



BEA Tuxedo

Tutorials for Developing a BEA Tuxedo Application

BEA Tuxedo Release 7.1
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Tutorials for Developing a BEA Tuxedo Application

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1 Developing a BEA Tuxedo Application

- Before Developing Your BEA Tuxedo Application
- Creating a BEA Tuxedo Client
- Creating a BEA Tuxedo Server
- Using Typed Buffers in Your Application
- Using BEA Tuxedo Messaging Paradigms in Your Application

Before Developing Your BEA Tuxedo Application

Before you begin developing your BEA Tuxedo application, it may be helpful to review the various concepts related to its design and the tools that are available to you. These concepts include identifying *clients* or the various ways input from the outside world is gathered and presented to your business for processing, and identifying *servers* or the programs containing the business logic that process the input data. Also important is reviewing the concept of *typed buffers* or how a client program allocates a memory area before sending data to another program. Another concept worth reviewing is that of the BEA Tuxedo *messaging paradigms*. Client programs access the BEA Tuxedo system by calling the ATMI library. Most calls in the ATMI library

support these different communication styles available to programmers, such as request/response and conversational. These are the building blocks of every BEA Tuxedo application.

For more information on concepts, such as application queues, event-based communication, and using ATMI, and on the tools available to you, refer to “BEA Tuxedo System Architecture” on page 2-1 in *Introducing the BEA Tuxedo System*. For information on programming an application, refer to *Programming a BEA Tuxedo Application Using C* and *Programming a BEA Tuxedo Application Using COBOL*.

Creating a BEA Tuxedo Client

Creating a BEA Tuxedo client is just like creating any other program in the C or C++ programming language. The BEA Tuxedo system provides you with a C-based programming interface known as the BEA Tuxedo Application to Transaction Monitor Interface or ATMI. The ATMI is an easy-to-use interface that enables the rapid development of BEA Tuxedo clients and servers.

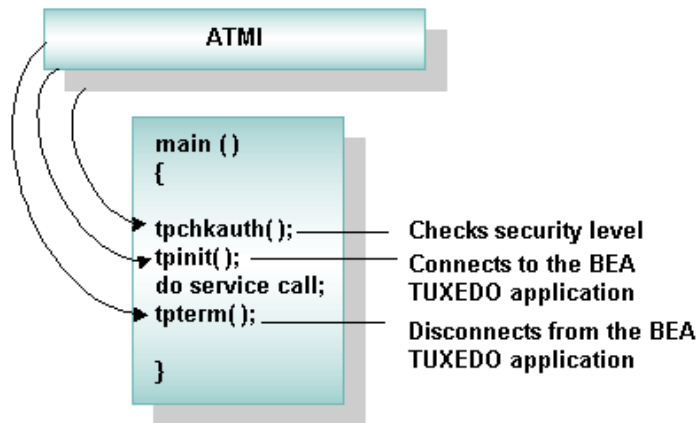
Note: The BEA Tuxedo system also supports a COBOL interface. (The examples shown here illustrate the C/C++ API.)

Client Tasks

Clients perform the following basic tasks:

- Clients may need to call `tpchkauth()` to determine the level of security required to join an application. Possible responses are: no security enabled, application password enabled, application authentication enabled, access control lists enabled, link-level encryption, public key encryption, auditing. (This is optional depending on whether you are using security levels.)
- Clients call `tpinit()` to connect to a BEA Tuxedo application. Any required security information is passed to the application as arguments for `tpinit()`.
- Clients perform service requests.
- Clients call `tpterm()` to disconnect from a BEA Tuxedo application.

Figure 1-1 Tasks a Client Performs



See Also

- “Writing Clients” on page 4-1 in *Programming a BEA Tuxedo Application Using C*
- “Administering Security” on page 2-1 in *Using BEA Tuxedo Security*
- “Using BEA Tuxedo Messaging Paradigms in Your Application” on page 1-7
- “What Are Typed Buffers” on page 2-24 in *Introducing the BEA Tuxedo System*
- “What You Can Do Using the ATMI” on page 2-4 in *Introducing the BEA Tuxedo System*
- “Setting Up Security” on page 3-32 in *Introducing the BEA Tuxedo System*

Creating a BEA Tuxedo Server

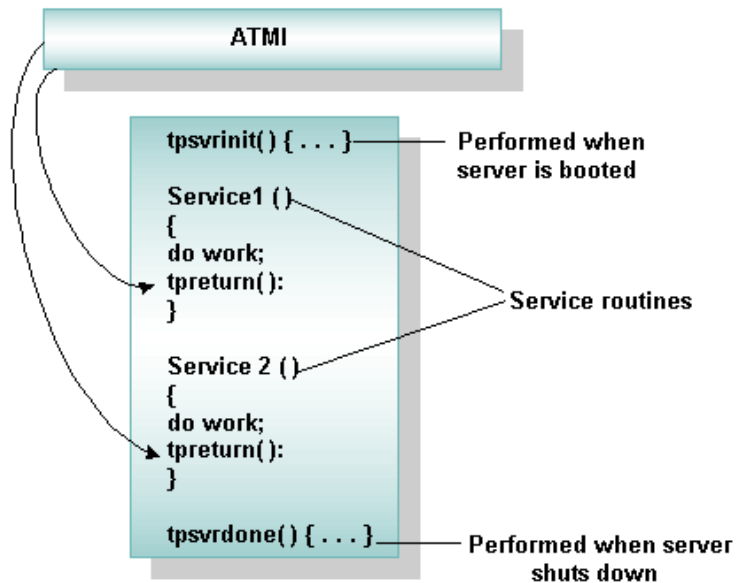
Developers use the ATMI programming interface to create a BEA Tuxedo client and server. However, BEA Tuxedo servers are not written by application developers as complete programs (that is, with a standard `main`). Instead, application developers write a set of specific business functions (known as services) that are compiled along with the BEA Tuxedo binaries to produce a server executable.

When a BEA Tuxedo server is booted, it continues running until it receives a shutdown message. A typical BEA Tuxedo server may perform thousands of service calls before being shut down and rebooted.

Server Tasks

- Application developers write the code and the BEA Tuxedo system servers invoke the `tpsvrinit()` function only when the BEA Tuxedo server is booted. Programmers use this function to open an application resource (such as a database) for later use.
- Application developers write the code and the BEA Tuxedo system servers invoke the `tpsvrdone()` function only when the BEA Tuxedo server is shut down. Programmers use this function to close any application resources opened by `tpsvrinit()`.
- Application developers write the code and the BEA Tuxedo system servers request named application services that process client requests. BEA Tuxedo clients do not call *servers* by name; they call *services*. A BEA Tuxedo client does not “know” the location of the server processing its request.
- Servers call the `tpreturn()` function to end a service request and return a buffer, if required, to the calling client.

Figure 1-2 Tasks a Server Performs



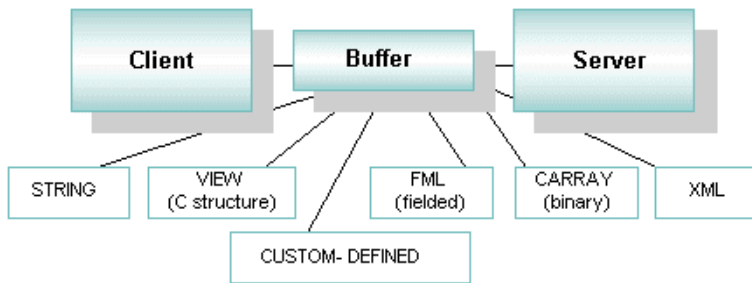
See Also

- “Writing Servers” on page 5-1 in *Programming a BEA Tuxedo Application Using C*
- “Using BEA Tuxedo Messaging Paradigms in Your Application” on page 1-7
- “What Are Typed Buffers” on page 2-24 in *Introducing the BEA Tuxedo System*
- “What You Can Do Using the ATMI” on page 2-4 in *Introducing the BEA Tuxedo System*

Using Typed Buffers in Your Application

All communication in the BEA Tuxedo system is transmitted through typed buffers. The BEA Tuxedo system offers application developers the choice of many different buffer types to facilitate this communication. All buffers passed through the BEA Tuxedo system have special headers, and must be allocated and freed through the BEA Tuxedo ATMI (`tpalloc()`, `tprealloc()`, and `tpfree()`).

