Oracle® Tuxedo

Scaling, Distributing, and Tuning CORBA Applications Guide

Release 22c
F97748-01
March 2025

Oracle Tuxedo Scaling, Distributing, and Tuning CORBA Applications Guide, Release 22c

F97748-01

Primary Author: Preeti Gandhe

Contributing Authors: Tulika Das

Contributors: Maggie Li

Contents

2 Scaling CORBA Server Applications

3 Distributing CORBA Applications

Index

List of Figures

List of Tables

Preface

This document provides information about the Scaling, Distributing, and Tuning CORBA Applications.

- Documentation Accessibility

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

1

Scaling, Distributing, and Tuning CORBA Applications

This topic introduces key concepts and tasks for scaling Oracle Tuxedo CORBA applications.

For more detailed information and examples for Oracle Tuxedo CORBA applications, see Scaling CORBA Server Applications .

> **Note:**
>
> The Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB were deprecated in Tuxedo 8.1 and are no longer supported. All Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB text references, associated code samples, must only be used to help implement/run third party Java ORB libraries, and for programmer reference only.
> Technical support for third party CORBA Java ORBs must be provided by their respective vendors. Oracle Tuxedo does not provide any technical support or documentation for third party CORBA Java ORBs.

This topic includes the following sections:

1.1 About Scaling Oracle Tuxedo CORBA Applications

This topic includes the following sections:

1.1.1 Application Scalability Requirements

Many applications perform adequately in an environment where between 1 to 10 server processes and 10 to 100 client applications are running. However, in an enterprise environment, applications may need to support hundreds of execution contexts (where the context can be a thread or a process), tens of thousands of client applications, and millions of objects at satisfactory performance levels.

Subjecting an application to exponentially increasing demands quickly reveals any resource shortcomings and performance bottlenecks in the application. Scalability is therefore an essential characteristic of Oracle Tuxedo applications.

You can build highly scalable Oracle Tuxedo applications by:

- Adding parallel processing capability to enable the Oracle Tuxedo domain to process multiple client requests simultaneously.
- Sharing the processing load on the server applications across multiple machines.

1.1.2 Oracle Tuxedo Scalability Features

Oracle Tuxedo supports large-scale application deployments by:

- Optimizing object state management
- Load balancing objects and requests across replicated server processes and server groups
- Using multithreaded servers, which are appropriate for certain types of applications and processing environments
- For CORBA applications, using factory-based routing
- Using data-dependent routing (Oracle Tuxedo ATMI only)
- Multiplexing incoming client connections

1.2 Using Object State Management

Object state management is a fundamental concern for large-scale client/server systems because they must achieve optimized throughput and response time. For more detailed information about using object state management, see Using a Stateless Object Model and the technical article Process-Entity Design Pattern.

- CORBA Object State Models
- Implementing Stateless and Stateful Objects
- Parallel Objects

1.2.1 CORBA Object State Models

Oracle Tuxedo CORBA supports three object state management models:

- Method-bound Objects
- Process-bound Objects
- Transaction-bound Objects

> **See Also:**
>
> Creating CORBA Server Applications for more information about these models.

1.2.1.1 Method-bound Objects

Method-bound objects are loaded into the machine's memory only for the duration of the client invocation. When the invocation is complete, the object is deactivated and any state data for that object is flushed from memory. In this document, a method-bound object is considered to be a *stateless object*.

You can use method-bound objects to create a stateless server model in your application. By using a stateless server model, you move requests that are already directed to active objects to any available server, which allows concurrent execution for thousands and even millions of objects. From the client application view, all the objects are available to service requests. However, because the server application maps objects into memory only for the duration of client invocations, few of the objects managed by the server application are in memory at any given moment.

1.2.1.2 Process-bound Objects

Process-bound objects remain in memory beginning when they are first invoked until the server process in which they are running is shut down. A process-bound object can be activated upon a client invocation or explicitly before any client invocation (a *preactivated* object). Applications can control the deactivation of process-bound objects. In this document, a process-bound object is considered to be a *stateful object*.

When appropriate, process-bound objects with a large amount of state data can remain in memory to service multiple client invocations, thereby avoiding reading and writing the object's state data on each client invocation.

1.2.1.3 Transaction-bound Objects

Transaction-bound objects can also be considered stateful because, within the scope of a transaction, they can remain in memory between invocations. If the object is activated within the scope of a transaction, the object remains active until the transaction is either committed or rolled back. If the object is activated outside the scope of a transaction, its behavior is the same as that of a method-bound object (it is loaded for the duration of the client invocation).

1.2.2 Implementing Stateless and Stateful Objects

In general, application developers need to balance the costs of implementing stateless objects against the costs of implementing stateful objects.

- About Stateless and Stateful Objects
- When to Use Stateless Objects
- When to Use Stateful Objects

1.2.2.1 About Stateless and Stateful Objects

The decision to use stateless or stateful objects depends on various factors. In the case where the cost to initialize an object with its durable state is expensive—because, for example, the object's data takes up a great deal of space, or the durable state is located on a disk very remote from the servant that activates it—it may make sense to keep the object stateful, even if the object is idle during a conversation. In the case where the cost to keep an object active is expensive in terms of machine resource usage, it may make sense to make such an object stateless.

By managing object state in a way that is efficient and appropriate for your application, you can maximize your application's ability to support large numbers of simultaneous client applications that use large numbers of objects. The way that you manage object state depends on the specific characteristics and requirements of your application. For CORBA applications, you manage object state by assigning the `method` activation policy to these objects, which has the effect of deactivating idle object instances so that machine resources can be allocated to other object instances.

1.2.2.2 When to Use Stateless Objects

Stateless objects generally provide good performance and optimal usage of server resources, because server resources are never used when objects are idle. Using stateless objects is a good approach to implementing server applications and are particularly appropriate when:

- The client application waits for user input between invocations on the object.
- The client request contains all the data needed by the server application, and the server can process the client request using only that data.
- The object has high access rates, but low access rates from any one particular client application.

By making an object stateless, you can generally assure that server application resources are not being reserved unnecessarily while waiting for input from the client application.

An application that employs a stateless object model has the following characteristics:

- Information about and associated with an invocation is not maintained after the server application has finished executing a client request.
- An incoming client request is sent to the first available server process. After the request has been satisfied, the application state disappears and the server application is available for another client application request.
- Durable state information for the object exists outside the server process. With each invocation on this object, the durable state is read into memory.
- Successive requests on an object from a given client application may be processed by a different server process.
- The overall system performance of a machine that is running stateless objects is usually enhanced.

1.2.2.3 When to Use Stateful Objects

A stateful object, once activated, remains in memory until a specific event occurs, such as the process in which the object exists is shut down, or the transaction in which the object is activated is completed.

Using stateful objects is recommended when:

- An object is used frequently by a large number of client applications, such as long-lived, well-known objects. When the server application keeps these objects active, the client application typically experiences minimal response time in accessing them. These active objects are shared by many client applications, and therefore relatively few objects of this type exist in memory.

> **Note:**
>
> You must carefully consider how objects will potentially be involved in a transaction. An object can be bound to a particular process temporarily (transaction-bound) or permanently (process-bound). An object that is involved in a transaction cannot be invoked by another client application or object (Oracle Tuxedo will likely return an error indicating that the object is busy). Stateful objects that are intended to be used by a large number of client applications can create bottlenecks if they are involved in transactions frequently or for long durations.

- A client application must invoke successive operations on an object to complete a transaction, and the client application is not idle while it waits for user input between invocations. If the object were deactivated between invocations, there would be a degradation of response time because state would be written and read between each invocation.

Stateful objects have the following behavior:

- State information is maintained between server invocations, and the object typically remains dedicated to a given client application for a specified duration. Even though data is sent and received between the client and server applications, the server process maintains additional context or application state information in memory.
- When one or more stateful objects use a lot of machine resources, server performance for tasks and processes not associated with the stateful object may be lower than with a stateless server model.
  For example, if an object has a lock on a database and is caching large amounts of data in memory, that database and the memory used by that stateful object are unavailable to other objects, potentially for the entire duration of a transaction.

1.2.3 Parallel Objects

Parallel objects are, by definition, stateless objects so they can exist concurrently on more than one server. In release 8.0 of Oracle Tuxedo, you can use the Implementation Configuration File (ICF) to force all objects in a specific implementation to be parallel objects. The effect is to improve performance. For more information on parallel objects, see Using Parallel Objects.

1.3 Replicating Server Processes and Server Groups

This topic includes the following sections:

> **See Also:**
>
> For more detailed information about replicating server processes and server groups, see the following topics:
>
> - Configuring Replicated Server Processes and Groups
> - Scaling by Replicating Server Processes and Server Groups

1.3.1 About Replicating Server Processes and Server Groups

The Oracle Tuxedo CORBA environment allows CORBA objects to be deployed across multiple servers to provide additional failover reliability and to split the client's workload through load balancing. Oracle Tuxedo CORBA load balancing is enabled by default. For more information about configuring load balancing, see Enabling System-controlled Load Balancing. For more information about distributing the application workload using Oracle Tuxedo CORBA features, see Distributing CORBA Applications.

The Oracle Tuxedo architecture provides the following server organization:

- Groups—individual servers can be combined to form a group. A group of servers runs on a single machine. Typically, the servers in a group access common resources (such as a database).
- Domains—machines can be combined to form a domain. A domain is administered centrally. Multiple domains are administered separately. Domains can also be interconnected and requests can be transparently routed from one domain to another. However, each domain is independently administered.

This architecture allows new servers, groups, or machines to be dynamically added or removed, to adapt the application to high- or low-demand periods, or to accommodate internal changes required to the application. The Oracle Tuxedo run time provides load balancing and failover by routing requests across available servers.

System administrators can scale an Oracle application by:

- Replicating Server Processes: Increase the number of server processes to support more active objects within a group and load balancing among servers.
- Replicating Server Groups: Increase the number of server groups so that Oracle can balance the load by distributing processing requests across multiple server machines.

1.3.2 Configuration Options

You can configure server applications as:

- A single machine with one or more server processes implementing one or more interfaces. The servers can be single-threaded or multithreaded.
- Multiple machines with multiple server processes and multiple interfaces.

You can add more parallel processing capability to client/server applications by replicating server processes or add more threads. You can add more server groups to split processing across resource managers. For CORBA applications, you can implement factory-based routing, as described in Using Factory-Based Routing (CORBA Servers Only).

1.3.3 Replicating Server Processes

System administrators can scale an application by replicating the servers to support more concurrent active objects, or process more concurrent requests, on the server node. To configure replicated server processes, see Configuring Replicated Server Processes and Groups .

> **Note:**
>
> Release 8.0 of Oracle supports the user-controlled concurrency model for active objects. For a discussion of the concurrency policy feature, see Parallel Objects.

- Benefits
- Guidelines

1.3.3.1 Benefits

The benefits of using replicated server processes include:

- Load balancing incoming requests.
- Processing client requests on any server within a group. As requests arrive in the Oracle domain for the server group, Oracle routes the request to the least busy server process within that group.
- Improving the server application's performance by using multiple server processes. Instead of having one server process handling one client request at one time, multiple server processes are available to handle multiple client requests simultaneously.
- Providing failover protection in the event that one of the server processes stops.

1.3.3.2 Guidelines

To achieve the maximum benefit of using replicated server processes, make sure that the CORBA objects instantiated by your server application have unique object IDs. This allows a client invocation on an object to cause the object to be instantiated on demand, within the bounds of the number of server processes that are available, and not queued up for an already active object.

You must also consider the trade-off between providing better application recovery by using multiple processes versus more efficient performance using threads (for some types of application patterns and processing environments).

Better failover occurs only when you add processes, *not* threads. For information about using single-threaded and multithreaded servers, see When to Use Multithreaded CORBA Servers.

1.3.4 Replicating Server Groups

Server groups are unique to Oracle and are key to the scalability features of Oracle. A group contains one or more servers on a single node. System administrators can scale an Oracle application by replicating server groups and configuring load balancing within a domain.

Replicating a server group involves defining another server group with the same type of servers and resource managers to provide parallel access to a shared resource (such as a

database). CORBA applications, for example, can use factory-based routing to split processing across the database partitions.

The `UBBCONFIG` file specifies how server groups are configured and where they run. By using multiple server groups, Oracle can:

- Spread the processing load for a given application or set of applications across additional machines.
- For CORBA applications, use factory-based routing to send one set of requests on a given interface to one group, and another set of requests on the same interface to another group.

To configure replicated server groups, see Configuring Replicated Server Processes and Groups.

1.4 Using Multithreaded Servers

This topic includes the following sections:

- About Multithreaded CORBA Servers
- When to Use Multithreaded CORBA Servers
- Coding Recommendations
- Configuring a Multithreaded CORBA Server

> **See Also:**
>
> Configuring Multithreaded Servers for instructions on how to configure servers for multithreading.

1.4.1 About Multithreaded CORBA Servers

System administrators can scale an Oracle application by enabling multithreading in CORBA servers, and by tuning configuration parameters (the maximum number of server threads that can be created) in the application's `UBBCONFIG` file.

Oracle CORBA supports the ability to configure multithreaded CORBA applications. A multithreaded CORBA server can service multiple object requests simultaneously, while a single-threaded CORBA server runs only one request at a time.

Server threads are started and managed by the Oracle CORBA software rather than an application program. Internally, Oracle CORBA manages a pool of available server threads. If a CORBA server is configured to be multithreaded, then when a client request is received, an available server thread from the thread pool is scheduled to execute the request. While the object is active, the thread is busy. When the request is complete, the thread is returned to the pool of available threads.

