID

See **Oracle Internet Directory**.

OID Control Utility

A command-line tool for issuing run-server and stop-server commands. The commands are interpreted and executed by the **OID Monitor** process.

OID Database Password Utility

The utility used to change the password with which Oracle Internet Directory connects to an Oracle Database.

OID Monitor

The Oracle Internet Directory component that initiates, monitors, and terminates the Oracle Internet Directory Server processes. It also controls the replication server if one is installed, and Oracle Directory Integration Platform Server.

Online Certificate Status Protocol (OCSP)

Online Certificate Status Protocol (OCSP) is one of two common schemes for checking the validity of digital certificates. The other, older method, which OCSP has superseded in some scenarios, is **certificate revocation list (CRL)**. OCSP is specified in **RFC** 2560.

one-way function

A function that is easy to compute in one direction but quite difficult to reverse compute, that is, to compute in the opposite direction.

one-way hash function

A **one-way function** that takes a variable sized input and creates a fixed size output.

See also: **hash function**.

Oracle Application Server Single Sign-On

OracleAS Single Sign-On consists of program logic that enables you to log in securely to applications such as expense reports, mail, and benefits. These applications take two forms: **partner application**s and **external application**s. In both cases, you gain access to several applications by authenticating only once.

Oracle Call Interface (OCI)

An application programming interface (API) that enables you to create applications that use the native procedures or function calls of a third-generation language to access an Oracle Database server and control all phases of SQL statement execution.

Oracle Certificate Authority

Oracle Application Server Certificate Authority is a **Certificate Authority (CA)** for use within your Oracle Application Server environment. OracleAS Certificate Authority uses Oracle Internet Directory as the storage repository for certificates. OracleAS Certificate Authority integration with OracleAS Single Sign-On and Oracle Internet Directory provides seamless certificate provisioning mechanisms for applications relying on them. A user provisioned in Oracle Internet Directory and authenticated in OracleAS Single Sign-On can choose to request a digital certificate from OracleAS Certificate Authority.

Oracle CMS

Oracle CMS implements the IETF **Cryptographic Message Syntax (CMS)** protocol. CMS defines data protection schemes that allow for secure message envelopes.

Oracle Containers for J2EE (OC4J)

A lightweight, scalable container for **Java 2 Platform, Enterprise Edition (J2EE)**.

Oracle Context

See **identity management realm-specific Oracle Context** and **root Oracle Context**.

Oracle Crypto

Oracle Crypto is a pure Java library that provides core cryptography algorithms.

Oracle Database Advanced Replication

A feature in the Oracle Database that enables database tables to be kept synchronized across two Oracle databases.

Oracle Delegated Administration Services

A set of individual, pre-defined services—called Oracle Delegated Administration Services units—for performing directory operations on behalf of a user. Oracle Internet Directory Self-Service Console makes it easier to develop and deploy administration solutions for both Oracle and third-party applications that use Oracle Internet Directory.

Oracle Directory Integration Platform

A collection of interfaces and services for integrating multiple directories by using Oracle Internet Directory and several associated plug-ins and connectors. A feature of Oracle Internet Directory that enables an enterprise to use an external user repository to authenticate to Oracle products.

Oracle Directory Integration Platform Server

In an Oracle Directory Integration Platform environment, a daemon process that monitors Oracle Internet Directory for change events and takes action based on the information present in the **directory integration profile**.

Oracle Directory Integration Platform

A component of **Oracle Internet Directory**. It is a framework developed to integrate applications around a central LDAP directory like Oracle Internet Directory.

Oracle Directory Manager

A Java-based tool with a graphical user interface for administering Oracle Internet Directory.

Oracle Enterprise Manager

A separate Oracle product that combines a graphical console, agents, common services, and tools to provide an integrated and comprehensive systems management platform for managing Oracle products.

Oracle HTTP Server

Software that processes Web transactions that use the Hypertext Transfer Protocol (HTTP). Oracle uses HTTP software developed by the Apache Group.

Oracle Identity Management

An infrastructure enabling deployments to manage centrally and securely all enterprise identities and their access to various applications in the enterprise.