Figure 1-3 Different Types of Buffers



The typed buffers facility allows for generic well-defined processing to be implemented once a buffer type is shared across any type of network and protocol and any type of CPU architecture and operating system supported by the BEA Tuxedo system. The advantage of typed buffers in a distributed environment is that they relieve your clients and servers from the details of preparing data to be transferred between heterogeneous computers linked by various communications networks. This affords an application programmer time to concentrate on their business logic, instead of focusing attention on writing this facility into their own programs.

See Also

- “What Are Typed Buffers” on page 2-24 in *Introducing the BEA Tuxedo System*

Using BEA Tuxedo Messaging Paradigms in Your Application

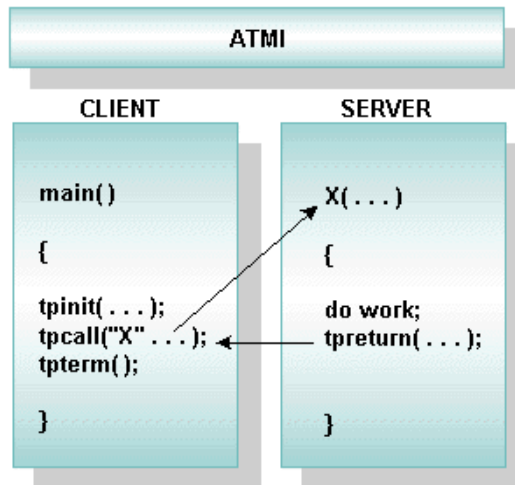
The BEA Tuxedo system offers several communication models that you can use in your application:

- Using the Request/Response Model (Synchronous Calls)
- Using the Request/Response Model (Asynchronous Calls)
- Using Nested Calls
- Using Forwarded Calls
- Using Conversational Communication
- Using Unsolicited Notification
- Using Event-based Communication
- Using Queue-based Communication
- Using Transactions

Using the Request/Response Model (Synchronous Calls)

To make a synchronous call, a BEA Tuxedo client uses the ATMI function `tpcall()` to send a request to a BEA Tuxedo server. The function does not invoke a BEA Tuxedo server by name; instead, it invokes a specified service, which is provided by any server that offers the service and is available. The client then waits for the requested service request to be performed. Until it receives a reply to its request, the client is not available for any other work. In other words, the client “blocks” until it receives a reply.

Figure 1-4 Using the Synchronous Request/Response Model



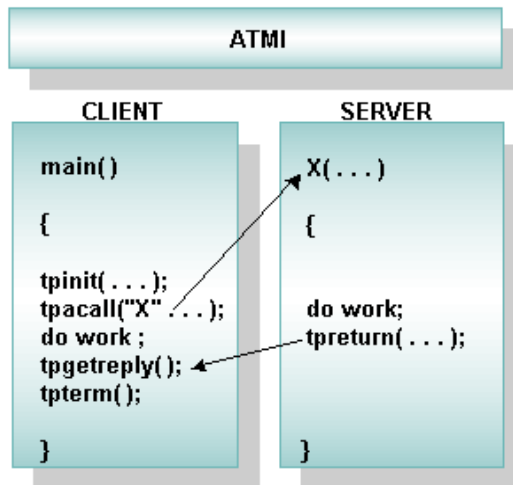
See Also

- “What Is Synchronous Messaging” on page 2-15 in *Introducing the BEA Tuxedo System*

Using the Request/Response Model (Asynchronous Calls)

To make an asynchronous call, a client calls two ATMI functions: the `tpacall(3c)` function, to request a service, and the `tpgetreply(3c)` function, to retrieve the reply. This method is commonly used when a client has tasks it can do between issuing a request and receiving a reply.

Figure 1-5 Using Asynchronous Calls



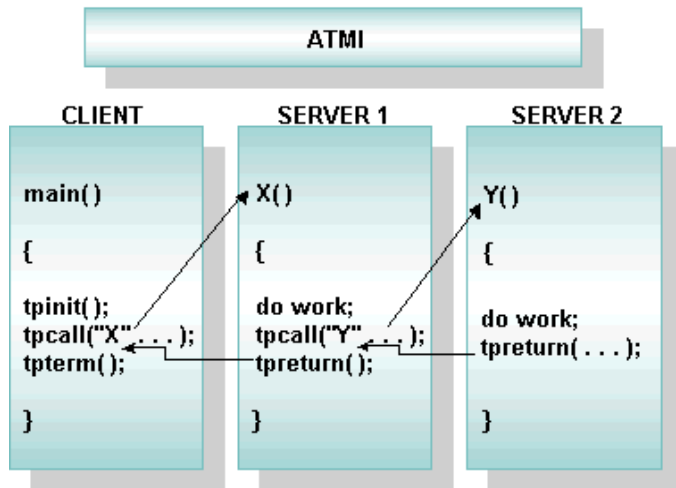
See Also

- “What Is Asynchronous Messaging” on page 2-16 in *Introducing the BEA Tuxedo System*

Using Nested Calls

Services can act as BEA Tuxedo clients and call other BEA Tuxedo services. In other words, you can request a service that, in turn, requests other services. For example, suppose a BEA Tuxedo client calls *service X* and waits for a reply. *Service X* then calls *service Y* and also waits for a reply. When *service X* receives a reply, it returns the reply to the calling client. This method is efficient because *service X* can take the reply from service Y, do more work on it, and modify the return buffer before sending a final reply back to the client.

Figure 1-6 Using Nested Calls



See Also

- “Nested Requests” on page 2-18 in *Introducing the BEA Tuxedo System*

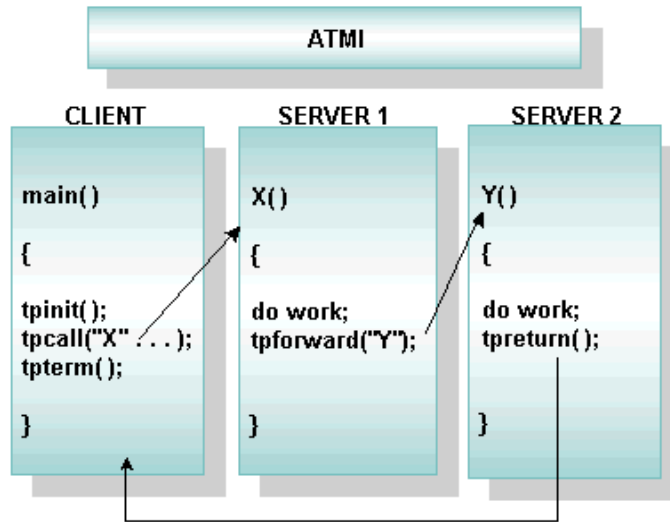
Using Forwarded Calls

With call forwarding, a nested service can return a reply directly to a client without going through the first service that was called, thereby freeing the first service to handle other requests. This capability is useful when the first service is acting strictly as a delivery agent, without adding data to the reply returned by the nested service.

To facilitate call forwarding, a service called by a client uses the `tpforward(3c)` function to pass the request to another service Y. This is the only situation in which a BEA Tuxedo service can end a service call without calling `tpreturn(3c)`.

Call forwarding is transparent to the client. In other words, the same client code is valid for service requests handled by one service and requests handled by more than one service.

Figure 1-7 Using Forwarded Calls



See Also

- “Forwarded Requests” on page 2-20 in *Introducing the BEA Tuxedo System*

Using Conversational Communication

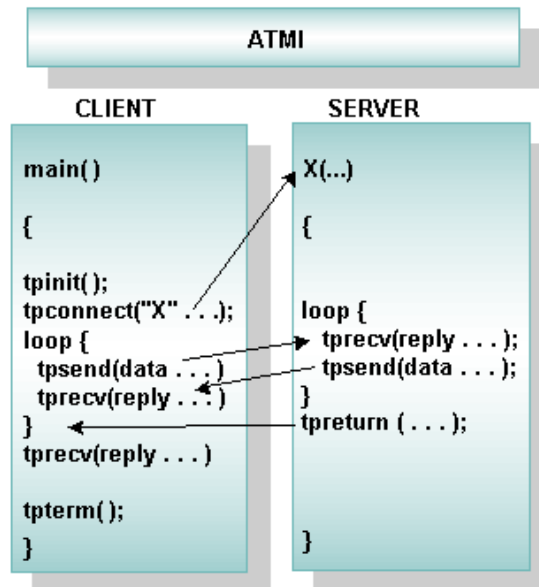
If multiple buffers need to be sent between a BEA Tuxedo client and a BEA Tuxedo service in a stateful manner, then the BEA Tuxedo conversation may be a suitable option.