1.4.2 When to Use Multithreaded CORBA Servers

Designing an application to use multiple, independent threads provides concurrency within an application and can improve overall throughput. Using multiple threads enables applications to be structured efficiently with threads servicing several independent tasks in parallel. Multithreading is particularly useful when:

- There is a set of lengthy operations that do not necessarily depend on other processing.
- The amount of data to be shared is small and identifiable.
- You can break the task into various activities that can be executed in parallel.
- There are occasions where objects must be reentrant.

Some computer operations take a substantial amount of time to complete. A multithreaded application design can significantly reduce the wait time between the request and completion of operations. This is true in situations when operations perform a large number of I/O operations such as when accessing a database, invoking operations on remote objects, or are CPU-bound on a multiprocessor machine. Implementing multithreading in a server process can increase the number of requests a server processes in a fixed amount of time.

The primary requirement for multithreaded server applications is the simultaneous handling of multiple client requests. For more information on the requirements and benefits of using multithreaded servers, see Using Multithreaded Servers.

1.4.3 Coding Recommendations

So as to be able to analyze the performance of multithreaded servers, include one of the following identifiers in each message if your client or server application sends messages to the user log (`ULOG`):

- Object ID
- Transaction ID (if the object is transactional)

1.4.4 Configuring a Multithreaded CORBA Server

To configure a multithreaded CORBA server, you change settings in the application's `UBBCONFIG` file. For information about defining the `UBBCONFIG` parameters to implement a multithreaded server, see Configuring Multithreaded Servers.

1.5 Using Factory-Based Routing (CORBA Servers Only)

This section discusses factory-based routing in Oracle CORBA applications in the following sections:

- About Factory-based Routing
- Characteristics of Factory-based Routing
- How Factory-based Is Implemented
- Configuring Factory-based Routing in the UBBCONFIG File

> **See Also:**
>
> Configuring Factory-based Routing in the UBBCONFIG File for more information about using factory-based routing

1.5.1 About Factory-based Routing

Factory-based routing enables you to a specify what server group is associated with an object reference. As a result, you can define the group and machine in which a given object is instantiated and then distribute the processing load for a given application across multiple machines.

With factory-based routing, routing is performed when a factory creates an object reference. The factory specifies field information in its call to the Oracle CORBA TP Framework to create an object reference. The TP Framework executes the routing algorithm based on the routing criteria that is defined in the `ROUTING` section of an application's `UBBCONFIG` file. The resulting object reference has, as its target, an appropriate server group for the handling of method invocations on the object reference. Any server that implements the interface in that server group is eligible to activate the servant for the object reference.

Thus, the activation of CORBA objects can be distributed by server group based on the defined criteria and different implementations of CORBA interfaces can be supplied in different groups. So you can replicate the same CORBA interface across multiple server groups, based on defined, group-specific differences.

The primary benefit of factory-based routing is that it provides a simple means to scale an application, and invocations on a given interface in particular, across a growing deployment environment. Distributing the deployment of an application across additional machines is strictly an administrative function that does not require you to recode or rebuild the application.

1.5.2 Characteristics of Factory-based Routing

Factory-based routing has the following characteristics:

- The factory object implementation can indirectly control the location of the created CORBA object by supplying application-specific routing information.
- An implementation of a particular CORBA interface can exist in more than one server process, as shown in Configuring Factory-based Routing in the UBBCONFIG File.
- Multiple CORBA interfaces can reside in a single server group.
- All server processes in a particular server group do *not* need to use the same CORBA interfaces.
- All object instances that offer a given interface within a group must support the same version of the implementation.
- Routing uses the bulletin board criteria and occurs in a server call.

1.5.3 How Factory-based Is Implemented

To implement factory-based routing, you must change the way your factories create object references. First, you must coordinate with the system designer to determine the fields and values to be used as the basis for routing. Then, for each interface, you must configure factory-based routing such that the interface definition for the factory specifies the parameter that represents the routing criteria that is used to determine the group ID.

To configure factory-based routing, define the following information in the `UBBCONFIG` file:

- Routing criteria identifier for a CORBA interface in the `INTERFACES` section.
- As many server groups as are required for distributing the system in the `GROUPS` section.

- Routing criteria in the `ROUTING` section.
- Groups, machines, and databases as required.

> **Note:**
>
> When implementing factory-based routing, remember that an object with a given interface and OID can be simultaneously active in two different groups *if* those two groups both contain the same object implementation. This can be avoided if your factories generate unique OIDs. To guarantee that only one object instance of a given interface name and OID is available at any one time in your domain, you must either:
>
> - Use factory-based routing to ensure that objects with a particular OID are always routed to the same group, or
> - Configure your domain so that a given object implementation is in only one group.
>
> If multiple clients have an object reference that contains a given interface name and OID, the reference will always be routed to the same object instance.
>
> Thereafter, the object reference will contain additional information that is used to provide an indication of where the target server exists. Factory-based routing is performed once per CORBA object, when the object reference is created.

1.5.4 Configuring Factory-based Routing in the UBBCONFIG File

Routing criteria specify the data values used to route requests to a particular server group. To configure factory-based routing, you define routing criteria in the `ROUTING` section of the `UBBCONFIG` file (for each interface for which requests are routed). For more detailed information about configuring factory-based routing, see Configuring Factory-based Routing in the UBBCONFIG File.

To configure factory-based routing across multiple domains, you must also configure the `factory_finder.ini` file to identify factory objects that are used in the current (local) domain but that are resident in a different (remote) domain. For more information, see “Configuring Multiple Domains for CORBA Applications” in the Using the Oracle Tuxedo Domains Component .

1.6 Using Parallel Objects

This topic includes the following sections:

- About Parallel Objects
- Configuring Parallel Objects

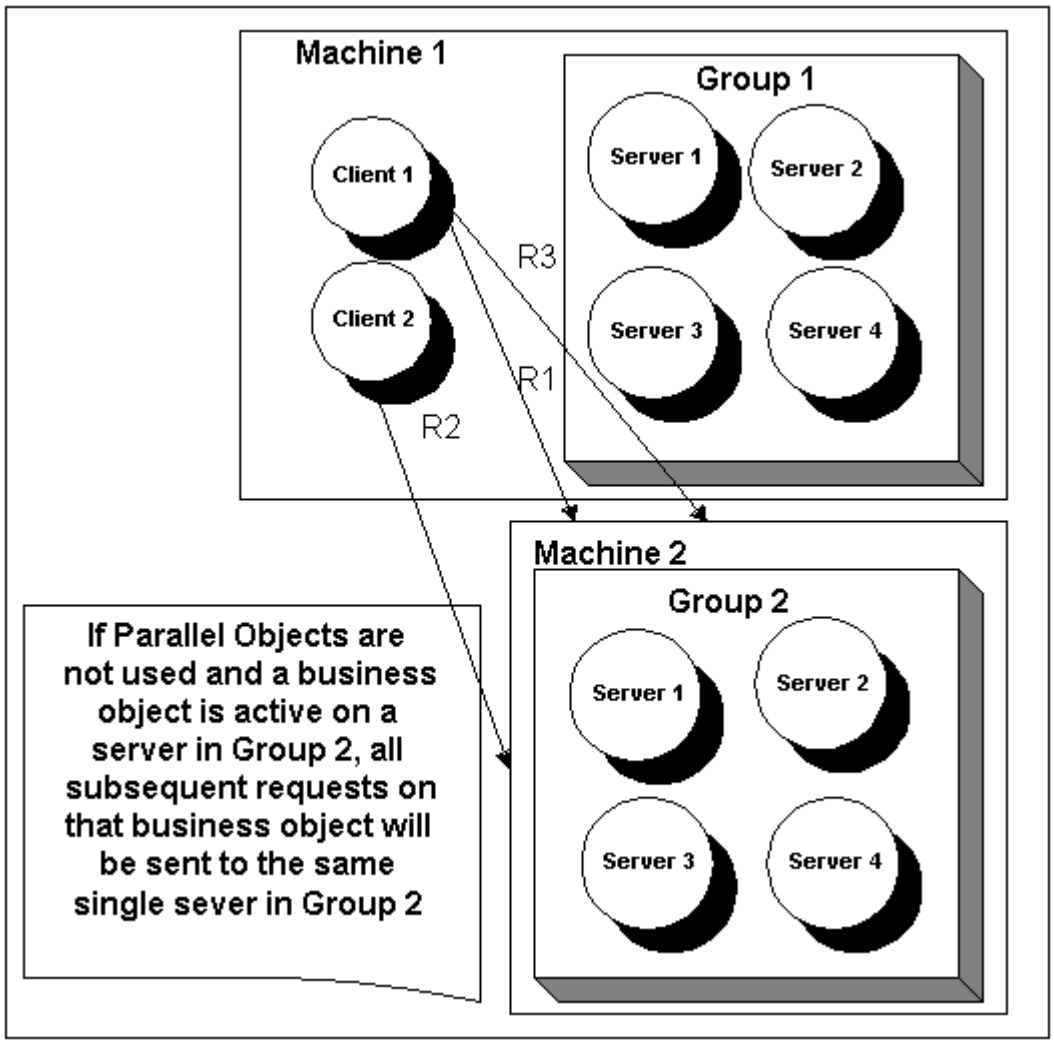
1.6.1 About Parallel Objects

Support for parallel objects has been added in release 8.0 of Oracle Tuxedo as a performance enhancement. The parallel objects feature enables you to designate all business objects in particular application as stateless objects. The effect is that, unlike stateful business objects, which can only run on one server in a single domain, stateless business objects can run on all servers in a single domain. Thus, the benefits of parallel objects are as follows:

> **Note:**
>
> You enable the parallel objects feature by setting the concurrency policy option to `user_controlled` in the ICF file. For more information, see Configuring Parallel Objects.
>
> - Parallel objects, which are stateless, can run on multiple servers in the same domain at the same time. The resulting utilization of all servers to service concurrent multiple requests improves performance.
> - When Oracle Tuxedo services requests to parallel business objects, it always looks for an available server to the local machine first. If all servers on the local machine are busy processing the requested business object, Oracle Tuxedo looks for an available server on other machines in the local domain. Thus, if there are multiple servers on the local machine, network traffic is reduced and performance is improved.

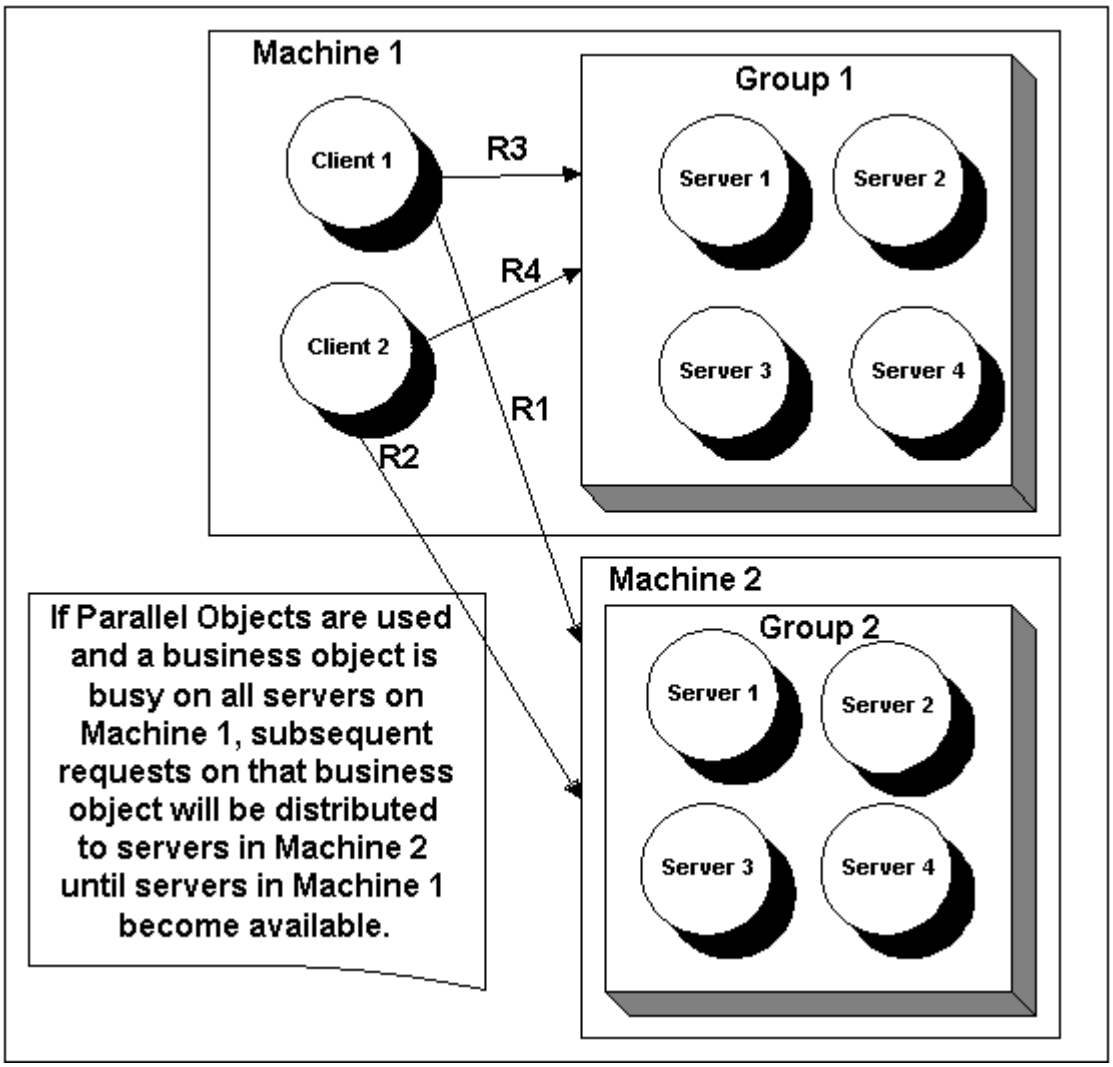
As illustrated in the following figure, if a stateful business object is active on a server on Machine 2, all subsequent requests to that business object will be sent to Group 2 on Machine 2. If the active object on Machine 2 is busy processing another request, the request is queued. Even after the business object stops processing requests on Machine 2, all subsequent requests on that stateful business object will still be sent to Group 2. After the object is deactivated on Machine 2, subsequent requests will be sent to Group 2 on Machine 2 and can be processed by other servers in Group 2.

