BEA Tuxedo

Using the BEA Tuxedo Domains Component

BEA Tuxedo Release 7.1
Document Edition 7.1
May 2000

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Document Edition	Date	Software Version
7.1	May 2000	BEA Tuxedo Release 7.1

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CHAPTER

1 About Domains

- What Is the BEA Tuxedo Domains Component
- Building a Multiple-domains Configuration
- Example of an Application Using Domain Gateways
- Messaging Paradigms Supported by Domain Gateways
- Defining Transaction and Blocking Timeouts in Domains
- Specifying How Your Domains Connect
- What Is the Domains Configuration File
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What Is the BEA Tuxedo Domains Component

The BEA Tuxedo application programming framework simplifies the development of open *online transaction processing* (OLTP) distributed applications by hiding the complexity associated with the distribution of application processing. The framework consists of the following:

- An extended client/server model that hides the heterogeneity of different computers and application programs, as well as the location of application programs.

- A centralized administration system that allows application administrators to control all cooperating machines as a single application.

As a business grows, application developers may need to organize different segments of the business by sets of functionality that require administrative autonomy but allow sharing of services and data. It may not be appropriate to structure a group of applications as a single distributed application because of the functionality, geographical location, confidentiality requirements, and potential growth of each. Also, an enterprise may want to expand business by cooperating with other organizations that provide OLTP services under the control of different transaction processing monitors, such as BEA's TOP END, Transarc's Encina, IBM's CICS, Bull's TDS, Bull's TP8, ICL's TPMS, and so forth.

Each set of functionality defines an application that spans one or more computers, and is administered independently from other applications. Such a functionally distinct application is referred to as a domain; in practice, the organization often uses the domain's functionality as part of its name so you find applications with names like the "accounting" domain or the "order entry" domain.

Business Operations Interoperating with Each Other

The BEA Tuxedo System Domains feature provides a framework for interoperability among the domains of a business that continues the BEA Tuxedo enhanced client/server model. Interoperability means more than merely the capability of communicating from one domain to another. By transparently making access to services of a remote domain available to users of the local domain (or accepting local service requests from users of a remote domain), Domains, in effect, breaks down the walls between the business applications of an organization. Application programmers can use the ATMI interface to access the services provided by remote domains, or to define services that can be executed by a remote domain.

The Domains feature also enables BEA Tuxedo applications to cooperate with dozens of applications running in other administrative domains. The BEA Tuxedo system provides a common framework for controlling very large applications that may include domains running other transaction processing systems.

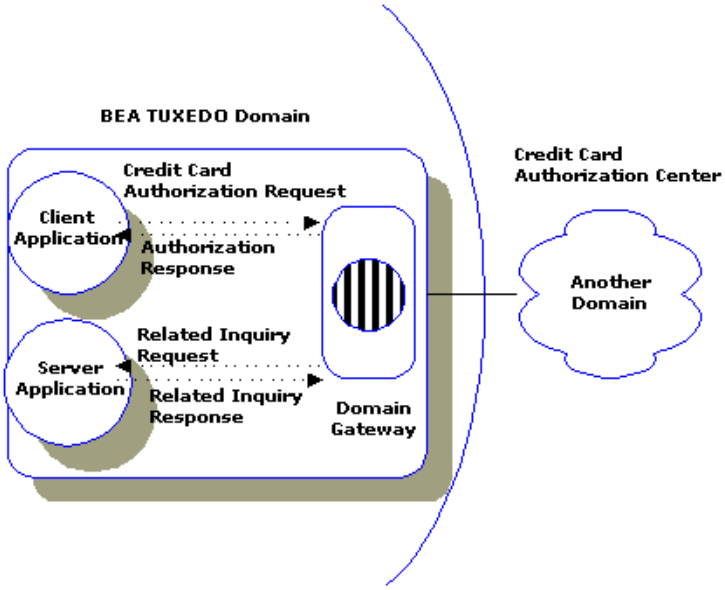
Building a Multiple-domains Configuration

To build a multiple-domain configuration, you need to consider the following tasks:

- Integrate your existing BEA Tuxedo application with other domains
- Ensure interoperability across domains
- Preserve or restrict access to services across domains
- Accept or deny service requests across domains

Domains achieves these tasks through a highly asynchronous, multitasking, multithreaded gateway. A domain gateway (DGW) is a BEA Tuxedo-supplied server that handles requests to remote domains and from remote domains. Any request can be processed within a transaction. The following figure illustrates how one BEA Tuxedo domain communicates with another domain via a domain gateway.

Figure 1-1 2-way Communication through a Gateway



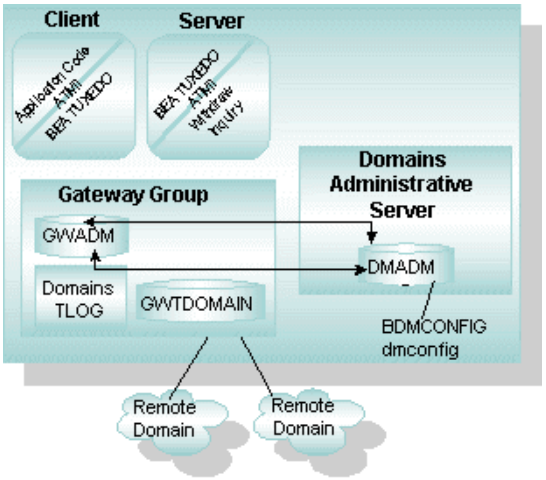
In this illustration, the gateway processes outgoing credit card authorization requests to another domain. The gateway also handles incoming authorization responses.

Domain gateways manage all the communication between domains. The gateway processes include a *gateway administrative server* (GWADM) that enables run-time administration of the domain gateway group and a *Domains administrative server (*DMADM*)* that enables run-time administration of the BEA Tuxedo application-wide Domains configuration information.

Tools to Set Up and Maintain a Multiple-domain Application

The following illustration shows the tools provided by the BEA Tuxedo system for setting up and maintaining a multiple-domain configuration.

Figure 1-2 Domains Administrative Tools



Domains Administrative Tool	Description
dmadmin(1)	A command that allows you to configure, monitor, and tune domain gateway groups dynamically. Use this command to update the BDMCONFIG file while an application is running. The command acts as a front-end process that translates administrative commands. These commands send requests to the DMADMIN service, a generic administrative service advertised by the DMADM server. DMADMIN invokes functions that validate, retrieve, or update information in the BDMCONFIG file.
DMCONFIG(5) BDMCONFIG	DMCONFIG is the text version of the configuration file for a multiple-domain configuration; BDMCONFIG is the binary version.
dmloadcf(1) and dmunloadcf(1)	dmloadcf—Reads the DMCONFIG file, checks the syntax, and optionally loads a binary BDMCONFIG configuration file dmunloadcf—Translates the BDMCONFIG configuration file from binary to text format
DMADM(5)	An administrative server that enables you to manage a Domains configuration at run time. DMADM provides a registration service for gateway groups. This service is requested by GWADM servers as part of their initialization procedure. The registration service downloads the configuration information required by the requesting gateway group. The DMADM server maintains a list of registered gateway groups, and propagates to these groups any changes made to the configuration file (BDMCONFIG).
GWADM(5)	An administrative server that supports run-time administration of a specific gateway group. This server registers with the DMADM server to obtain the configuration information used by the corresponding gateway group. GWADM accepts requests from DMADMIN for run-time statistics or changes in the run-time options of the specified gateway group. Periodically, GWADM sends an "I-am-alive" message to the DMADM server. If no reply is received from DMADM, GWADM registers again. This process ensures the GWADM server always has the current information about the Domains configuration for its group.

Domains Administrative Tool	Description
GWTDOMAIN(5)	A gateway process that receives and forwards messages from clients and servers in all connected domains (for BEA Tuxedo Domains).

Types of Domain Gateways

The BEA Tuxedo system provides different types of gateways to accommodate various network transport protocols used to communicate with remote domains. Access to remote domains that use the same communication and transaction commitment protocol is provided through a group of gateways that implement the configuration defined for a particular local domain. Following are the different types of domain gateways:

- *BEA Tuxedo Domains (TDomains) gateway* (that is, the GWTDOMAIN gateway)—provides interoperability between two or more BEA Tuxedo applications through a specially designed TP protocol that flows over network transport protocols such as TCP/IP.

  Note: GWTDOMAIN gateways should not be specified as members of an MSSQ set. They should not have a reply queue (REPLYQ=N should be specified). GWTDOMAIN gateways are recommended to be restartable.

- *BEA eLink for Mainframe-OSI TP gateway*—provides interoperability between BEA Tuxedo applications and other transaction processing applications that use the OSI TP standard. OSI TP is a protocol for distributed transaction processing defined by the International Standards Organization (ISO).

- *BEA eLink for Mainframe-SNA gateway*—provides interoperability between clients and servers in a BEA Tuxedo domain, and clients and servers in an MVS/CICS or MVS/IMS environment in a remote SNA domain. It also supports communication with multiple SNA networks.

- *BEA eLink for Mainframe-TCP*:

  - *For CICS gateway*—makes it possible for non-transactional tasks within BEA Tuxedo regions to access services provided by CICS application programs and vice-versa. It enables a BEA Tuxedo domain to communicate,

via the TCP/IP network transport protocol, with a CICS environment. (A BEA Tuxedo domain is a single computer or network of computers controlled by a single BEA Tuxedo configuration file.)

- *For IMS gateway*—provides transparent communications between client and server transactions in an IMS system and a BEA Tuxedo domain, a CICS system, or another IMS system.

- *BEA TOP END Domain Gateway (TEDG)*—provides interoperability between TOP END systems and BEA Tuxedo domains.

Functionality Supported by Domain Gateways

Domain gateways support the following functionality:

- *Administration*—Gateways can be booted or shut down exactly as any other BEA Tuxedo server. Run-time administration is provided through an administrative server, `DMADM`. Using `DMADM`, application administrators can make changes to a domains configuration file, and tune the performance of a gateway group. (The `DMADM` administrative server should be booted before gateway groups.)

- *ATMI*—Gateways can access the programming interface between a domain and the BEA Tuxedo system ensuring access to the following messaging models:

  - *Request/Response Model*—Application programs using the BEA Tuxedo system can request services from applications running in another domains. Also, remote applications can request services from local servers. (No changes are required to the application program to accommodate this interdomain functionality.)

  - *Conversational Model*—Application programs can establish conversations with programs running in other domains. Remote domains can establish conversations with conversational services offered by local servers. (No changes are required to the application program to accommodate this interdomain functionality.)

  - *Queuing Model*—Application programs using the BEA Tuxedo system can store data on queues. Any client or server can store messages or service requests in a queue on a remote domain and all stored requests are sent through the transaction protocol to ensure safe storage. (No changes are

required to the application program to accommodate this interdomain functionality.)

- *Multidomain Interaction*—Gateways can communicate with multiple domains.
- *Multinetwork Support*—Gateways can communicate with other domains via a variety of network protocols, such as `TCP/IP`, `IPX/SPX`, and others. However, a gateway is limited by the capabilities of the networking library to which it is linked. In other words, a gateway typically supports a single type of network protocol.
- *Transaction Management*—Application programs can interoperate with other domains within a transaction. The gateway coordinates the commitment or rollback of transactions running across domains.
- *Typed Buffer Support*—Gateways can perform encoding and decoding operations for all the types of buffers defined by the application.

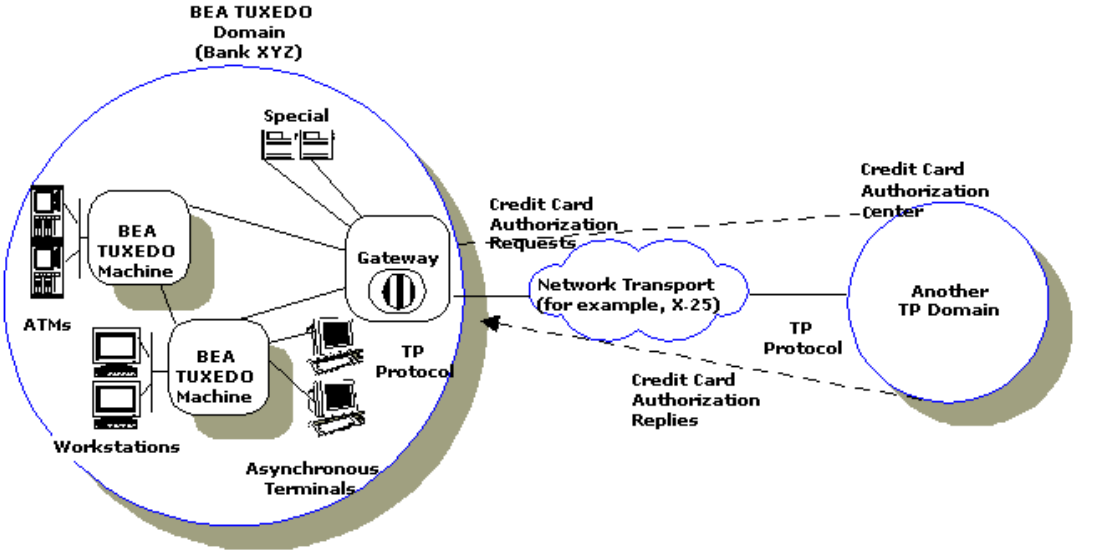
See Also

- "What Is a Multiple-domain Configuration" on page 3-49 in *Introducing the BEA Tuxedo System*
- "Example of an Application Using Domain Gateways" on page 1-9
- "Messaging Paradigms Supported by Domain Gateways" on page 1-11

Example of an Application Using Domain Gateways

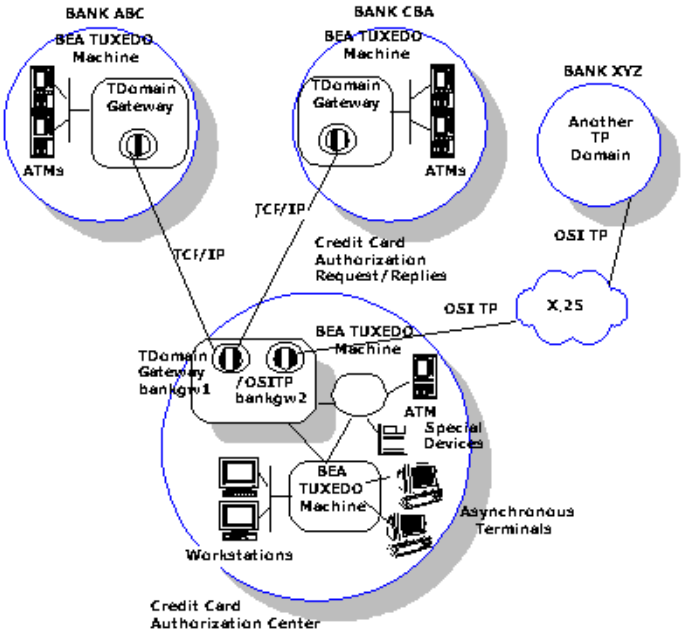
The following figure shows a BEA Tuxedo application that requires services (in this case, credit card authorizations) from a remote domain.

Figure 1-3 High-level View of Two Communicating Domains



The application also accepts service requests (for example, balance inquiries) from remote domains. The gateway process provides bidirectional transaction control, and administrative tools for configuring a local domain to interoperate with other domains. `BDMCONFIG`, the configuration file for a multiple-domain application, identifies exported services, imported services, addressing, any access control lists to be used. The following figure shows a more detailed view of a sample Domains environment.

Figure 1-4 Example Domains Environment



The example shows a credit card authorization center running under the control of the BEA Tuxedo system. The authorization center has two gateway groups: `bankgw1` (which uses the TCP/IP protocol) and `bankgw2` (which uses the OSI TP protocol). `bankgw1` provides access to two remote BEA Tuxedo domains (Bank ABC and Bank CBA); `bankgw2` provides access to one remote domain (Bank XYZ) using the OSI TP protocol.

In this example, Bank ABC generates service requests to the credit card authorization center. These requests are received by a gateway running within group `bankgw1`. This gateway issues a service request, on behalf of the remote domain, to the credit card authorization service provided by a local server. The server processes the request and sends the reply to the gateway, and the gateway forwards the reply to Bank ABC.

The credit card authorization center may also issue service requests. For example, the authorization center may send balance inquiries to Bank XYZ. Domains makes this possible by providing a gateway that acts like as a local server that advertises services available on other domains as if they were local services.

Domains provides the notion of a *local domain* that controls incoming requests and provides a generic addressing framework for the application. Local domains help to provide partial views of an application, that is, a subset of the local services available to a set of remote domains. Each local domain is always represented by a single gateway server group.

Messaging Paradigms Supported by Domain Gateways

The functions of the BEA Tuxedo client/server model are supported by the following messaging paradigms in domain gateways:

- "Request/Response Communication Between Local and Remote Services" on page 1-11
- "Conversational Communication Between Local and Remote Services" on page 1-13
- "Queued Messaging for Data Storage" on page 1-13

Request/Response Communication Between Local and Remote Services

Domain gateways provide support for the request/response model of communication defined by the ATMI interface. A BEA Tuxedo application can request remote services exactly as if they were offered locally.

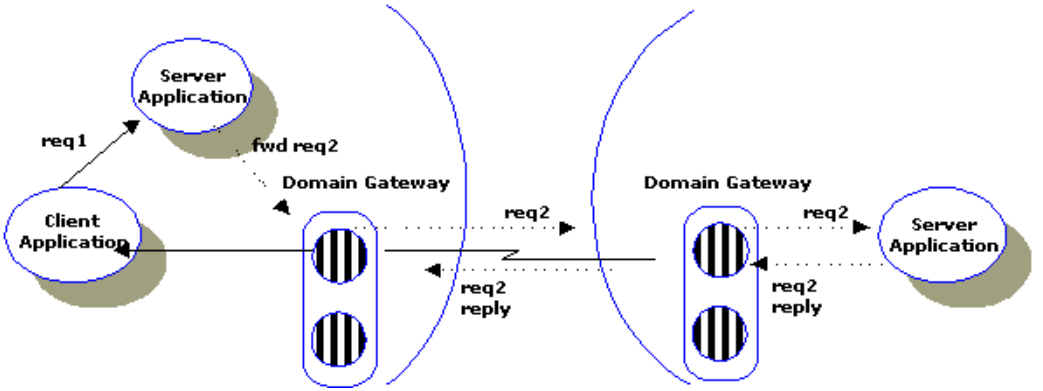
Support for ATMI Functions

The following BEA Tuxedo ATMI functions are logically limited to use within a single application and are not supported across domains:

- `tpinit(3c)`/`tpterm(3c)`—BEA Tuxedo applications do not attach to the environment of a remote domain; they use Domain gateways to access a remote domain. Therefore, an extra `tpinit()`/`tpterm()` sequence is not needed for remote applications.
- `tpadvertise(3c)` and `tpunadvertise(3c)`—cannot be used across domains. Domain gateways do not support dynamic service advertisements across domains.
- `tpnotify(3c)` and `tpbroadcast(3c)`—Domains does not support the unsolicited communication paradigm provided by these primitives.
- Event posting (`tppost(3c)`) and notification of events (`tpsubscribe(3c)`)—Domains does not support these functions across domains.