Oracle Internet Directory

A general purpose directory service that enables retrieval of information about dispersed users and network resources. It combines **Lightweight Directory Access Protocol (LDAP)** Version 3 with the high performance, scalability, robustness, and availability of the Oracle Database.

Oracle Liberty SDK

Oracle Liberty SDK implements the **Liberty Alliance** Project specifications enabling federated single sign-on between third-party Liberty-compliant applications.

Oracle Net Services

The foundation of the Oracle family of networking products, allowing services and their client applications to reside on different computers and communicate. The main function of Oracle Net Services is to establish network sessions and transfer data between a client application and a server. Oracle Net Services is located on each computer in the network. Once a network session is established, Oracle Net Services acts as a data courier for the client and the server.

Oracle PKI certificate usages

Defines Oracle application types that a **certificate** supports.

Oracle PKI SDK

Oracle PKI SDK implements the security protocols that are necessary within **public key infrastructure (PKI)** implementations.

Oracle SAML

Oracle SAML provides a framework for the exchange of security credentials among disparate systems and applications in an XML-based format as outlined in the **OASIS** specification for the **Security Assertions Markup Language (SAML)**.

Oracle Security Engine

Oracle Security Engine extends Oracle Crypto by offering X.509 based certificate management functions. Oracle Security Engine is a superset of Oracle Crypto.

Oracle S/MIME

Oracle S/MIME implements the **Secure/Multipurpose Internet Mail Extension (S/MIME)** specifications from the **Internet Engineering Task Force (IETF)** for secure e-mail.

Oracle Wallet Manager

A Java-based application that security administrators use to manage public-key security credentials on clients and servers.

See also: *Oracle Advanced Security Administrator's Guide*.

Oracle Web Services Security

Oracle Web Services Security provides a framework for authentication and authorization using existing security technologies as outlined in the **OASIS** specification for Web Services Security.

Oracle XML Security

Oracle XML Security implements the W3C specifications for XML Encryption and XML Signature.

OracleAS Portal

An OracleAS Single Sign-On **partner application** that provides a mechanism for integrating files, images, applications, and Web sites. The External Applications portlet provides access to external applications.

other information repository

In an Oracle Directory Integration Platform environment, in which Oracle Internet Directory serves as the **central directory**, any information repository except Oracle Internet Directory.

OWM

See **Oracle Wallet Manager**.

partition

A unique, non-overlapping directory naming context that is stored on one directory server.

partner application

An Oracle Application Server application or non-Oracle application that delegates the authentication function to the OracleAS Single Sign-On server. This type of application spares users from reauthenticating by accepting **mod_osso** headers.

peer-to-peer replication

Also called multimaster replication or *n*-way replication. A type of replication that enables multiple sites, acting as equals, to manage groups of replicated data. In such a replication environment, each node is both a supplier and a consumer node, and the entire directory is replicated on each node.

PKCS#1

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS#1 provides recommendations for the implementation of public-key cryptography based on the RSA algorithm, covering the following aspects: cryptographic primitives; encryption schemes; signature schemes; ASN.1 syntax for representing keys and for identifying the schemes.

PKCS#5

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS#5 provides recommendations for the implementation of password-based cryptography.

PKCS#7

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS #7 describes general syntax for data that may have cryptography applied to it, such as digital signatures and digital envelopes.

PKCS#8

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS #8 describes syntax for private key information, including a private key for some public key algorithms and a set of attributes. The standard also describes syntax for encrypted private keys.

PKCS#10

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS #10 describes syntax for a request for certification of a public key, a name, and possibly a set of attributes.

PKCS#12

The Public Key Cryptography Standards (PKCS) are specifications produced by RSA Laboratories. PKCS #12 describes a transfer syntax for personal identity information, including private keys, certificates, miscellaneous secrets, and extensions. Systems (such as browsers or operating systems) that support this standard allow a user to import, export, and exercise a single set of personal identity information—typically in a format called a **wallet**.