Figure 1-1 Using Stateful Business Objects



As illustrated in the following figure, if a parallel object is running on all the servers in Group 1 on Machine 1 (multiple instances of stateless, user-controlled business objects can run on multiple servers at the same time), subsequent requests to that business object will be sent to Machine 2 and distributed to the servers in Group 2 until a server becomes available in Group 1. As long as there is a server available on the local machine, requests will be distributed to the servers on Machine 1, unless the Oracle Tuxedo load-balancing feature determines that, due to loads on the servers, the request must be serviced by a server in Group 2. To make this determination, the load-balancing feature uses the `LOAD` parameter, which is set in the `INTERFACES` section of the

Figure 1-2 Using Stateless Business Objects



`UBBCONFIG` file. For information on the `LOAD` parameter, see Modifying the INTERFACES Section.

1.6.2 Configuring Parallel Objects

Support for parallel objects was added to Oracle Tuxedo in release 8.0. You use the ICF file to implement parallel objects for a particular CORBA application. The ICF includes a user-controlled concurrency policy option that sets all business objects implemented in the application, to which the ICF file applies, to stateless objects.

The concurrency policy determines whether the Active Object Map (AOM) is used to guarantee that an object is active in only one server at any one time. In previous releases, use of the AOM was mandatory, not optional. Use of the AOM is referred to as system-controlled concurrency. Unlike the system-controlled concurrency model, the user-controlled model, which does not use the AOM, allows the same object to be active in more than one server at a time. Thus, user-controlled concurrency can be used to improve performance and load balancing. For more information about configuring user-controlled concurrency for parallel objects, see Parallel Objects in the CORBA Programming Reference.

1.7 Multiplexing Incoming Client Connections

System administrators can scale an Oracle Tuxedo application by increasing, in the `UBBCONFIG` file, the number of incoming client connections that an application site supports. Oracle Tuxedo provides a multicontexted, multistated gateway of listener/handlers to handle the multiplexing of all the requests issued by the client.

This topic includes the following sections:

- IIOP Listener and Handler
- Increasing the Number of ISH Processes

1.7.1 IIOP Listener and Handler

The IIOP Listener (ISL) enables access to Oracle Tuxedo CORBA objects by remote Oracle Tuxedo CORBA clients that use IIOP. The ISL is a process that listens for remote CORBA clients requesting IIOP connections. The IIOP Handler (ISH) is a multiplexor process that acts as a surrogate on behalf of the remote CORBA client. Both the ISL and ISH run on the application site. An application site can have one or more ISL processes and multiple associated ISH processes. Each ISH is associated with a single ISL.

The client connects to the ISL process using a known network address. The ISL balances the load among ISH processes by selecting the best available ISH and passing the connection directly to it. The ISL/ISH manages the context on behalf of the application client. For more information about ISL and ISH, see the description of ISL in the File Formats, Data Descriptions, MIBs, and System Processes Reference.

1.7.2 Increasing the Number of ISH Processes

System administrators can scale an Oracle Tuxedo CORBA application by increasing the number of ISH processes on an application site, thereby enabling the ISL to load balance among more ISH processes. By default, an ISH can handle up to 10 client connections. To increase this number, pass the optional `CLOPT -x` *mpx-factor* parameter to the ISL command, specifying in *mpx-factor* the number of ISH client connections each ISH can handle (up to 4096), and therefore the degree of multiplexing, for the ISH. Increasing the number of ISH processes may affect application performance as the application site services more concurrent processes.

System administrators can tune other ISH options as well to scale Oracle Tuxedo applications. For more information, see the description of ISL in the File Formats, Data Descriptions, MIBs, and System Processes Reference.

2

Scaling CORBA Server Applications

Using the Production sample application as an example, this topic demonstrates scaling an CORBA C++ application to increase its processing capability. Ensure to read the following before you begin:

- About Scaling Oracle Tuxedo CORBA Applications for a comprehensive introduction to tuning and scaling Oracle Tuxedo CORBA applications.
- Production Sample Application in the Oracle Tuxedo online documentation.

This topic includes the following sections:

2.1 About Scaling the Production Sample Application

The Production sample application provides the same end-user functionality as the Wrapper sample application. The Production sample application demonstrates how to use features of the Oracle Tuxedo software to scale an existing Oracle Tuxedo application.

This section includes the following topics:

2.1.1 Design Goals

The primary design goal of the Production sample application is to significantly increase the number of client applications it can accommodate by:

- Processing, in parallel and on one machine, client requests on multiple objects that implement the same interface.
- Directing requests on behalf of certain students to one machine, and other students to other machines.
- Adding more machines to share the processing load.

2.1.2 How the Application Has Been Scaled

To accommodate these design goals, the Production sample application has been scaled by:

- Implementing a stateless object model to scale up the number of client requests the server process can manage simultaneously.
- Replicating the University, Billing, and Oracle Tuxedo Teller Application server processes within the groups in which they are configured (the `ORA_GRP` and `APP_GRP` server groups defined in the `UBBCONFIG` file).
- Replicating the `ORA_GRP` and `APP_GRP` server groups on an additional server machine, Production Machine 2, and also partitioning the database.
- Assigning unique object IDs (OIDs) to the following objects so that they can be instantiated multiple times simultaneously in their respective groups.
- `RegistrarFactory`
- `Registrar`
- `TellerFactory`
- `Teller`
  This makes these objects available on a per-client application (and not per-process) basis, thereby accommodating a parallel processing capability.
- Implementing factory-based routing to direct client requests on behalf of some students to one machine, and other students to another machine.

> **Note:**
>
> To make the Production sample application easy to use, this application is configured on the Oracle Tuxedo software kit to run on one machine, using one database. The examples shown in this chapter, however, show running this application on two machines using two databases. The Production sample application is designed so that it can be configured to run on several machines and to use multiple databases. Changing the configuration to multiple machines and databases involves modifying the `UBBCONFIG` file and partitioning the databases, which is described in Scaling the Application Further.

The sections that follow describe how the Production sample application uses replicated server processes and server groups, object state management, and factory-based routing to meet its scalability goals.

2.2 Changing the OMG IDL

The only OMG IDL changes for the Production sample application are limited to the `find_registrar()` and `find_teller()` operations on, respectively, the `RegistrarFactory` and `TellerFactory` objects. These two operations need to be modified to require, respectively, a student ID and account number, which are needed to implement factory-based routing. See Scaling with Factory-based Routing to read about how the Production sample application implements and uses factory-based routing.

2.3 Using a Stateless Object Model

This section describes how object state management is used with the `Registrar` and `Teller` objects in the Production sample applications to increase the application's scalability. For an introduction to object state management, see Using Object State Management.

To increase scalability, the `Registrar` and `Teller` objects are configured in the Production server application with the `method` activation policy. The `method` activation policy assigned to these two objects results in the following behavior changes:

- Whenever these objects are invoked, they are instantiated by the Oracle Tuxedo domain in the appropriate server group.
- After the invocation is complete, the Oracle Tuxedo domain deactivates these objects.

With the Basic through the Wrapper sample applications, the `Registrar` object was process-bound (`process` activation policy). All client requests on the `Registrar` object invariably went to the same object instance in the memory of the server machine. The Basic sample application design may be adequate for a small-scale deployment. However, as client application demands increase, client requests on the `Registrar` object eventually become queued, and response time drops.

However, when the `Registrar` and `Teller` objects are stateless (`method` activation policy), and the server processes that manage these objects are replicated, the `Registrar` and Teller objects can process multiple client requests in parallel. The only constraint on the number of simultaneous client requests that these objects can handle is the number of server processes that are available that can instantiate the `Registrar` and `Teller` objects. These stateless objects, thereby, make for more efficient use of machine resources and reduced client response time.

Most importantly, so that Oracle Tuxedo CORBA can instantiate copies of the `Registrar` and `Teller` objects in each of the replicated server processes, each copy of these objects must be unique. To make each instance of these objects unique, the factories for those objects must assign unique object IDs to them.

For the Oracle Tuxedo application to instantiate copies of the `Registrar` and `Teller` objects in each of the replicated server application processes, each copy of the `Registrar` and `Teller` objects have an unique object ID (OID). The factories that create these objects are responsible for assigning them unique OIDs. For information about generating unique object IDs, see *Creating CORBA Server Applications*. For more information about other design considerations, see Additional Design Considerations.

2.4 Scaling by Replicating Server Processes and Server Groups

This topic includes the following sections:

This topic describes how the Production sample application was scaled by replicating server processes and server groups. For an introduction to this topic, see Scaling by Replicating Server Processes and Server Groups.

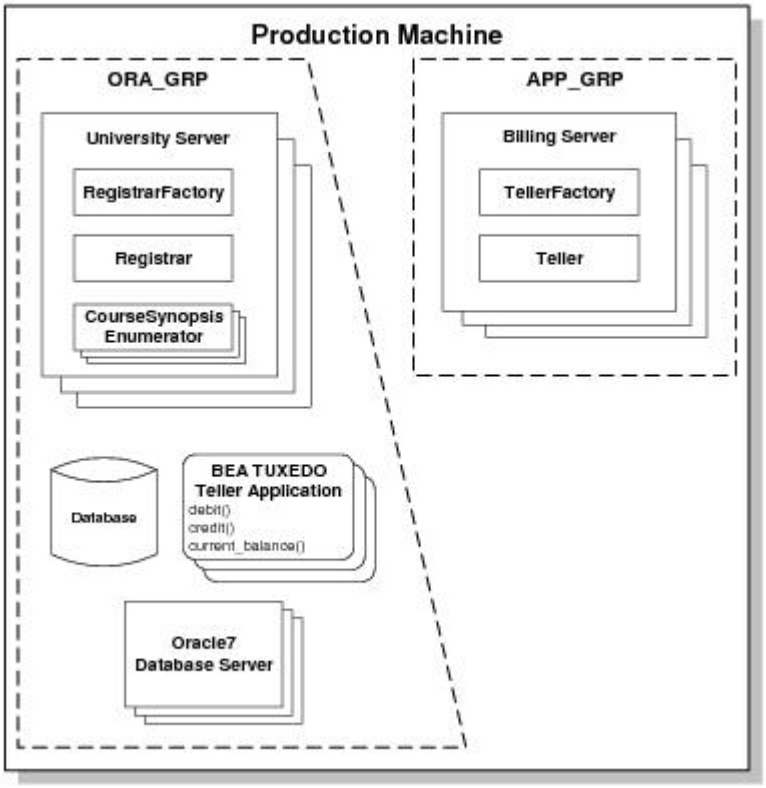
2.4.1 Replicating Server Processes in the Production Application

This section describes how the Production sample application replicates server applications. For an introduction to this feature, see Replicating Server Processes.

The following figure shows the replicated `ORA_GRP` and `APP_GRP` groups running on a single machine.

- The University server application, Oracle Tuxedo Teller Application, and Oracle7 TMS server processes are replicated within the `ORA_GRP` group.
- The Billing server process is replicated within the `APP_GRP` group.

Figure 2-1 Replicated Server Groups in the Production Sample



When a request arrives for either of these groups, the Oracle Tuxedo domain has several server processes available that can process the request, and the Oracle Tuxedo domain can choose the server process that is the least busy.

In following figure, note the following points:

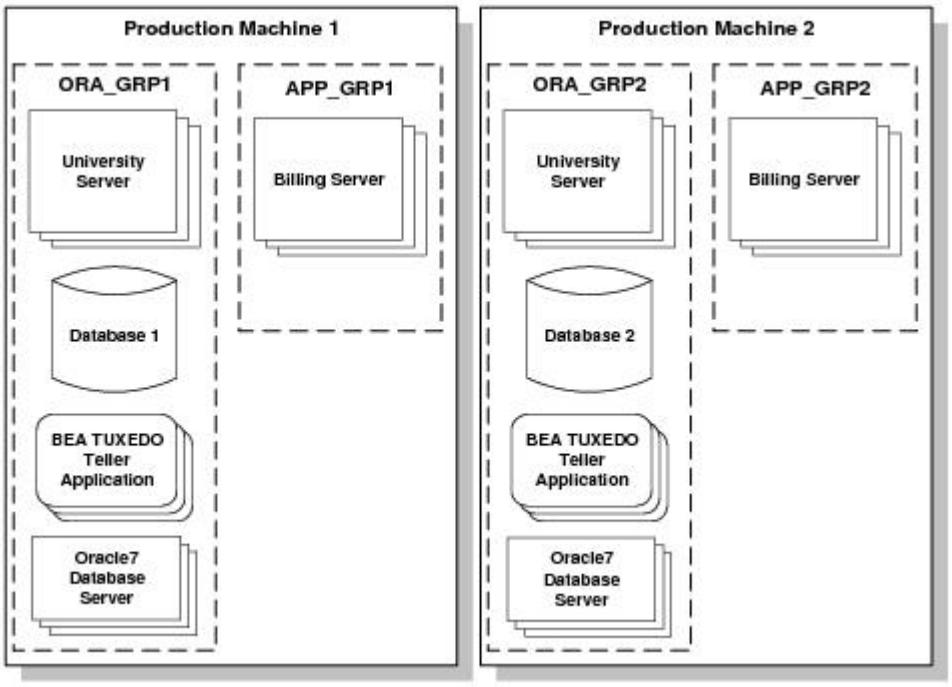
- At any time, there may be no more than one instance of the `RegistrarFactory`, `Registrar`, `TellerFactory`, or `Teller` objects within a given server process.
- There may be any number of `CourseSynopsisEnumerator` objects in any University server process.