Support for `tpforward(3c)` is provided to preserve application portability. Forwarded requests are interpreted by domain gateways as simple service requests. This process is shown in the following diagram, which illustrates the simple scenario of a service using `tpforward` to send a request to a remote service.

Figure 1-5 Using tpforward to Send a Request to a Remote Service



Conversational Communication Between Local and Remote Services

The ATMI is a connection-oriented interface that enables clients to establish and maintain conversations with services programmed in the conversational paradigm.

BEA Tuxedo applications use `tpconnect(3c)` to open a conversation with a remote service, `tpsend(3c)` and `tprecv(3c)` to communicate with this service, and `tpdiscon(3c)` to end the conversation. Domain gateways maintain the conversation with the remote service, and support the same semantics for returns (that is, `tpreturn` with `TPSUCCESS` or `TPFAIL`) and disconnects that are defined for BEA Tuxedo conversational services.

Note: The ATMI connection-oriented functions provide half-duplex conversations; `tpforward(3c)` is not allowed within a conversational service.

Application administrators indicate that a remote service is conversational by specifying `CONV=Y` in the `DM_REMOTE_SERVICES` section of the `DMCONFIG` file.

Queued Messaging for Data Storage

The BEA Tuxedo system enables messages to be queued to persistent storage (disk) or to non-persistent storage (memory) for later processing or retrieval. ATMI provides primitives that allow messages to be added (that is, `tpenqueue`) or read (that is, `tpdequeue`) from queues. Reply messages and error messages can be queued for later return to clients. An administrative command interpreter (that is, `qmadmin`) is provided for creating, listing, and modifying queues. Server are provided to accept requests to enqueue and dequeue messages (that is, `TMQUEUE` server), to forward messages from the queue for processing (that is, `TMQFORWARD` server), and to manage the transactions that involve queues (that is, `TMS_QM` server).

Domain gateways extend support for queued messaging services across domains.

See Also

- "What Is Request/Reply Communication" on page 2-14 in *Introducing the BEA Tuxedo System*
- "What Is Conversational Communication" on page 2-9 in *Introducing the BEA Tuxedo System*
- "What Is Queue-based Communication" on page 2-13 in *Introducing the BEA Tuxedo System*

Typed Buffers to Package Data

In BEA Tuxedo applications, typed buffers are used to send data between clients and servers. The typed buffer mechanism allows application programmers to transfer data without knowing which data representation scheme is used by the machines on which the application's clients and servers are running.

A domain gateway can receive and process service requests sent from workstations, BEA Tuxedo machines, and remote domains with different machine representations. A typed buffer switch decodes the data sent with the service request. The administrator must define the typed buffer switch appropriate for the application.

Data-dependent routing depends upon matching specified criteria to fields within data. If data is encoded, however, there is no way to determine the contents of that data in order to route that data accurately. In addition, a domain gateway needs access to the contents for the following reasons:

- The gateway may have to apply data-dependent routing to select the appropriate remote domain for the service requested. (Data-dependent routing criteria for remote domains are defined in the Domains configuration file.)
- Different data formats may be used within different domains, depending on the networking protocols implemented or used in each domain.

Therefore a domain gateway always tries to decode any service request that is received encoded.

OSI terminology provides a useful distinction between abstract syntax (that is, the structure of the data) and transfer syntax (that is, the particular encoding used to transfer the data). Each typed buffer implicitly defines a particular data structure (that is, its abstract syntax) and the encoding rules (or typed buffer operations) required to map the data structure to a particular transfer syntax (for example, XDR).

The BEA Tuxedo system provides a set of predefined buffer types (STRING, CARRAY, FML, VIEW, X_C_TYPE, X_OCTET, X_COMMON, and XML) and the encoding rules required to map these types to the XDR transfer syntax.

Note: A programmer can supply a custom buffer type by adding an instance to the tm_typesw array in *TUXDIR*/lib/tmtypesw.c (see tuxtypes(5) and typesw(5)), and supplying routines for the new type (see buffer(3c)).

See Also

- "What Are Typed Buffers" on page 2-24 in *Introducing the BEA Tuxedo System*
- "Customizing a Buffer" on page 3-28 in *Programming a BEA Tuxedo Application Using C*
- tuxtypes(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*
- typesw(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

Defining Transaction and Blocking Timeouts in Domains

The BEA Tuxedo system provides two timeout mechanisms: a *transaction timeout* mechanism and a *blocking timeout* mechanism. The transaction timeout is used to define the duration of a transaction, which may involve several service requests. The timeout value is defined when the transaction is started (with tpbegin(3c)). The blocking timeout is used to define the duration of individual service requests, that is, how long the application is willing to wait for a reply to one service request.

The BEA Tuxedo transaction timeout mechanism is used unchanged in the Domains framework. Use of the same transaction timeout mechanism is necessary because domain gateways implement the TMS functionality and therefore are required to handle the TMS_TIMEOUT messages generated by the Bulletin Board Liaison (BBL).

Domain gateways, however, cannot use the BEA Tuxedo *blocking timeout* mechanism. The blocking timeout mechanism uses information stored in the registry slot assigned to each client or server. (Information in the registry slot is used by the local BBL to detect requesters that have been blocked for a time greater than BLOCKTIME.) Domain gateways, however, are multitasking servers that can process several service requests at a time, which means they cannot use the registry slot mechanism. When a blocking timeout condition arises, the domain gateway sends an error/failure reply message to the requester, and *cleans* any context associated with the service request.

Specifying How Your Domains Connect

You can specify the conditions under which a local domain gateway tries to establish a connection to a remote domain by selecting one of the following connection policies:

- Connect at boot time (ON_STARTUP)
- Connect when a client program requests a remote service (ON_DEMAND)
- Accept incoming connections but do not initiate a connection automatically (INCOMING_ONLY)

Determining the Availability of Remote Services with the Dynamic Status Feature

The gateway process (GWTDOMAIN) advertises those services that are imported from one or more remote domains in the bulletin board. These services typically remain advertised regardless of whether the remote service is reachable.

The capability of the BEA Tuxedo domain gateways known as Dynamic Status reports the status (as determined by the BEA Tuxedo system) of remote services.

When Dynamic Status is in effect, the status of a remote service depends on the status of the network connection between the local and remote gateways. Remote services are considered available whenever a connection to the domain on which they reside is available. When a network connection to a remote domain is not available, services in that domain are considered unavailable. This policy is invoked when the connection policy is `ON_STARTUP` (that is, when a local domain gateway tries to establish a connection to a remote domain at boot time) or `INCOMING_ONLY` (that is, when a local domain gateway does not try to establish a connection to remote domains upon starting).

For each service, the gateway keeps track, not only of the remote domains from which the service is imported, but also of which remote domains are available. In this way, the gateway provides intelligent load balancing of requests to remote domains. If all the remote domains from which a service is imported become unreachable, the service is suspended in the bulletin board.

For example, suppose a service called RSVC is imported from two remote domains, as specified by the following entries in the `DM_REMOTE_SERVICES` section of the configuration file:

```
RSVC RDOM=R1
RSVC RDOM=R2
```

When connections to both `R1` and `R2` are up, the gateway load balances requests for the `RSVC` service. If the connection to `R1` goes down, the gateway sends all requests for `RSVC` to `R2`. If both connections go down, the gateway suspends `RSVC` in the bulletin board. Subsequent requests for `RSVC` are either routed to a local service or another gateway, or fail with `TPENOENT`.

Note: When the connection policy is `ON_DEMAND`, a connection is attempted only when either a client requests a remote service or an administrative "connect" command is run.

How Your Connection Policy Affects Dynamic Status

Dynamic Status is not available in all Domains configurations; whether it is available depends on which connection policy you establish between your domains. The following table describes how each connection policy affects Dynamic Status.

Table 1-1 Availability of Dynamic Status

Under This Policy	Dynamic Status Is
ON_STARTUP	On. Services imported from a remote domain are advertised as long as a connection to that remote domain is active. A connection can be established in any of the following ways: ■ Automatically ■ Manual through the `dmadmin` command ■ Through an incoming connection
ON_DEMAND	Off. Services imported from remote domains are continually advertised. Ways in which a connection can be established are: ■ Client request ■ Manually through the `dmadmin command` ■ Through an incoming connection
INCOMING_ONLY	On. Remote services are initially suspended. A domain gateway is available for incoming connections from remote domains, and remote services are advertised when the local domain gateway receives an incoming connection or when a manual `connect` command is issued. A connection can be established in the following ways: ■ Manually through the `dmadmin` command ■ Through an incoming connection

What Is the Domains Configuration File

All domains configuration information is stored in a binary file called BDMCONFIG. You can create and edit a text version of this file, DMCONFIG, with any text editor. You can update the compiled BDMCONFIG file while the system is running by using the dmadmin(1) command when using Domains. In a multi-domain application, a separate BDMCONFIG file must be created for each participating domain.

System access to the BDMCONFIG file is provided through the Domains administrative server, DMADM(5). When a gateway group is booted, the gateway administrative server, GWADM(5), requests from the DMADM server, a copy of the configuration file required by that group. The GWADM and DMADM servers also ensure that run-time changes to the configuration are reflected in the corresponding domain gateway group.

Descriptions of Sections of the DMCONFIG File

Section of the DMCONFIG File	Purpose
DM_LOCAL_DOMAINS	Describes the environment for a particular domain gateway group. It assigns a logical application name, LDOM, to the subset of local services available to remote domains. You can use multiple entries in this section to define multiple gateway groups within a single BEA Tuxedo application. Each gateway group can provide access to domains of different types.
DM_REMOTE_DOMAINS	Identifies the remote domains available to clients and servers of this Domains application.
DM_LOCAL_SERVICES	Describes the local services provided by a local domain (LDOM) in the DM_LOCAL_DOMAINS section. Specification of services can also be used to restrict access to local services from remote domains; only services specified are available to remote domains.
DM_REMOTE_SERVICES	Describes the set of services provided by remote domains. It also names the local gateway group (through the LDOM parameter) that provides access to the remote service.

Section of the DMCONFIG File	Purpose
DM_ROUTING	Specifies criteria for data-dependent routing used by gateways to route service requests to specific remote domains.
DM_ACCESS_CONTROL	Specifies an Access Control List that names (via RDOMs) the remote domains permitted to request local services. The ACL parameter in the DM_LOCAL_SERVICES section, can be used by setting ACL=*name_of_list* to restrict access to a particular local service to the listed set of remote domains.
DM_*dmtype*	Defines the parameters required for a particular Domains configuration. Currently, the value of *dmtype* can be OSITP, SNAX, TOPEND, or TDOMAIN. This topic focuses only on TDOMAIN. Consult BEA eLink for Mainframe documentation for information about OSITP and SNAX. Consult *Using the BEA Tuxedo TOP END Domain Gateway* for information about TOPEND. Each domain type must be specified in a separate section. In a DM_TDOMAIN section, entries associated with a remote domain can be specified more than once, with different network addresses, to implement the *mirrored* gateway facility. (See DMCONFIG(5) for a description and an example of a mirrored gateway.)

Domains Terminology Improvements

In this release, some of the domains terminology is changing. The Domains MIB uses improved class and attribute terminology to describe the interaction between local and remote domains. While this improved terminology is more accurate than previous domains terminology, the scope of changes to domains-related documentation and error messages is limited in this release. The improved terminology has been applied to the DM_MIB classes, reference page, and error messages, the DMCONFIG file syntax, and various DMCONFIG error messages.

For backwards compatibility, aliases are provided between the DMCONFIG terminology used prior to this release and the improved Domains MIB terminology. In this release, DMCONFIG accepts both versions of the terminology. For details, see “Domains Terminology Improvements” in the DM_MIB(5) reference page.

See Also

- "Configuring a Domains Environment" on page 2-18
- `DMCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*
- "Converting the Domains Configuration File" on page 1-21

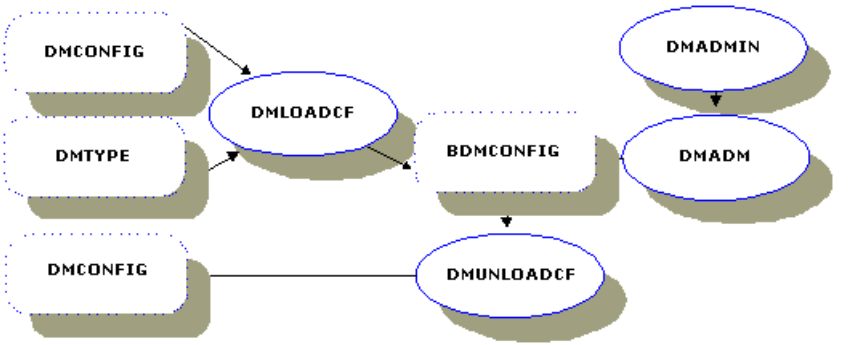
Converting the Domains Configuration File

This section provides instructions for converting a text version of a Domains configuration file (`DMCONFIG`) to a binary version (`BDMCONFIG`), and vice versa.

Converting DMCONFIG to a Binary File

The `dmloadcf(1)` command parses `DMCONFIG` (a text file), and loads the information about the Domains configuration into a binary file called `BDMCONFIG`. The command uses the environment variable `BDMCONFIG` to point to the directory in which the configuration should be stored. The `BDMCONFIG` file can be stored on the same device as the `TUXCONFIG` file (or the binary version of the `UBBCONFIG` file).

Figure 1-6 Relationships Between Configuration Commands and Files



The dmloadcf(1) command, through the -c option, also provides an estimate of the IPC resources needed for each local domain specified in the configuration.

As shown in the preceding figure, the dmloadcf command uses the $TUXDIR/udataobj/DMTYPE file. It checks the DMTYPE file to verify that the domain types specified in the configuration file are valid. Each Domains instantiation has a domain type. The type is used as a tag in the file *TUXDIR*/udataobj/DMTYPE. Each line in this file has the following format.

dmtype:access_module_lib:comm_libs:tm_typesw_lib:gw_typesw_lib

The file has the following entry for TDOMAIN:

```
TDOMAIN:-lgwt:-lnwi -lnws -lnwi::
```

Converting the BDMCONFIG File to a Text File

To unload a binary version of a Domains configuration file (that is, to convert it from binary to text format), run the dmunloadcf(1)command.

Features of BEA Tuxedo System Domains

- *Aliasing capability*—This feature allows you to define map service names between local and remote applications, allowing for easy integration of applications that use different naming schemes.
- *Availability*—You can specify alternate destinations to handle failure conditions.
- *Scalability and modular growth*—Programmers can structure their applications for modularity, isolation of failures, and independent growth. Interoperation with other transaction processing applications is achieved easily by adding to the Domains configuration the description of services used by a remote application.
- *Security*—An access control list (ACL) facility is provided to restrict access to local services from a particular set of remote domains. Domains also provides encryption and password verification.
- *Transparency and independence*—Application programmers need no knowledge of how services are distributed. A service may be available on the same machine as a client, on another machine in the local domain, or on a remote domain. Client application programmers do not need to know the implementation changes made to a service, the location of a service, network addresses, and so on.
- *Transaction management and reliability*—The Domains feature is integrated with the BEA Tuxedo transaction management capabilities.

CHAPTER

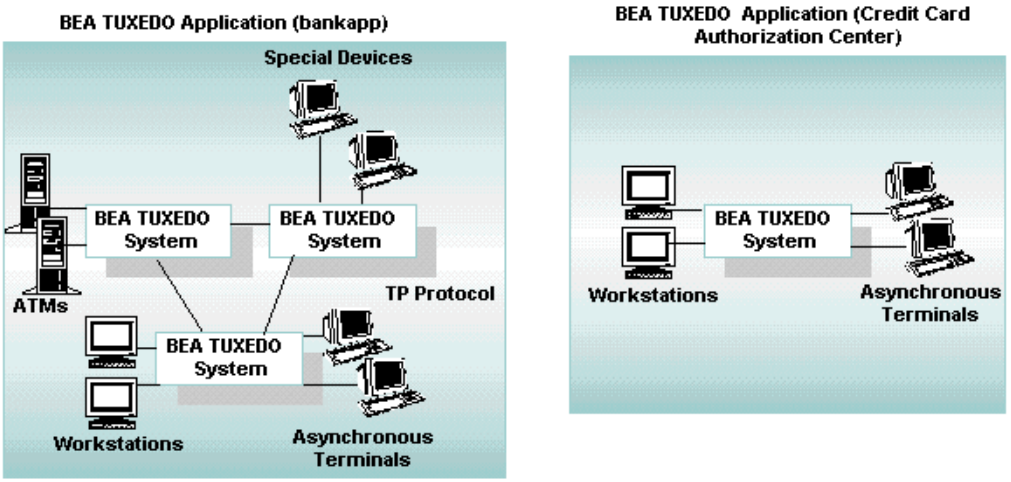
2 Planning and Configuring Domains

- Planning to Build Domains from Multiple BEA Tuxedo Applications
- Sample Domains Application: creditapp
- Configuring a Domains Environment
- How to Compress Data Between Domains
- How to Route Service Requests to Remote Domains
- Setting Up Security in Domains
- Configuring the Connections Between Your Domains
- Configuring Failover and Failback in a Domains Environment

Planning to Build Domains from Multiple BEA Tuxedo Applications

Suppose a bank has developed the two BEA Tuxedo applications shown in the following figure: bankapp and a credit card authorization center.

Figure 2-1 Two BEA Tuxedo Applications



The bankapp application connects ATMs at various bank branches to the central bank office. The Credit Card Authorization Center processes applications for credit cards. Over time, the bank realizes that their customers would be better served if the bankapp application could communicate directly with the credit card authorization application. In this way, they could offer instant credit cards to anyone opening a new account.

bankapp is distributed as a sample application with the BEA Tuxedo software. The credit card authorization application is a hypothetical extension of bankapp.