PKI

See **public key infrastructure (PKI)**.

plaintext

Plaintext is readable data prior to a transformation to ciphertext using encryption, or readable data that is the result of a transformation from ciphertext using decryption.

point-to-point replication

Also called fan-out replication is a type of replication in which a supplier replicates directly to a consumer. That consumer can then replicate to one or more other consumers. The replication can be either full or partial.

policy precedence

In Oracle Application Server Certificate Authority (OCA), policies are applied to incoming requests in the order that they are displayed on the main policy page. When the OCA policy processor module parses policies, those that appear toward the top of the policy list are applied to requests first. Those that appear toward the bottom of the list are applied last and take precedence over the others. Only enabled policies are applied to incoming requests.

policy.properties

A multipurpose configuration file for Oracle Application Server Single Sign-On that contains basic parameters required by the single sign-on server. Also used to configure advanced features of OracleAS Single Sign-On, such as multilevel authentication.

POSIX

Portable Operating System Interface for UNIX. A set of programming interface standards governing how to write application source code so that the applications are portable between operating systems. A series of standards being developed by the **Internet Engineering Task Force (IETF)**.

POST

An authentication method whereby login credentials are submitted within the body of the login form.

predicates

In Oracle Application Server Certificate Authority (OCA), a policy predicate is a logical expression that can be applied to a policy to limit how it is applied to incoming certificate requests or revocations. For example, the following predicate expression specifies that the policy in which it appears can have a different effect for requests or revocations from clients with DNs that include "ou=sales,o=acme,c=us":

```
Type=="client" AND DN=="ou=sales,o=acme,c=us"
```

primary node

In an Oracle Application Server Cold Failover Cluster (Identity Management), the cluster node on which the application runs at any given time.

See also: **secondary node**.

private key

A private key is the secret key in a **public/private key pair** used in **public key cryptography**. An entity uses its private key to decrypt data that has been encrypted with its **public key**. The entity can also use its private key to create **digital signature**s. The security of data encrypted with the entity's public key as well as signatures created by the private key depends on the private key remaining secret.

private key cryptography

See **symmetric cryptography**.

profile

See **directory integration profile**.

provisioned applications

Applications in an environment where user and group information is centralized in Oracle Internet Directory. These applications are typically interested in changes to that information in Oracle Internet Directory.

provisioning

The process of providing users with access to applications and other resources that may be available in an enterprise environment.

provisioning agent

An application or process that translates Oracle-specific provisioning events to external or third-party application-specific events.

provisioning integration profile

A special kind of **directory integration profile** that describes the nature of provisioning-related notifications that Oracle Directory Integration Platform sends to the directory-enabled applications.

proxy server

A server between a client application, such as a Web browser, and a real server. It intercepts all requests to the real server to see if it can fulfil the requests itself. If not, it forwards the request to the real server. In OracleAS Single Sign-On, proxies are used for load balancing and as an extra layer of security.

See also: **load balancer**.

proxy user

A kind of user typically employed in an environment with a middle tier such as a firewall. In such an environment, the end user authenticates to the middle tier. The middle tier then logs into the directory on the end user's behalf. A proxy user has the privilege to switch identities and, once it has logged into the directory, switches to the end user's identity. It then performs operations on the end user's behalf, using the authorization appropriate to that particular end user.

public key

A public key is the non-secret key in a **public/private key pair** used in **public key cryptography**. A public key allows entities to encrypt data that can only then be decrypted with the public key's owner using the corresponding **private key**. A public key can also be used to verify digital signatures created with the corresponding private key.

public key certificate

See **certificate**.

public key cryptography

Public key cryptography (also known as asymmetric cryptography) uses two keys, one public and the other private. These keys are called a key pair. The private key must be kept secret, while the public key can be transmitted to any party. The private key and the public key are mathematically related. A message that is signed by a private key can be verified by the corresponding public key. Similarly, a message encrypted by the public key can be decrypted by the private key. This method ensures privacy because only the owner of the private key can decrypt the message.

public key encryption

The process in which the sender of a message encrypts the message with the public key of the recipient. Upon delivery, the message is decrypted by the recipient using the recipient's private key.

public key infrastructure (PKI)

A public key infrastructure (PKI) is a system that manages the issuing, distribution, and authentication of **public key**s and **private key**s. A PKI typically comprises the following components:

- A **Certificate Authority (CA)** that is responsible for generating, issuing, publishing and revoking digital certificates.
- A **Registration Authority (RA)** that is responsible for verifying the information supplied in requests for certificates made to the CA.
- A directory service where a **certificate** or **certificate revocation list (CRL)** gets published by the CA and where they can be retrieved by relying third parties.
- Relying third parties that use the certificates issued by the CA and the **public key**s contained therein to verify **digital signature**s and encrypt data.

public/private key pair

A mathematically related set of two numbers where one is called the private key and the other is called the public key. Public keys are typically made widely available, while private keys are available only to their owners. Data encrypted with a public key can only be decrypted with its associated private key and vice versa. Data encrypted with a public key cannot be decrypted with the same public key.