2.4.2 Replicating Server Groups in the Production Application

This section describes how the Production sample application replicates server groups. For an introduction to this feature, see Replicating Server Groups.

The following figure shows the Production sample application groups replicated on another machine, as specified in the application's `UBBCONFIG` file, as `ORA_GRP2` and `APP_GRP2`.

Figure 2-2 Replicating Server Groups Across Machines



In following figure, the only difference between the content of the groups on Production Machines 1 and 2 is the database:

- The database on Production Machine 1 contains student and account information for students with IDs between `100001` and `100005`.
- The database on Production Machine 2 contains student and account information for students with IDs between `100006` and `100010`.

> **Note:**
>
> The course information table in both databases is identical.

The student information in a given database may be completely unrelated to the account information in the same database.

For more information about how the Production sample application uses factory-based routing to distribute the application's processing load across multiple machines, see Scaling with Factory-based Routing.

2.4.3 Configuring Replicated Server Processes and Groups in the Production Application

The following code snippet shows excerpts from the `GROUPS` and `SERVERS` sections of the `UBBCONFIG` file for the Production sample application.

```
*GROUPS
    APP_GRP1
        LMID        = SITE1
        GRPNO       = 2
        TMSNAME     = TMS
    APP_GRP2
        LMID        = SITE1
        GRPNO       = 3
        TMSNAME     = TMS
    ORA_GRP1
        LMID        = SITE1
        GRPNO       = 4
        OPENINFO    = "ORACLE_XA:Oracle_XA+Acc=P/scott/..."
        CLOSEINFO   = ""
        TMSNAME     = "TMS_ORA"
    ORA_GRP2
        LMID        = SITE1
        GRPNO       = 5
        OPENINFO    = "ORACLE_XA:Oracle_XA+Acc=P/scott/..."
        CLOSEINFO   = ""
        TMSNAME     = "TMS_ORA"

*SERVERS
    # By default, activate 2 instances of each server
    # and allow the administrator to activate up to 5
    # instances of each server
    DEFAULT:
        MIN = 2
        MAX = 5
    tellp_server
        SRVGRP = ORA_GRP1
        SRVID = 10
        RESTART = N
    tellp_server
        SRVGRP = ORA_GRP2
        SRVID = 10
        RESTART = N

    billp_server
        SRVGRP = APP_GRP1
        SRVID = 10
        RESTART = N
    billp_server
        SRVGRP = APP_GRP2
        SRVID = 10
        RESTART = N
    univp_server
        SRVGRP = ORA_GRP1
```

```
    SRVID = 20
    RESTART = N
univp_server
    SRVGRP = ORA_GRP2
    SRVID = 20
    RESTART = N
```

2.5 Scaling with Factory-based Routing

This topic describes how the Production sample application was scaled using factory-based routing. For an introduction to factory-based routing, see Using Factory-Based Routing (CORBA Servers Only).

This topic includes the following sections:

- About Factory-based Routing in the Production Application
- Configuring Factory-based Routing in the UBBCONFIG File
- Implementing Factory-based Routing in a Factory
- What Happens at Run Time

2.5.1 About Factory-based Routing in the Production Application

This section describes how the Production sample application uses a factory-based routing. For an introduction to this feature, see Using Factory-Based Routing (CORBA Servers Only).

You can use factory-based routing to expand the load-balancing and scalability features of Oracle Tuxedo CORBA. In the Production sample application, you can use factory-based routing to send requests to register one subset of students to one machine, and requests for another subset of students to another machine. As you increase your application's processing capability, you can easily modify the factory-based routing in your application to add more machines.

The primary design consideration regarding implementing factory-based routing in the Production sample application is in choosing the value on which routing is based. The Production sample application uses factory-based routing in the following ways:

- Requests from client applications to the `Registrar` object are routed based on the student ID. Requests from student ID `100001` to `100005` go to Production Machine 1. Requests from student ID `100006` to `100010` go to Production Machine 2.
- Requests from the `Registrar` object to the `Teller` object are routed based on account number. Billing requests for account `200010` to `200014` go to Production Machine 1. Billing requests for account `200015` to `200019` go to Production Machine 2.

2.5.2 Configuring Factory-based Routing in the UBBCONFIG File

The University Production sample application demonstrates how to implement factory-based routing. The `INTERFACES`, `ROUTING`, and `GROUPS` sections from the `ubb_b.nt` configuration file show how you can implement factory-based routing in an Oracle Tuxedo CORBA application. You can find the `ubb_p.nt` or `ubb_p.mk` `UBBCONFIG` files for this sample in the directory where the Oracle Tuxedo software is installed (see the `\samples\corba\university\production` subdirectory).

The UBBCONFIG file must specify the following data in the INTERFACES and ROUTING sections, as well as how groups and machines are identified.

1. The INTERFACES section lists the names of the interfaces for which you want to enable factory-based routing. For each interface, this section specifies the kinds of criteria on which the interface routes. This section specifies the routing criteria via an identifier, FACTORYROUTING, as shown in the following code snippet.

```
INTERFACES
"IDL:beasys.com/UniversityP/Registrar:1.0"
FACTORYROUTING = STU_ID
"IDL:beasys.com/BillingP/Teller:1.0"
FACTORYROUTING = ACT_NUM
```

   The following listing shows the fully qualified interface names for the two interfaces in the Production sample in which factory-based routing is used. The FACTORYROUTING identifier specifies the names of the routing values, which are STU_ID and ACT_NUM, respectively.

2. The ROUTING section specifies the parameters in the following table for each routing value.

Table 2-1 Parameters Specified in the ROUTING Section

Parameter	Description
TYPE	Specifies the type of routing. In the Production sample, the type of routing is factory-based routing. Therefore, this parameter is defined as FACTORY.
FIELD	Specifies the variable name that the factory inserts in the routing value. In the Production sample, the field parameters are student_id and account_number, respectively.
FIELDTYPE	Specifies the data type of the routing value. In the Production sample, the field types for student_id and account_number are long.
RANGES	Specifies the values that are routed to each group.

The following code snippet shows the ROUTING section of the UBBCONFIG file used in the Production sample application.

```
ROUTING
    STU_ID
        FIELD     = "student_id"
        TYPE      = FACTORY
        FIELDTYPE = LONG
        RANGES    = "100001-100005:ORA_GRP1,100006-100010:ORA_GRP2"
    ACT_NUM
        FIELD     = "account_number"
        TYPE      = FACTORY
        FIELDTYPE = LONG
        RANGES    = "200010-200014:APP_GRP1,200015-200019:APP_GRP2"
```

The following listing shows that Registrar object references for students with IDs in one range are routed to one server group, and Registrar object references for students with IDs in another range are routed to another group. Likewise, Teller object references for accounts in one range are routed to one server group, and Teller object references for accounts in another range are routed to another group.

3. The groups specified by the RANGES identifier in the ROUTING section of the UBBCONFIG file need to be identified and configured. For example, the Production sample specifies four groups: APP_GRP1, APP_GRP2, ORA_GRP1, and ORA_GRP2. These groups need to be configured, and the machines on which they run need to be identified.
The following code snippet shows the GROUPS section of the Production sample UBBCONFIG file, in which the ORA_GRP1 and ORA_GRP2 groups are configured. Notice how the names in the GROUPS section match the group names specified in the RANGES parameter in the ROUTING section. This is critical for factory-based routing to work correctly. Furthermore, any change in the way groups are configured in an application must be reflected in the ROUTING section. (

> **Note:**
>
> The Production sample packaged with the Oracle Tuxedo software is configured to run entirely on one machine. However, you can easily configure this application to run on multiple machines.)

```
*GROUPS
    APP_GRP1
        LMID      = SITE1
        GRPNO     = 2
        TMSNAME   = TMS
    APP_GRP2
        LMID      = SITE1
        GRPNO     = 3
        TMSNAME   = TMS
    ORA_GRP1
        LMID      = SITE1
        GRPNO     = 4
        OPENINFO = "ORACLE_XA:Oracle_XA+Acc=P/scott/
tiger+SesTm=100+LogDir=.+MaxCur=5"
        CLOSEINFO = ""
        TMSNAME   = "TMS_ORA"
    ORA_GRP2
        LMID      = SITE1
        GRPNO     = 5
OPENINFO = "ORACLE_XA:Oracle_XA+Acc=P/scott/
tiger+SesTm=100+LogDir=.+MaxCur=5"
        CLOSEINFO = ""
        TMSNAME   = "TMS_ORA"
```

2.5.3 Implementing Factory-based Routing in a Factory

Factories implement factory-based routing in the way the invocation to the TP::create_object_reference() operation is implemented. This operation has the C++ binding for create_object_reference in the following code snippet.

```
CORBA::Object_ptr  TP::create_object_reference (
                       const char* interfaceName,
                       const PortableServer::oid &stroid,
                        CORBA::NVlist_ptr criteria);
```

The third parameter to this operation, `criteria`, specifies a list of named values to be used for factory-based routing. To implement factory-based routing in a factory, you need to build the `NVlist`. The use of factory-based routing is optional and is dependent on this argument. Instead of using factory-based routing, you can pass a value of `0` (zero) for this argument.

As stated previously, the `RegistrarFactory` object in the Production sample application specifies the value `STU_ID`. This value must exactly match the following information in the `UBBCONFIG` file:

- The routing name, type, and allowable values specified by the `FACTORYROUTING` identifier in the `INTERFACES` section.
- The routing criteria name, field, and field type specified in the `ROUTING` section.

The `RegistrarFactory` object inserts the student ID into the `NVlist` using the code shown in the following code snippet.

```
// put the student id (which is the routing criteria)
// into a CORBA NVList:
CORBA::NVList_var v_criteria;
TP::orb()->create_list(1, v_criteria.out());
CORBA::Any any;
any <<= (CORBA::Long)student;
v_criteria->add_value("student_id", any, 0);
```

The `RegistrarFactory` object has an invocation to the `TP::create_object_reference()` operation, as shown in the following code snippet. The following code snippet passes the `NVlist` created.

```
// create the registrar object reference using
// the routing criteria :
CORBA::Object_var v_reg_oref =
    TP::create_object_reference(
        UniversityP::_tc_Registrar->id(),
        object_id,
        v_criteria.in()
    );
```

The Production sample application also uses factory-based routing in the `TellerFactory` object to determine the group in which `Teller` objects should be instantiated based on an account number.

2.5.4 What Happens at Run Time

When you implement factory-based routing in a factory, Oracle Tuxedo CORBA generates an object reference. The following example shows how the client application gets an object reference to a `Registrar` object when factory-based routing is implemented.

1. The client application invokes the `RegistrarFactory` object, requesting a reference to a `Registrar` object. The request includes a student ID.
2. The `RegistrarFactory` inserts the student ID into an `NVlist`, which is used as the routing criteria.
3. The `RegistrarFactory` invokes the `TP::create_object_reference()` operation, passing the `Registrar` interface name, a unique OID, and the `NVlist`.

4. Oracle Tuxedo CORBA compares the contents of the routing tables with the value in the `NVlist` to determine a group ID.
5. Oracle Tuxedo CORBA inserts information about the group into the object reference.

When the client application subsequently invokes an object using the object reference, Oracle Tuxedo CORBA routes the request to the group specified in the object reference.

> **Note:**
>
> If you use the process-entity design pattern, you should use caution in how you implement factory-based routing. The object can service only those entities that are contained in the group's database.

2.6 Additional Design Considerations

This topic includes the following sections:

2.6.1 About the Additional Design Considerations

When designing the `Registrar` and `Teller` objects, you should ensure that:

- The `Registrar` and `Teller` objects work properly for the Production deployment environment; namely, across multiple replicated server processes and multiple groups. Given that the University and Billing server processes are replicated, the design must consider how these two objects should be instantiated.
- Client requests for registration and billing operations for a given student go to the correct server group, given that the two server groups in the Production Oracle Tuxedo domain each deal with different databases.

These objects must have unique object IDs (OIDs) and must be method-bound (that is, they must have the `method` activation policy assigned to them).

2.6.2 Instantiating the Registrar and Teller Objects

In the University server applications that are less sophisticated than the Production sample application, the run-time behavior of the `Registrar` and `Teller` objects was simpler:

- Each object was process-bound, meaning that each was activated the first time it was invoked, and it stayed in memory until the server process in which it ran was shut down.
- Since there was only one server group running in the Oracle Tuxedo domain, and only one University and Billing server process in the group, all client requests were directed to the same objects. As multiple client requests arrived in the Oracle Tuxedo domain, these objects each processed one client request at one time.
- Because there was only one instance of each object in the server processes in which they ran, neither object needed a unique OID. The OID for each object specified only the Interface Repository ID.

However, because the University and Billing server processes are now replicated, Oracle Tuxedo CORBA must be able to differentiate among multiple instances of the `Registrar` and `Teller` objects. For example, if there are two University server processes running in a group, Oracle Tuxedo CORBA must have a means to distinguish between the `Registrar` object running in the first University server process and the `Registrar` object running in the second University server process. To distinguish multiple instances of these objects, each object instance must be unique.