1 *Developing a BEA Tuxedo Application*

Use BEA Tuxedo conversations judiciously because a server engaged in a conversation is unavailable until the conversation has ended. To implement a conversation, incorporate the following steps in your code.

1. The BEA Tuxedo client starts the conversation with the `tpconnect()` function.
2. The BEA Tuxedo client and the conversational server exchange buffers using the `tpsend()` and `tprecv()` functions. A special flag is set in the service calls to indicate which participant has control of the conversation.
3. The conversation ends in normal conditions, when the server calls `tpreturn()` or the `tpdiscon()` function.

Figure 1-8 Using Conversations



See Also

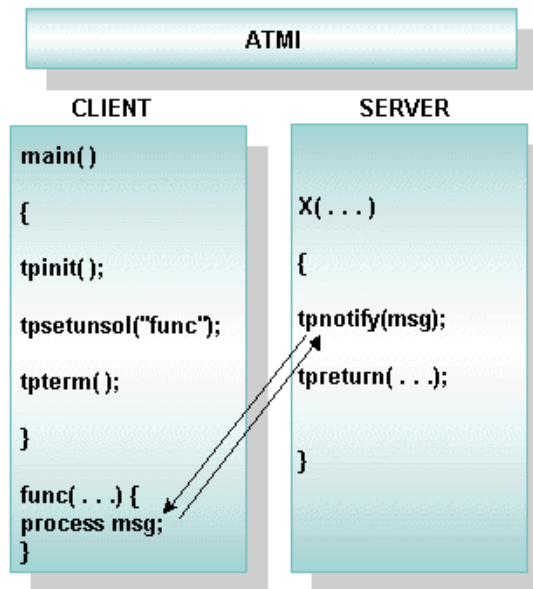
- “What Is Conversational Communication” on page 2-9 in *Introducing the BEA Tuxedo System*

Using Unsolicited Notification

To enable unsolicited notification, a BEA Tuxedo client creates an unsolicited message handle using the `tpsetunsol()` function. To send an unsolicited message, a BEA Tuxedo client or server can use either the `tpnotify()` function, to send a message to a single client, or the `tpbroadcast()` function, to send a message to multiple clients at the same time. When a client receives a message, the BEA Tuxedo system calls the client's unsolicited handler function.

In a signal-based system, a client does not have to poll for unsolicited messages. However, in a non-signal based system, a client must check for unsolicited messages using the `tpchkunsol()` function. Whenever a client makes a service request, `tpchkunsol()` is called implicitly.

Figure 1-9 Handling Unsolicited Notification



Note: If you call `tpnotify()` with the `tpack` flag bit set, you will receive an acknowledgement of your request.

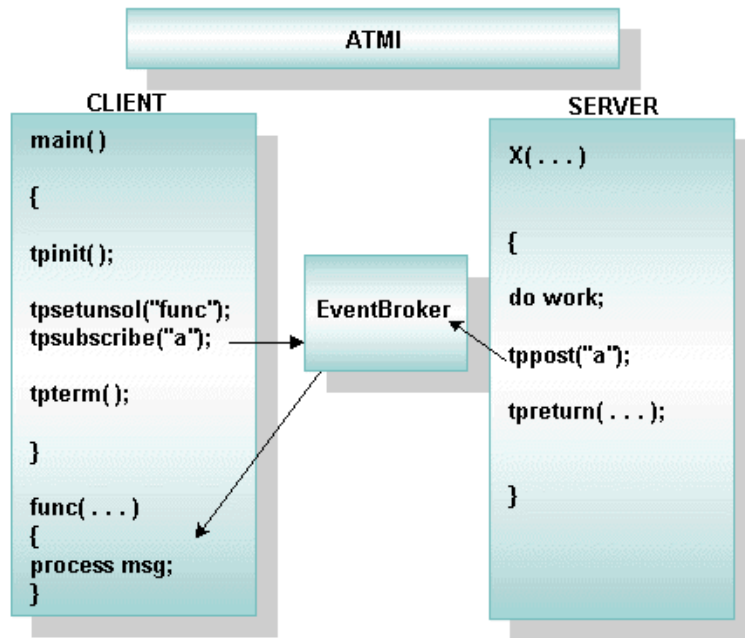
See Also

- “What Is Unsolicited Communication” on page 2-17 in *Introducing the BEA Tuxedo System*

Using Event-based Communication

In event-based communication, events can also be posted to application queues, log files, and system commands. Any BEA Tuxedo client can subscribe to a user-defined event using the `tpsubscribe()` function and receive an unsolicited message whenever a BEA Tuxedo service or client issues a `tppost()` function. Clients can also subscribe to system-defined events that are triggered whenever the BEA Tuxedo system detects the event. When a server dies, for example, the `.SysServerDied` event is posted. No application server is needed to post this event, because it is performed by the BEA Tuxedo system.

Figure 1-10 Using Event-based Communication



See Also

- “How the EventBroker Works” on page 2-10 in *Introducing the BEA Tuxedo System*

Using Queue-based Communication

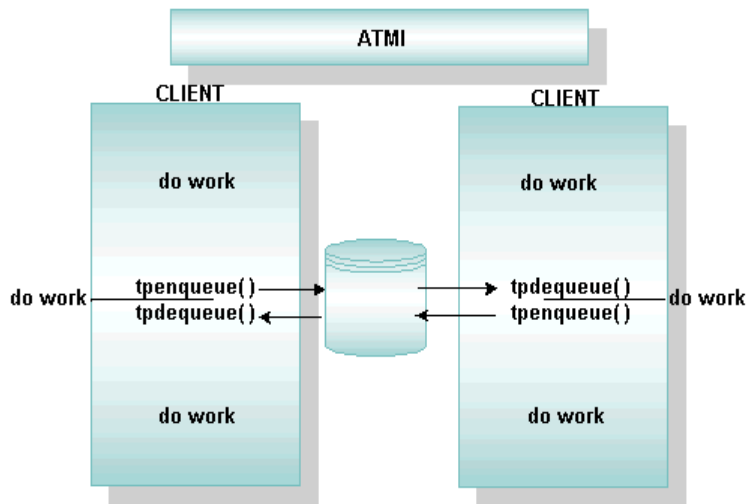
To interface with the /Q system, a BEA Tuxedo client uses two ATMI functions: `tpenqueue()`, to put messages into the queue space, and `tpdequeue()`, to take messages out of the queue space.

The following model represents peer-to-peer asynchronous messaging. Here, a client enqueues a message to a service using `tpenqueue()`. Optionally, the names of a reply queue and a failure queue can be included in the call to `tpenqueue()`. The client can also specify a correlation identifier value to accompany the message. This value is persistent across queues so that any reply or failure message associated with the queued message can be identified when it is read from the reply or the failure queue.

The client can use the default queue ordering (for example, a time after which the message should be dequeued), or can specify an override of the default queue ordering (asking, for example, that this message be put at the top of the queue or ahead of another message on the queue). The call to `tpenqueue()` sends the message to the `TMQUEUE` server, the message is queued to stable storage, and an acknowledgment is sent to the client. The acknowledgment is not seen directly by the client, but can be assumed when the client gets a successful return. (A failure return includes information about the nature of the failure.) A message identifier assigned by the queue manager is returned to the application. The identifier can be used to dequeue a specific message. It can also be used in another `tpenqueue()` to identify a message on the queue ahead of the next message to be enqueued.

Before an enqueued message is made available for dequeuing, the transaction in which the message is enqueued must be committed successfully. A client uses `tpdequeue()` to dequeue messages from the queue.