RC2

Rivest Cipher Two (RC2) is a 64-bit **block cipher** developed by Ronald Rivest for RSA Security, and was designed as a replacement for **Data Encryption Standard (DES)**.

RC4

Rivest Cipher Four (RC4) is a **stream cipher** developed by Ronald Rivest for RSA Security. RC4 allows variable key lengths up to 1024 bits. RC4 is most commonly used to secure data communications by encrypting traffic between Web sites that use the **Secure Sockets Layer (SSL)** protocol.

RDN

See **relative distinguished name (RDN)**.

readable data

Data prior to a transformation to ciphertext via encryption or data that is the result of a transformation from ciphertext via decryption.

realm

See **identity management realm**.

realm search base

An attribute in the **root Oracle Context** that identifies the entry in the **directory information tree (DIT)** that contains all **identity management realm**s. This attribute is used when mapping a simple realm name to the corresponding entry in the directory.

referral

Information that a directory server provides to a client and which points to other servers the client must contact to find the information it is requesting.

See also: **knowledge reference**.

Registration Authority (RA)

The Registration Authority (RA) is responsible for verifying and enrolling users before a certificate is issued by a **Certificate Authority (CA)**. The RA may assign each applicant a relative distinguished value or name for the new certificate applied. The RA does not sign or issue certificates.

registry entry

An entry containing runtime information associated with invocations of Oracle Internet Directory servers, called a **directory server instance**. Registry entries are stored in the directory itself, and remain there until the corresponding directory server instance stops.

relational database

A structured collection of data that stores data in tables consisting of one or more rows, each containing the same set of columns. Oracle makes it very easy to link the data in multiple tables. This is what makes Oracle a relational database management system, or RDBMS. It stores data in two or more tables and enables you to define relationships between the tables. The link is based on one or more fields common to both tables.

relative distinguished name (RDN)

The local, most granular level entry name. It has no other qualifying entry names that would serve to uniquely address the entry. In the example, `cn=Smith,o=acme,c=US`, the RDN is `cn=Smith`.

remote master site (RMS)

In a replicated environment, any site, other than the **master definition site (MDS)**, that participates in **Oracle Database Advanced Replication**.

replica

Each copy of a **naming context** that is contained within a single server.

replication agreement

A special directory entry that represents the replication relationship among the directory servers in a **directory replication group (DRG)**.

response time

The time between the submission of a request and the completion of the response.

RFC

The Internet Request For Comments (or RFC) documents are the written definitions of the protocols and policies of the Internet. The Internet Engineering Task Force (IETF) facilitates the discussion, development, and establishment of new standards. A standard is published using the RFC acronym and a reference number. For example, the official standard for e-mail is RFC 822.

root CA

In a hierarchical **public key infrastructure (PKI)**, the root **Certificate Authority (CA)** is the CA whose **public key** serves as the most trusted datum for a security domain.

root directory specific entry (DSE)

An entry storing operational information about the directory. The information is stored in a number of attributes.

root DSE

See **root directory specific entry (DSE)**.

root Oracle Context

In the Oracle Identity Management infrastructure, the root Oracle Context is an entry in Oracle Internet Directory containing a pointer to the default identity management realm in the infrastructure. It also contains information on how to locate an identity management realm given a simple name of the realm.

RSA

RSA is a **public key cryptography** algorithm named after its inventors (Rivest, Shamir, and Adelman). The RSA algorithm is the most commonly used encryption and authentication algorithm and is included as part of the Web browsers from Netscape and Microsoft, and many other products.

RSAES-OAEP

The RSA Encryption Scheme - Optimal Asymmetric Encryption Padding (RSAES-OAEP) is a public key encryption scheme combining the **RSA** algorithm with the OAEP method. Optimal Asymmetric Encryption Padding (OAEP) is a method for encoding messages developed by Mihir Bellare and Phil Rogaway.