Take a look at the configuration file (represented in the following sample code) to see how to implement bankapp as a multiprocessor application: *TUXDIR*/apps/bankapp/ubbmp.

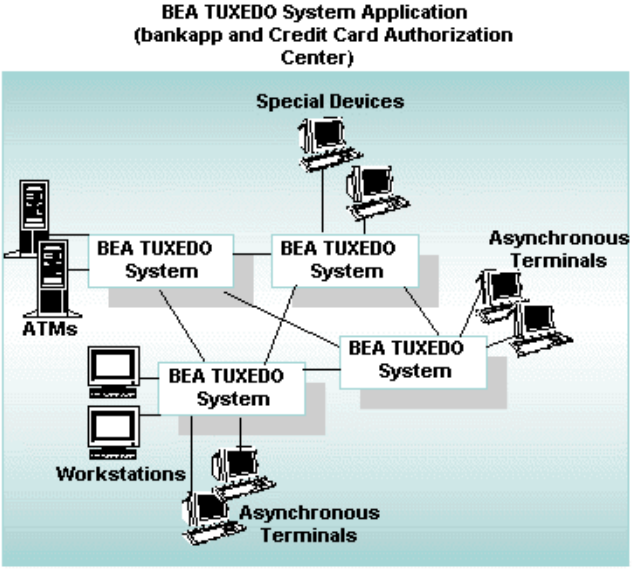
You have the following options:

- "Option 1: Reconfigure the Applications" on page 2-4
- "Option 2: Redefine the Applications as Separate BEA Tuxedo Domains" on page 2-9

Option 1: Reconfigure the Applications

One solution is to combine two BEA Tuxedo applications into one, as shown in the following figure.

Figure 2-2 Combining Two BEA Tuxedo System Applications



In the process of combining the two applications into a single configuration, the following changes are made:

- `OPTION=LAN` is specified and a `NETWORK` section is included.
- Server migration is enabled by specifying `OPTION=MIGRATE`; at the same time a backup master site is defined.
- The gateway server is redefined as three other servers: `TLRA`, `ACCTA`, and `CRDT`.
- Credit Authorization services are added.

Configuration File for Combining the Sample Applications

The following code shows a possible configuration file for the combined applications.

Listing 2-1 Sample Configuration File for the Combined Application

```
*RESOURCES
IPCKEY          76666
UID             0000
GID             000
PERM            0660
MAXACCESSERS    40
MAXSERVERS      35
MAXSERVICES     75
MAXCONV         10
MASTER          SITE1,SITE2
SCANUNIT        10
MODEL           MP
LDBAL           Y
OPTIONS         LAN,MIGRATE
MAXGTT          100
MAXBUFTYPE      16
SCANUNIT        10
SANITYSCAN      5
DBBLWAIT        6
BBLQUERY        50
BLOCKTIME       2
#
#
*MACHINES
#
mach1 LMID=SITE1
                TUXDIR="/home/mylogin/tuxroot"
                APPDIR="/home/mylogin/bankapp"
                ENVFILE="/home/mylogin/bankapp/ENVFILE"
                TLOGDEVICE="/home/mylogin/bankapp/TLOG"
                TLOGNAME=TLOG
                TUXCONFIG="/home/mylogin/bankapp/tuxconfig"
                ULOGPFX="/home/mylogin/bankapp/ULOG"
                TYPE="type1"
#
mach2 LMID=SITE2
                TUXDIR="/home/mylogin/tuxroot"
```

```
                APPDIR="/home/mylogin/bankapp"
                ENVFILE="/home/mylogin/bankapp/ENVFILE"
                TLOGDEVICE="/home/mylogin/bankapp/TLOG"
                TLOGNAME=TLOG
                TUXCONFIG="/home/mylogin/bankapp/tuxconfig"
                ULOGPFX="/home/mylogin/bankapp/ULOG"
                TYPE="type2"
#
mach3 LMID=SITE3
                TUXDIR="/home/mylogin/tuxroot"
                APPDIR="/home/mylogin/bankapp"
                ENVFILE="/home/mylogin/bankapp/ENVFILE"
                TLOGDEVICE="/home/mylogin/bankapp/TLOG"
                TLOGNAME=TLOG
                TUXCONFIG="/home/mylogin/bankapp/tuxconfig"
                ULOGPFX="/home/mylogin/bankapp/ULOG"
                TYPE="type2"
#
mach4 LMID=SITE4
                TUXDIR="/home/mylogin/tuxroot"
                APPDIR="/home/mylogin/bankapp"
                ENVFILE="/home/mylogin/bankapp/ENVFILE"
                TLOGDEVICE="/home/mylogin/bankapp/TLOG"
                TLOGNAME=TLOG
                TUXCONFIG="/home/mylogin/bankapp/tuxconfig"
                ULOGPFX="/home/mylogin/bankapp/ULOG"
                TYPE="type1"
#
*GROUPS
#
DEFAULT:  TMSNAME=TMS_SQL    TMSCOUNT=2
BANKB1    LMID=SITE1         GRPNO=1
OPENINFO="TUXEDO/SQL:/home/mylogin/bankapp/bankdl1:bankdb:readwrite"
BANKB2              LMID=SITE2         GRPNO=2
OPENINFO="TUXEDO/SQL:/home/mylogin/bankapp/bankdl2:bankdb:readwrite"
BANKB3              LMID=SITE3         GRPNO=3
OPENINFO="TUXEDO/SQL:/home/mylogin/bankapp/bankdl3:bankdb:readwrite"
BANKB4    LMID=SITE4         GRPNO=4
OPENINFO="TUXEDO/SQL:/home/mylogin/bankapp/bankdl4:bankdb:readwrite"
#
#
*NETWORK
#
SITE1     NADDR="<network address of SITE1>"
          BRIDGE="<device of provider1>"
          NLSADDR="<network listener address of SITE1>"
SITE2     NADDR="<network address of SITE2>"
          BRIDGE="<device of provider2>"
          NLSADDR="<network listener address of SITE2>"
```

```
SITE3    NADDR="<network address of SITE3>"
         BRIDGE="<device of provider3>"
         NLSADDR="<network listener address of SITE3>"
SITE4    NADDR="<network address of SITE4>"
         BRIDGE="<device of provider4>"
         NLSADDR="<network listener address of SITE4>"
#
*SERVERS
#
DEFAULT: RESTART=Y MAXGEN=5 REPLYQ=Y CLOPT="-A"
# Servers for the bankapp part
TLR      SRVGRP=BANKB1   SRVID=2
TLR      SRVGRP=BANKB2   SRVID=3         RQADDR=tlr2       CLOPT="-A -- -T 600"
TLR      SRVGRP=BANKB3   SRVID=4
XFER     SRVGRP=BANKB1   SRVID=10
XFER     SRVGRP=BANKB2   SRVID=6
XFER     SRVGRP=BANKB3   SRVID=8
ACCT     SRVGRP=BANKB1   SRVID=11
ACCT     SRVGRP=BANKB2   SRVID=7
ACCT     SRVGRP=BANKB3   SRVID=13
BTADD    SRVGRP=BANKB1   SRVID=12
BTADD    SRVGRP=BANKB2   SRVID=14
BTADD    SRVGRP=BANKB3   SRVID=16
# Servers for the Credit Authorization Part
TLRA     SRVGRP=BANKB4   SRVID=5                            CLOPT="-A -- -T 600"
ACCTA    SRVGRP=BANKB4   SRVID=9
CRDT     SRVGRP=BANKB4   SRVID=15
#
#
*SERVICES
#
DEFAULT:         LOAD=50         AUTOTRAN=N
# Services for the bankapp part
BR_ADD           PRIO=20         ROUTING=BRANCH_ID
TLR_ADD          PRIO=20         ROUTING=BRANCH_ID
WITHDRAWAL       PRIO=50         ROUTING=ACCOUNT_ID
DEPOSIT          PRIO=50         ROUTING=ACCOUNT_ID
TRANSFER         PRIO=50         ROUTING=ACCOUNT_ID
INQUIRY          PRIO=50         ROUTING=ACCOUNT_ID
CLOSE_ACCT       PRIO=40         ROUTING=ACCOUNT_ID
OPEN_ACCT        PRIO=40         ROUTING=BRANCH_ID
# Services for the Credit Authorization part
WITHDRAWALA      PRIO=50
INQUIRYA         PRIO=50
OPENCA           PRIO=40
CLOSECA          PRIO=40
DEPOSITA         PRIO=50
OPEN_ACCT2       PRIO=40
OPENC            PRIO=40
```

```
#
#
*ROUTING
#
ACCOUNT_ID          FIELD=ACCOUNT_ID
                    BUFTYPE="FML"
                    RANGES="10000-39999:BANKB1,
                             40000-69999:BANKB2,
                             70000-109999:BANKB3,
                             *:*"
BRANCH_ID       FIELD=BRANCH_ID
                    BUFTYPE="FML"
                    RANGES="1-3:BANKB1,
                             4-6:BANKB2,
                             7-10:BANKB3,
                             *:*"
#
```

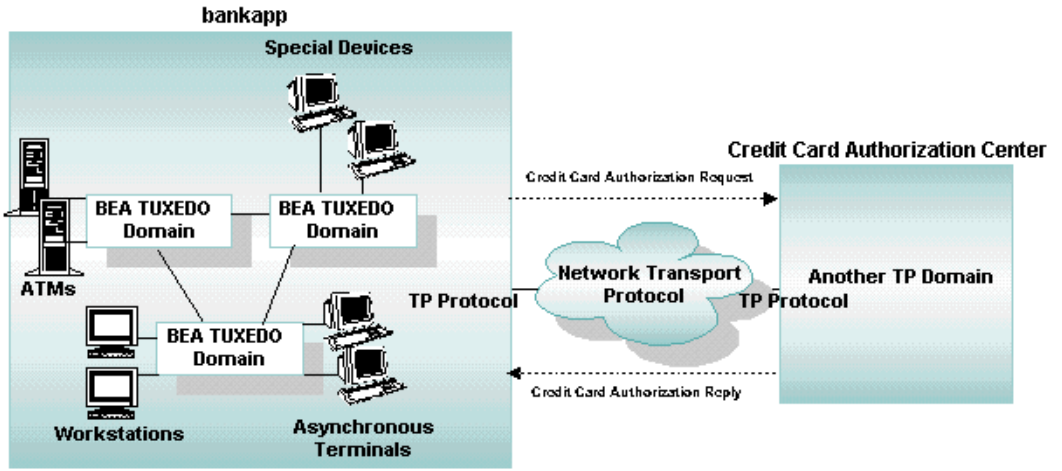
Limitations of Option 1

- Administering a single large application can be more cumbersome than administering two smaller ones; each smaller one has its own administrative interface.
- Booting a networked application can be more costly because of the time required to boot each server and because of the need to propagate bulletin boards across the network. Smaller, separate applications can be booted simultaneously.

Option 2: Redefine the Applications as Separate BEA Tuxedo Domains

The following figure shows the combined application reconfigured as four BEA Tuxedo domains (TDomains). (Three of the domains are in the left-hand box.)

Figure 2-3 Domains Configuration



Modifying the Application Configuration Files

To reconfigure the combined application as TDOMAINs, make the following changes to the `UBBCONFIG` files:

- Change `MODEL` to `SHM`.
- Remove the `NETWORK` section.

  Note: You can use `MP` mode and also write the `NETWORK` section in a muliple domain environment depending on your specific application needs.

- Add domain-specific servers, for example `DMADM`, `GWADM`, and `GWTDOMAIN`, to the `SERVERS` section.

The following code shows a sample converted UBBCONFIG file.

Listing 2-2 Converted UBBCONFIG File

```
*RESOURCES
IPCKEY          76666
UID             7901
GID             601
PERM            0660
MAXACCESSERS    40
MAXSERVERS      35
MAXSERVICES     75
MAXCONV         10
MASTER          SITE1
SCANUNIT        10
MODEL           SHM
LDBAL           Y
MAXGTT          100
MAXBUFTYPE      16
SCANUNIT        10
SANITYSCAN      5
BBLQUERY        50
BLOCKTIME       2
#
*MACHINES
sfexpz          LMID=SITE1
                TUXDIR="/home/mylogin/tuxroot"
                APPDIR="/home/mylogin/creditapp"
                ENVFILE="/home/mylogin/creditapp/ENVFILE"
                TLOGDEVICE="/home/mylogin/creditapp/TLOG"
                TLOGNAME=TLOG
                TUXCONFIG="/home/mylogin/creditapp/tuxconfig"
                ULOGPFX="/home/mylogin/creditapp/ULOG"
                TYPE="type1"
#
#
#
*GROUPS
DEFAULT:        LMID=SITE1
BANKB1          GRPNO=1  TMSNAME=TMS_SQL         TMSCOUNT=2
OPENINFO="TUXEDO/SQL:/home/mylogin/creditapp/crdtdl1:bankdb:readwrite"
BANKB2          GRPNO=2
BANKB3          GRPNO=3
BANKB4          GRPNO=4
DMADMGRP  LMID=mach1 GRPNO=5
#
#
```

```
#
*SERVERS
#
DEFAULT: RESTART=Y MAXGEN=5 REPLYQ=Y CLOPT="-A"
GWADM           SRVGRP=BANKB2    SRVID=30
                REPLYQ = N RESTART = Y GRACE = 0
GWTDOMAIN       SRVGRP=BANKB2    SRVID=31
                REPLYQ = N RESTART = Y GRACE = 0
GWADM           SRVGRP=BANKB3    SRVID=24
                REPLYQ = N RESTART = Y GRACE = 0
GWTDOMAIN       SRVGRP=BANKB3    SRVID=25
                REPLYQ = N RESTART = Y GRACE = 0
GWADM           SRVGRP=BANKB4    SRVID=20
                REPLYQ = N RESTART = Y GRACE = 0
GWTDOMAIN       SRVGRP=BANKB4    SRVID=21
                REPLYQ = N RESTART = Y GRACE = 0
DMADM           SRVGRP="DMADMGRP"   SRVID=50
                REPLYQ = N RESTART = Y GRACE = 0
TLRA      SRVGRP=BANKB1  SRVID=2         CLOPT="-A -- -T 100"
BTADD     SRVGRP=BANKB1  SRVID=3
ACCTA     SRVGRP=BANKB1  SRVID=4
CRDT      SRVGRP=BANKB1  SRVID=5
CRDTA     SRVGRP=BANKB1  SRVID=6
*SERVICES
DEFAULT:        LOAD=50
INQUIRYA        PRIO=50
WITHDRAWALA     PRIO=50
OPEN_ACCT2      PRIO=40
OPENC           PRIO=40
OPENCA          PRIO=40
CLOSECA         PRIO=40
BR_ADD          PRIO=20
TLR_ADD         PRIO=20
```

Adding DMCONFIG Files

You also need to create four DMCONFIG files, as shown in the following sample.

Listing 2-3 Sample DMCONFIG File

```
#
#
*DM_LOCAL_DOMAINS
#
#
QDOM1   GWGRP=BANKB2
        TYPE=TDOMAIN
        DOMAINID=QDOM1
        BLOCKTIME=10
        MAXDATALEN=56
        MAXRDOM=89
        DMTLOGDEV="/home/mylogin/creditapp/DMTLOG"
        AUDITLOG="/home/mylogin/creditapp/AUDITLOG"

QDOM2   GWGRP=BANKB3
        TYPE=TDOMAIN
        DOMAINID=QDOM2
        BLOCKTIME=10
        MAXDATALEN=56
        MAXRDOM=89
        DMTLOGDEV="/home/mylogin/creditapp/DMTLOG"
        AUDITLOG="/home/mylogin/creditapp/AUDITLOG"
        DMTLOGNAME="DMTLOG_TDOM2"
QDOM3   GWGRP=BANKB4
        TYPE=TDOMAIN
        DOMAINID=QDOM3
        BLOCKTIME=10
        MAXDATALEN=56
        MAXRDOM=89
        DMTLOGDEV="/home/mylogin/creditapp/DMTLOG"
        AUDITLOG="/home/mylogin/creditapp/AUDITLOG"
        DMTLOGNAME="DMTLOG_TDOM3"
#
*DM_REMOTE_DOMAINS
#
#
TDOM1   TYPE=TDOMAIN
        DOMAINID=TDOM1
```

```
TDOM2   TYPE=TDOMAIN
        DOMAINID=TDOM2

TDOM3   TYPE=TDOMAIN
        DOMAINID=TDOM3
#
#
*DM_TDOMAIN
#
QDOM1    NWADDR="0x0002DEEF93026927"
         NWDEVICE="/dev/tcp"
QDOM2    NWADDR="0x0002BEEF93026927"
         NWDEVICE="/dev/tcp"
QDOM3    NWADDR="0x0002CEEF93026927"
         NWDEVICE="/dev/tcp"
TDOM1    NWADDR="0x0002DEEF93026947"
         NWDEVICE="/dev/null"
TDOM2    NWADDR="0x0002BEEF9302691D"
         NWDEVICE="/dev/tcp"
TDOM3    NWADDR="0x0002CEEF9302690E"
         NWDEVICE="/dev/tcp"
#
#
#
*DM_LOCAL_SERVICES
#
#
WITHDRAWALA
INQUIRYA
OPENCA
CLOSECA
```

Sample Domains Application: creditapp

A sample application, `creditapp`, is distributed with the BEA Tuxedo system. `creditapp` is a runnable version of the hypothetical application that was the basis for separating `bankapp` and the credit card application into domains, as discussed earlier in this topic.

The application is located in *`TUXDIR`*`/apps/creditapp` and includes the following files.

Listing 2-4 creditapp Files

```
ACCT.ec         ACCTA.ec        AUDITC.c        BAL.ec          BALANCE.m
BALANCEA.m      BALC.ec         BTADD.ec        CBALANCE.m      CCLOSE.m
CDEPOSIT.m      CLOSE.m         COPEN.m         CRDT.ec         CRDTA.ec
CRMENU.m        CRMENU2.m       CTRANSFER.m     CWITHDRAW.m     DEPOSIT.m
DEPOSITA.m      FILES           HCBALANCE.m     HCCLOSE.m       HCLOSE.m
HCOPEN.m        HCWITHDRAW.m    HELP.m          HOPEN.m         OPEN.m
README          RUNME           RUNME.sh        SETUP.sh        TLR.ec
TLR1.ec         TLR2.ec         TLR3.ec         TLRA.ec         TRANSFER.m
WITHDRAW.m      WITHDRAWA.m     XFER.c          appinit.c       aud.h
aud.v           audit.c         auditcon.c      bank.flds       bank.flds.h
bank.h          cleanup.sh      crbank.sh       crbankdb.sh     crdt_app.mk
crdt_app2.mk    crdt_app3.mk    crdt_app4.mk    crdt_flds.h     crdtvar
crdtvar2        credit.flds     crtlog.sh       crtlog2         crtlog2.sh
domcon1         domcon2         domcon3         domcon4         driver.sh
envfile.sh      gendata.c       gentran.c       hostmk          listnr
populate.sh     run.sh          setenv          ubbdom1         ubbdom2
ubbdom3         ubbdom4         util.c
```

The creditapp README File

The following `README` file is from the `creditapp` directory. The `README` file documents a script that installs and runs `creditapp`. It has been edited to include a few things that were not included in the original script.