To make each `Registrar` and `Teller` object unique, the factories for those objects must change the way in which they make object references to them. For example, when the `RegistrarFactory` object in the Basic sample application created an object reference to the `Registrar` object, the `TP::create_object_reference()` operation specified an OID that consisted only of the string `registrar`. However, in the Production sample application, the same `TP::create_object_reference()` operation uses a generated unique OID instead.

As a result of giving each `Registrar` and `Teller` object a unique OID, multiple instances of these objects may be running simultaneously in the Oracle Tuxedo domain. This characteristic is typical of the stateless object model, and is an example of how the Oracle Tuxedo domain can be highly scalable while it offers high performance.

Finally, because unique `Registrar` and `Teller` objects need to be brought into memory for each client request on them, it is critical that these objects be deactivated when the invocations on them are completed so that any object state associated with them does not remain idle in memory. The Production server application addresses this issue by assigning the `method` activation policy to these two objects in the Implementation Configuration File (ICF).

2.6.3 Ensuring That Student Registration Occurs in the Correct Server Group

The primary scalability advantage of using replicated server groups is being able to distribute processing across multiple machines. However, if your application interacts with a database, which is the case with the University sample applications, it is critical that you consider the impact of these multiple server groups on the database interactions.

In many cases, you may have one database associated with each machine in your deployment. If your server application is distributed across multiple machines, you must consider how you set up your databases.

The Production sample application, as described in this chapter, uses two databases. However, this application can easily be configured to accommodate more. The system administrator can decide on how many databases to use.

In the Production sample application, the student and account information is partitioned across the two databases, but course information is identical. Having identical course information in both databases is not a problem because the course information is read-only for the purposes of course registration. However, the student and account information is read-write. If multiple databases were also to contain identical data for students and accounts (that is, the database is not partitioned), the application would need to deal with the overhead of synchronizing the updates to student and account information across all the databases each time any student or account information were to change.

The Production sample application uses factory-based routing to send one set of requests to one machine, and another set to the other machine. How factory-based routing is implemented in the `RegistrarFactory` object depends on the way in which references to `Registrar` objects are created.

For example, when the client application sends a request to the `RegistrarFactory` object to get an object reference to a `Registrar` object, the client application includes a student ID in that request. The client application must use the object reference that the `RegistrarFactory` object returns to make all subsequent invocations on a `Registrar` object on a particular student's behalf, because the object reference returned by the factory is group-specific. Therefore, for example, when the client application subsequently invokes the `get_student_details()` operation on the `Registrar` object, the client application can be assured that the `Registrar` object is active in the server group associated with the database containing data for that student.

To show how this works, consider the following execution scenario, which is implemented in the Production sample application:

1. The client application invokes the `find_registrar()` operation on the `RegistrarFactory` object. Included in this invocation is the student ID `1000003`.
2. Oracle Tuxedo CORBA routes the client request to any `RegistrarFactory` object.
3. The `RegistrarFactory` object uses the student ID to create an object reference to a `Registrar` object in `ORA_GRP1`, based on the routing information in the `UBBCONFIG` file, and returns that object reference to the client application.
4. The client application invokes the `register_for_courses()` operation on the `Registrar` object.
5. Oracle Tuxedo CORBA receives the client request and routes it to the server group specified in the object reference. In this case, the client request goes to the University server process in `ORA_GRP1`, which is on Production Machine1.
6. The University server process instantiates a `Registrar` object and sends the client invocation to it.

The `RegistrarFactory` object from the preceding scenario returns to the client application a unique reference to a `Registrar` object that can be instantiated only in `ORA_GRP1`, which runs on Production Machine 1 and has a database containing student data for students with IDs in the range `100001` to `100005`. Therefore, when the client application sends subsequent requests to this `Registrar` object on behalf of a given student, the `Registrar` object interacts with the correct database.

2.6.4 Ensuring That the Teller Object Is Instantiated in the Correct Server Group

When the `Registrar` object needs a `Teller` object, the `Registrar` object invokes the `TellerFactory` object, using the TellerFactory object reference cached in the University Server object.

However, because factory-based routing is used in the `TellerFactory` object, the `Registrar` object passes the student's account number when the `Registrar` object requests a reference to a `Teller` object. This way, the `TellerFactory` object creates a reference to a `Teller` object in the group that has the correct database.

> **Note:**
>
> For the Production sample application to work properly, it is essential that the system administrator configures the server groups and the databases properly. In particular, the system administrator must make sure that a match exists between the routing criteria specified in the routing tables and the databases to which requests using those criteria are routed. Using the Production sample as an example, the database in a given group must contain the correct student and account information for the requests that are routed to that group.

2.7 Scaling the Application Further

In the future, the system administrator of the Production sample application may want to add capacity to the Oracle Tuxedo domain. For example, the University may eventually experience a large increase in the student population, or the Production application may be scaled up to accommodate the course registration process for an entire state university system, encompassing several campuses. This can be done without modifying or rebuilding the application.

The system administrator can continually add capacity by:

- Replicating the server groups in the Production sample application across additional machines.
  The system administrator must modify the `UBBCONFIG` file to specify the additional server groups, the server processes that run in those groups, and the machines on which the server groups run.
- Changing the factory-based routing tables.
  For example, instead of routing to the two existing groups in the Production sample application, the system administrator can modify the routing rules in the `UBBCONFIG` file to partition the application further among additional server groups added to the Oracle Tuxedo domain. Any modification to the routing tables must match the information for the configured server groups and machines in the `UBBCONFIG` file.

> **Note:**
>
> If you add capacity to an existing Oracle Tuxedo CORBA application that uses a database, you must also consider the impact on how the database is set up, particularly when you are using factory-based routing. For example, if the Production sample application is distributed across six machines, the database on each machine must be set up appropriately and in accordance with the routing tables in the `UBBCONFIG` file.

3
Distributing CORBA Applications

This topic describes how to distribute applications in the Oracle Tuxedo CORBA environment, using a CORBA application as an example.

> **Note:**
>
> The Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB were deprecated in Tuxedo 8.1 and are no longer supported. All Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB text references, associated code samples, must only be used to help implement/run third party Java ORB libraries, and for programmer reference only.
> Technical support for third party CORBA Java ORBs must be provided by their respective vendors. Oracle Tuxedo does not provide any technical support or documentation for third party CORBA Java ORBs.

This topic includes the following sections:

3.1 Why Distribute an Application?

This topic includes the following sections:

3.1.1 About Distributing an Application

Distributing an application enables you to select which parts of an application must be grouped together logically and where these groups must run. You distribute an application by creating more than one entry in the `GROUPS` section of the `UBBCONFIG` file, and by dividing application resources or tasks among the groups. Creating groups of servers enables you to partition a very large application into its component business applications, and to assure that each of these into logical components is of a manageable size and in an optimal location.

3.1.2 Benefits of a Distributed Application

The benefits of a distributed application include:

- Scalability—to increase the load that an application can sustain:
  - Place extra server processes in a group.
  - Add machines to the application and redistribute the groups across the machines.
  - Replicate a group onto other machines within the application and use load balancing.
  - Segment a database and use data-dependent routing to reach the groups dealing with these separate database segments (the Oracle Tuxedo ATMI system).

With the Oracle Tuxedo CORBA system, you can use factory-based routing to distribute the processing of a particular CORBA interface across multiple server groups and, if desired, across multiple machines. This feature allows you to distribute the processing load, which can prevent the processing bottlenecks that occur when concurrent, resource-intensive applications compete for the available CPU, memory, disk I/O, and network resources. For an example of using factory-based routing, see Scaling with Factory-based Routing.

For more information about Oracle Tuxedo CORBA scalability features, see Scaling, Distributing, and Tuning CORBA Applications.

- Ease of Development and Maintenance—the separation of the business application logic into services or components that communicate through well-defined messages or interfaces allows both development and maintenance to be similarly separated and thereby simplified.
- Reliability—when multiple machines are in use and one fails, the remainder can continue operation. Similarly, when multiple server processes are within a group and one fails, the others are available to perform work. Finally, if a machine must fail, but there are multiple machines within the application, these other machines can be used to handle the load.
- Coordination of Autonomous Actions—if you have separate applications, you can coordinate autonomous actions, as a single logical *unit of work*, among applications. *Autonomous actions* are actions that involve multiple server groups and multiple resource manager interfaces.

3.1.3 Characteristics of Distributing an Application

A distributed application:

- Enlarges the client and/or server model.
- Establishes multiple server groups.
- Enables transparent access to Oracle Tuxedo services or Oracle Tuxedo CORBA interfaces.
- In Oracle Tuxedo, allows data-dependent partitioning of data.
- In Oracle Tuxedo CORBA, allows partitioning of CORBA objects in multiple groups across multiple machines, or distributing application factory interfaces and application interfaces.
- Enables management of multiple resources.
- Supports a networked model.

3.2 Using Data-dependent Routing (Oracle Tuxedo ATMI Servers Only)

This topic applies to Oracle Tuxedo servers only.

This topic includes the following sections:

3.2.1 About Data-dependent Routing

Data-dependent routing is a mechanism whereby a service request is routed by a client (or a server acting as a client) to a server within a specific group based on a data value contained within the buffer that is sent. Within the internal code of a service call, Oracle Tuxedo chooses a destination server by comparing a data field with the routing criteria it finds in the bulletin board shared memory.

For any given service, a routing criteria identifier can be specified in the `SERVICES` section of the `UBBCONFIG` file. The routing criteria identifier (in particular, the mapping of data ranges to server groups) is specified in the `ROUTING` section.

3.2.2 Characteristics of Data-dependent Routing

Data-dependent routing has the following characteristics:

- The service request assigned to a server in the group is based on a data value.
- Routing uses the bulletin board criteria and occurs in a server call.
- The routing criteria identifier for a service is specified in the `SERVICES` section of the `UBBCONFIG` file.
- The routing criteria identifier is defined in the `ROUTING` section of the `UBBCONFIG` file.

3.2.3 Sample Distributed Application

The following table illustrates how client requests are routed to servers. In this example, a banking application called `bankapp` uses data-dependent routing. For `bankapp`, there are three groups (`BANKB1`, `BANKB2`, and `BANKB3`), and two routing criteria (`Account_ID` and `Branch_ID`). The services `WITHDRAW`, `DEPOSIT`, and `INQUIRY` are routed using the `Account_ID` field. The services `OPEN` and `CLOSE` are routed using the `Branch_ID` field.

Table 3-1 Data-dependent Routing Criteria for Sample Distributed Application

Server Group	Routing Criteria	Services
BANKB1	`Account_ID: 10000 - 49999`	`WITHDRAW, DEPOSIT,` and `INQUIRY`
	`Branch_ID: 1 - 4`	`OPEN` and `CLOSE`
BANKB2	`Account_ID: 50000 - 79999`	`WITHDRAW, DEPOSIT,` and `INQUIRY`
	`Branch_ID: 5 - 7`	`OPEN` and `CLOSE`
BANKB3	`Account_ID: 80000 -109999`	`WITHDRAW, DEPOSIT,` and `INQUIRY`

Table 3-1 (Cont.) Data-dependent Routing Criteria for Sample Distributed Application

Server Group	Routing Criteria	Services
	Branch_ID: 8 - 10	OPEN and CLOSE

3.2.4 Example of UBBCONFIG Sections in a Distributed Application

The following code snippet shows a sample UBBCONFIG file that contains the GROUPS, SERVICES, and ROUTING sections of a configuration file to accomplish data-dependent routing in the Oracle Tuxedo system.

```
*GROUPS
BANKB1            GRPNO=1
BANKB2            GRPNO=2
BANKB3            GRPNO=3
#
*SERVICES
WITHDRAW          ROUTING=ACCOUNT_ID
DEPOSIT           ROUTING=ACCOUNT_ID
INQUIRY           ROUTING=ACCOUNT_ID
OPEN_ACCT         ROUTING=BRANCH_ID
CLOSE_ACCT        ROUTING=BRANCH_ID
#
*ROUTING
ACCOUNT_ID        FIELD=ACCOUNT_ID BUFTYPE="FML"
                   RANGES="MIN - 9999:*,
                      10000-49999:BANKB1,
                      50000-79999:BANKB2,
                      80000-109999:BANKB3,
                      *:*"
BRANCH_ID         FIELD=BRANCH_ID BUFTYPE="FML"
                   RANGES="MIN - 0:*,
                      1-4:BANKB1,
                      5-7:BANKB2,
                      8-10:BANKB3,
                        *:*"
```

3.3 Configuring the UBBCONFIG File

For more information about the UBBCONFIG file, see Creating a Configuration Filein *Oracle® Tuxedo Application Configuration Guide*.

This topic includes the following sections:

- About the UBBCONFIG File in Distributed Applications
- Modifying the GROUPS Section
- Modifying the SERVICES Section
- Modifying the INTERFACES Section
- Creating the ROUTING Section

3.3.1 About the UBBCONFIG File in Distributed Applications

The UBBCONFIG file contains a description of either data-dependent routing (Oracle Tuxedo) or factory-based routing (Oracle Tuxedo CORBA), as follows:

- The GROUPS section is populated with as many server groups as are required for distributing the system. This allows the system to route a request to a server in a specific group. These groups can all reside on the same site (SHM mode) or, if there is networking, the groups can reside on different sites (MP mode).
- For data-dependent routing in Oracle Tuxedo, the SERVICES section must list the routing criteria for each service that uses the ROUTING parameter.

> **Note:**
>
> If a service has multiple entries, each with a different SRVGRP parameter, all such entries must set ROUTING the same way to ensure consistency for that service. A service can route only on one field, which must be the same for all the same services.