S/MIME

See **Secure/Multipurpose Internet Mail Extension (S/MIME)**.

SAML

See **Security Assertions Markup Language (SAML)**.

SASL

See **Simple Authentication and Security Layer (SASL)**.

scalability

The ability of a system to provide throughput in proportion to, and limited only by, available hardware resources.

schema

The collection of **attribute**s, **object class**es, and their corresponding **matching rule**s.

secondary node

In an Oracle Application Server Cold Failover Cluster (Identity Management), the cluster node to which an application is moved during a failover.

See also: **primary node**.

secret key

A secret key is the **key** used in a **symmetric algorithm**. Since a secret key is used for both encryption and decryption, it must be shared between parties that are transmitting ciphertext to one another but must be kept secret from all unauthorized entities.

secret key cryptography

See **symmetric cryptography**.

Secure Hash Algorithm (SHA)

Secure Hash Algorithm (SHA) is a **hash function** algorithm that produces a 160-bit **message digest** based upon the input. The algorithm is used in the Digital Signature Standard (DSS). With the introduction of the Advanced Encryption Standard (AES) which offers three key sizes: 128, 192 and 256 bits, there has been a need for a companion hash algorithm with a similar level of security. The newer SHA-256, SHA-284 and SHA-512 hash algorithms comply with these enhanced requirements.

Secure Sockets Layer (SSL)

Secure Sockets Layer (SSL) is a protocol designed by Netscape Communications to enable encrypted, authenticated communications across networks (such as the Internet). SSL uses the **public key encryption** system from RSA, which also includes the use of a digital certificate. SSL provides three elements of secure communications: **confidentiality**, **authentication**, and **integrity**.

SSL has evolved into **Transport Layer Security (TLS)**. TLS and SSL are not interoperable. However, a message sent with TLS can be handled by a client that handles SSL.

Secure/Multipurpose Internet Mail Extension (S/MIME)

Secure/Multipurpose Internet Mail Extension (S/MIME) is an Internet Engineering Task Force (IETF) standard for securing MIME data through the use of **digital signature**s and **encryption**.

Security Assertions Markup Language (SAML)

Security Assertions Markup Language (SAML) is an **XML**-based framework for exchanging security information over the Internet. SAML enables the exchange of **authentication** and **authorization** information between various security services systems that otherwise would not be able to interoperate. The SAML 1.0 specification was adopted by **OASIS** in 2002.

server certificate

A **certificate** that attests to the identity of an organization that uses a secure Web server to serve data. A server certificate must be associated with a **public/private key pair** issued by a mutually trusted **Certificate Authority (CA)**. Server certificates are required for secure communications between a browser and a Web server.

service provider

These are organizations recognized by the members of a **circle of trust** as the entities that provide Web-based services to users. Service providers enter into partnerships with other service providers and identity providers with the goal of providing their common users with secure single sign-on between all parties of the **federation**.

service time

The time between the initiation of a request and the completion of the response to the request.

session key

A **secret key** that is used for the duration of one message or communication session.

SGA

See **System Global Area (SGA)**.

SHA

See **Secure Hash Algorithm (SHA)**.

shared server

A server that is configured to allow many user processes to share very few server processes, so the number of users that can be supported is increased. With shared server configuration, many user processes connect to a dispatcher. The dispatcher directs multiple incoming network session requests to a common queue. An idle shared server process from a shared pool of server processes picks up a request from the queue. This means a small pool of server processes can server a large amount of clients. Contrast with dedicated server.

sibling

An entry that has the same parent as one or more other entries.

Signed Public Key And Challenge (SPKAC)

Signed Public Key And Challenge (SPKAC) is a proprietary protocol used by the Netscape Navigator browser to request certificates.

simple authentication

The process by which the client identifies itself to the server by means of a DN and a password which are not encrypted when sent over the network. In the simple authentication option, the server verifies that the DN and password sent by the client match the DN and password stored in the directory.