Listing 2-5 README File for creditapp

```
SIMPLE BUILD PROCEDURE

The creditapp application is an enhancement of the
bankapp and hostapp applications.

The creditapp application is designed to be a four domain application,
so the software must be built on four machines. The RUNME.sh
script will lead you through the necessary steps.


Step 1: Copy the Software for creditapp.

Make a new directory under your $HOME directory and copy all of
the source files from <TUXDIR>/apps/creditapp into that directory.
```

```
TUXDIR is the root directory under which your BEA TUXEDO System
software is installed. We call the new directory
$HOME /creditapp. The rest of the steps in this procedure are
done in the directory $HOME/creditapp.


Step 2: On each of the remaining three machines:

Make a directory creditapp in a directory that can be used for the application.

We call this directory $HOME/creditapp.

Make a note of the full directory path for $HOME/creditapp and TUXDIR
for each machine. These will be needed by the RUNME.sh script.


Step 3: On the “master site” execute the “RUNME.sh” script.

The shell script “RUNME.sh” is an interactive program designed to
lead you through initialization, booting, shutdown and cleanup
of the four domain creditapp application. The shell is interactive
and requires no command line arguments. All you need in the directory
is the source from the TUXDIR/apps/creditapp directory that you
copied in Step 1.

You will be prompted to enter values for RSH and RCP
environment variables, or accept the defaults.

IT IS VERY IMPORTANT THAT VALUES FOR RSH AND RCP BE ENTERED AS THEY ARE
USED TO REMOTE COPY AND EXECUTE THE NECESSARY SCRIPTS.

The following environment variables are important. The script picks up
the values for TUXDIR and APPDIR from your environment and
prompts you (in OPTION 4) for BLKSIZE:

TUXDIR         Root directory of the BEA TUXEDO System where you have
                 installed the software.

APPDIR          Directory in which the creditapp application resides.
                 crdtvar.dm1 initially is set to allow this to default
                 to the current working directory, which agrees with
                 our intention to use $HOME/creditapp. This is the
                 directory into which you copied the creditapp files in
                 Step 1.

BLKSIZE         Logical blocksize for the database in bytes.
                 Must be an integral multiple of the physical
                page size of the computer (for example, 512 bytes or 4096 bytes).

When you invoke RUNME.sh you are shown a menu with 10 options (11 counting “quit”).
Here is the list of choices:
```

```
          1) Initialize configuration files and makefiles.
          2) Copy files to remote sites.
          3) Build crdtapp clients and servers.
          4) Create databases.
          5) Generate binary tuxconfig and bdmconfig files.
          6) Create Transaction Log file.
          7) Boot the application.
          8) Populate the database.
          9) Shutdown the application.
          10) Cleanup IPC Resources, database files and log files.
          q) Quit.

To go through the complete process of building and running the sample
application, start with choice No. 1. When the script completes a step,
the menu is displayed for your next choice.


OPTION 1. Initialize configuration files and makefiles.
          This option sets up makefiles, UBBCONFIG and DMCONFIG files that are
          necessary for the application.

          All questions must be answered.

          ENTER the system name: enter uname for machines you are using
                                 beginning with the current machine you are on.


          ENTER TUXDIR for each machine.

          ENTER APPDIR for each machine.


          Continue to answer all queries.


          An example of 4 hexadecimal digits may be (beef, cfff, 6774, aeef).
NOTE: EACH MACHINE MUST HAVE A UNIQUE HEX SEQUENCE.


OPTION 2. Copies the files to the other domains in the configuration.


OPTION 3. Builds clients and servers on all machines.

          NOTE: CAREFULLY CHECK THAT THE BUILDS ARE COMPLETED SUCCESSFULLY ON
                EACH SITE. IF NECESSARY YOU MAY RUN THE BUILD YOURSELF.

                ON THE SPECIFIC SITE ENTER
                nohup make -f CRDT{$MACH}.mk2
```

```
                where ${MACH} is the uname for the machine you are building on.
                For example,

                        nohup make -f CRDTtux1.mk2

OPTION 4. Builds the databases on each site.

          NOTE: ON EACH SITE MAKE SURE THE BLKSIZE VALUE IN files

                crdt${MACH}.dm1 for the primary site

                or crdt${MACH}.dm2 for the remote sites

                where ${MACH} is the uname for the machine you are building on

                ARE CORRECT FOR THAT SPECIFIC MACHINE

OPTION 5. Generates the tuxconfig and bdmconfig files.

All other options are similar to bankapp.

After OPTION 8 : Populate the database

                  Enter q to Quit the menu.

RUNNING CREDITAPP.
_____________________

            On each machine a script run.sh exists.

            Execute run.sh.

            run
At the response :

               Is this machine the Credit Card Authorization Center(y/n)?

               If machine is the primary machine answer y .
               If machine is any other answer n.

On the primary machine a different menu will be seen than the other 3 machines.

All Credit accounts exist on primary machine and all machines can access any
account.

            ACCOUNTS 10000000 - 120000000
```

```
Machines 2,3,4 are the enhanced bankapp application.

            ACCOUNTS 10000 - 39999 exist on machine 2
            ACCOUNTS 40000 - 79999 exist on machine 3
            ACCOUNTS 80000 - 109999 exist on machine 4

All processing is done using the /DOMAIN software.

A tail -f of the ULOG###### will show the actual processing of the requests.

On the machine that will process the request enter :

           tail -f ULOG###### where ###### is today's date.
```

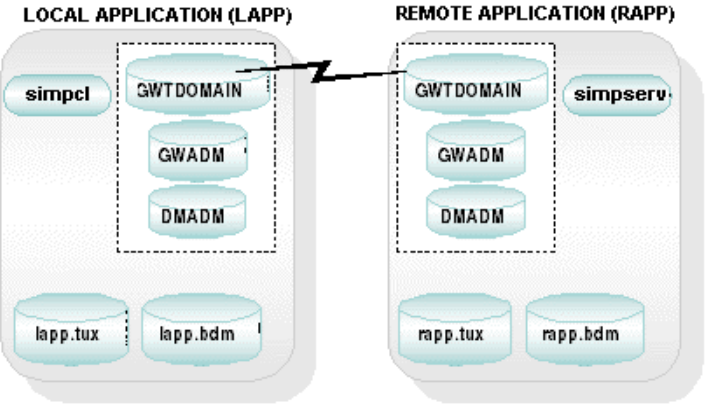
Configuring a Domains Environment

To configure a Domains environment, an administrator needs to specify all the information a BEA Tuxedo domain needs to know about other domains. This information includes services imported from other domains, addressing and security parameters for contacting remote domains, access control lists, services exported to these domains, whether data-dependent routing is used, and parameters for controlling access to exported services. This information is defined in the `UBBCONFIG` configuration file and in the `DMCONFIG` configuration file.

Configuring a Sample Domains Application (simpapp)

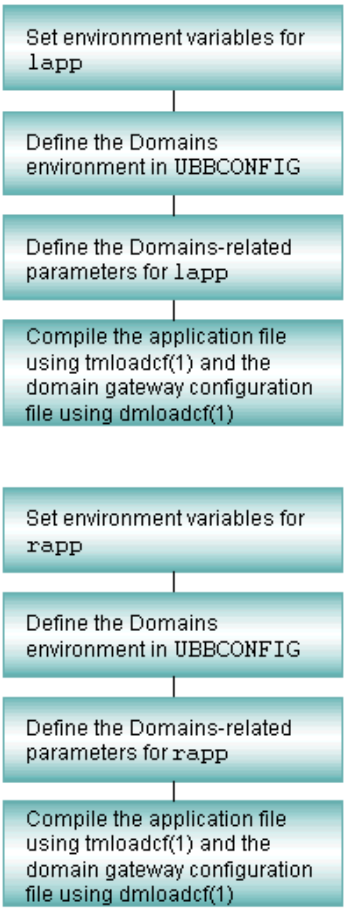
The Domains example illustrated in the following figure consists of two applications: `lapp`, a *local application*, and `rapp`, a *remote application*. Both are based on the `simpapp` example provided with the BEA Tuxedo system. `lapp` is configured to allow its clients to access a service called `TOUPPER`, which is advertised in `rapp`.

Figure 2-4 Local and Remote Applications in simpapp



Configuration Tasks

The following tasks are required to configure the `simpapp` domain consisting of two applications: `lapp` (the local application) and `rapp` (the remote application).



How to Set Environment Variables for lapp

You need to set the following environment variables for the application to be configured successfully:

- TUXDIR—The BEA Tuxedo system root directory (for example, /opt/tuxedo)
- TUXCONFIG—The application configuration file (for example, lapp.tux)
- BDMCONFIG—The domain gateway configuration file (for example, lapp.bdm)
- PATH—Must include *TUXDIR*/bin
- LD_LIBRARY_PATH—Must include *TUXDIR*/lib (this path name varies, depending on your operating system)

Example

```
$ TUXDIR=/opt/tuxedo
$ TUXCONFIG=/home/lapp/lapp.tux
$ BDMCONFIG=/home/lapp/lapp.dom
$ PATH=$TUXDIR/bin:$PATH
$ LD_LIBRARY_PATH=$TUXDIR/lib:$LD_LIBRARY_PATH
$ export TUXDIR TUXCONFIG BDMCONFIG PATH LD_LIBRARY_PATH
```

How to Define the Domains Environment for lapp (in the ubbconfig File)

For the sample local application configuration file, `lapp.ubb`, only the required parameters are defined. Default settings are used for the other parameters.

Two server groups are defined:

- The first group contains the Domains administrative server (`DMADM`).
- The second group contains the gateway administrative server (`GWADM`) and the domain gateway (`GWTDOMAIN`).

  Note: For a gateway type other than `GWTDOMAIN`, an executable other than `GWTDOMAIN` must be used. Refer to the BEA eLink for Mainframe documentation and *Using the BEA Tuxedo TOP END Domain Gateway* for additional information.

Server Definitions

- `DMADM`—The Domains administrative server enables run-time modification of the configuration information, required by domain gateway groups, that resides in the binary Domains configuration file. `DMADM` supports a list of registered gateway groups. There must be only one instance of `DMADM` per Domains application.
- `GWADM`—The gateway administrative server enables run-time administration of a particular domain gateway group. This server gets Domains configuration information from the `DMADM` server. It also provides administrative functionality and transaction logging for the gateway group.
- `GWTDOMAIN`—The Domains gateway server enables access to and from remote Domains, allowing interoperability of two or more BEA Tuxedo domains. Information about the local and remote services it needs to export and import is included in the Domains configuration file. The Domains gateway server should always be configured with `REPLYQ=N`.

Example of an Application Configuration File for lapp

Listing 2-6 Example of an Application Configuration File (lapp.ubb)

```
# lapp.ubb
#
*RESOURCES
IPCKEY          111111

MASTER          LAPP
MODEL           SHM

*MACHINES
giselle

                LMID=LAPP
                TUXDIR="/opt/tuxedo"
                APPDIR="/home/lapp"
                TUXCONFIG="/home/lapp/lapp.tux"

*GROUPS

LDMGRP          GRPNO=1 LMID=LAPP
LGWGRP          GRPNO=2 LMID=LAPP

*SERVERS

DMADM           SRVGRP=LDMGRP SRVID=1
GWADM           SRVGRP=LGWGRP SRVID=1
GWTDOMAIN       SRVGRP=LGWGRP SRVID=2 REPLYQ=N

*SERVICES
```

How to Define Domains Parameters for lapp (in the DMCONFIG File)

For the sample local Domain gateway configuration file, `lapp.dom`, only the required parameters are defined. Default settings are used for optional parameters.

The `DM_LOCAL_DOMAIN` section identifies the local domains and their associated gateway groups. This section has one entry, `LAPP`, and specifies the following parameters required for the domain gateway processes in that group:

- `GWGRP` specifies the name of the gateway server group as specified in the application.
- `TYPE` of `TDOMAIN` indicates that the local domain will be communicating with another BEA Tuxedo domain. This parameter indicates the protocol used by the gateways. Other options include SNA, OSI TP, TOP END Domain gateway, TCP for CICS, and TCP for IMS.
- `DOMAINID` identifies the name of the domain gateway and must be unique across all domains.

The `DM_REMOTE_DOMAINS` section identifies the known set of remote domains and their characteristics. This section has one entry (`RAPP`). `TYPE` is used to classify the type of domains. `DOMAINSID` is a unique domain identifier.

The `DM_TDOMAIN` section defines the addressing information required by the BEA Tuxedo Domains component. Following are entries in the section for each local and remote domain specified in this configuration file:

- `NWADDR` specifies either the network address at which connections will be accepted from other BEA Tuxedo domains (local domain entry), or the network address at which connections to other BEA Tuxedo domains will be made (remote domain entry).

The `DM_LOCAL_SERVICES` section provides information about the services that are exported. This section of our sample file has no entries because no services are being exported.

The DM_REMOTE_SERVICES section provides information about the services that are imported. The TOUPPER service is imported so that it can be accessed by clients in the local domain.

Example of a Domain Gateway Configuration File for lapp

Listing 2-7 Example of a Domain Gateway Configuration File (lapp.dom)

```
#
# lapp.dom
#
*DM_LOCAL_DOMAINS

LAPP          GWGRP=LGWGRP
              TYPE=TDOMAIN
              DOMAINID=”111111"

*DM_REMOTE_DOMAINS

RAPP          TYPE=TDOMAIN
              DOMAINID=”222222"

*DM_TDOMAIN

LAPP           NWADDR=”//mach1:5000"

RAPP           NWADDR=”//mach2:5000"

*DM_LOCAL_SERVICES

*DM_REMOTE_SERVICES

TOUPPER
```

How to Compile Application and Domains Gateway Configuration Files for lapp

The local application configuration file (`lapp.ubb`) contains the information necessary to boot the local application. You must compile this file into a binary data file (`lapp.tux`) by running `tmloadcf(1)`.

The local domain gateway configuration file (`lapp.dom`) contains the information used by the domain gateway for one domain for communication with other domains. You must compile this file into a binary data file (`lapp.bdm`) by running `dmloadcf(1)`.

To compile both configuration files, complete the procedure shown in the following sample session.

```
$ cd /home/lapp
$ TUXCONFIG=/home/lapp/lapp.tux; export TUXCONFIG
$ tmloadcf -y lapp.ubb
$ BDMCONFIG=/home/lapp/lapp.dom; export BDMCONFIG
$ dmloadcf -y lapp.dom
```

Once you create both the local and remote domains, you can then boot the application using `tmboot(1)`. The order in which the two domains are booted does not matter. Monitor the applications with `dmadmin(1)`. Once both applications are booted, a client in the local application can call the `TOUPPER` service residing in the remote application.

```
$ tmboot -y
```

How to Set Environment Variables for rapp

You must set the following environment variables for an application to be configured successfully:

- TUXDIR—The BEA Tuxedo system root directory (for example, /opt/tuxedo)
- TUXCONFIG—The full path name of the application configuration file (for example, rapp.tux)
- BDMCONFIG—The full path name of the domain gateway configuration file (for example, rapp.bdm)
- PATH—Must include *TUXDIR*/bin
- LD_LIBRARY_PATH—Must include *TUXDIR*/lib (this path name varies, depending on your operating system)

Example

```
$ TUXDIR=/opt/tuxedo
$ TUXCONFIG=/home/rapp/rapp.tux
$ BDMCONFIG=/home/rapp/rapp.dom
$ PATH=$TUXDIR/bin:$PATH
$ LD_LIBRARY_PATH=$TUXDIR/lib:$LD_LIBRARY_PATH
$ export TUXDIR PATH LD_LIBRARY_PATH TUXCONFIG BDMCONFIG
```

How to Define the Domains Environment for rapp (in the UBBCONFIG File)

For the sample remote application configuration file, `rapp.ubb`, only the required parameters are defined. Default settings are used for optional parameters.

The following three server groups are defined:

- The first server group (`SRVGP=RDMGRP`) contains the Domains administrative server (`DMADM`).
- The second server group (`SRVGP=RGWGRP`) contains the gateway administrative server, `GWADM`, and the domain gateway, `GWTDOMAIN`.
- The third server group (`SRVGP=APPGRP`) contains the application server `simpserv`.

The following four servers are defined:

- `DMADM`—Domains administrative server
- `GWADM`—Gateway administrative server
- `GWTDOMAIN`—Domains gateway server
- `simpserv`—Application server for `simpapp` that advertises the `TOUPPER` service, which converts strings from lowercase to uppercase characters

Example of an Application Configuration File for rapp

Listing 2-8 Example of an Application Configuration File (rapp.ubb)

```
# rapp.ubb
#
*RESOURCES
IPCKEY          222222

MASTER          RAPP

MODEL           SHM

*MACHINES

juliet

                LMID=RAPP
                TUXDIR="/opt/tuxedo"
                APPDIR="/home/rapp"
                 TUXCONFIG="/home/rapp/rapp.tux"

*GROUPS

RDMGRP          GRPNO=1 LMID=RAPP
RGWGRP          GRPNO=2 LMID=RAPP
APPGRP          GRPNO=3 LMID=RAPP

*SERVERS

DMADM           SRVGRP=RDMGRP SRVID=1
GWADM           SRVGRP=RGWGRP SRVID=1
GWTDOMAIN       SRVGRP=RGWGRP SRVID=2 REPLYQ=N
simpserv        SRVGRP=APPGRP SRVID=1

*SERVICES
TOUPPER
```

How to Define Domains Parameters for rapp (in the DMCONFIG File)

For the sample remote Domain gateway configuration file, `rapp.dom`, only the required parameters are defined. Default settings are used for optional parameters.

This configuration file is similar to the local Domains gateway configuration file. The difference is that the two files list different services to be exported and imported.