Figure 1-11 Peer-to-Peer Asynchronous Messaging Model

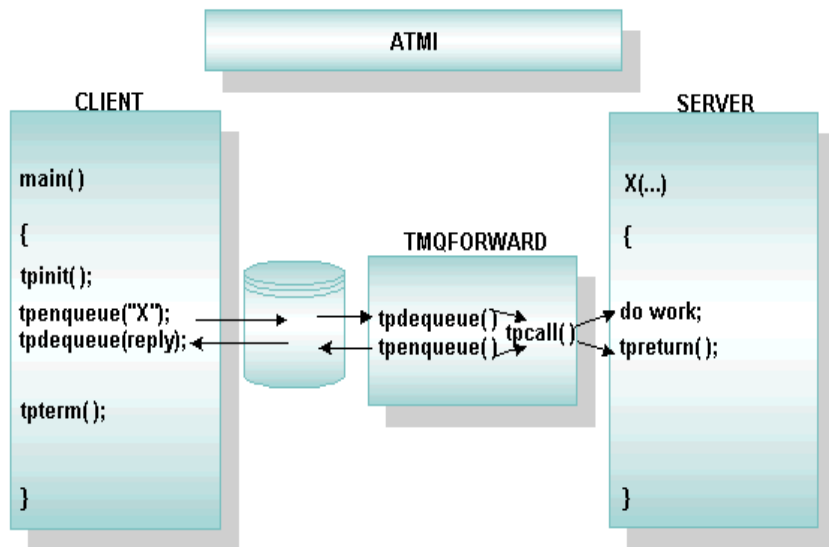


In the following graphic, forwarding a message to another server is illustrated.

The client enqueues a message intended for service X on the server. The service receives this message when it is active and when the handling instructions for the message are met (for example, the message can be encoded to be activated on Friday at 6 PM). Once the service is completed, it returns the reply to the queue space, from which it can be retrieved by the client.

This system of queuing is transparent to services. In other words, the same application code is used for a service, regardless of whether the service is invoked through queuing or direct service invocation using `tp(a)call`.

Figure 1-12 Using Queue Forwarding for Queue-based Service Invocation



See Also

- “What Is Queue-based Communication” on page 2-13 in *Introducing the BEA Tuxedo System*

Using Transactions

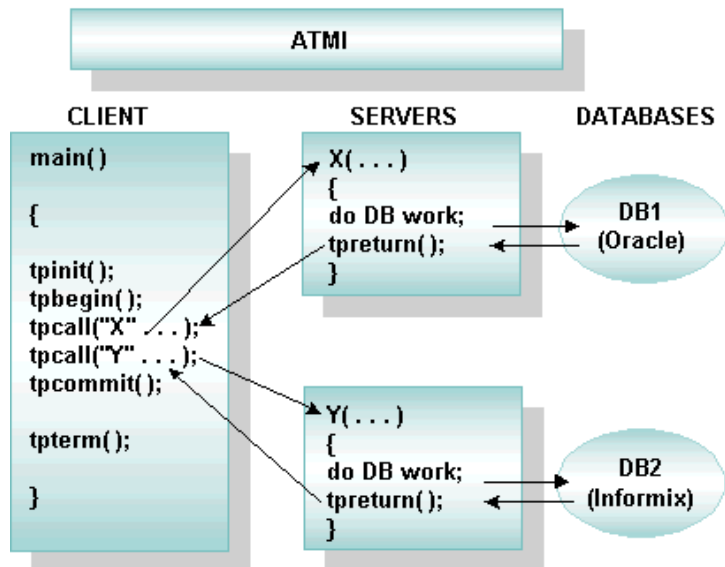
To implement transactions, an application programmer uses three ATMI functions:

- `tpbegin()` to start the transaction
- `tpcommit()` to start the 2-phase commit process
- `tpabort()` to immediately cancel the transaction.

Any code placed outside the begin and commit/abort sequence is not included in the transaction.

In the following example, a client begins a transaction, requests two services, and then commits the transaction. Because the service requests are made between the beginning and the commitment of the transaction, both services join the transaction.

Figure 1-13 Using Transactions



See Also

- “Managing Transactions” on page 3-34 in *Introducing the BEA Tuxedo System*
- “Tutorial for bankapp, a Full C Application” on page 3-1
- “Tutorial for CSIMPAPP, a Simple COBOL Application” on page 4-1
- “Tutorial for simpapp, a Simple C Application” on page 2-1
- “Tutorial for STOCKAPP, a Full COBOL Application” on page 5-1

1 *Developing a BEA Tuxedo Application*

2 Tutorial for simpapp, a Simple C Application

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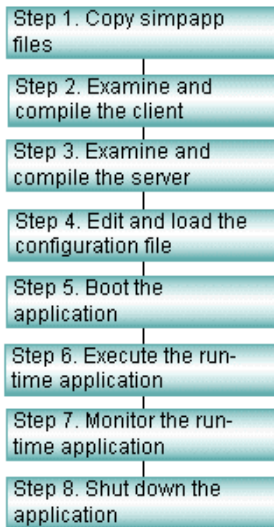
What Is simpapp

`simpapp` is a sample application that includes one client and one server. This application is distributed with the BEA Tuxedo software. The server performs only one service: it accepts a lower case alphabetic string from the client and returns the same string in upper case.

Preparing simpapp Files and Resources

This topic is a tutorial that leads you, step by step, through the process of developing and running a sample BEA Tuxedo application. The following flowchart summarizes the process. Click on each task for instructions on completing that task.

Figure 2-1 simpapp Development Process



Before You Begin

Before you can run this tutorial, the BEA Tuxedo software must be installed so that the files and commands referred to are available. If the installation has already been done by someone else, you need to know the path name of the directory in which the software is installed (`TUXDIR`). You also need to have read and write permissions on the directories and files in the BEA Tuxedo directory structure so you can copy `simpapp` files and execute BEA Tuxedo commands.

About This Tutorial

The instructions for the `simpapp` tutorial are based on a UNIX system platform. While specific platform instructions for the UNIX operating system environment remain relatively the same, instructions (for example, how to copy `simpapp` files, set environment variables), for other non-UNIX platforms (such as Windows NT) may be different. Examples used may vary significantly depending on your platform.

What You Will Learn

After you complete this tutorial, you will be able to understand the tasks clients and servers can perform, edit a configuration file for your own environment, and invoke `tmadmin` to check on the activity of your application. You will understand the basic elements of all BEA Tuxedo applications—client processes, server processes, and a configuration file—and you will know how to use BEA Tuxedo system commands to manage your application.

Step 1: How to Copy the simpapp Files

Note: The following instructions are based on a UNIX system platform. Instruction for non-UNIX platforms, such as Windows NT, may be different. Examples used in the sample applications may vary significantly, depending on the specific platform.

1. Make a directory for `simpapp` and `cd` to it.

```
mkdir simpdir
cd simpdir
```

Note: This step is suggested so you can see the `simpapp` files you have at the start and the additional files you create along the way. Use the standard shell (`/bin/sh`) or the Korn shell; do not use `csh`.

2. Set and export environment variables.

```
TUXDIR=pathname of the BEA Tuxedo system root directory
TUXCONFIG=pathname of your present working directory/tuxconfig
```

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```
PATH=$PATH:$TUXDIR/bin
LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$TUXDIR/lib
export TUXDIR TUXCONFIG PATH LD_LIBRARY_PATH
```

You need `TUXDIR` and `PATH` to be able to access files in the BEA Tuxedo system directory structure and to execute BEA Tuxedo system commands. On Sun Solaris, `/usr/5bin` must be the first directory in your `PATH`. With AIX on the RS/6000, use `LIBPATH` instead of `LD_LIBRARY_PATH`. On HP-UX on the HP 9000, use `SHLIB_PATH` instead of `LD_LIBRARY_PATH`.

You need to set `TUXCONFIG` to be able to load the configuration file, described in “Step 4: Editing and Loading the Configuration File” on page 2-11.

3. Copy the `simpapp` files.

```
cp $TUXDIR/samples/atmi/simpapp/* .
```

Note: It is best to begin with a copy of the files rather than the originals delivered with the software because you will edit some of the files to make them executable.

4. List the files.

```
$ ls
  README      env          simpapp.nt  ubbmp      wsimpcl
  README.as400 setenv.cmd  simpcl.c   ubbsimple
  README.nt   simpapp.mk  simpserv.c  ubbws
$
```

Note: Except for the `README` files, the other files are variations of `simp*.*` and `ubb*` files for non-UNIX system platforms. The `README` files provide explanations of the other files.

The three files that are central to the application are:

- `simpcl.c`—the source code for the client program
- `simpserve.c`—the source code for the server program
- `ubbsimple`—the text form of the configuration file for the application.

See Also

- “What Is `simpapp`” on page 2-1

Step 2: Examining and Compiling the Client

How to Examine the Client

Review the client program source code.