- For factory-based routing in Oracle Tuxedo CORBA, the INTERFACES section must list the name of the routing criteria for each CORBA interface that uses the FACTORYROUTING parameter. This parameter is set to the name of a routing criteria defined in the ROUTING section.
- Add a ROUTING section to the configuration file to show mappings between data ranges and groups so that the system can send the request to a server in a specific group. Each ROUTING section item contains an identifier that is used in the INTERFACES section (for Oracle Tuxedo ATMI) or in the SERVICES section (for Oracle Tuxedo).

3.3.2 Modifying the GROUPS Section

The parameters in the GROUPS section implement two important aspects of distributed transaction processing:

- They associate a group of servers with a particular LMID and a particular instance of a resource manager.
- By allowing a second LMID to be associated with the server group, they name an alternate machine to which a group of servers can be migrated if the MIGRATE option is specified.

The following table describes the parameters in the GROUPS section.

Table 3-2 Parameters Specified in the GROUPS Section

Parameter	Meaning
LMID	LMID must be assigned in the MACHINES section to indicate that this server group runs on this particular machine. A second LMID value can be specified (separated from the first by a comma) to name an alternate machine to which this server group can be migrated if the MIGRATE option has been specified. Servers in the group must specify RESTART=Y to migrate.

Table 3-2 (Cont.) Parameters Specified in the GROUPS Section

Parameter	Meaning
GRPNO	Associates a numeric group number with this server group. The number must be greater than zero (0) and less than 30000. It must be unique among entries in the GROUPS section in this configuration file. (Required)
TMSNAME	Specifies which transaction management server (TMS) must be associated with this server group.
TMSCOUNT	Specifies how many copies of TMSNAME must be started for this server group. The minimum value is 2. If not specified, the default is 3. All TMSNAME servers started for a server group are automatically set up in an MSSQ set. (Optional)
OPENINFO	Specifies information needed to open a particular instance of a particular resource manager, or it indicates that such information is not required for this server group. When a resource manager is named in the OPENINFO parameter, information such as the name of the database and the access mode is included. The entire value string must be enclosed in double quotes and must not be more than 256 characters. The format of the OPENINFO string is dependent on the requirements of the vendor providing the underlying resource manager. The string required by the vendor must be prefixed with rm_name:, which is the published name of the vendor's transaction (XA) interface followed immediately by a colon (:). The OPENINFO parameter is ignored if TMSNAME is not set or is set to TMS. If TMSNAME is set but the OPENINFO string is set to the null string ("") or if this parameter does not appear on the entry, it means that a resource manager exists for the group but does not require any information for executing an open operation.
CLOSEINFO	Specifies information the resource manager needs when closing a database. The parameter can be omitted or the null string can be specified. The default is the null string.

3.3.3 Modifying the SERVICES Section

The SERVICES section contains parameters that control the way application services are handled. An entry line in this section is associated with a service by its identifier name. Because the same service can be link edited with more than one server, the SRVGRP parameter is provided to tie the parameters for an instance of a service to a particular group of servers.

- Parameters to Modify
- Sample SERVICES Section

3.3.3.1 Parameters to Modify

Two parameters in the SERVICES section are particularly related to distributed transaction processing (DTP) for Oracle Tuxedo CORBA applications that use Oracle Tuxedo ATMI services: AUTOTRAN, and TRANTIME.

The following table describes the parameters in the SERVICES section.

Table 3-3 Parameters Specified in the SERVICES Section

Parameter	Meaning
AUTOTRAN	Determines whether a transaction must be started automatically if a message received by this service is not already in transaction mode. The default is N. Use of the parameter must be coordinated with the programmers that code the services for your application.

Table 3-3 (Cont.) Parameters Specified in the SERVICES Section

Parameter	Meaning
TRANTIME	Specifies a timeout value, in seconds, for transactions automatically started in this service. The default is 30 seconds. Required only if AUTOTRAN=Y and another timeout value is required.

3.3.3.2 Sample SERVICES Section

The following code snippet shows a sample SERVICES section.

```
*SERVICES

    # Publish Tuxedo Teller application services
    #
    DEBIT
        AUTOTRAN=Y
    CREDIT
        AUTOTRAN=Y
    CURRBALANCE
        AUTOTRAN=Y
```

3.3.4 Modifying the INTERFACES Section

The INTERFACES section contains parameters that control the way application interfaces are handled. An entry line in this section is associated with an interface by its identifier name. Because the same interface can be link edited with more than one server, the SRVGRP parameter is provided to tie the parameters for an instance of a interface to a particular group of servers.

- Parameters to Modify
- Sample INTERFACES Section

3.3.4.1 Parameters to Modify

Three parameters in the INTERFACES section are particularly related to distributed transaction processing (DTP): FACTORYROUTING, AUTOTRAN, and TRANTIME.

The following table describes the parameters in the INTERFACES section.

Table 3-4 Parameters Specified in the INTERFACES Section

Parameter	Meaning
FACTORYROUTING = criterion-name	Specifies the name of the routing criteria to be used for factory-based routing for this Oracle Tuxedo CORBA interface. You must specify a FACTORYROUTING parameter for interfaces requesting factory-based routing.

Table 3-4 (Cont.) Parameters Specified in the INTERFACES Section

Parameter	Meaning
AUTOTRAN	Determines whether a transaction should be started automatically if a message received by this interface is not already in transaction mode. The default is N. Use of this parameter should be coordinated with the programmers that code the interface for your application so that it matches the setting of the transaction policy option in the application's ICF file.
TRANTIME	Specifies a timeout value, in seconds, for transactions automatically started in this interface. The default is 30 seconds. Required only if AUTOTRAN=Y and a timeout value other than the default is required.
LOAD = number	Specifies an arbitrary number between 1 and 100 that represents the relative load that the CORBA interface is expected to impose on the system. The numbering scheme is relative to the LOAD numbers assigned to other CORBA interfaces used by this application. The default is 50. This number is used by the Oracle Tuxedo system to select the best server to which to route the request

3.3.4.2 Sample INTERFACES Section

The following code snippet shows a sample INTERFACES section.

```
*INTERFACES
   "IDL:beasys.com/UniversityP/Registrar:1.0"
        FACTORYROUTING = STU_ID
        AUTOTRAN=Y
        TRANTIME=50

   "IDL:beasys.com/BillingP/Teller:1.0"
        FACTORYROUTING = ACT_NUM
        AUTOTRAN=Y
```

3.3.5 Creating the ROUTING Section

For information about ROUTING parameters that support Oracle Tuxedo data-dependent routing or Oracle Tuxedo CORBA factory-based routing, see Creating a Configuration File in *Oracle® Tuxedo Application Configuration Guide*.

The following code snippet shows the ROUTING section of the UBBCONFIG file used in the Production sample application for factory-based routing.

```
*ROUTING

   STU_ID
      FIELD     = "student_id"
      TYPE      = FACTORY
      FIELDTYPE = LONG
      RANGES    = "100001-100005:ORA_GRP1,100006-100010:ORA_GRP2"

   ACT_NUM
      FIELD     = "account_number"
      TYPE      = FACTORY
      FIELDTYPE = LONG
      RANGES    = "200010-200014:APP_GRP1,200015-200019:APP_GRP2"
```

3.4 Configuring the factory_finder.ini (CORBA Applications Only)

For CORBA applications, to configure factory-based routing across multiple domains, you must configure the `factory_finder.ini` file to identify factory objects that are used in the current (local) domain but that are resident in a different (remote) domain. For more information, see Configuring Multiple Domains Multiple Domains for CORBA Applications in *Using the Oracle Tuxedo Domains Component*.

3.5 Modifying the Domain Gateway Configuration File to Support Routing

This section is specific to Oracle Tuxedo and explains how and why you need to modify the domain gateway configuration to support routing. For more information about the domain gateway configuration file, see Configuring Multiple Domains Multiple Domains for CORBA Applications in *Using the Oracle Tuxedo Domains Component*.

This topic includes the following sections:

- About the Domain Gateway Configuration File
- Parameters in the DM_ROUTING Section of the DMCONFIG File (Oracle Tuxedo ATMI Only)

3.5.1 About the Domain Gateway Configuration File

The Domain gateway configuration information is stored in a binary file called `BDMCONFIG`. The `DMCONFIG` file (ASCII) is created and edited with any text editor. The compiled `BDMCONFIG` file can be updated while the system is running by using the `dmadmin(1)` command.

You must have one `BDMCONFIG` file for each Oracle Tuxedo application that requires the Domains functionality. 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 required by that group. The `GWADM` server and the `DMADM` server also ensure that run-time changes to the configuration are reflected in the corresponding Domain gateway groups.

> **Note:**
>
> For more information about the domain gateway configuration file, see Configuring Multiple Domains Multiple Domains for CORBA Applications in *Using the Oracle Tuxedo Domains Component*.

3.5.2 Parameters in the DM_ROUTING Section of the DMCONFIG File (Oracle Tuxedo ATMI Only)

The `DM_ROUTING` section provides information for data-dependent routing of service requests using `FML`, `VIEW`, `X_C_TYPE`, and `X_COMMON` typed buffers. Lines within the `DM_ROUTING` section have the form `CRITERION_NAME`, where `CRITERION_NAME` is the (identifier) name of the routing

entry specified in the SERVICES section. The CRITERION_NAME entry may contain no more than 15 characters.

- Parameters to Specify
- Routing Field Description
- Example of a Five-Site Domain Configuration Using Routing

3.5.2.1 Parameters to Specify

The following table describes the parameters in the DM_ROUTING section.

Table 3-5 Parameters Specified in the DM_ROUTING Section

Parameter	Description
FIELD = identifier	Specifies the name of the routing field. It must contain 30 characters or fewer. This field is assumed to be a field name identified in an FML field table (for FML buffers) or an FML VIEW table (for VIEW, X_C_TYPE, or X_COMMON buffers). The FLDTBLDIR and FIELDTBLS environment variables are used to locate FML field tables; the VIEWDIR and VIEWFILES environment variables are used to locate FML VIEW tables. If a field in an FML32 buffer is used for routing, it must have a field number less than or equal to 8191.
BUFTYPE = "type1[:subtype1[,subtype2 . . .]] [;type2[:subtype3[, . . .]]] . . ."	Specifies list of types and subtypes of data buffers for which this routing entry is valid. The types are restricted to FML, VIEW, X_C_TYPE, and X_COMMON. No subtype can be specified for type FML, and subtypes are required for the other types (* is not allowed). Duplicate type/subtype pairs cannot be specified for the same routing criteria name; more than one routing entry can have the same criteria name as long as the type/subtype pairs are unique. This parameter is required. If multiple buffer types are specified for a single routing entry, the data types of the routing field for each buffer type must be the same. (If the field value is not set (for FML buffers), or does not match any specific range, and a wildcard range has not been specified, then an error is returned to the application process that requested the execution of the remote service.) No routing is allowed on CORBA and EJB (TGIOP is not a valid buffer type).
RANGES ="range1:rdom1[,range2:rdom2 ...]"	Specifies the ranges and associated remote domain names (RDOM) for the routing field. The string must be enclosed in double quotes, with the format of a comma-separated ordered list of range/RDOM pairs. A range is either a single value (signed numeric value or character string in single quotes), or a range of the form *lower - upper* (where *lower* and *upper* are both signed numeric values or character strings in single quotes). The value of *lower* must be less than or equal to upper. A single quote embedded in a character string value (such as "O'Brien"), must be preceded by two backslashes ("O\\'Brien"). • Use MIN 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. • Use MAX to indicate the maximum value for the data type of the associated FIELD. For strings and carrays, it is effectively 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, and 6 - MAX is all numbers greater than or equal to 6. The metacharacter * (wildcard) in the position of a range indicates any values not covered by the other ranges previously seen in the entry. Only one wildcard range is allowed per entry and it should be last (ranges following it are ignored).

3.5.2.2 Routing Field Description

The routing field can be of any data type supported in FML or VIEW. A numeric routing field must have numeric range values, and a string routing field must have string range values.

String range values for string, carray, and character field types must be placed inside a pair of single quotation marks and cannot be 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(): an optional sign, followed by a string of digits optionally containing a decimal point, and an optional e or E followed by an optional sign or space, and an integer.

When a field value matches a range, the associated RDOM value specifies the remote domain to which the request must be routed. An RDOM value of * indicates that the request can go to any remote domain known by the gateway group. Within a range/RDOM pair, the range is separated from the RDOM by a colon (:).