Simple Authentication and Security Layer (SASL)

A method for adding authentication support to connection-based protocols. To use this specification, a protocol includes a command for identifying and authenticating a user to a server and for optionally negotiating a security layer for subsequent protocol interactions. The command has a required argument identifying a SASL mechanism.

single key-pair wallet

A **PKCS#12**-format wallet that contains a single user **certificate** and its associated **private key**. The **public key** is imbedded in the certificate.

single sign-off

The process by which you terminate an OracleAS Single Sign-On session and log out of all active partner applications simultaneously. You can do this by logging out of the application that you are working in.

single sign-on (SSO)

A process or system that enables a user to access multiple computer platforms or application systems after being authenticated only once.

single sign-on SDK

Legacy APIs to enable OracleAS Single Sign-On partner applications for single sign-on. The SDK consists of PL/SQL and Java APIs as well as sample code that demonstrates how these APIs are implemented. This SDK is now deprecated and **mod_osso** is used instead.

single sign-on server

Program logic that enables users to log in securely to single sign-on applications such as expense reports, mail, and benefits.

SLAPD

Standalone LDAP daemon. An LDAP directory server service that is responsible for most functions of a directory except replication.

slave

See **consumer**.

smart knowledge reference

A **knowledge reference** that is returned when the knowledge reference entry is in the scope of the search. It points the user to the server that stores the requested information.

SOAP

Simple Object Access Protocol (SOAP) is an **XML**-based protocol that defines a framework for passing messages between systems over the Internet via HTTP. A SOAP message consists of three parts — an envelope that describes the message and how to process it, a set of encoding rules for expressing instances of application-defined datatypes, and a convention for representing remote procedure calls and responses.

specific administrative area

Administrative areas control:

- Subschema administration
- Access control administration
- Collective attribute administration

A *specific* administrative area controls one of these aspects of administration. A specific administrative area is part of an autonomous administrative area.

SPKAC

See **Signed Public Key And Challenge (SPKAC)**.

sponsor node

In replication, the node that is used to provide initial data to a new node.

SSL

See **Secure Sockets Layer (SSL)**.

stream cipher

Stream ciphers are a type of **symmetric algorithm**. A stream cipher encrypts in small units, often a bit or a byte at a time, and implements some form of feedback mechanism so that the key is constantly changing. **RC4** is an example of a stream cipher.

See also: **block cipher**.

subACLSubentry

A specific type of **subentry** that contains **access control list (ACL)** information.

subclass

An object class derived from another object class. The object class from which it is derived is called its **superclass**.

subentry

A type of entry containing information applicable to a group of entries in a subtree. The information can be of these types:

- Access control policy points
- Schema rules
- Collective attributes

Subentries are located immediately below the root of an administrative area.

subordinate CA

In a hierarchical **public key infrastructure (PKI)**, the subordinate **Certificate Authority (CA)** is a CA whose certificate signature key is certified by another CA, and whose activities are constrained by that other CA.

subordinate reference

A **knowledge reference** pointing downward in the **directory information tree (DIT)** to a **naming context** that starts immediately below an entry

subschema DN

The list of **directory information tree (DIT)** areas having independent **schema** definitions.

subSchemaSubentry

A specific type of **subentry** containing **schema** information.

subtree

A section of a directory hierarchy, which is also called a **directory information tree (DIT)**. The subtree typically starts at a particular directory node and includes all subdirectories and objects below that node in the directory hierarchy.

subtype

An attribute with one or more options, in contrast to that same attribute without the options. For example, a `commonName` (`cn`) attribute with American English as an option is a subtype of the `commonName` (`cn`) attribute without that option. Conversely, the `commonName` (`cn`) attribute without an option is the **supertype** of the same attribute with an option.

success URL

When using Oracle Application Server Single Sign-On, the URL to the routine responsible for establishing the session and session cookies for an application.

super user

A special directory administrator who typically has full access to directory information.

superclass

The **object class** from which another object class is derived. For example, the object class `person` is the superclass of the object class `organizationalPerson`. The latter, namely, `organizationalPerson`, is a **subclass** of `person` and inherits the attributes contained in `person`.

superior reference

A **knowledge reference** pointing upward to a **directory system agent (DSA)** that holds a naming context higher in the **directory information tree (DIT)** than all the naming contexts held by the referencing DSA.