The `DM_LOCAL_SERVICES` section provides information about the services exported by each local domain. In this example, the `TOUPPER` service is exported and included in the `DM_LOCAL_SERVICES` section. No service is imported so there are no entries in the `DM_REMOTE_SERVICES` section of our sample file.

Example of a Domain Gateway Configuration File for rapp

Listing 2-9 Example of a Domain Gateway Configuration File (rapp.dom)

```
# rapp.dom
#

*DM_LOCAL_DOMAINS

RAPP        GWGRP=RGWGRP
            TYPE=TDOMAIN
            DOMAINID=”222222"

*DM_REMOTE_DOMAINS

LAPP        TYPE=TDOMAIN
            DOMAINID=”111111"

*DM_TDOMAIN

RAPP        NWADDR=”//mach2:5000"

LAPP        NWADDR=”//mach1:5000"
```

```
*DM_LOCAL_SERVICES
TOUPPER
*DM_REMOTE_SERVICES
```

How to Compile Application and Domain Gateway Configuration Files for rapp

The remote application configuration file (`rapp.ubb`) contains the information used by the domain gateway for one domain, for communication with other domains. You must compile this file into a binary data file (`rapp.tux`).

The remote domain gateway configuration file (`rapp.dom`) contains the information used by domain gateways to initialize the context required for communications with other domains. This configuration file is similar to the local domain gateway configuration file. The difference is that the two files list different services to be exported and imported. You must compile this file into a binary data file (`rapp.bdm`).

```
$ cd /home/rapp
$ TUXCONFIG=/home/rapp/rapp.tux; export TUXCONFIG
$ tmloadcf -y rapp.ubb
$ BDMCONFIG=/home/rapp/rapp.dom; export BDMCONFIG
$ dmloadcf -y rapp.dom
```

Once you create both the local and remote domains, you can then boot the application using `tmboot(1)`. The order in which the two domains are booted does not matter. Monitor the applications with `dmadmin(1)`. Once both applications are booted, a client in the local application can call the `TOUPPER` service residing in the remote application.

```
$ tmboot -y
```

See Also

- “What Is the Domains Configuration File” on page 1-19
- “How to Compress Data Between Domains” on page 2-32
- “How to Route Service Requests to Remote Domains” on page 2-32

- "Converting the Domains Configuration File" on page 1-21
- DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*
- UBBCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

How to Compress Data Between Domains

Data sent between domains can be compressed for faster performance. To configure compression, set the CMPLIMIT parameter in DMCONFIG.

See Also

- DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*
- "Compressing Data Over a Network" on page 4-2 in *Administering a BEA Tuxedo Application at Run Time*

How to Route Service Requests to Remote Domains

Data-dependent routing information used by gateways to send service requests to specific remote domains is provided in the DM_ROUTING section of the DMCONFIG file. The FML32, VIEW32, FML, VIEW, X_C_TYPE, and X_COMMON typed buffers are supported.

To create a routing table for a domain, specify the following:

- Buffer type for which the routing entry is valid
- Name of the routing entry and field
- Ranges and associated remote domain names of the routing field.

The following table describes these fields.

Routing Table Field	Description
Buffer type	A list of types and subtypes of data buffers for which this routing entry is valid. The types may be included: FML32, VIEW32, FML, VIEW, X_C_TYPE, and X_COMMON. No subtype can be specified for type FML; subtypes are required for the other types. The * (or *wildcard*) value is not allowed. Duplicate *type*/*subtype* pairs cannot be specified for the same routing criteria name; one criteria name can be specified in multiple routing entries as long as the *type*/*subtype* pairs are unique. If multiple buffer types are specified for a single routing entry, the data types of the routing field for all buffer types must be the same. Valid values for *type* are: [:*subtype1*[,*subtype2* . . .]] [;*type2*[:*subtype3*[,*subtype4* . . .]]] . . . The maximum total length of 32 *type*/*subtype* combinations is 256 characters. Valid values for *subtype* may not include semicolons, colons, commas, or asterisks. Example: FML
Domain routing criteria	The name (identifier) of the routing entry. A valid value is any string of 1-15 characters, inclusive. Example: ROUTTAB1
Routing field name	The name of the routing field. It is assumed that the value of this field is a name identified in an FML field table (for FML buffers) or an FML VIEW table (for VIEW, X_C_TYPE, or X_COMMON buffers). A valid value is an identifier string that is 1-30 characters, inclusive. Example: FIELD1

Routing Table Field	Description
Ranges	A value comprised of a set of numbers (that must have numeric values) and an alphanumeric string (that must have string values) associated with remote domain names (`RDOM`) for the routing field. The routing field can be of any data type supported in `FML`. String range values for `string`, `carray`, and character field types must meet the following criteria: ■ Placed inside a pair of single quotes and not preceded by a sign. ■ Short and long integer values are a string of digits, optionally preceded by a plus or minus sign. ■ Floating point numbers are of the form accepted by the C compiler or `atof()` as follows: an optional sign, then a string of digits optionally containing a decimal point, then an optional e or E followed by an optional sign or space, followed by an integer. When a field value matches a range, the associated `RDOM` value specifies the remote domains to which the request should be routed. An `RDOM` value of * indicates that the request can go to any remote domain known by the gateway group. Valid values for this field are a comma-separated ordered list of *`range`*/*`RDOM`* pairs where a *`range`* is one of two types: (a) a single value (signed numeric value or character string in single quotes); or (b) a range of the form *`lower`*-*`upper`* (where *`lower`* and *`upper`* are both signed numeric values or character strings in single quotes). Note that *`lower`* must be less than or equal to *`upper`*. Within a *`range`*/*`RDOM`* pair, the range is separated from the `RDOM` by a colon (:). `MIN` can be used to indicate the minimum value for the data type of the associated `FIELD:` ■ For `strings` and `carrays`, it is the null string ■ For character fields, it is `0` ■ For numeric values, it is the minimum numeric value that can be stored in the field. `MAX` can be used to indicate the maximum value for the data type of the associated `FIELD:` ■ For `strings` and `carrays`, it is an unlimited string of octal-255 characters ■ For a character field, it is a single octal-255 character ■ For numeric values, it is the maximum numeric value that can be stored in the field. Thus, `MIN - -5` is all numbers less than or equal to -5; `- MAX` is the set of all numbers greater than or equal to 6. The metacharacter * (*`wildcard`*) in the range position indicates any values not covered by other ranges previously seen in the entry; one wildcard range is allowed per entry, which should be listed last in the field (ranges following it are ignored). Example: `1-100:REMDOM3`

Setting Up Security in Domains

The BEA Tuxedo system provides the following standard security mechanisms:

- *Access Control Lists*—restrict availability of services to authorized users whose names are included in lists that are automatically checked services are requested.
- *Authentication*—verifies the identity of clients, servers, and administrative programs. The default security mechanism provided with the BEA Tuxedo system is an *application authentication* scheme that uses one password per BEA Tuxedo application. Clients are required to present this password before being allowed to join an application. Servers are authenticated to be running as the user identified as the administrator.
- *Encryption*—security mechanisms to convert data to coded format that is unintelligible to users.
- *Security Plug-in Interface*—allows installation of third-party security systems such as custom authentication and authorization. The plug-in interface is available to applications running BEA Tuxedo Release 7.1 or later software. For information on setting up security in domains using the security plug-in interface, see "Establishing a Link Between Domains" on page 2-24 in *Using BEA Tuxedo Security*.

The BEA Tuxedo security mechanisms provided for individual applications and those provided for Domains configurations are relatively independent but compatible:

- The BEA Tuxedo system provides the following security mechanisms for Domains configurations: authentication of remote domains; access control on exported local services for remote domains; and encryption mechanisms to protect interdomain communication.
- If BEA Tuxedo system security is set to `ACL` or `MANDATORY_ACL`, then user IDs flow through the system with requests, and `ACL` checking takes place. If system security is set to `USER_AUTH`, then user IDs flow through the system, but no `ACL` checking takes place.
- Even if you assign a security level of `NONE` to your BEA Tuxedo application, you can still set up Domains security to enforce security restrictions between domains. Note, however, that in order to use an application password in a Domains configuration, you must already have a value of `APP_PW` set for the security level in each participating application.

Domains Security Mechanisms

Because distinct domains may exist under different ownership, the native BEA Tuxedo application password scheme may not, of itself, provide sufficient security. Domains, therefore, provides additional security mechanisms:

- *Access Control Lists*—Restrict availability of services in a local domain to a list of selected remote domains. You configure this security level in the `DM_ACCESS_CONTROL` section of `DMCONFIG`.
- *Domains Authentication*—Techniques are required to ensure the proper identity of each remote domain. Domains provides three levels of password security: `NONE` specifies no authentication; `APP_DW` is authentication using the application password, which must match on the two domains; and `DM_PW`, which is authentication using specific passwords per local/remote domain pair. Each of these is selected by setting the `SECURITY` parameter in the `DM_LOCAL_DOMAINS` section for the local domain access point involved to the required level (`APP_DW`, `DM_PW`, `NONE`).
- *Link-Level Encryption*—You can use encryption across domains to ensure data privacy. In this way, a network-based eavesdropper cannot learn the content of BEA Tuxedo messages or application-generated messages flowing from one domain gateway to another. You configure this security mechanism by setting the `MINENCRYPTBITS` and `MAXENCRYPTBITS` parameters in the `DMCONFIG` file.
- *Local Domains Access*—Restricts local services to remote domains. If a service is not exported to remote domains, it is simply unavailable to them. A service is exported by placing an entry in the `DM_LOCAL_SERVICES` section of the `DMCONFIG` file for the service.
- *User Identity Mapping to Mainframes*—Provides a mechanism whereby user identities within a domain can be mapped to and from external user identities. This mechanism is currently used by BEA eLink for Mainframe-SNA to map to and from RACF (remote access control facility) user names on IBM LU6.2 mainframes. To use this mechanism, refer to the following `dmadmin` configuration commands:

- `addumap`—Add local user mappings to remote user mappings for a local/remote domain pair. Mappings are defined to be inbound, outbound, or both.
- `addusr`—Add remote user names and passwords to the remote user and password tables of a remote domain.
- `delumap`—Delete local to remote user mappings for a local/remote domain pair.
- `delusr`—Delete remote user names and passwords from the remote user and password tables of a remote domain.
- `modusr`—Change remote passwords in the password tables of a remote domain.

See Also

- "How to Create a Domains Access Control List (ACL)" on page 2-38
- "How to Set Up Domains Authentication" on page 2-39
- "Examples of Coding Security Between Domains" on page 2-41
- `dmadmin(1)` in *BEA Tuxedo Command Reference*

How to Create a Domains Access Control List (ACL)

To create a domain ACL, you must specify the name of the domain ACL and a list of the remote domains that are part of the list (the Domain Import `VIEW` List) in the `DM_ACCESS_CONTROL` section of the `DMCONFIG` file. The following table describes these two fields.

Domain ACL Field	Description
Domain ACL name	The name of this ACL. A valid name consists of a string of 1-30 characters, inclusive. It must be printable and it may not include a colon, a pound sign, or a new line character. Example: `ACLGRP1`
Remote Domain list	The list of remote domains that are granted access in this access control list. A valid value in this field is a set of one or more comma-separated remote domain names. Examples: `REMDOM1,REMDOM2,REMDOM3`

Using Standard BEA Tuxedo Access Control Lists with Imported Remote Services

A remote service imported from a remote domain is viewed simply as a service within a BEA Tuxedo domain. The standard BEA Tuxedo ACL mechanism then, can be used to restrict access to this service by particular groups of users.

For information on using BEA Tuxedo access control lists, refer to the following entries in the *BEA Tuxedo Command Reference*: `tpacladd(1)`, `tpaclmod(1)`, `tpacldel(1)`, `tpusradd(1)`, `tpusrmod(1)`, `tpusrdel(1)`, `tpgrpadd(1)`, `tpgrpmod(1)`, and `tpgrpdel(1)`.

How to Set Up Domains Authentication

Domain gateways can be made to authenticate incoming connections requested by remote domains and outgoing connections requested by local domains. The authentication mechanism is optional and compatible with the BEA Tuxedo mechanism specified in the TUXCONFIG file.

Application administrators can define when security should be enforced for incoming connections from remote domains. You can specify the level of security used by a particular local domain by setting the SECURITY parameter in the DM_LOCAL_DOMAINS section of the DMCONFIG file. There are three levels of password security:

- *Application Password* (using the APP_PW option)— Incoming connections from remote domains are authenticated using the application password defined in the TUXCONFIG file. The BEA Tuxedo application password is administered with tmloadcf(1), which prompts for the password when the SECURITY option is enabled in the TUXCONFIG file. The password is automatically propagated with the TUXCONFIG file to the other machines in the configuration. You can update the password dynamically using the tmadmin command.
- *No Security* (using the NONE option)—Incoming connections from remote domains are not authenticated.
- *Remote Domains Password* (using the DM_PW option)—BEA Tuxedo Domains uses this feature to enforce security between two or more BEA Tuxedo domains. Connections between the local and remote domains are authenticated using passwords defined in the DM_PASSWORDS section of the BDMCONFIG file. These passwords are added to the binary configuration file after dmloadcf has been run, using the passwd subcommand of the dmadmin(1) command. Each entry contains the password used by a remote domain to access a particular local domain and the password required by the local domain, in turn, to access the remote domain.

If the SECURITY parameter is not set in TUXCONFIG (that is, if it defaults to NONE or if it is set explicitly to NONE), the Domains configuration can still require the Domain gateways to enforce security at the DM_PW level. If the DM_PW option is selected, then each remote domain must have a password defined in the DM_PASSWORDS section of the BDMCONFIG file. In other words, incoming connections from remote domains without a password are rejected by domain gateways.

DM_PASSWORDS Section Table Entries

The DM_PASSWORDS table contains the following entries for each remote domain:

- LDOM—The name of the local domain providing access to the remote domain
- RDOM—The name of the remote domain
- LPWD—The password used by a local domain to authenticate with the remote domain
- RPWD—The password used by the remote domain to authenticate with the local domain

  Note: Passwords are stored securely in encrypted format.

See Also

- "Examples of Coding Security Between Domains" on page 2-41
- dmadmin(1) in *BEA Tuxedo Command Reference*
- DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

Examples of Coding Security Between Domains

The SECURITY parameter in the DM_LOCAL_DOMAINS section of the DMCONFIG file specifies the security type of a local domain. If authentication is required, it is done every time a connection is established between the local domain and a remote domain. If the security types of the two domains are incompatible, or if the passwords do not match, the connection fails.

Example 1: Setting Security to APP_PW

If the SECURITY parameter in the UBBCONFIG is set to APP_PW or higher, then SECURITY in the DMCONFIG can be set to NONE, APP_PW, or DM_PW. Because you can define multiple views of a domain in one DMCONFIG file (one view per local domain definition), you can assign a different type of security mechanism to each of those views.

Note: If SECURITY is set to APP_PW for a local domain access point in the DMCONFIG, then SECURITY in the UBBCONFIG must be set to APP_PW or higher.

Listing 2-10 Setting Security to APP_PW for Both Application and Domains

```
DOM1: SECURITY in UBBCONFIG set to APP_PW
      SECURITY in DMCONFIG set to APP_PW

DOM2: SECURITY in UBBCONFIG set to APP_PW
      SECURITY in DMCONFIG set to APP_PW
```

In this example, both DOM1 and DOM2 enforce APP_PW security.

On the initiator side, the pertinent attributes in UBBCONFIG and DMCONFIG are set as follows.

```
UBBCONFIG
 SECURITY=APP_PW

DMCONFIG
 *DM_LOCAL_DOMAINS
DOM1
  DOMAINID=DOM1
  SECURITY=APP_PW

 *DM_REMOTE_DOMAINS
DOM2 DOMAINID="DOM2"
```

On the responder side, the pertinent attributes in `UBBCONFIG` and `DMCONFIG` are set as follows.

```
UBBCONFIG
 SECURITY=APP_PW

DMCONFIG
 *DM_LOCAL_DOMAINS
DOM2
  DOMAINID=DOM2
  SECURITY=APP_PW

 *DM_REMOTE_DOMAINS
DOM1 DOMAINID="DOM1"
```

After the `TUXCONFIG` and `BDMCONFIG` files have been created, boot the applications on `DOM1` and `DOM2`.

Example 2: Setting Security to NONE

If `SECURITY` is set to `NONE` for a local domain, incoming connection attempts are not authenticated. Even with `SECURITY` set to `NONE`, a local domain can still connect to remote domains that have `SECURITY` set to `DM_PW`, but before such a connection can be established, you must define the passwords on both sides by running `dmadmin(1)` or by using `DM_MIB(5)`.

Listing 2-11 Setting Security to NONE for Both Application and Domains

```
DOM1: SECURITY in UBBCONFIG set to NONE
       SECURITY in DMCONFIG set to NONE

DOM2: SECURITY in UBBCONFIG set to NONE
       SECURITY in DMCONFIG set to DM_PW
```

In this example, DOM1 is not enforcing any security but DOM2 is enforcing DM_PW security.

On the initiator side, the pertinent attributes in UBBCONFIG and DMCONFIG are set as follows.

```
UBBCONFIG
 SECURITY=NONE

DMCONFIG
 *DM_LOCAL_DOMAINS
DOM1
   DOMAINID=DOM1
   SECURITY=NONE

 *DM_REMOTE_DOMAINS
DOM2 DOMAINID="DOM2"
```

On the responder side, the pertinent attributes in UBBCONFIG and DMCONFIG are set as follows.

```
UBBCONFIG
 SECURITY=NONE

DMCONFIG
 *DM_LOCAL_DOMAINS
DOM2
   DOMAINID=DOM2
   SECURITY=DM_PW

 *DM_REMOTE_DOMAINS
DOM1 DOMAINID="DOM1"
```

After the required attributes have been set in the TUXCONFIG and BDMCONFIG files, boot the applications on DOM1 and DOM2.

```
On DOM1:
     dmadmin
```

```
      passwd DOM1 DOM2
       Enter Local Domain Password:foo1
       Reenter Local Domain Password:foo1
       Enter Remote Domain Password:foo2
       Reenter Remote Domain Password:foo2

On DOM2:
     dmadmin
     passwd DOM2 DOM1
     Enter Local Domain Password:foo2
     Reenter Local Domain Password:foo2
     Enter Remote Domain Password:foo1
      Reenter Remote Domain Password:foo1
```

Once passwords have been created on both domains, a connection can be established and services can be invoked on the remote domain.