```
$ more simpcl.c
```

The output is shown in the following list.

Listing 2-1 Source Code of simpcl.c

```
1  #include <stdio.h>
2  #include "atmi.h"          /* TUXEDO */
3
4
5
6
7  #ifdef __STDC__
8  main(int argc, char *argv[])
9
10 #else
11
12 main(argc, argv)
13 int argc;
14 char *argv[];
15 #endif
16
17 {
18
19     char *sendbuf, *rcvbuf;
20     int  sendlen, rcvlen;
21     int  ret;
22
23     if(argc != 2) {
24         fprintf(stderr, "Usage: simpcl string\n");
25         exit(1);
26     }
27     /* Attach to BEA TUXEDO as a Client Process */
28     if (tpinit((TPINIT *) NULL) == -1) {
29         fprintf(stderr, "Tpinit failed\n");
30         exit(1);
```

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```
31         }
32         sendlen = strlen(argv[1]);
33         if((sendbuf = (char *)tpalloc("STRING", NULL, sendlen+1))== NULL){
34             fprintf(stderr,"Error allocating send buffer\n");
35             tpterm();
36             exit(1);
37         }
38         if((rcvbuf = (char *)tpalloc("STRING", NULL, sendlen+1))== NULL){
39             fprintf(stderr,"Error allocating receive buffer\n");
40             tpfree(sendbuf);
41             tpterm();
42             exit(1);
43         }
44         strcpy(sendbuf, argv[1]);
45         ret = tpcall("TOUPPER", sendbuf, NULL, &rcvbuf, &rcvlen, 0);
46         if(ret == -1) {
47             fprintf(stderr, "Can't send request to service TOUPPER\n");
48             fprintf(stderr, "Tperrno = %d, %s\n", tperrno,
49                 tmemsgs[tperrno]);
50             tpfree(sendbuf);
51             tpfree(rcvbuf);
52             tpterm();
53             exit(1);
54         }
55         printf("Returned string is: %s\n", rcvbuf);
56
57         /* Free Buffers & Detach from BEA TUXEDO */
58         tpfree(sendbuf);
59         tpfree(rcvbuf);
60         tpterm();
61     }
```

Table 2-1 Significant Lines in the simpcl.c Source Code

Line(s)	File/Function	Purpose
2	atmi.h	Header file required whenever BEA Tuxedo ATMI functions are used.
28	tpinit()	The ATMI function used by a client program to join an application.

Line(s)	File/Function	Purpose
33	<code>tpalloc()</code>	The ATMI function used to allocate a typed buffer. <code>STRING</code> is one of the five basic BEA Tuxedo buffer types; <code>NULL</code> indicates there is no subtype argument. The remaining argument, <code>sendlen + 1</code> , specifies the length of the buffer plus 1 for the null character that ends the string.
38	<code>tpalloc()</code>	Allocates another buffer for the return message.
45	<code>tpcall()</code>	Sends the message buffer to the <code>TOUPPER</code> service specified in the first argument. Also includes the address of the return buffer. <code>tpcall()</code> waits for a return message.
35, 41, 52, 60	<code>tpterm()</code>	The ATMI function used to exit an application. A call to <code>tpterm()</code> is used to exit the application before exiting in response to an error condition (lines 36, 42, and 53). The final call to <code>tpterm()</code> (line 60) is issued after the message has been printed.
40, 50, 51, 58, 59	<code>tpfree()</code>	Frees allocated buffers. <code>tpfree()</code> is the functional opposite of <code>tpalloc()</code> .
55	<code>printf()</code>	The successful conclusion of the program. It prints out the message returned from the server.

How to Compile the Client

1. Run `buildclient` to compile the client program.

```
buildclient -o simpcl -f simpcl.c
```

The output file is `simpcl` and the input source file is `simpcl.c`.

2. Check the results.

```
$ ls -l
total 97
-rwxr-x--x 1 usrid  grpid  313091 May 28 15:41 simpcl
-rw-r----- 1 usrid  grpid   1064 May 28 07:51 simpcl.c
-rw-r----- 1 usrid  grpid    275 May 28 08:57 simpserv.c
-rw-r----- 1 usrid  grpid    392 May 28 07:51 ubbsimple
```

As can be seen, we now have an executable module called `simpcl`. The size of `simpcl` may vary.

See Also

- “What Is simpapp” on page 2-1
- `buildclient(1)` in *BEA Tuxedo Command Reference*
- *BEA Tuxedo C Function Reference*

Step 3: Examining and Compiling the Server

How to Examine the Server

Review the server program source code.

```
$ more simpserv.c
```

Listing 2-2 Source Code of `simpsev.c`

```
*/  
  
/* #ident"@(#) apps/simpapp/simpsev.c$Revision: 1.1 $" */  
1 #include <stdio.h>  
2 #include <ctype.h>  
3 #include <atmi.h> /* TUXEDO Header File */  
4 #include <userlog.h> /* TUXEDO Header File */  
5 /* tpsvrinit is executed when a server is booted, before it begins  
   processing requests. It is not necessary to have this function.  
   Also available is tpsvrdone (not used in this example), which is  
   called at server shutdown time.  
  
9 */  
10 #if defined(__STDC__) || defined(__cplusplus)  
  
12 tpsvrinit(int argc, char *argv[])  
13 #else  
14 tpsvrinit(argc, argv)  
15 int argc;  
16 char **argv;  
17 #endif
```

Step 3: Examining and Compiling the Server

```
18     {
19         /* Some compilers warn if argc and argv aren't used.
20          */
21         argc = argc;
22         argv = argv;
23         /* userlog writes to the central TUXEDO message log */
24         userlog("Welcome to the simple server");
25         return(0);
26     }
27 /* This function performs the actual service requested by the client.
    Its argument is a structure containing, among other things, a pointer
    to the data buffer, and the length of the data buffer.
30 */
31 #ifdef __cplusplus
32 extern "C"
33 #endif
34 void
35 #if defined(__STDC__) || defined(__cplusplus)
36 TOUPPER(TPSVCINFO *rqst)
37 #else
38 TOUPPER(rqst)
39 TPSVCINFO *rqst;
40 #endif
41 {
42     int i;
43
44     for(i = 0; i < rqst->len-1; i++)
45         rqst->data[i] = toupper(rqst->data[i]);
46     /* Return the transformed buffer to the requestor. */
47     tpreturn(TPSUCCESS, 0, rqst->data, 0L, 0);
48 }
```

Table 2-2 Significant Parts of the `simpserv.c` Source Code

Line(s)	File/Function	Purpose
whole file		A BEA Tuxedo server does not contain a <code>main()</code> . The <code>main()</code> is provided by the BEA Tuxedo system when the server is built.
12	<code>tpsvrinit()</code>	This subroutine is called during server initialization, that is, before the server begins processing service requests. A default subroutine (provided by the BEA Tuxedo system) writes a message to <code>USERLOG</code> indicating that the server has been booted. <code>userlog(3c)</code> is a log used by the BEA Tuxedo system and can be used by applications.
38	<code>TOUPPER()</code>	The declaration of a service (the only one offered by <code>simpserv</code>). The sole argument expected by the service is a pointer to a <code>TPSVCINFO</code> structure, which contains the data string to be converted to uppercase.
45	for loop	Converts the input to uppercase by repeated calls to <code>toupper</code> .
49	<code>tpreturn()</code>	Returns the converted string to the client with the <code>TPSUCCESS</code> flag set.

How to Compile the Server

1. Run `buildserver` to compile the server program.

```
buildserver -o simpserv -f simpserv.c -s TOUPPER
```

The executable file to be created is named `simpserv` and `simpserv.c` is the input source file. The `-s TOUPPER` option specifies the service to be advertised when the server is booted.

2. Check the results.

```
$ ls -l
total 97
-rwxr-x--x 1 usrid grpuid 313091 May 28 15:41 simpcl
-rw-r----- 1 usrid grpuid 1064 May 28 07:51 simpcl.c
-rwxr-x--x 1 usrid grpuid 358369 May 29 09:00 simpserv
-rw-r----- 1 usrid grpuid 275 May 28 08:57 simpserv.c
-rw-r----- 1 usrid grpuid 392 May 28 07:51 ubbsimple
```

You now have an executable module called `simpserv`.