supertype

An attribute without options, in contrast to the same attribute with one or more options. For example, the `commonName` (`cn`) attribute without an option is the supertype of the same attribute with an option. Conversely, a `commonName` (`cn`) attribute with American English as an option is a **subtype** of the `commonName` (`cn`) attribute without that option.

supplier

In replication, the server that holds the master copy of the **naming context**. It supplies updates from the master copy to the **consumer** server.

symmetric algorithm

A symmetric algorithm is a cryptographic algorithm that uses the same key for encryption and decryption. There are essentially two types of symmetric (or secret key) algorithms — **stream cipher**s and **block cipher**s.

symmetric cryptography

Symmetric cryptography (or shared secret cryptography) systems use the same key to encipher and decipher data. The problem with symmetric cryptography is ensuring a secure method by which the sender and recipient can agree on the secret key. If a third party were to intercept the secret key in transit, they could then use it to decipher anything it was used to encipher. Symmetric cryptography is usually faster than asymmetric cryptography, and is often used when large quantities of data need to be exchanged. **DES**, **RC2**, and **RC4** are examples of symmetric cryptography algorithms.

symmetric key

See **secret key**.

System Global Area (SGA)

A group of shared memory structures that contain data and control information for one Oracle database instance. If multiple users are concurrently connected to the same instance, the data in the instance SGA is shared among the users. Consequently, the SGA is sometimes referred to as the "shared global area." The combination of the background processes and memory buffers is called an Oracle instance.

system operational attribute

An attribute holding information that pertains to the operation of the directory itself. Some operational information is specified by the directory to control the server, for example, the time stamp for an entry. Other operational information, such as access information, is defined by administrators and is used by the directory program in its processing.

think time

The time the user is not engaged in actual use of the processor.

third-party access management system

Non-Oracle single sign-on system that can be modified to use OracleAS Single Sign-On to gain access to Oracle Application Server applications.

throughput

The number of requests processed byOracle Internet Directory for each unit of time. This is typically represented as "operations per second."

Time Stamp Protocol (TSP)

Time Stamp Protocol (TSP), as specified in RFC 3161, defines the participating entities, the message formats, and the transport protocol involved in time stamping a digital message. In a TSP system, a trusted third-party Time Stamp Authority (TSA) issues time stamps for messages.

TLS

See **Transport Layer Security (TLS)**.

Transport Layer Security (TLS)

A protocol providing communications privacy over the Internet. The protocol enables client/server applications to communicate in a way that prevents eavesdropping, tampering, or message forgery.

Triple Data Encryption Standard (3DES)

Triple Data Encryption Standard (3DES) is based on the **Data Encryption Standard (DES)** algorithm developed by IBM in 1974, and was adopted as a national standard in 1977. 3DES uses three 64-bit long keys (overall key length is 192 bits, although actual key length is 56 bits). Data is encrypted with the first key, decrypted with the second key, and finally encrypted again with the third key. This makes 3DES three times slower than standard DES but also three times more secure.

trusted certificate

A third party identity that is qualified with a level of trust. The trust is used when an identity is being validated as the entity it claims to be. Typically, trusted certificates come from a **Certificate Authority (CA)** you trust to issue user certificates.

trustpoint

See **trusted certificate**.

TSP

See **Time Stamp Protocol (TSP)**.

Unicode

A type of universal character set, a collection of 64K characters encoded in a 16-bit space. It encodes nearly every character in just about every existing character set standard, covering most written scripts used in the world. It is owned and defined by Unicode Inc. Unicode is canonical encoding which means its value can be passed around in different locales. But it does not guarantee a round-trip conversion between it and every Oracle character set without information loss.

UNIX Crypt

The UNIX encryption algorithm.

URI

Uniform Resource Identifier (URI). A way to identify any point of content on the Web, whether it be a page of text, a video or sound clip, a still or animated image, or a program. The most common form of URI is the Web page address, which is a particular form or subset of URI called a **URL**.

URL

Uniform Resource Locator (URL). The address of a file accessible on the Internet. The file can be a text file, HTML page, image file, a program, or any other file supported by HTTP. The URL contains the name of the protocol required to access the resource, a domain name that identifies a specific computer on the Internet, and a hierarchical description of the file location on the computer.