Listing 2-12 Setting Application Security to NONE and Domains Security to DM_PW

On the initiator side, the pertinent attributes in `UBBCONFIG` *and* `DMCONFIG` *are set as follows.*

```
UBBCONFIG
 SECURITY=NONE

DMCONFIG
 *DM_LOCAL_DOMAINS
 DOM1
 DOMAINID=DOM1
  SECURITY=DM_PW

 *DM_REMOTE_DOMAINS
 DOM2 DOMAINID="DOM2"
```

On the responder side, the pertinent attributes in `UBBCONFIG` *and* `DMCONFIG` *are set as follows.*

```
UBBCONFIG
 SECURITY=NONE

DMCONFIG
 *DM_LOCAL_DOMAINS
 DOM2
  DOMAINID=DOM2
  SECURITY=DM_PW
```

```
 *DM_REMOTE_DOMAINS
 DOM1 DOMAINID="DOM1"
```

After the required attributes have been set in the `TUXCONFIG` *and* `BDMCONFIG` *files, boot the applications on* `DOM1` *and* `DOM2`*.*

On DOM1:

```
     dmadmin
      passwd DOM1 DOM2
      Enter Local Domain Password:foo1
      Reenter Local Domain Password:foo1
      Enter Remote Domain Password:foo2
       Reenter Remote Domain Password:foo2
```

On DOM2:

```
     dmadmin
      passwd DOM2 DOM1
      Enter Local Domain Password:foo2
      Reenter Local Domain Password:foo2
      Enter Remote Domain Password:foo1
      Reenter Remote Domain Password:foo1
```

Once passwords have been created on both domains, a connection can be established and services can be invoked on the remote domain.

Configuring the Connections Between Your Domains

You can specify *the* conditions under which a local domain gateway tries to establish a connection to a remote domain. To specify these conditions, assign a value to the CONNECTION_POLICY parameter in the Domains configuration file. You can select any of the following connection policies:

- Connect at boot time (ON_STARTUP)
- Connect when a client program requests a remote service (ON_DEMAND)
- Accept incoming connections but do not initiate a connection automatically (INCOMING_ONLY)

For connection policies of ON_STARTUP and INCOMING_ONLY, Dynamic Status is invoked. Dynamic Status is a BEA Tuxedo Domains capability that checks and reports the status of remote services.

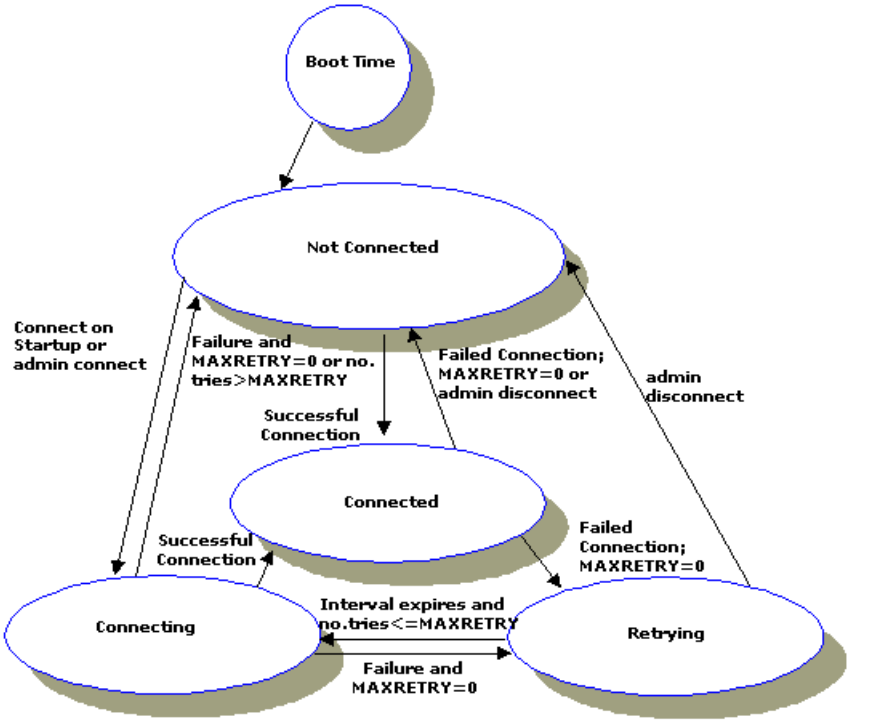
How to Request Connections at Boot Time (ON_STARTUP Policy)

A policy of ON_STARTUP means that a domain gateway attempts to establish a connection with its remote domains when the gateway server is initialized. By default, this connection policy retries failed connections every 60 seconds, but you can specify a different value for this interval (using the RETRY_INTERVAL parameter). This policy invokes Dynamic Status.

```
CONNECTION_POLICY=ON_STARTUP
```

The following diagram shows how connections are attempted and made by a gateway for which the connection policy is ON_STARTUP.

Figure 2-5 Connections Made with an ON_STARTUP Policy



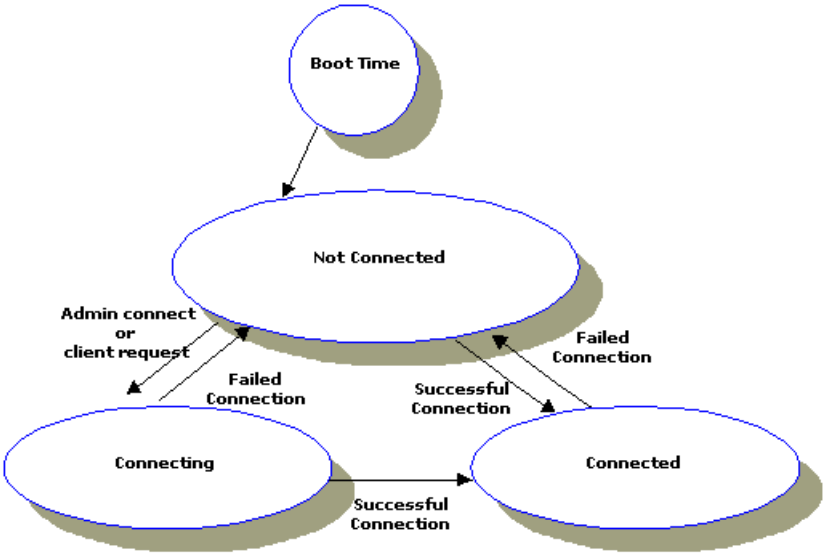
How to Request Connections for Client Demands (ON_DEMAND Policy)

A connection policy of ON_DEMAND means that a connection is attempted only when either a client requests a remote service or an administrative "connect" command is run. The default setting for CONNECTION_POLICY is ON_DEMAND. Connection retry processing is not allowed when the connection policy is ON_DEMAND. This policy does not invoke Dynamic Status.

```
CONNECTION_POLICY=ON_DEMAND
```

The following diagram shows how connections are attempted and made by a gateway for which the connection policy is `ON_DEMAND`.

Figure 2-6 Connections Made with an ON_DEMAND Policy



How to Limit Connections to Incoming Messages Only (INCOMING_ONLY Policy)

A connection policy of `INCOMING_ONLY` means that a domain gateway does not try to establish a connection to remote domains upon starting. Connection retry processing is not allowed when the connection policy is `INCOMING_ONLY`. This policy invokes Dynamic Status.

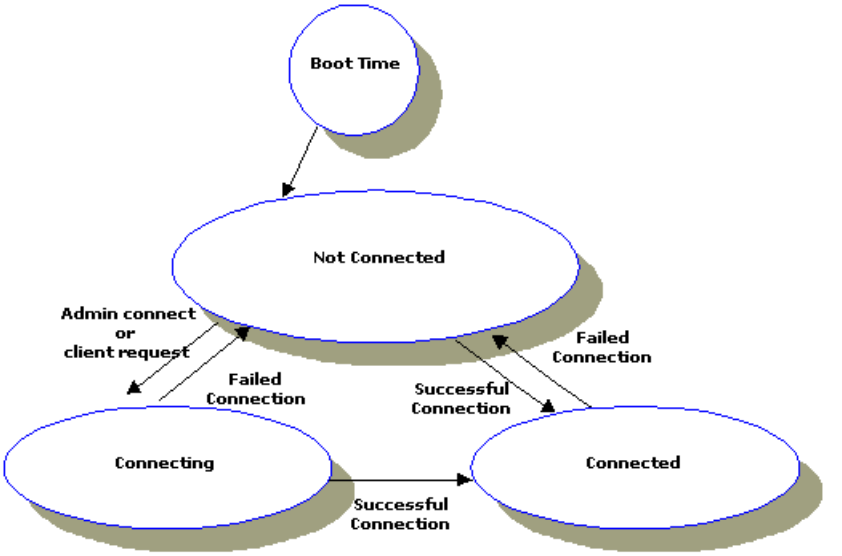
To use this policy, enter the following line in your Domains configuration file.

```
CONNECTION_POLICY=INCOMING_ONLY
```

Note: You can also establish a connection manually using the `dmadmin connect` command.

The following diagram shows how connections are attempted and made by a gateway for which the connection policy is INCOMING_ONLY.

Figure 2-7 Connections Made with an INCOMING_ONLY Policy (accept incoming connections)



How to Configure the Connection Retry Interval for ON_STARTUP Only

When the CONNECTION_POLICY parameter is set to ON_STARTUP, then the connection retry capability is available. The connection retry capability enables a domain gateway to retry, automatically, a failed attempt to connect to a remote domain. As an administrator, you can control the frequency of automatic connection attempts. To do so, specify the length (in seconds) of the interval during which the gateway should wait before trying, again, to establish a connection. You can specify the retry interval by setting the RETRY_INTERVAL parameter in the DM_LOCAL_DOMAINS section of the Domains configuration file as follows.

RETRY_INTERVAL=*number_of_seconds*

Note: You can specify between 0 and 2147483647 seconds.

If the connection policy is ON_STARTUP and you do not specify a value for the RETRY_INTERVAL parameter, a default of 60 is used.)

The RETRY_INTERVAL parameter is valid only when the connection policy is ON_STARTUP. For the other connection policies (ON_DEMAND and INCOMING_ONLY), retry processing is disabled.

How to Configure the Maximum Retry Number

You indicate the number of times that a domain gateway tries to establish connections to remote domains before quitting by assigning a value to the MAXRETRY parameter: the minimum value is 0; the default and maximum value is the value of the MAXLONG parameter.

- If you set MAXRETRY=0, automatic connection retry processing is turned off. The server does not attempt to connect to the remote gateways automatically.
- If you set MAXRETRY=*number*, the gateway tries to establish a connection the specified number of times before quitting.

  Note: The RETRY_INTERVAL is rounded up to a multiple of SCANUNIT.
- If you set MAXRETRY=MAXLONG, retry processing is repeated indefinitely or until a connection is established.

The MAXRETRY parameter is valid only when the connection policy is ON_STARTUP. For the other connection policies (ON_DEMAND and INCOMING_ONLY), retry processing is disabled.

Table 2-1 Example of Settings of the MAXRETRY and RETRY_INTERVAL Parameters

If You Set	Then
CONNECTION_POLICY=ON_STARTUP RETRY_INTERVAL=30 MAXRETRY=3	The gateway makes 3 attempts to establish a connection, at 30 seconds intervals, before quitting.
CONNECTION_POLICY=ON_STARTUP MAXRETRY=0	The gateway attempts to establish a connection at initialization time but does not retry if the first attempt fails.
CONNECTION_POLICY=ON_STARTUP RETRY_INTERVAL=30	The gateway attempts to establish a connection every 30 seconds until a connection is established.

See Also

- "Controlling the Connections Between Domains" on page 2-52
- "Configuring Domains-level Failover and Failback" on page 2-55
- DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

Controlling the Connections Between Domains

As the administrator, you can control the number of connections you want to establish between domains. You can also break the connections between local and remote domains.

How to Establish Connections Between Domains

To establish a connection between a local gateway and a remote domain, run the `dmadmin` command with the `connect` (`co`) subcommand, as follows.

```
dmadmin co -d local_domain_name
```

By default, connections are established between the local domain you have specified and all remote domains configured for the local gateway. If you want to establish a connection to only one remote domain, specify that domain on the command line with the `-R` option.

```
dmadmin co -d local_domain_name -R remote_domain_name
```

If a connection attempt fails and you have configured the domain to try again, repeated attempts to connect (via automatic connection retry processing) are made.

How to Break Connections Between Domains

To break a connection between a local gateway and a remote domain (making sure that the gateway does not try to reestablish the connection through automatic connection retry processing), run the `dmadmin` command with the `disconnect` (`dco`) subcommand, as follows.

```
dmadmin dco -d local_domain_name
```

By default, all remote domains configured for the local gateway are disconnected. If you want to end the connection to only one remote domain, specify that domain on the command line with the `-R` option as follows.

`dmadmin dco -d` *`local_domain_name`* `-R` *`remote_domain_name`*

Automatic connection retry processing is stopped by this command, regardless of whether there are any active connections when the command is run.

How to Report on Connection Status

Using the `printdomain` command, you can generate a report on connection status and the connections being retried. The `connect` command reports whether a connection attempt has succeeded. The `printdomain` command prints information about the specified local domain, including a list of remote domains, a list of remote domains to which it is connected, an a list of remote domains to which it is trying to establish connections.

The following example shows a `dmadmin` session in which the `printdomain` command is issued (in its abbreviated form, `pd`) for a local domain called `LDOM`.

```
$ dmadmin
dmadmin - Copyright (c) 1996 BEA Systems, Inc.
Portions * Copyright 1986-1997 RSA Data Security, Inc.
All Rights Reserved.
Distributed under license by BEA Systems, Inc.
TUXEDO is a registered trademark.

pd -d LDOM
Local domain :LDOM
  Connected domains:
  Domainid:  RDOM1
  Disconnected domains being retried:
  Domainid: RDOM2

 dco -d LDOM -R RDOM1
Operation completed successfully. Use printdomain(pd) to obtain
results.

 dco -d LDOM -R RDOM2
Operation completed successfully. Use printdomain(pd) to obtain
results.
```

```
 co -d LDOM -R RDOM3
Operation completed successfully. Use printdomain(pd) to obtain
results.

pd -d LDOM
Local domain :LDOM
  Connected domains:
  Domainid: RDOM3
```

Configuring Failover and Failback in a Domains Environment

Two types of failover can be performed in a Domains environment: link-level failover and Domains-level failover. This section provides instructions for both:

- "How to Configure Domains to Support Link-level Failover" on page 2-54
- "Configuring Domains-level Failover and Failback" on page 2-55

If you want failover and failback functionality in your domain, you must configure your Domains configuration file to support it.

For details about the Domains configuration file, see the `DMCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*.

How to Configure Domains to Support Link-level Failover

Link-level failover is a mechanism that ensures that an alternate network link becomes active when a primary link fails. To use link-level failover, the primary and alternate gateways must reside on different remote domains (that is, *gateway mirroring* must be used). Currently, link-level failover does not support multiple alternate links to the same gateway.

To implement link-level failover, specify it in the DM_TDOMAINS section of the Domains configuration file (DMCONFIG) as follows:

```
*DM_TDOMAINS
RDOM1 NWADDR=//addr1:0
RDOM1 NWADDR=//addr2:0
```

The first entry refers to the primary network link for remote domain RDOM1; the second entry refers to the alternate link.

Link-level failback is a manual procedure. When the primary link is restored, the administrator must bring down the alternate link manually. This operation may cause requests that are in progress to fail, and new traffic to be resumed over the primary link.

Note: For more detailed information on gateway mirroring, see DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*.

Configuring Domains-level Failover and Failback

Domains-level failover is a mechanism that transfers requests to alternate remote domains when a failure is detected with a primary remote domain. It also provides failback to the primary remote domain when that domain is restored.

This level of failover/failback depends on Dynamic Status. The domain must be configured with a CONNECTION_POLICY of ON_STARTUP or INCOMING_ONLY to enable Domains-level failover/failback.

Domains-level failover/failback defines a remote domain as available when a network connection to the remote domain exists, and unavailable when a network connection to the remote domain does not exist.

Prerequisite to Using Domains-level Failover and Failback

To use Domains-level failback, you must specify ON_STARTUP or INCOMING_ONLY as the value of the CONNECTION_POLICY parameter.

A connection policy of ON_DEMAND is unsuitable for Domains-level failback as it operates on the assumption that the remote domain is always available. If you do not specify ON_STARTUP or INCOMING_ONLY as your connection policy, your servers cannot fail over to the alternate remote domains that you have specified with the RDOM parameter.

Note: A remote domain is *available* if a network connection to it exists; a remote domain is *unavailable* if a network connection to it does not exist.

How to Configure Domains to Support Failover

To support failover, you must specify a list of the remote domains responsible for executing a particular service in your Domains configuration file. Specifically, you must specify such a list as the value of the RDOM parameter in the DM_REMOTE_SERVICES section. You can also specify alternate domains, as follows.

```
RDOM=identifier_1, identifier_2, identifier_3
```

Example

Suppose the TOUPPER and TOUPPER2 services are available from three remote domains: R1 (the primary remote domain), R2, and R3. Include the following entry in your Domains configuration file.

```
*DM_REMOTE_SERVICES
DEFAULT: RDOM=R1, R2, R3
TOUPPER
TOUPPER2
```

How to Configure Domains to Support Failback

Failback occurs when a network connection to the primary remote domain is reestablished for any of the following reasons:

- Automatic retries (ON_STARTUP only)
- Incoming connections
- Manual dmadmin connect command

Note: For automatic retries, connection retry must be turned on (that is, MA54ETRY>0)

CHAPTER

3 Administering Domains

- Using Domains Run-time Administrative Commands
- Using the Administrative Interface, dmadmin(1)
- Using the Domains Administrative Server, DMADM(5)
- Using the Gateway Administrative Server, GWADM(5)
- Using the Gateway Process
- Managing Transactions in a Domains Environment

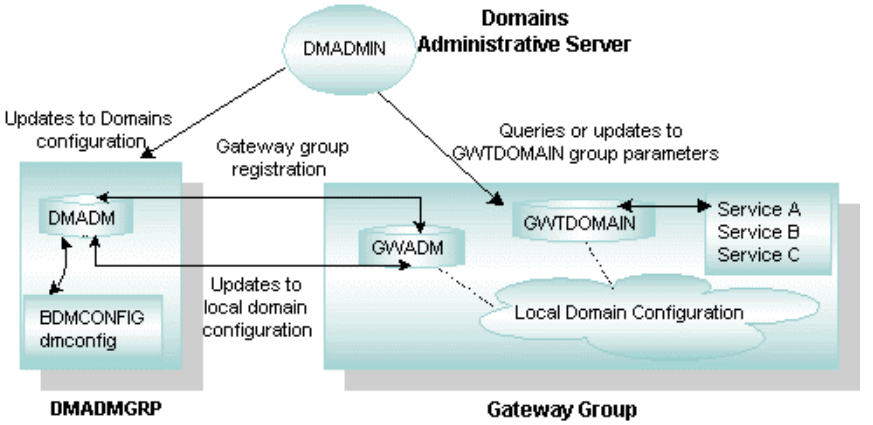
Using Domains Run-time Administrative Commands

To integrate the Domains component with an existing BEA Tuxedo application, add entries for domain gateway groups and gateway servers to the `TUXCONFIG` file. You can use either the `tmconfig(1)` (see `tmconfig, wtmconfig(1)`) or `tmadmin(1)` command to add a multiple-domain configuration to a running BEA Tuxedo application. You can also use `tmadmin` to list the information available in the bulletin board for Domain gateway groups and individual gateways.