See Also

- “What Is simpapp” on page 2-1
- `buildserver(1)` in *BEA Tuxedo Command Reference*
- *BEA Tuxedo C Function Reference*

Step 4: Editing and Loading the Configuration File

How to Edit the Configuration File

1. In a text editor, familiarize yourself with `ubbsimple`, which is the configuration file for `simpapp`.

Listing 2-3 The simpapp Configuration File

```
1$
2
3 #Skeleton UBBCONFIG file for the BEA Tuxedo Simple Application.
4 #Replace the <bracketed> items with the appropriate values.
5 RESOURCES
```

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```
6 IPCKEY          <Replace with valid IPC Key greater than 32,768>
7
8 #Example:
9
10 #IPCKEY         62345
11
12 MASTER         simple
13 MAXACCESSERS   5
14 MAXSERVERS     5
15 MAXSERVICES    10
16 MODEL          SHM
17 LDBAL          N
18
19 *MACHINES
20
21 DEFAULT:
22
23     APPDIR="<Replace with the current pathname>"
24     TUXCONFIG="<Replace with TUXCONFIG Pathname>"
25     TUXDIR="<Root directory of Tuxedo (not /)>"
26 #Example:
27 #     APPDIR="/usr/me/simpdir"
28 #     TUXCONFIG="/usr/me/simpdir/tuxconfig"
29 #     TUXDIR="/usr/tuxedo"
30
31 <Machine-name> LMID=simple
32 #Example:
33 #tuxmach       LMID=simple
34 *GROUPS
35 GROUP1
36             LMID=simple   GRPNO=1   OPENINFO=NONE
37
38 *SERVERS
39 DEFAULT:
40             CLOPT="-A"
41 simpserv      SRVGRP=GROUP1 SRVID=1
42 *SERVICES
43 TOUPPER
```

2. For each <string> (that is, for each string shown between angle brackets), substitute an appropriate value.

How to Load the Configuration File

1. Run `tmloadcf` to load the configuration file.

```
$ tmloadcf ubbsimple
Initialize TUXCONFIG file: /usr/me/simpdir/tuxconfig [y, q] ? y
$
```

2. Check the results.

```
$ ls -l
total 216
-rwxr-x--x 1 usrid grpuid 313091    May 28 15:41 simpl
-rw-r----- 1 usrid grpuid  1064    May 28 07:51 simpl.c
-rwxr-x--x 1 usrid grpuid 358369    May 29 09:00 simplserv
-rw-r----- 1 usrid grpuid   275    May 28 08:57 simplserv.c
-rw-r----- 1 usrid grpuid 106496    May 29 09:27 tuxconfig
-rw-r----- 1 usrid grpuid   382    May 29 09:26 ubbsimple
```

You now have a file called `TUXCONFIG`. The `TUXCONFIG` file is a new file under the control of the BEA Tuxedo system.

See Also

- “What Is `simpapp`” on page 2-1
- `tmloadcf(1)` in *BEA Tuxedo Command Reference*
- `UBBCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*

Step 5: How to Boot the Application

1. Execute `tmboot` to bring up the application.

```
$ tmboot
Boot all admin and server processes? (y/n): y
Booting all admin and server processes in
/usr/me/simpdir/tuxconfig
Booting all admin processes ...
```

```
exec BBL -A:
process id=24223 ... Started.

Booting server processes ...

exec simpserv -A :
process id=24257 ... Started.
2 processes started.
$
```

The BBL is the administrative process that monitors the shared memory structures in the application. `simserv` is the `simpapp` server that runs continuously, awaiting requests.

See Also

- “What Is `simpapp`” on page 2-1
- `tmboot(1)` in *BEA Tuxedo Command Reference*
- “How to Boot the Application” on page 1-9 in *Administering a BEA Tuxedo Application at Run Time*

Step 6: How to Execute the Run-time Application

To execute your `simpapp`, have the client submit a request.

```
$ simpcl "hello, world"
Returned string is: HELLO, WORLD
```

See Also

- “What Is `simpapp`” on page 2-1

Step 7: How to Monitor the Run-time Application

As the administrator, you can use the `tmadmin` command interpreter to check an application and make dynamic changes. To run `tmadmin`, you must have the `TUXCONFIG` environment variable set.

`tmadmin` can interpret and run over 50 commands. For a complete list, see `tmadmin(1)`. Here we use two of the `tmadmin` commands.

1. Enter the following command.

```
$ tmadmin
```

The following lines are displayed.

```
tmadmin - Copyright (c) 1999 BEA Systems, Inc. All rights reserved.
>
```

Note: The greater-than sign (>) is the `tmadmin` prompt.

2. Enter the `printserver(psr)` command to display information about servers.

```
> psr
a.out Name Queue Name Grp Name ID RqDone Load Done Current Service
-----
BBL          531993      simple    0      0          0 ( IDLE )
simpserv    00001.00001 GROUP1    1      0          0 ( IDLE )
>
```

3. Enter the `printservice(psc)` command to display information about the services:

```
> psc
Service Name Routine Name a.out Name Grp Name ID Machine # Done Status
-----
TOUPPER      TOUPPER      simpserv  GROUP1    1 simple      - AVAIL
>
```

See Also

- “What Is simpapp” on page 2-1
- `tmadmin(1)` in *BEA Tuxedo Command Reference*

Step 8: How to Shut Down the Application

1. Run `tmshutdown` to bring down the application.

```
$ tmshutdown
Shutdown all admin and server processes? (y/n): y
Shutting down all admin and server processes in
/usr/me/simppdir/tuxconfig
Shutting down server processes ...

Server Id = 1 Group Id = GROUP1 Machine = simple: shutdown
succeeded.
Shutting down admin processes ...

Server Id = 0 Group Id = simple Machine = simple: shutdown
succeeded.
2 processes stopped.
$
```

2. Check the ULOG