3.5.2.3 Example of a Five-Site Domain Configuration Using Routing

The following code snippet shows a configuration file that defines a five-site domain configuration. It has four bank branch domains communicating with a Central Bank Branch. Three of the bank branches run within other Oracle Tuxedo system domains. The fourth branch runs under the control of another TP domain, and OSI-TP is used in the communication with that domain. The example shows the Oracle Tuxedo Domain gateway configuration file from the Central Bank point of view. In the DM_TDOMAIN section, this example shows a mirrored gateway for b01.

```
# BEA TUXEDO DOMAIN CONFIGURATION FILE FOR THE CENTRAL BANK
#
#
*DM_LOCAL_DOMAINS
# <local domain name> <Gateway Group name> <domain type> <domain id> <log
device>
#                     [<audit log>] [<blocktime>]
#                     [<log name>] [<log offset>] [<log size>]
#                     [<maxrdom>] [<maxrdtran>] [<maxtran>]
#                     [<maxdatalen>] [<security>]
#                     [<tuxconfig>] [<tuxoffset>]

#
#
DEFAULT: SECURITY = NONE
c01     GWGRP = bankg1
        TYPE = TDOMAIN
        DOMAINID = "BA.CENTRAL01"
        DMTLOGDEV = "/usr/apps/bank/DMTLOG"
        DMTLOGNAME = "DMTLG_C01"
c02     GWGRP = bankg2
        TYPE = OSITP
        DOMAINID = "BA.CENTRAL01"
        DMTLOGDEV = "/usr/apps/bank/DMTLOG"
        DMTLOGNAME = "DMTLG_C02"
        NWDEVICE = "OSITP"
        URCH = "ABCD"
```

```
#
*DM_REMOTE_DOMAINS
#<remote domain name>  <domain type> <domain id>
#
b01     TYPE = TDOMAIN
        DOMAINID = "BA.BANK01"
b02     TYPE = TDOMAIN
        DOMAINID = "BA.BANK02"
b03     TYPE = TDOMAIN
        DOMAINID = "BA.BANK03"
b04     TYPE = OSITP
        DOMAINID = "BA.BANK04"
        URCH = "ABCD"
#
*DM_TDOMAIN
#
#     <local or remote domainname> <network address> [nwdevice]
#
# Local network addresses
c01     NWADDR = "//newyork.acme.com:65432"     NWDEVICE ="/dev/tcp"
c02     NWADDR = "//192.76.7.47:65433"     NWDEVICE ="/dev/tcp"
# Remote network addresses: second b01 specifies a mirrored gateway
b01     NWADDR = "//192.11.109.5:1025" NWDEVICE = "/dev/tcp"
b01     NWADDR = "//194.12.110.5:1025" NWDEVICE = "/dev/tcp"
b02     NWADDR = "//dallas.acme.com:65432"  NWDEVICE = "/dev/tcp"
b03     NWADDR = "//192.11.109.156:4244" NWDEVICE = "/dev/tcp"
#
*DM_OSITP
#
#<local or remote domain name> <apt> <aeq>
#                              [<aet>] [<acn>] [<apid>] [<aeid>]
#                              [<profile>]
#
c02     APT = "BA.CENTRAL01"
        AEQ = "TUXEDO.R.4.2.1"
        AET = "{1.3.15.0.3},{1}"
        ACN = "XATMI"
b04     APT = "BA.BANK04"
        AEQ = "TUXEDO.R.4.2.1"
        AET = "{1.3.15.0.4},{1}"
        ACN = "XATMI"
*DM_LOCAL_SERVICES
#<service_name>  [<Local Domain name>] [<access control>] [<exported svcname>]
#                [<inbuftype>] [<outbuftype>]
#
open_act        ACL = branch
close_act       ACL = branch
credit
debit
balance
loan            LDOM = c02      ACL = loans
*DM_REMOTE_SERVICES
#<service_name>   [<Remote domain name>] [<local domain name>]
#                 [<remote svcname>] [<routing>] [<conv>]
#                 [<trantime>] [<inbuftype>] [<outbuftype>]
#
```

```
tlr_add   LDOM = c01  ROUTING = ACCOUNT
tlr_bal   LDOM = c01  ROUTING = ACCOUNT
tlr_add   RDOM = b04  LDOM = c02 RNAME ="TPSU002"
tlr_bal   RDOM = b04  LDOM = c02 RNAME ="TPSU003"
*DM_ROUTING
# <routing criteria>    <field> <typed buffer> <ranges>
#
ACCOUNT FIELD = branchid  BUFTYPE ="VIEW:account"
        RANGES ="MIN - 1000:b01, 1001-3000:b02, *:b03"
*DM_ACCESS_CONTROL
#<acl name>   <Remote domain list>
#
branch  ACLIST = b01, b02, b03
loans   ACLIST = b04
```

4

Tuning CORBA Applications

> **Note:**
>
> The Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB were deprecated in Tuxedo 8.1 and are no longer supported. All Oracle Tuxedo CORBA Java client and Oracle Tuxedo CORBA Java client ORB text references, associated code samples, must only be used to help implement/run third party Java ORB libraries, and for programmer reference only.
> Technical support for third party CORBA Java ORBs must be provided by their respective vendors. Oracle Tuxedo does not provide any technical support or documentation for third party CORBA Java ORBs.

This topic includes the following sections:

> **See Also:**
>
> Monitoring a Runtime System for more information about monitoring Oracle Tuxedo applications, see in the *Oracle® Tuxedo Run-Time Application Administrator's Guide*

4.1 Maximizing Application Resources

Making correct decisions in the following areas can improve the functioning of your Oracle Tuxedo applications:

- When to Use MSSQ Sets (Oracle Tuxedo ATMI Servers Only)
- How to assign load factors.

- How to package interfaces and/or services into servers.
- How to set application parameters.
- How to tune operating system IPC parameters.
- How to detect and eliminate bottlenecks.

4.2 When to Use MSSQ Sets (Oracle Tuxedo ATMI Servers Only)

> **Note:**
>
> Multiple Servers, Single Queue (MSSQ) sets are not supported in Oracle Tuxedo CORBA servers.

The following table describes when to use MSSQ sets with Oracle Tuxedo servers.

Table 4-1 When and When Not to Use MSSQ Sets

Use MSSQ Sets When	Do Not Use MSSQ Sets When
There are several, but not too many servers.	There is a large number of servers. (A compromise is to use many MSSQ sets.)
Buffer sizes are not too large.	Buffer sizes are large enough to exhaust one queue.
The servers offer identical sets of services.	Services are different for each server.
The messages involved are reasonably sized.	Long messages are being passed to the services causing the queue to be exhausted. This causes non-blocking sends to fail, or blocking sends to block.
Optimization and consistency of service turnaround time is paramount.	Optimization and consistency of service turnaround time is not critical.

The following two analogies help to show why using MSSQ sets is sometimes, but not always, beneficial:

- An application in which MSSQ sets are used appropriately is similar to a bank, where all the tellers offer the same services and customers wait in line for the first available teller. This efficient arrangement ensures the best use of available services.
- An application in which it is better to avoid using MSSQ sets is similar to a supermarket, where each cashier offers a different set of services: some accept cash only, some accept credit cards, and still others serve only customers buying fewer than ten items.

4.3 Enabling System-controlled Load Balancing

You can control whether a load-balancing algorithm is used on the Oracle Tuxedo system as a whole. When load balancing is used, a load factor is applied to each service within the system, allowing you to track the total load on every server. Every service request is sent to the qualified server that is least loaded.

> **Note:**
>
> On Oracle Tuxedo CORBA systems, system-controlled load balancing is enabled automatically. You *cannot* disable load balancing by specifying `LDBAL=N`.

To determine how to assign load factors (located in the `SERVICES` section), run an application continually and calculate the average time it takes for each service to be performed. Assign a `LOAD` value of 50 (`LOAD=50`) to any service that requires the average amount of time that you calculated. Any service taking longer to execute than the calculated average must have a `LOAD>50`. Any service taking less to execute than the calculated average must have a `LOAD<50`.

A `LOAD` factor is assigned to each service performed, which keeps track of the total load of services that each server has performed. Each service request is routed to the server with the smallest total load. The routing of that request causes the server's total to be increased by the `LOAD` factor of the service requested.

You can also apply LOAD factors to interfaces. For more information about LOAD factors, see Creating a Configuration File in the *Oracle® Tuxedo Application Configuration Guide*

4.4 Configuring Replicated Server Processes and Groups

To configure replicated server processes and groups in the Oracle Tuxedo domain, complete the following steps:

1. Edit the application's `UBBCONFIG` file using a text editor.
2. In the `GROUPS` section, specify the names of the groups you want to configure.
3. In the SERVERS section, specify the parameters in the following table for the server process you want to replicate.

Table 4-2 Parameters Specified in the SERVERS Section

Parameter	Description
Server application name	Specifies the name of the executable file that contains the application server.
`GROUP`	Specifies the name of the group to which the server process belongs. If you are replicating a server process across multiple groups, specify the server process once for each group.
`SRVID`	Specifies a numeric identifier, giving the server process a unique identity.
`MIN`	Specifies the number of instances of the server process to start when you start the application.
`MAX`	Specifies the maximum number of server processes that can be running at any one time.

The `MIN` and `MAX` parameters determine the degree to which a given server application can process requests on a given interface in parallel. During run time, the system administrator can examine resource bottlenecks and start additional server processes, if necessary, thereby scaling the application. For more information, see Monitoring a Running Application in the *Oracle® Tuxedo Run-Time Application Administrator's Guide*

The `MAX` parameter controls the maximum number of instances. However, Oracle Tuxedo does not spawn instances automatically. The system will automatically start up to the specified `MIN` number of instances. Between `MIN` and `MAX`, the system administrator will

need to spawn new instances manually. Once `MAX` is reached, an error will be returned by `tmboot`, `tmadmin`, or the `TMIB` API.

4.5 Configuring Multithreaded Servers

This topic includes the following sections:

> **Note:**
>
> Using Multithreaded Servers for more information about multithreaded servers.

- Setting the OPENINFO Parameter for Database Interoperation
- Parameters Used to Configure Multithreaded Servers
- Assigning Priorities to Interfaces

4.5.1 Setting the OPENINFO Parameter for Database Interoperation

To enable the use of threads by a multithreaded server when interoperating with the Oracle XA database software, you must add `Threads=true` to the `OPENINFO` parameter in the `GROUPS` section of the `UBBCONFIG` file, as shown in the following code snippet. For more information, see the Oracle XA online documentation.

```
OPENINFO="ORACLE_XA:Oracle_XA+Acc=P/scott/
tiger+SesTm=100+LogDir=.+MaxCur=5+Threads=true"
```

4.5.2 Parameters Used to Configure Multithreaded Servers

The following parameters are used configure multithreaded CORBA servers. These parameters are set in `UBBCONFIG` file:

- MAXOBJECTS

> **Note:**
>
> While the `MAXOBJECTS` parameter does not specifically apply to threads, you may want to increase this parameter because multithreaded applications have the potential to activate more objects at any point in time than single-threaded applications.

- MAXACCESSERS
- MAXDISPATCHTHREADS
- MINDISPATCHTHREADS
- THREADSTACKSIZE
- CONCURR_STRATEGY

For a description how to set these parameters, see the following topics:

- see Creating a Configuration File and How to Configure the Oracle Tuxedo System to Take Advantage of Thread in the *Oracle® Tuxedo Application Configuration Guide*

- Setting the MAXACCESSERS, MAXSERVERS, MAXINTERFACES, and MAXSERVICES Parameters in *Oracle Tuxedo Run-Time Application Administrator's Guide*

4.5.3 Assigning Priorities to Interfaces

This topic includes the following sections:

- About Priorities to Interfaces
- Characteristics of the PRIO Parameter

4.5.3.1 About Priorities to Interfaces

You can exert significant control over the flow of data in an application by assigning priorities to Oracle Tuxedo Interfaces using the `PRIO` parameter. For a CORBA application running on an Oracle Tuxedo system, you can specify the `PRIO` parameter for each interface named in the `INTERFACES` section of the application's `UBBCONFIG` file.

For example, Server 1 offers Interfaces A, B, and C. Interfaces A and B have a priority of 50 and Interface C has a priority of 70. An interface requested for C is always dequeued before a request for A or B. Requests for A and B are dequeued equally with respect to one another. The system dequeues every tenth request in first in first out (FIFO) order to prevent a message from waiting indefinitely on the queue.

You can also dynamically change a priority with the `tpsprio()` call. Only preferred clients must be able to increase the interface priority. In a system on which servers perform interface request, the server can call `tpsprio()` to increase the priority of its interface so the user does not wait in line for every interface request that is required.

4.5.3.2 Characteristics of the PRIO Parameter

The `PRIO` parameter must be used carefully. Depending on the order of messages on the queue (for example, A, B, and C), some (such as A and B) will be dequeued only one in ten times. This means reduced performance and potential slow turnaround time on the service.

The characteristics of the `PRIO` parameter are as follows:

- It determines the priority of an interface on the server's queue.
- The highest assigned priority gets first preference. This interface must occur less frequently.
- A lower priority message does not remain forever enqueued, because every tenth message is retrieved on a FIFO basis. Response time must not be a concern of the lower priority interface.

Assigning priorities enables you to provide more efficient service to the most important requests and slower service to the less important requests. You can also give priority to specific users or in specific circumstances.

4.6 Bundling Services into Servers (Oracle Tuxedo ATMI Servers Only)

This topic includes the following sections:

- About Bundling Services

- When to Bundle Services

4.6.1 About Bundling Services

The easiest way to package services into server executables is to not package them at all. Unfortunately, if you do not package services, the number of server executables, and also message queues and semaphores, rises beyond an acceptable level. There is a trade-off between not bundling services and bundling services too much.

4.6.2 When to Bundle Services

You must bundle services for the following reasons:

- Functional similarity—if some services are similar in their role in the application, you can bundle them in the same server. The application can offer all or none of them at a given time. An example is the `bankapp` application, in which the `WITHDRAW`, `DEPOSIT`, and `INQUIRY` services are all teller operations. Administration of services becomes simpler.
- Similar libraries—for example, if you have three services that use the same 100K library and three services that use different 100K libraries, bundling the first three services saves 200K. Often, functionally equivalent services have similar libraries.
- Filling the queue—bundle only as many services into a server as the queue can handle. Each service added to an unfilled MSSQ set may add relatively little to the size of an executable, and nothing to the number of queues in the system. Once the queue is filled, however, the system performance degrades and you must create more executables to compensate.
- Placement of call-dependent services—avoid placing, in the same server, two (or more) services that call each other. If you do so, the server will issue a call to itself, causing a deadlock.

4.7 Performance Options

Performance options were added to Oracle Tuxedo in release 8.0. These options enable you to turn off specific features in the Oracle Tuxedo infrastructure. You must turn off these features only if they are not required by your CORBA or ATMI applications. The following table describes these options.