Once your Domains environment is configured and integrated, you can administer it dynamically using a set of administrative tools provided by the Domains software. For example, you can specify and modify the list of services that are accessible across applications. The Domains software preserves the characteristics of the BEA Tuxedo programming interface (ATMI) and extends the scope of the ATMI so that clients can invoke services across domains. This functionality allows programmers to expand or partition applications without changing any application code.

The following figure shows the relationship between administrative commands and servers in the Domains administrative subsystem.

Figure 3-1 Domains Run-time Administration



Domains offers the following administrative commands:

- `dmadmin(1)` command, a generic administrative service—enables administrators to configure, monitor, and tune domain gateway groups dynamically, and to update the Domains configuration file (`BDMCONFIG`) while the BEA Tuxedo application is running. The command acts as a front-end process that translates administrative commands into service requests which it then sends to the `DMADMIN` service, a generic administrative service advertised by the `DMADM` server. The `DMADMIN` service invokes the validation, retrieval, or update of functions provided in the `DMADM` server to maintain the `BDMCONFIG` file.

- `DMADM(5)`, the gateway group administrative server—provides the administrative processing required for updating the Domains configuration. This server acts as a back-end to the `dmadmin` command. It provides a registration service to

gateway groups. This registration service is requested by GWADM servers as part of their initialization procedure. The registration service downloads the configuration information required by the requesting gateway group. The DMADM server maintains a list of registered gateway groups, and propagates to these groups any changes made to the configuration.

- GWADM(5), the gateway process—The GWADM server registers with the DMADM server to obtain the configuration information used by the corresponding gateway group. The GWADM accepts queries from DMADM to obtain run-time statistics or to change the run-time options of the corresponding gateway group. Periodically, the GWADM server sends an "I-am-alive" message to the DMADM server. If no reply is received from the DMADM server, the GWADM server registers again. This mechanism makes sure the GWADM server always has the latest copy of the Domains configuration for its group.

- GWTDOMAIN(5)—The gateway process, GWTDOMAIN, which provides connectivity to remote gateway processes, focuses on throughput of messages between BEA Tuxedo domains. Clients and servers send and receive messages across BEA Tuxedo domains via the GWTDOMAIN process.

  Note: For a gateway type other than GWTDOMAIN, an executable other than GWTDOMAIN must be used. Refer to the BEA eLink for Mainframe documentation and *Using the BEA Tuxedo TOP END Domain Gateway* for additional information.

- BDMCONFIG— the binary version of the Domains configuration file, which contains all the configuration parameters that the BEA Tuxedo software interprets to create a viable application.

Note: You can also specify gateway parameters when a gateway group is booted using the CLOPT parameter, when the GWADM server is defined in the SERVERS section of the TUXCONFIG file.

How to Migrate DMADM and a Domain Gateway Group

The migration of DMADM is possible. To migrate DMADM to a new machine, complete the following steps.

1. Copy DMCONFIG to the new machine and run dmloadcf.
2. Shut down all domain gateway groups (GWADM and a domain gateway, for example, GWTDOMAIN).

   Note: If the domain gateway groups are not shut down, they will continue to function, but after DMADM has been migrated, all MIB requests for them will fail.

3. Migrate the DMADM group to the new machine.

The migration of a domain gateway group is possible. However, when transactions are being used, the domain gateway group can be migrated only across machines of the same type. To migrate a domain gateway group, complete the following steps.

1. In the DMCONFIG file, add multiple listening addresses, in the following format, to the DM_TDOMAIN section:

   ```
   *DM_TDOMAIN
   LDOM NWADDR="//primary:port"
   LDOM NWADDR="//backup:port"
   ```

   Note: This step is unnecessary if third-party IP failover solutions are used.

2. If you are using transactions, you must copy the Domains transaction log manually to the backup machine.
3. The DMCONFIG files for the remote domains should include both network addresses as specified in Step 1.
4. Migrate the domain gateway group to the new machine.

Using the Administrative Interface, dmadmin(1)

`dmadmin` is an administrative interface to the `DMADM` and `GWADM` servers. The communication between the two servers is done via FML typed buffers. Administrators can use the `dmadmin` command in the following ways:

- For the interactive administration of the information stored in the `BDMCONFIG` file and the different gateway groups running within a particular BEA Tuxedo application.
- To obtain statistics or other information gathered by gateway groups.
- To change gateway group parameters.
- To add (or update) information in the `BDMCONFIG` file.

Note: You can delete information from the `BDMCONFIG` file at run time only if the deletions do not involve an active gateway group.

See Also

- `dmadmin(1)` in *BEA Tuxedo Command Reference*

Using the Domains Administrative Server, DMADM(5)

The Domains administrative server, DMADM(5), is a BEA Tuxedo-supplied server that performs the following functions:

- Supports run-time administration of the BDMCONFIG file
- Maintains the BDMCONFIG file
- Supports a list of registered gateway groups
- Propagates run-time configuration changes to the registered gateway groups

The DMADM server advertises two services:

- DMADMIN, which is used by the DMADMIN and the GWADM servers.
- A service called DMADM_*svrid*, where SRVID is the appropriate server ID for the service. Registered GWADM servers use DMADM_*svrid* for specific administrative functions (for example, to refresh the gateway group configuration information or to signal that a GWADM is still registered).

The DMADM server must be defined in the SERVERS section of the TUXCONFIG file as a server running within a group (for example, DMADMGRP). There should be only one instance of the DMADM server in this group and it must be defined with no reply queue (REPLYQ=N).

See Also

- DMADM(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

Using the Gateway Administrative Server, GWADM(5)

The gateway administrative server, GWADM(5), is a BEA Tuxedo-supplied server that provides administrative functions for a Domains gateway group. The main functions of the GWADM server include the following:

- To get Domains configuration information from the DMADM server, and to accept queries from dmadmin. The GWADM server gets the gateway group configuration information by registering with the DMADM server. The GWADM server then makes the configuration available to gateways by storing the information in shared memory.
- To provide administrative functionality for a gateway group, for example, to accept queries from dmadmin for run-time statistics or to change the run-time parameters of the gateway group.
- To provide transaction logging functionality for a gateway group. The GWADM server determines which transactions need to be logged by reading information stored in shared memory. When the GWADM server is booted; scans the log to see whether any transactions need to be recovered; it then reconstructs the transaction information in shared memory. The gateway server scans the information in shared memory and performs recovery for the corresponding transactions. The recovery procedure is performed asynchronously with new incoming or outgoing requests received by the gateway group.

The GWADM server advertises a service name based on the local domain name (the value of the LDOM keyword in the BDMCONFIG). The dmadmin command uses this service to retrieve information from all active gateway groups or from a specific gateway group.

The GWADM server must be defined in the SERVERS section of the TUXCONFIG file. It should not be part of the MSSQ used by the gateways associated with the group and it must not have a reply queue, that is, REPLYQ=N must be specified. It must be the first server booted within the gateway group; that is, either (a) it must have a SEQUENCE number, or (b) it must be defined ahead of the gateway servers.

The GWADM server requires the existence of a DMADM server. Specifically, a DMADM server must be booted before that GWADM is booted.

The GWADM server must create the shared memory required by the gateway group to populate the configuration tables with information received from the DMADM server. The GWADM server uses IPC_PRIVATE with shmget and stores the ipckey returned in the shmid field of its registry entry in the bulletin board. Gateways can obtain the ipckey by retrieving the GWADM registry entry and checking the shmid field.

See Also

- GWADM(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*

Using the Gateway Process

A gateway process provides connectivity to remote gateway processes, and can communicate with one or more remote gateways simultaneously. A gateway advertises the services imported to a BEA Tuxedo application and controls access to the local services exported by the application. You define your application's exported and imported services in the Domains configuration file (DMCONFIG). Use dmadmin to dynamically configure, monitor, and tune domain gateway groups.

See Also

- "Types of Domain Gateways" on page 1-6

Managing Transactions in a Domains Environment

Application programmers can request the execution of remote services within a transaction. Also, users of remote domains can request local services to be executed within a transaction. Domains, therefore, coordinates the mapping of remote transactions to local transactions, and the sane termination (commitment or rollback) of these transactions.

The BEA Tuxedo system architecture uses a separate process, the Transaction Manager Server (`TMS`), to coordinate the commitment and recovery of transaction branches accessing a particular group. In a Domains environment, however, this architecture would require extra messages from the gateway to the `TMS` server to process a commitment for an incoming transaction. To simplify the Domains architecture and to reduce the number of messages, the `TMS` code is integrated with the gateway code. Thus, domain gateways can process the transaction protocol used by the BEA Tuxedo system. The BEA Tuxedo transaction protocol requires that the gateway group advertise the `TMS` service, which is done when the first gateway is booted. Once the `TMS` service is advertised, any transaction control messages directed to the gateway group are placed on the gateway's queue.

Domains gateway groups should be defined in the `TUXCONFIG` file without the `TMSNAME`, `TMSCOUNT`, `OPENINFO`, and `CLOSEINFO` parameters. These four parameters apply only to groups that use an XA-compliant resource manager, which Domains gateways do not use.

The commitment protocol across domains is strictly hierarchical. It is not possible to flatten the transaction tree because the structure of the transaction tree is not fully known by every domain; a superior knows only its immediately subordinate domains. Flattening the tree would also require the root domain to be fully connected to all domains participating in the transaction.

Transaction Management Capabilities

Domain gateways provide four capabilities that you can use to manage transactions. These capabilities are described in the following sections:

- "Using the TMS Capability Across Domains" on page 3-10
- "Using GTRID Mapping in Transactions" on page 3-13
- "Using Logging to Track Transactions" on page 3-20
- "Recovering Failed Transactions" on page 3-23

Using the TMS Capability Across Domains

In the BEA Tuxedo system, the TMS is a special server that is implicitly associated with server groups that use X/Open XA-compliant resource managers. The TMS server releases application servers from the delays associated with the distributed 2-phase commitment protocol. TMSs coordinate the commitment of a transaction via special service requests to the TMS service, which is offered by all TMS servers.

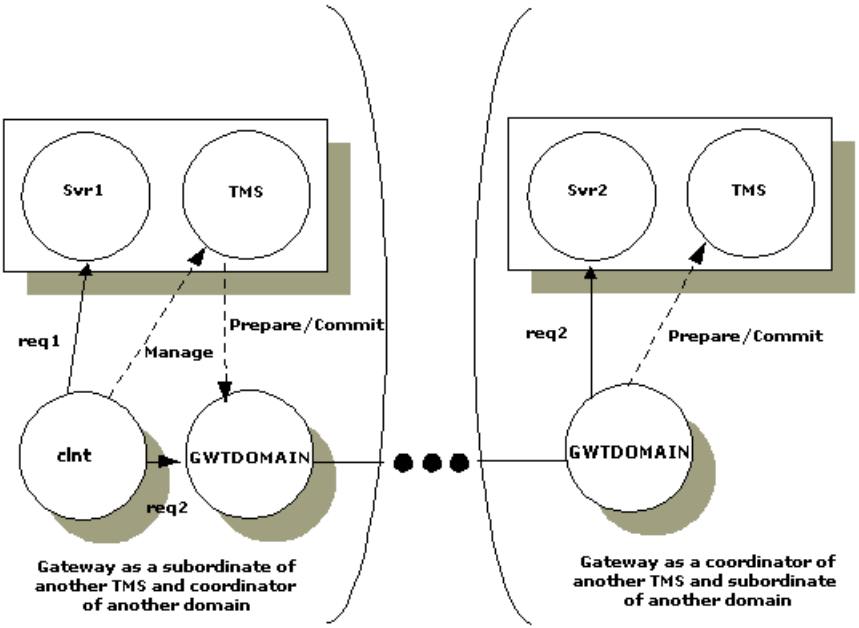
In a Domains environment, GWTDOMAIN gateways are not associated with an XA-compliant resource manager. The Transaction Processing Working Group (TPWG) of X/Open has proposed an advanced XA interface. This interface is not used in the BEA Tuxedo system because the interface does not match the highly asynchronous and non-blocking model required by the gateway. While Domains gateways do not use a separate TMS server, they do offer the TMS capability, which allows gateways to coordinate the 2-phase commitment of transactions executed across domains.

How Gateways Coordinate Transactions Across Domains

1. Domain gateways advertise the TMS service and perform all operations associated with that service. Messages sent to this service are placed on the queue used by the appropriate gateway group, and the gateways manage the transactions associated with the group.

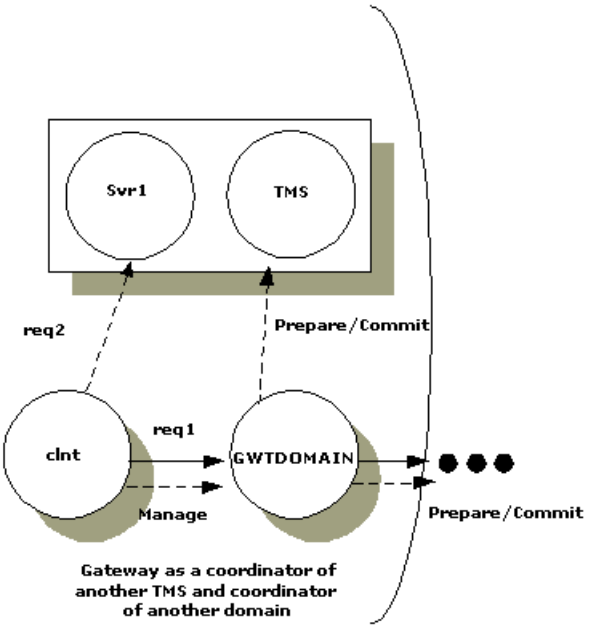
2. A gateway can act as a subordinate of transactions coordinated by another group within the domain. In this case, the gateway is a superior of the transaction branches executed in other remote domains. When acting as a subordinate of a transaction coordinated by a remote domain, the gateway also acts as the coordinator for all groups in the local domain accessed by the transaction. The gateway, acting as both subordinate and coordinator, is illustrated in the following figure.

Figure 3-2 The Gateway as Subordinate/Coordinator of Another Domain Group



3. As a coordinator of transactions within the domain, the gateway manages the commitment of a transaction for a particular client. This is illustrated in the following figure.

Figure 3-3 Client Commit Managed by a Gateway



4. Gateways manage transaction commitment for a particular client or for a server that uses the forwarding service with the `AUTOTRAN` capability. When this combination is used, the last server in the forward chain (the Domains gateway) issues the commit and becomes the coordinator of the transaction. (A domain gateway always acts as the last server in a forward chain.)

5. Gateways automatically start and terminate transactions for remote services specified with the `AUTOTRAN` capability. This capability is required when an the application administrator wants to enforce reliable network communication with remote services. Administrators can specify this capability by setting the `AUTOTRAN` parameter to `Y` in the corresponding remote service definition. (For more information, refer to the

6. `DM_REMOTE_SERVICES Section` of `DMCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*.

7. Gateways map the BEA Tuxedo system transaction protocol to the networking transaction protocol used for interoperation with remote domains. How this mapping is done depends on which instantiation of Domains you are using: TDomains, SNA, or OSI TP.

Using GTRID Mapping in Transactions

In the BEA Tuxedo system, a transaction tree is a 2-level tree where the root is the gateway group coordinating a global transaction and branches are involved in the transaction. Each group performs its part of the global transaction independently from the parts performed by other groups. Each group, therefore, implicitly defines a transaction branch. The BEA Tuxedo system, through Transaction Manager Servers (TMSs), coordinates the completion of the global transaction, making sure each branch is completed.

A GTRID is a Global Transaction Identifier. GTRID mapping defines how to construct a transaction tree that crosses domain boundaries. You specify GTRIDs using the MAXGTT parameter in the RESOURCES section of the configuration file.

Defining Tightly-coupled and Loosely-coupled Relationships

In the X/Open DTP Model, a Transaction Manager Server can construct transaction trees by defining either *tightly-coupled* or *loosely-coupled* relationships with a Resource Manager (RM) by the way it interprets the transaction identifiers (XIDs) used by the XA interface.

A *tightly-coupled relationship* is one in which a single transaction identifier, XID, is used by all processes participating in a single global transaction, accessing a single RM. This relationship maximizes data sharing between processes; XA-compliant RMs expect to share locks for resources used by processes having the same XID. The BEA Tuxedo system achieves the tightly-coupled relationship via the group concept; that is, all work done by a group on behalf of a given global transaction belongs to the same transaction branch; all the processes executed by the group are given the same XID.

In a *loosely-coupled relationship*, the TMS generates a transaction branch for each part of the work in support of the global transaction. The RM handles each transaction branch separately; there is no sharing of data or of locks between the transaction branches. Deadlocks between transaction branches can occur and result in the rollback

of a global transaction. In the BEA Tuxedo application, when different groups participate in a single global transaction, each group defines a separate transaction branch, which results in a loosely-coupled relationship.

Global Transactions Across Domains

There are several differences between global transactions in a single BEA Tuxedo application and global transactions across domains. The first difference is that in the Domains framework, the transaction tree cannot be flattened to a 2-level tree. There are two reasons for this:

- The transaction may involve more domains than can be known from the root domain (where the transaction is controlled), so the structure of the transaction tree cannot be fully known.
- If a transaction tree is flattened to two levels, the root domain must be connected directly to all domains in the transaction.

This means that the commitment protocol across domains must be hierarchical. Even a loop-back service request defines a new branch in the transaction tree.