```
$ cat ULOG*
$
113837.tuxmach!tmloadcf.10261: CMDTUX_CAT:879: A new file system
has been created. (size = 32 4096-byte blocks)
113842.tuxmach!tmloadcf.10261: CMDTUX_CAT:871: TUXCONFIG file
/usr/me/simppdir/tuxconfig has been created
113908.tuxmach!BBL.10768: LIBTUX_CAT:262: std main starting
113913.tuxmach!simpserve.10925: LIBTUX_CAT:262: std main starting
113913.tuxmach!simpserve.10925: Welcome to the simple server
114009.tuxmach!simpserve.10925: LIBTUX_CAT:522: Default
tpsrdone() function used.
114012.tuxmach!BBL.10768: CMDTUX_CAT:26: Exiting system
```

See Also

- “What Is simpapp” on page 2-1
- `tmsshutdown(1)` in *BEA Tuxedo Command Reference*
- `userlog(3c)` in *BEA Tuxedo C Function Reference*
- “How to Shut Down Your Application” on page 1-11 in *Administering a BEA Tuxedo Application at Run Time*
- “What Is the User Log (ULOG)” on page 2-17 in *Administering a BEA Tuxedo Application at Run Time*

2 *Tutorial for simpapp, a Simple C Application*

3 Tutorial for bankapp, a Full C Application

- What Is bankapp
- Familiarizing Yourself with bankapp
- Preparing bankapp Files and Resources
- Running bankapp

What Is bankapp

`bankapp` is a sample banking application that is provided with the BEA Tuxedo software. The application performs the following banking functions: opens and closes accounts, retrieves account balances, deposits or withdraws money from an account, and transfers monies from one account to another.

About This Tutorial

This tutorial leads you, step by step, through the procedure you must perform to develop the `bankapp` application. Once you have “developed” `bankapp` through this tutorial, you will be ready to start developing applications of your own.

The `bankapp` tutorial is presented in three sections:

- Familiarizing Yourself with `bankapp`
- Preparing `bankapp` Files and Resources
- Running `bankapp`

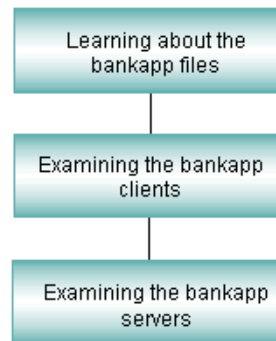
Note: This information has been written for UNIX and Windows NT system users with some experience in application development, administration, or system programming. We assume some familiarity with the BEA Tuxedo software.

Familiarizing Yourself with `bankapp`

Instructions in this sample application are automated for your convenience through shell scripts that work in a UNIX or Windows NT environment: `RUNME.sh` and `RUNME.cmd`. The associated `readme` files discuss how to run these files. Go through these files to understand the procedure more thoroughly and then follow these step-by-step instructions to help you set up and manage a distributed application.

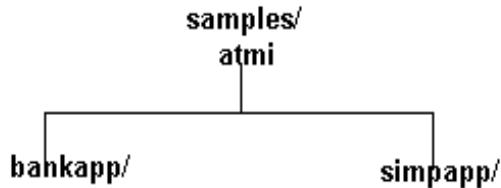
`bankapp` uses a demo relational database delivered with the software that enables you to use the sample application. Various commands and SQL code within the sample application (included for demo purposes only) provide access to the database.

This documentation provides a tour of the files, client, and services that make up the `bankapp` application. Click on any of the following activities for more information about that part of the tour.



Learning About the bankapp Files

The files that make up the `bankapp` application are delivered in a directory called `bankapp`, which is positioned as follows.



Exploring the Banking Application Files

The `bankapp` directory contains the following files:

- Five source files for service subroutines using embedded SQL statements
- Eight C source files
- One request/response client program (`audit`)
- One conversational server (`AUDIT`)
- One conversational client (`auditcon`)
- Three servers (or files associated with servers)
- Two files that generate data or transactions for the application
- Miscellaneous files
- Generic BEA Tuxedo application files (that is, files needed in any BEA Tuxedo application)
- Makefile for various add-ons
- Files provided to facilitate the use of `bankapp` as an example

3 Tutorial for bankapp, a Full C Application

The following table lists the files of the banking application. The table lists the source files delivered with the BEA Tuxedo software, files that are generated when the `bankapp.mk` is run, and a summary of the contents of each file.

Table 3-1 Description of the Banking Application Files

Source File	Generated File	Contents
<code>ACCT.ec</code>	<code>ACCT.c</code> , <code>ACCT.o</code> , <code>ACCT</code>	Contains two services: <code>OPEN_ACCT</code> and <code>CLOSE_ACCT</code> to open and close accounts.
<code>ACCTMGR.c</code>	<code>ACCTMGR</code>	A server that subscribes to events and logs notifications. Contains <code>WATCHDOG</code> and <code>Q_OPENACCT_LOG</code> services.
<code>AUDITC.c</code>	<code>AUDITC</code>	Contains a conversational server that handles service requests from the client <code>auditcon</code> .
<code>BAL.ec</code>	<code>BAL.c</code> , <code>BAL.o</code> , <code>BAL</code>	Contains a set of services: <code>ABAL</code> , <code>TBAL</code> , <code>ABAL_BID</code> , and <code>TBAL_BID</code> that allow the audit client to obtain bank-wide or branch-wide account or teller balances.
<code>BALC.ec</code>	<code>BALC.c</code> , <code>BALC.o</code> , <code>BALC</code>	Contains two services: <code>ABALC_BID</code> , and <code>TBALC_BID</code> . These services are the same as <code>TBAL_BID</code> and <code>ABAL_BID</code> , except that <code>TPSUCCESS</code> is returned when a branch ID is not found, which allows <code>auditcon</code> to continue running.
<code>bankmgr.c</code>	<code>bankmgr</code>	A client program that subscribes to events of special interest.
<code>BTADD.ec</code>	<code>BTADD.c</code> , <code>BTADD.o</code> , <code>BTADD</code>	Contains two services: <code>BR_ADD</code> and <code>TLR_ADD</code> for adding branches and tellers to the database.
<code>cracl.sh</code>	-	A shell script that creates Access Control Lists to demonstrate the Access Control security level.
<code>crqueue.sh</code>	-	A shell script that creates application queues for use in event notification.
<code>crusers.sh</code>	-	A shell script that creates groups and users to demonstrate the authentication security level.
<code>event.flds</code>	-	A field table file used in the event feature.
<code>FILES</code>	-	A descriptive list of all the files in <code>bankapp</code> .

Source File	Generated File	Contents
README	-	Installation and boot procedures for all platforms except Windows NT.
README.nt	-	Installation and boot procedures for the Windows NT platform.
README2	-	Documentation of additions to bankapp that demonstrate new features. The file is located in the <code>samples/atmi/bankapp</code> directory.
README2.nt	-	Documentation of additions to bankapp that demonstrate new features for the Windows NT platform. The file is located in the <code>samples\atmi\bankapp</code> directory.
RUNME.cmd		An interactive script to build, configure, boot, and shut down the application for Windows NT.
RUNME.sh	-	An interactive script to build, configure, boot, and shut down the application for UNIX.
showq.sh!	-	A shell script that displays the status and contents of a message queue.
TLR.ec	TLR.c, TLR.o, TLR	Contains three services: WITHDRAWAL, DEPOSIT, and INQUIRY.
usrevtf.sh	-	A shell script that creates an ENVFILE for the BEA Tuxedo server TMUSREVT.
XFER.c	XFER.o, XFER	Contains TRANSFER service.
aud.v	aud.V, aud.h	An FML view used to define the structure passed between the audit client and the BAL server.
appinit.c	appinit.o	Contains customized versions of <code>tpsvrinit()</code> and <code>tpsvrdone()</code> for all servers other than TLR.
audit.c	audit.o, audit	A client that obtains bank-wide or branch-wide account and teller balances via the ABAL, TBAL, ABAL_BID, and TBAL_BID services.
auditcon.c	auditcon	An interactive version of audit that uses conversations and four services: ABAL, TBAL, ABALC_BID, and TBALC_BID.

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Source File	Generated File	Contents
bankapp.mk	-	An application makefile for UNIX.
bankapp.nt	-	An application makefile for Windows NT.
bank.flds	bank.flds.h	A field table file containing bank database fields and auxiliary FML fields used by servers.
bank.h	-	Contains data definitions pertinent to multiple C programs in the application.
bankvar	-	Contains some environment variables for bankapp. Other environment variables are defined in ENVFILE, but because ENVFILE is set from within bankvar, you can control the entire environment for your application through bankvar.
crbank.sh	crbank	A shell script that creates databases for all banks when bankapp is run in SHM mode.
crbankdb.sh	crbankdb	A shell script that creates a database for one server group.
crtlog.sh	crtlog, TLOG	A shell script that creates a UDL and a TLOG on the master site and a UDL on the non-master sites.
driver.sh	driver	A shell script that drives the application by piping FML buffers with transaction requests through ud(1).
envfile.sh	envfile, ENVFILE	A shell script that creates ENVFILE for use by tmloadcf.
gendata.c	gendata	A program that generates ud-readable requests to add ten branches, thirty tellers, and two hundred accounts.
gentran.c	gentran	A program that generates ud-readable transaction requests from four services: DEPOSIT, WITHDRAWAL, TRANSFER, and INQUIRY.
populate.sh	populate	A shell script that populates the database by piping FML buffers with requests to add branches, tellers, and accounts through ud(1).
ubbmp	TUXCONFIG	A sample UBBCONFIG file for use in an MP-mode configuration.

Source File	Generated File	Contents
ubbshm	TUXCONFIG	A sample UBBCONFIG file for use in a SHM-mode configuration.
util.c	util.o	A set of functions, such as <code>getstr1()</code> , that are commonly used by services.
bankclt.c	bankclt	Client for bankapp.

See Also

- “Familiarizing Yourself with bankapp” on page 3-2

Examining the bankapp Clients

What Is the bankclt.c File

The `bankclt` file contains the client program that requests BEA Tuxedo services from the `bankapp` application. This client program is text-based and provides the following options:

- Balance Inquiry
- Withdrawal
- Deposit
- Transfer
- Open Account
- Close Account
- Exit Application

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Each of these options, except *Exit Application*, calls a subroutine that performs the following tasks:

1. Obtains the user input from the keyboard using the `get_account()`, `get_amount()`, `get_socsec()`, `get_phone()`, and the `get_val()` functions.
2. Puts the values into a global FML buffer (`*fbfr`). (Some functions add more fields than others. This is dependent on the information needed by the servers.)
3. Enables routines that make a request to the BEA Tuxedo system through the `do_tpcall()` function to invoke the required service. The following table lists the functions and the services they invoke.

Table 3-2 Services Called by Function

Function Name	Input FML Fields	Output FML Fields	Service Name
<code>BALANCE()</code>	ACCOUNT_ID	SBALANCE	INQUIRY
<code>WITHDRAWAL()</code>	ACCOUNT_ID SAMOUNT	SBALANCE	WITHDRAWAL
<code>DEPOSIT()</code>	ACCOUNT_ID SAMOUNT	SBALANCE	DEPOSIT
<code>TRANSFER()</code>	ACCOUNT_ID (0) ¹ ACCOUNT_ID (1) SAMOUNT	SBALANCE (0) SBALANCE (1)	TRANSFER
<code>OPEN_ACCT()</code>	LAST_NAME FIRST_NAME MID_INIT SSN ADDRESS PHONE ACCT_TYPE BRANCH_ID SAMOUNT	ACCOUNT_ID SBALANCE	OPEN_ACCT
<code>CLOSE_ACCT()</code>	ACCOUNT_ID	SBALANCE	CLOSE_ACCT

¹The number in parentheses is the FML occurrence number for that field.

4. After the call completes successfully, each function gets the fields it needs from the returned FML buffer and prints the results.

The `do_tpcall()` function (that begins on line 447 in `bankclt.c`) follows:

Listing 3-1 do_tpcall() in bankclt.c