Table 4-3 Performance Options

Option	Description	How to set . . .
Service and Interface Caching options (SICACHEENTRIESMAX and TMSICACHEENTRIESMAX)	This option enables you to cache service and interface entries, and to use the cached copies of the service or interface without locking the bulletin board.	For more information about these options, see Administering an Oracle Tuxedo Application at Run Time and `UBBCONFIG(5)` and `TM_MIB(5)`, and `tuxenv(5)` in the *File Formats, Data Descriptions, MIBs, and System Processes Reference*.

Table 4-3 (Cont.) Performance Options

Option	Description	How to set . . .
Turning off threads (TMNOTHREADS)	Set this option to yes to turn off multithreaded processing. For applications that do not use threads, turning them off should significantly improve performance.	You use the `tuxenv(5)` to set this option. For more information, see Administering an Oracle Tuxedo Application at Run Time and `tuxenv(5)` in the *File Formats, Data Descriptions, MIBs, and System Processes Reference*.
Turning off auditing and authorization (Options {[NO_AA]})	Setting this option disables the auditing and authorization functions on a per application basis.	You set this option in the `RESOURCES` section of the `UBBCONFIG` file. For more information, see Administering an Oracle application at Run Time and `OPTION` in the `RESOURCES` section of `UBBCONFIG(5)` in the *File Formats, Data Descriptions, MIBs, and System Processes Reference*.
Turning off XA Transactions (NO_XA)	Setting this option turns Off XA Transactions.	For more information about the `NO_XA` option, see Administering an Oracle Tuxedo Application at Run Time and `UBBCONFIG(5)` and TM_MIB(5) in the *File Formats, Data Descriptions, MIBs, and System Processes Reference*.

See Also:

For more information about `UBBCONFIG(5)`, `tuxenv(5)`, and `TM_MIB(5)` see, Section 5 - File Formats, Data Descriptions, MIBs, and System Processes Reference

4.8 Enhancing Efficiency with Application Parameters

You can set these application parameters to enhance the efficiency of your system.

This topic includes the following sections:

- MAXDISPATCHTHREADS
- MINDISPATCHTHREADS
- Setting the MAXACCESSERS, MAXOBJECTS, MAXSERVERS, MAXINTERFACES, and MAXSERVICES Parameters
- Setting the MAXGTT, MAXBUFTYPE, and MAXBUFSTYPE Parameters
- Setting the SANITYSCAN, BLOCKTIME, BBLQUERY, and DBBLWAIT Parameters

4.8.1 MAXDISPATCHTHREADS

The `MAXDISPATCHTHREADS` parameter determines the maximum number of concurrently dispatched threads that each server process can spawn. When specifying this parameter, consider the following:

- The value for `MAXDISPATCHTHREADS` determines the maximum size that the thread pool can grow to be, as it increases in size to accommodate incoming requests.

- The default value for MAXDISPATCHTHREADS is 1. If you specify a value greater than 1, the system creates and uses a special dispatcher thread. This dispatcher thread is not included in the number of threads determining the maximum size of the thread pool.
- Specifying a value of 1 for the MAXDISPATCHTHREADS parameter indicates that the server application must be configured as a single-threaded server. A value greater than 1 indicates that the server application must be configured as a multithreaded server.
- The value you specify for the MAXDISPATCHTHREADS parameter must not be less than the value you specify for the MINDISPATCHTHREADS parameter.
- The operating system resources limit the maximum number of threads that can be created in a process. MAXDISPATCHTHREADS must be less than that limit, minus the number of application managed threads that your application requires.

The value of the MAXDISPATCHTHREADS parameter affects other parameters. For example, the MAXACCESSORS parameter controls the number of simultaneous accesses to the Oracle Tuxedo system, and each thread counts as one accessor. For a multithreaded server application, you must account for the number of system-managed threads that each server is configured to run. A system-managed thread is a thread that is started and managed by the Oracle Tuxedo software, as opposed to threads started and managed by an application. Internally, Oracle Tuxedo manages a pool of available system-managed threads. When a client request is received, an available system-managed thread from the thread pool is scheduled to execute the request. When the request is completed, the system-managed thread is returned to the pool of available threads.

For example, if that you have 4 multithreaded servers in your system and each server is configured to run 50 system-managed threads, the accessor requirement for these servers is the sum total of the accessors, calculated as follows:

```
50 + 50 + 50 + 50 = 200 accessors
```

4.8.2 MINDISPATCHTHREADS

Use the MINDISPATCHTHREADS parameter to specify the number of server dispatch threads that are started when the server is initially booted. When you specify this parameter, consider the following:

- The value for MINDISPATCHTHREADS determines the initial allocation of threads in the thread pool.
- The separate dispatcher thread that is created when MAXDISPATCHTHREADS is greater than 1 is not counted as part of the MINDISPATCHTHREADS limit.
- The value you specify for MINDISPATCHTHREADS must not be greater than the value you specify for MAXDISPATCHTHREADS.
- The default value for MINDISPATCHTHREADS is 0.

4.8.3 Setting the MAXACCESSERS, MAXOBJECTS, MAXSERVERS, MAXINTERFACES, and MAXSERVICES Parameters

The MAXACCESSERS, MAXOBJECTS, MAXSERVERS, MAXINTERFACES, and MAXSERVICES parameters increase semaphore and shared memory costs, so you must choose the minimum value that satisfies the needs of the system. You must also allow for the variation in the number of clients accessing the system at the same time. Defaults may be appropriate for a generous allocation

of IPC resources. However, it is prudent to set these parameters to the lowest appropriate values for the application.

For multithreaded servers, you must account for the number of threads that each server is configured to run. The MAXACCESSERS parameter sets the maximum number of concurrent accessors of an Oracle Tuxedo system. Accessors include native and remote clients, servers, and administration processes. For more information on setting the MAXACCESSERS parameter, see MAXDISPATCHTHREADS.

4.8.4 Setting the MAXGTT, MAXBUFTYPE, and MAXBUFSTYPE Parameters

You must increase the value of the MAXGTT parameter if the product of multiplying the number of clients in the system times the percentage of time they are committing a transaction is close to 100. This may require a great number of clients, depending on the speed of commit. If you increase MAXGTT, you must also increase TLOGSIZE accordingly for every machine. You must set MAXGTT to 0 for applications that do not use distributed transactions.

You can limit the number of buffer types and subtypes allowed in the application with the MAXBUFTYPE and MAXBUFSTYPE parameters, respectively. The current default for MAXBUFTYPE is 16. Unless you are creating many user-defined buffer types, you can omit MAXBUFTYPE. However, if you intend to use many different VIEW subtypes, you may want to set MAXBUFSTYPE to exceed its current default of 32.

4.8.5 Setting the SANITYSCAN, BLOCKTIME, BBLQUERY, and DBBLWAIT Parameters

If a system is running on slower processors (for example, due to heavy usage), you can increase the timing parameters: SANITYCAN, BLOCKTIME, and individual transaction timeouts. If networking is slow, you can increase the value of the BLOCKTIME, BBLQUERY, and DBBLWAIT parameters.

4.9 Setting Application Parameters

The following table describes the system parameters available for tuning an application.

Table 4-4 System Parameters for Application Tuning

Parameters	Action
MAXACCESSERS, MAXOBJECTS, MAXSERVERS, MAXINTERFACES, and MAXSERVICES	Set the smallest satisfactory value because of IPC cost. Allow for extra clients.
MAXGTT, MAXBUFTYPE, and MAXBUFSTYPE	Increase MAXGTT for many clients; set MAXGTT to 0 for nontransactional applications. Use MAXBUFTYPE only if you create eight or more user-defined buffer types. If you use many different VIEW subtypes, increase the value of MAXBUFSTYPE.
BLOCKTIME, TRANTIME, and SANITYSCAN	Increase the value for a slow system.
BLOCKTIME, TRANTIME, BBLQUERY, and DBBLWAIT	Increase values for slow networking.

4.10 Determining IPC Requirements

The values of different system parameters determine IPC requirements. You can use the `tmboot -c` command to test a configuration's IPC needs. The values of the following parameters affect the IPC needs of an application:

- `MAXACCESSERS`
- `REPLYQ`
- `RQADDR` (that allows `MSSQ` sets to be formed)
- `MAXSERVERS`
- `MAXSERVICES`
- `MAXGTT`

The following table describes the system parameters that affect the IPC needs of an application.

Table 4-5 Tuning IPC Parameters

Parameter (s)	Action
`MAXACCESSERS`	Equals the number of semaphores. Number of message queues is almost equal to `MAXACCESSERS +` the number of servers with reply queues (the number of servers in `MSSQ set +` the number of `MSSQ` sets).
`MAXSERVERS`,`MAXSERVICES`, and `MAXGTT`	While `MAXSERVERS`, `MAXSERVICES`, `MAXGTT`, and the overall size of the `ROUTING`, `GROUP`, and `NETWORK` sections affect the size of shared memory, an attempt to devise formulas that correlate these parameters can become complex. Instead, simply run `tmboot -c` or `tmloadcf -c` to calculate the minimum IPC resource requirements for your application.

Table 4-5 (Cont.) Tuning IPC Parameters

Parameter (s)	Action
Queue-related kernel parameters	Require to be tuned to manage the flow of buffer traffic between clients and servers. The maximum total size of a queue in bytes must be large enough to handle the largest message in the application, and to typically be 75 to 85 percent full. A smaller percentage is wasteful. A larger percentage causes message sends to block too frequently. Set the maximum size for a message to handle the largest buffer that the application sends. Maximum queue length (the largest number of messages that are allowed to sit on a queue at once) must be adequate for the application's operations. Simulate or run the application to measure the average fullness of a queue or its average length. This may be a trial and error process in which tunables are estimated before the application is run and are adjusted after running under performance analysis. For a large system, analyze the effect of parameter settings on the size of the operating system kernel. If unacceptable, reduce the number of application processes or distribute the application to more machines to reduce `MAXACCESSERS`.

4.11 Measuring System Traffic

This topic includes the following sections:

- About System Traffic and Bottlenecks
- Example of Detecting a System Bottleneck
- Detecting Bottlenecks on UNIX
- Detecting Bottlenecks on Windows

> **See Also:**
>
> Monitoring a Running Systemfor more information about monitoring Oracle Tuxedo applications and measuring traffic in the *Oracle® Tuxedo Run-Time Application Administrator's Guide*.

4.11.1 About System Traffic and Bottlenecks

Bottlenecks can occur in your system when traffic volume nears resource capacity. You can measure service traffic using a global counter in your implementation code.

For example, in Tuxedo applications, when `tpsvrinit()` is invoked at boot time, you can initialize a global counter and record a starting time. Subsequently, each time a particular service is called, the counter is incremented. When the server is shut down by invoking the `tpsvrdone()` function, the final count and the ending time are recorded. This mechanism allows you to determine how busy a particular service is over a specified period of time.

> **Note:**
>
> For CORBA C++ applications, use the `Server::initialize()` and `Server::release()` operations.

In Oracle Tuxedo, bottlenecks can originate from data flow patterns. The quickest way to detect bottlenecks is to begin with the client and measure the amount of time required by relevant services.

4.11.2 Example of Detecting a System Bottleneck

Suppose Client 1 requires 4 seconds to print to the screen. Calls to `time`(2) determine that the `tpcall` to service A is the culprit with a 3.7 second delay. Service A is monitored at the top and bottom and takes 0.5 seconds. This implies that a queue may be clogged, which was determined by using the `pq` command.

On the other hand, suppose service A takes 3.2 seconds. The individual parts of Service A can be bracketed and measured. Perhaps Service A issues a `tpcall` to Service B, which requires 2.8 seconds. It must then be possible to isolate queue time or message send blocking time. Once the relevant amount of time has been identified, the application can be retuned to handle the traffic.

Using `time`(2), you can measure the duration of the following:

- The entire client program.
- A client service request only.
- The entire service function.
- The service function making a service request (if any).

4.11.3 Detecting Bottlenecks on UNIX

On UNIX systems, the `sar`(1) command provides valuable performance information that can be used to find system bottlenecks. You can use the `sar`(1) command to:

- Sample cumulative activity counters in the operating system at predetermined intervals.
- Extract data from a system file.

The following table describes the `sar`(1) command options.

Table 4-6 sar(1) Command Options (Continued)

Option	Description
`-u`	Gathers CPU utilization numbers, including the portion of the time running in user mode, running in system mode, idle with some process waiting for block I/O, and otherwise idle.

Table 4-6 (Cont.) sar(1) Command Options (Continued)

Option	Description
`-b`	Reports buffer activity, including transfers per second of data between system buffers and disk, or other block devices.
`-c`	Reports system call activity. This includes system calls of all types, as well as specific system calls such as `fork(2)` and `exec(2)`.
`-w`	Monitors system swapping activity. This includes the number of transfers for swap-ins and swap-outs.
`-q`	Reports average queue lengths while occupied and the percent of time occupied.
`-m`	Reports message and system semaphore activities, including the number of primitives per second.
`-p`	Reports paging activity, including the address translation page faults, page faults and protection errors, and the valid pages reclaimed for free lists.
`-r`	Reports unused memory pages and disk blocks, including the average number of pages available to user processes and the disk blocks available for process swapping.

Note:

Some UNIX platforms do not provide the `sar`(1) command, but offer equivalent commands instead. BSD, for example, offers the `iostat`(1) command. Sun Microsystems, Inc. offers `perfmeter`(1).

4.11.4 Detecting Bottlenecks on Windows

On Windows, use the Performance Monitor to collect system information and detect bottlenecks. Click the Start button and select Programs, then Administration Tools, and then click Performance Monitor.

Glossary

Index