Note: A loop-back request goes to another domain and then comes back to be processed in the original domain. For example, domain A requests a service of domain B. The service in domain B requests another service in domain A. The transaction tree has two branches at the network level: a branch b1 from A to B and a branch b2 from B to A. Domain A cannot commit the work done on branch b2 before receiving commit instructions from B.

The structure of a transaction tree for global transactions across domains also depends on the distributed transaction processing protocol used by a relevant Domains instantiation. For example, in the OSI TP protocol each *dialogue* (the OSI TP word for a service request) is associated with a different transaction branch. In the BEA Tuxedo system, the OSI TP instantiation uses a dialogue for each service request, so each service request is mapped to a separate transaction branch. The XAP-TP interface hides this mapping and provides a mechanism by which an entire OSI TP subtree can be referenced by a user-defined identifier. (In the BEA Tuxedo implementation, this identifier is the `GTRID`.) The `GTRID` is used to instruct XAP-TP how a transaction tree must be constructed, that is, which dialogues must be included within a given OSI TP transaction. Therefore, from the BEA Tuxedo perspective, a whole OSI TP subtree can be managed as a single transaction branch.

This property, however, applies only to outgoing service requests (that is, service requests sent from the root domain to subordinate domains). It cannot be applied to incoming service requests. The OSI TP instantiation consequently implements a loosely-coupled relationship; each incoming service request is mapped to a new BEA Tuxedo global transaction.

The TDOMAIN instantiation tries to optimize `GTRID` mapping by implementing a tightly-coupled relationship. In TDOMAIN, multiple service requests issued on behalf of the same global transaction are mapped to the same network transaction branch. Therefore, incoming service requests can be mapped to a single BEA Tuxedo transaction. However, the hierarchical structure of interdomain communication and the interdomain transaction tree must still be maintained.

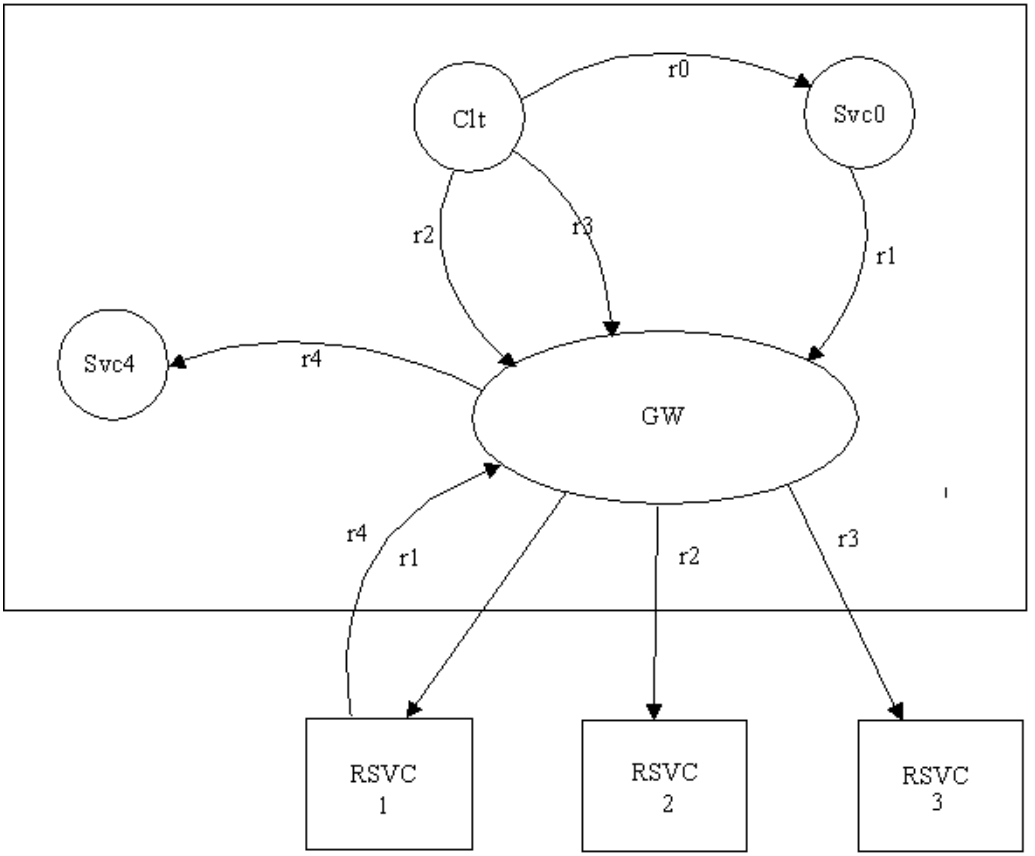
The optimization that TDOMAIN introduces applies only to a single domain. When two or more domains are involved in a transaction, the network transaction tree contains at least one branch per domain interaction. Hence, across domains, the network transaction tree remains loosely-coupled. There are as many branches as there are domains involved in the transaction (even if all the branches access the same resource manager instance).

Domains gateway groups implement a loosely-coupled relationship because they generate different transaction branches for interdomain transactions.

Example of a Service Request Graph Generating Local and Remote Requests

The following figure shows the service request graph for a client that generates three service requests: one local request (`r0`) and two remote requests (`r2` and `r3`). Request `r0` goes to a local service (`Svc0`), which generates another remote service request (`r1`). Request `r1` goes to remote service `Rsvc1`, which issues a loop-back service request `r4` to local service `Svc4`. `Svc0` and `Svc4` are executed in different groups (`G0` and `G4`). The domain gateway is executed within another group (`GW`), and the remote services `Rscv1`, `Rsvc2`, and `Rsvc3` are executed in another domain (domain B).

Figure 3-4 Service Request Graph



Transaction Trees for BEA eLink for Mainframe-OSI TP and BEA Tuxedo Domains

The following two figures show the transaction tree for BEA eLink for Mainframe-OSI TP and the transaction tree for BA Tuxedo Domains. It is assumed, in these figures, that both domains A and B are BEA Tuxedo system applications.

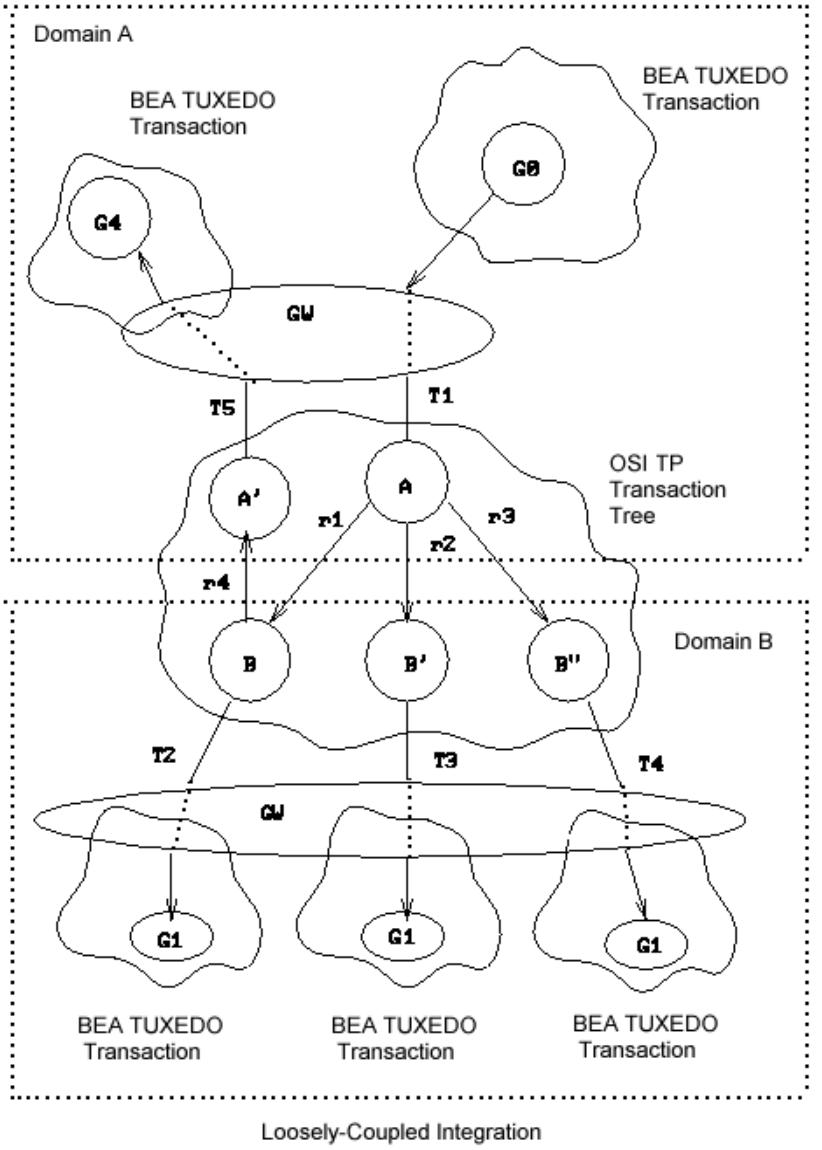
BEA eLink for Mainframe-OSI TP is loosely-coupled because of the OSI TP protocol. The transaction tree for this instantiation shows group G0 in Domain A coordinating the global transaction started by the client. Group `G0` coordinates group `GW`. Requests `r1`, `r2`, and `r4` are mapped each to an OSI TP dialogue and therefore to an OSI TP transaction branch. However, OSI TP uses the XAP-TP feature that allows an entire OSI TP transaction to be referred by a unique identifier (`T1`) and uses this identifier for requests `r1`, `r2`, and `r3`. It is up to XAP-TP to generate OSI TP transaction identifiers and to construct the corresponding OSI TP transaction tree. The only function that must be performed by the generic Domains software is the mapping of service requests r1, r2, and r3 to the `T1` identifier.

In Domain B, OSI TP uses the rule that new transaction branches must be mapped to a new BEA Tuxedo transaction. Therefore, OSI TP transaction branches `r1`, `r2`, and `r3` get mapped to three different BEA Tuxedo transactions (the corresponding mapping is represented by identifiers `T2`, `T3`, and `T4`). The graph shows the gateway group `GW` in Domain B coordinating three BEA Tuxedo transactions on group `G1`.

Finally, there is the loop-back service request `r4` that generates another branch in the transaction tree. OSI TP maps this request to identifier `T2`, but XAP-TP generates a new branch in its transaction tree (`r4`: B to A'). This is a new transaction branch on Domain A, and therefore, the gateway generates a new mapping `T5` to a new BEA Tuxedo transaction. Therefore, the transaction graph shows that gateway group GW on Domain A coordinates group `G4`.

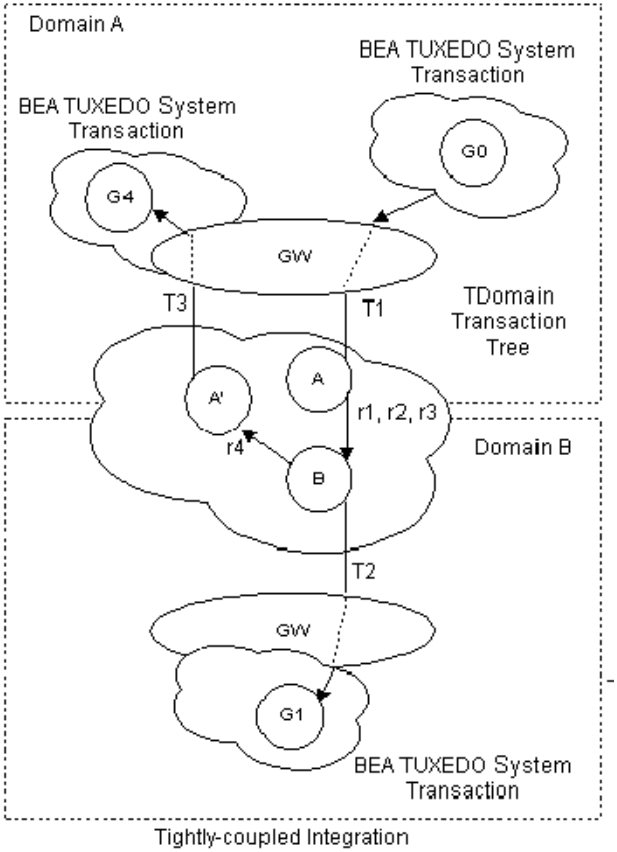
Notice that the hierarchical nature of the OSI TP protocol is fully enforced by these mappings. However, because these mappings introduce a loosely-coupled relationship, the probability of intratransaction deadlock is increased (for example, there are three BEA Tuxedo transactions accessing the RM represented by group `G1`).

Figure 3-5 Transaction Tree for BEA eLink for Mainframe-OSI TP Environment



The TDOMAIN instantiation provides a tightly-coupled integration that solves this deadlock problem by minimizing the number of transaction branches required in the interoperation between two domains. The corresponding transaction tree is shown in the following figure.

Figure 3-6 Transaction Tree for TDOMAIN Environment



Notice that the gateway still must perform mappings between a BEA Tuxedo system transaction and a network transaction, and that the hierarchical nature of the communication between domains must be strictly enforced. The diagram shows that requests `r1`, `r2`, and `r3` are mapped to a single TDOMAIN transaction branch. Therefore, on domain B only one BEA Tuxedo system transaction needs to be generated; `T2` represents this mapping and the graph shows gateway group `GW` on

domain B coordinating group G1. Request r4 is mapped to identifier T2 on Domain B, but TDOMAIN will generate a new branch in its transaction tree (r4: B to A'). Because this is a new transaction branch on Domain A, the gateway generates a new mapping, T3, to a new BEA Tuxedo system transaction. The graph shows that gateway group GW on Domain A also coordinates group G4. Hence, the hierarchical nature of interdomain communication is fully enforced with this mapping: group G4 cannot commit before group G1.

Summary of Domains Transaction Management

Domains transaction management can be summarized as follows:

- Gateways generate mappings from a BEA Tuxedo system transaction to a network transaction. A new mapping is generated for each BEA Tuxedo system transaction and each incoming network transaction branch.
- Each instantiation of Domains (TDomains, SNA, or OSI TP) handles its own representation of the network transaction tree. All instantiations observe the hierarchical nature of the interdomain communication.

Using Logging to Track Transactions

Logging is used to keep track of the progress of a 2-phase commit protocol. The information stored in the log is used to make sure a transaction is completed in the event of a network failure or machine crash.

To ensure completion of transactions across domains, domain gateways log the mapping between local and remote identifiers. Along with this information, the Domains transaction management facility records the decisions made during different phases of the commitment protocol, and any information available about the remote domains involved in the transaction. In the OSI TP case, the XAP-TP interface logs the information required for the recovery of the OSI TP protocol machine. The information is referred to as a *blob* (binary large object) and is kept in the same log record as the commit information to make recovery easier.

Domains log records have a different structure from the log records stored in the BEA Tuxedo system TLOG. TLOG records are fixed in size and are stored in a single page. Domains log records vary in size; more than one page may be required to store the record. The Domains logging mechanism, DMTLOG, has the capability of storing variable-size log records.

When a TMS is the superior of a domain gateway group, the BEA Tuxedo TLOG is still required to coordinate the commitment.

How Logging Works

Logging is performed by the GWADM administrative server. The request for a log write is made by the GWTDOMAIN process, but the actual log write is performed by the GWADM process.

You must create a log called DMTLOG for each domain gateway group. The DMTLOG files are defined in the DM_LOCAL_DOMAINS section of the DMCONFIG file. To create a DMTLOG file, add an entry for the DMTLOGDEV parameter:

DMTLOGDEV=*string*

where *string* is the name of the log file. In addition, you cam set one or both of the two optional parameters:

- DMTLOGNAME=*identifier*
- DMTLOGSIZE=*numeric*

For more information, refer to DMCONFIG(5) in *BEA Tuxedo File Formats and Data Descriptions Reference*.

Administrators also have the option of using the run-time administration utility (DMADMIN) to create a DMTLOG. For more information, refer to dmadmin(1) in *BEA Tuxedo Command Reference*.

If a DMTLOG has not been created when a domain gateway group is booted, the gateway server automatically creates the log, based on information in the BDMCONFIG file.

Until a logging device is specified in the BDMCONFIG file, a Domain gateway group cannot process requests in transaction mode and the gateway group cannot offer the TMS service.

To coordinate the commit protocol, Domains gateways require the following two log records:

- *Ready record*—A ready record is a file created by a gateway acting as a leaf or intermediate machine in a transaction tree. It records information about the superior and subordinate remote domains involved in the transaction. A ready record indicates that all subordinates of the domain gateway group logging the record have been prepared.
- *Commit record*—A commit record documents that a transaction has been committed. A domain gateway creates a commit record as the coordinator of a particular transaction tree.

When a transaction has been committed on all machines, these logs for the transaction are removed.

When the OSI TP protocol is being used, two types of heuristic records are logged:

- *Log Heuristic record*—This record holds the details of a heuristic decision in the domain until the outcome of the relevant transaction is known by the superior.
- *Log Damage record*—This record is created to indicate one of two conditions for a transaction branch: (run with `tmadmin(1)`) a *heuristic hazard* (when the outcome of the transaction branch for a subordinate is unknown) or a *heuristic mix* (when the transaction subtree has a mixed outcome).

Heuristic log records persist until they are explicitly removed by the administrator. This persistence is required to provide the correct information during recovery after a crash, and to provide diagnostic information for administrators.

The administrator uses the `forgettran` command (run with `tmadmin(1)`) to remove heuristic records when they are no longer needed.

Recovering Failed Transactions

When a domain gateway group is booted, the gateway server performs an automatic *warm-start* of the DMTLOG. The warm-start includes scanning the log to see if any transactions were not completed. If incomplete transactions are found, action is taken to complete them.

In OSI TP, any *blobs* stored in the DMTLOG with a transaction record are passed to the network access module, which uses the blobs to reconstruct its internal state and to recover any failed connections

In the case of heuristic decisions, if a domain gateway group is a subordinate of a local TMS and a heuristic decision has been indicated, the TMS generates a TMS_STATUS message to learn the final decision:

- If a gateway fails, then it cleans up after itself when it is restarted (this is called a *hot-start*). The gateway rolls back all undecided transactions in which it was involved.
- If a communication line failure occurs and the first phase of the commit has not been completed, the gateway rolls back the transactions associated with that connection.
- If OSI TP Domains is being used and a transaction fails in the second phase of the commit, recovery is managed by XAP-TP.