URLC token

The OracleAS Single Sign-On code that passes authenticated user information to the **partner application**. The partner application uses this information to construct the session cookie.

user name mapping module

A OracleAS Single Sign-On Java module that maps a user **certificate** to the user's nickname. The nickname is then passed to an authentication module, which uses this nickname to retrieve the user's certificate from the directory.

user search base

In the Oracle Internet Directory default **directory information tree (DIT)**, the node in the identity management realm under which all the users are placed.

UTC (Coordinated Universal Time)

The standard time common to every place in the world. Formerly and still widely called Greenwich Mean Time (GMT) and also World Time, UTC nominally reflects the mean solar time along the Earth's prime meridian. UTC is indicated by a z at the end of the value, for example, 200011281010z.

UTF-8

A variable-width 8-bit encoding of **Unicode** that uses sequences of 1, 2, 3, or 4 bytes for each character. Characters from 0-127 (the 7-bit ASCII characters) are encoded with one byte, characters from 128-2047 require two bytes, characters from 2048-65535 require three bytes, and characters beyond 65535 require four bytes. The Oracle character set name for this is AL32UTF8 (for the Unicode 3.1 standard).

UTF-16

16-bit encoding of **Unicode**.The Latin-1 characters are the first 256 code points in this standard.

verification

Verification is the process of ensuring that a given **digital signature** is valid, given the **public key** that corresponds to the **private key** purported to create the signature and the data block to which the signature purportedly applies.

virtual host

A single physical Web server machine that is hosting one or more Web sites or domains, or a server that is acting as a proxy to other machines (accepts incoming requests and reroutes them to the appropriate server).

In the case of OracleAS Single Sign-On, virtual hosts are used for load balancing between two or more OracleAS Single Sign-On servers. They also provide an extra layer of security.

virtual host name

In an Oracle Application Server Cold Failover Cluster (Identity Management), the host name corresponding to a particular virtual IP address.

virtual IP address

In an Oracle Application Server Cold Failover Cluster (Identity Management), each physical node has its own physical IP address and physical host name. To present a single system image to the outside world, the cluster uses a dynamic IP address that can be moved to any physical node in the cluster. This is called the virtual IP address.

wait time

The time between the submission of the request and initiation of the response.

wallet

An abstraction used to store and manage security credentials for an individual entity. It implements the storage and retrieval of credentials for use with various cryptographic services. A wallet resource locator (WRL) provides all the necessary information to locate the wallet.

Wallet Manager

See **Oracle Wallet Manager**.

Web service

A Web service is application or business logic that is accessible using standard Internet protocols, such as **HTTP**, **XML**, and **SOAP**. Web Services combine the best aspects of component-based development and the World Wide Web. Like components, Web Services represent black-box functionality that can be used and reused without regard to how the service is implemented.

Web Services Description Language (WSDL)

Web Services Description Language (WSDL) is the standard format for describing a Web service using **XML**. A WSDL definition describes how to access a Web service and what operations it will perform.

WSDL

See **Web Services Description Language (WSDL)**.

WS-Federation

Web Services Federation Language (WS-Federation) is a specification developed by Microsoft, IBM, BEA, VeriSign, and RSA Security. It defines mechanisms to allow **federation** between entities using different or like mechanisms by allowing and brokering trust of identities, attributes, and authentication between participating **Web service**s.

See also: **Liberty Alliance**.

X.500

X.500 is a standard from the International Telecommunication Union (ITU) that defines how global directories should be structured. X.500 directories are hierarchical with different levels for each category of information, such as country, state, and city.

X.509

X.509 is the most widely used standard for defining digital certificates. A standard from the International Telecommunication Union (ITU), for hierarchical directories with authentication services, used in many **public key infrastructure (PKI)** implementations.

XML

Extensible Markup Language (XML) is a specification developed by the World Wide Web Consortium (W3C). XML is a pared-down version of Standard Generalized Mark-Up Language (SGML), designed especially for Web documents. XML is a metalanguage (a way to define tag sets) that allows developers to define their own customized markup language for many classes of documents.

XML canonicalization (C14N)

This is a process by which two logically equivalent XML documents can be resolved to the same physical representation. This has significance for digital signatures because a signature can only verify against the same physical representation of the data against which it was originally computed. For more information, see the W3C's XML Canonicalization specification.

Index

D

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

W