```
/*
 * This function does the tpcall to Tuxedo.
 */
static int
do_tpcall(char *service)
{
    long len;
    char *server_status;
    /* Begin a Global transaction */
    if (tpbegin(30, 0) == -1) {
        (void)fprintf(stderr, "ERROR: tpbegin failed (%s)\n",
            tpstrerror(tperrno));
        return(-1);
    }
    /* Request the service with the user data */
    if (tpcall(service, (char *)fbfr, 0, (char **)&fbfr, &len,
        0) == -1) {
        if(tperrno== TPESVCFAIL && fbfr != NULL &&
            (server_status=Ffind(fbfr,STATLIN,0,0)) != 0) {
            /* Server returned failure */
            (void)fprintf(stderr, "%s returns failure
            (%s)\n",
                service,server_status);
        }
        else {
            (void)fprintf(stderr,
                "ERROR: %s failed (%s)\n", service,
                tpstrerror(tperrno));
        }
        /* Abort the transaction */
        (void) tpabort(0);
        return(-1);
    }
    /* Commit the transaction */
    if(tpcommit(0) < 0) {
        (void)fprintf(stderr, "ERROR: tpcommit failed
        (%s)\n",
            tpstrerror(tperrno));
    }
}
```

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```
        return(-1);
    }
    return(0);
}
```

The `do_tpcall()` function performs the following tasks:

- Begins a global transaction by calling `tpbegin()`, which ensures that all work is done as a single unit.
- Calls `tpcall()` with the requested service name (`char *service`) and the supplied FML buffer (the global `*fbfr` pointer).
- If `tpcall()` fails with a server-indicated failure (`TPSVCERR`), it prints the message from the server in the `STATLIN FML` field. The transaction is rolled back with `tpabort()` and it returns -1.
- If `tpcall()` fails with any other error, it prints the error message and rolls back the transaction with `tpabort()` and returns -1.
- If `tpcall()` succeeds, it commits the transaction using `tpcommit()` and returns 0.

Note: The `unsolfcn()` function is invoked if there is an unsolicited message to the client. It only supports `STRING` buffer types and prints the message.

How `ud(1)` Is Used in `bankapp`

`bankapp` uses the BEA Tuxedo program `ud(1)`, which allows fielded buffers to be read from standard input and sent to a service. In the sample application, `ud` is used by both the `populate` and `driver` programs:

- In `populate`, a program called `gendata` passes service requests to `ud` with customer account information to be entered in the `bankapp` database.
- In `driver`, the data flow is similar, but the program is `gentran` and the purpose is to pass transactions to the application to simulate an active system.

A Request/Response Client: audit.c

audit is a request/response client program that makes branch-wide or bank-wide balance inquiries, using the services: ABAL, TBAL, ABAL_BID, and TBAL_BID. You can invoke it in two ways:

- `audit [-a | -t]`—Prints the bank-wide total value of all accounts, or bank-wide cash supply of all tellers. Option `-a` or `-t` must be specified to indicate whether account balances or teller balances are to be tallied.
- `audit [-a | -t] branch_ID` —Prints the branch-wide total value of all accounts, or branch-wide cash supply of all tellers, for branch denoted by `branch_ID`. Option `-a` or `-t` must be specified to indicate whether account balances or teller balances are to be tallied.

The source code for audit contains two major parts: `main()` and a subroutine called `sum_bal()`. BEA Tuxedo ATMI functions are used in both parts. The program uses a VIEW typed buffer and a structure that is defined in the `aud.h` header file. The source code for the structure can be found in the view description file, `aud.v`.

The following pseudo-code shows the algorithm for the program.

Listing 3-2 audit Pseudo-code

```
main()
{
    Parse command-line options with getopt();
    Join application with tpinit();
    Begin global transaction with tpbegin();
    If (branch_ID specified) {
        Allocate buffer for service requests with tppalloc();
        Place branch_ID into the aud structure;
        Do tpcall() to "ABAL_BID" or "TBAL_BID";
        Print balance for branch_ID;
        Free buffer with tpfree();
    }
    else /* branch_ID not specified */
        call subroutine sum_bal();
    Commit global transaction with tpcommit();
    Leave application with tpterm();
}
sum_bal()
}
```

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```
Allocate buffer for service requests with tmalloc();
For (each of several representative branch_ID's,
    one for each site)
    Do tpcall() to "ABAL" or "TBAL";
For (each representative branch_ID) {
    Do tpgetrply() with TPGETANY flag set
        to retrieve replies;
    Add balance to total;
    Print total balance;
}
Free buffer with tpfree();
}
```

Following is a summary of the two main parts of the audit source code.

In the programs `main()`:

1. `/* Join application */`
2. `/* Start global transaction */`
3. `/* Create buffer and set data pointer */`
4. `/* Do tpcall */`
5. `/* Commit global transaction */`
6. `/* Leave application */`

In the subroutine `sum_bal`:

1. `/* Create buffer and set data pointer */`
2. `/* Do tpcall */`
3. `/* Do tpgetrply to retrieve answers to questions */`

A Conversational Client: `auditcon.c`

`auditcon` is a conversational version of the `audit` program. The source code for `auditcon` uses the ATMI functions for conversational communication: `tpconnect()` to establish the connection between the client and service, `tpsend()` to send a message, and `tprecv()` to receive a message.

The following pseudo-code shows the algorithm for the program.

Listing 3-3 auditcon Pseudo-code

```
main()
{
    Join the application
    Begin a transaction
    Open a connection to conversational service AUDITC
    Do until user says to quit: {
        Query user for input
        Send service request
        Receive response
        Print response on user's terminal
        Prompt for further input
    }
    Commit transaction
    Leave the application
}
```

A Client that Monitors Events: bankmgr.c

bankmgr is included with bankapp as an example of a client that is designed to run constantly. It subscribes to application-defined events of special interest, such as the opening of a new account or a withdrawal above \$10,000. (The bankmgr.c client is more fully described in the README2 file of bankapp and in the bankmgr.c code itself.)

See Also

- “Familiarizing Yourself with bankapp” on page 3-2
- “What You Can Do Using the ATMI” on page 2-4 in *Introducing the BEA Tuxedo System*
- “What Are the BEA Tuxedo Messaging Paradigms” on page 2-8 in *Introducing the BEA Tuxedo System*
- “What Is bankapp” on page 3-1
- “What Are Typed Buffers” on page 2-24 in *Introducing the BEA Tuxedo System*
- “Using Event-based Communication” on page 1-14
- *BEA Tuxedo Command Reference*
- *BEA Tuxedo C Function Reference*

Examining the bankapp Servers and Services

This topic provides the following information:

- A description of the servers and services delivered with `bankapp`
- A description of how the services are link-edited into servers
- Pseudo-code for each service that is either accessed by the BEA Tuxedo `bankclt.c`, or the application client, `audit.c`
- Descriptions of the relationships between the `bankapp` services and servers
- Descriptions of the `buildserver(1)` command options used to compile and build each server with the `main()` defined by the BEA Tuxedo system
- An alternative method for structuring servers

Servers are executable processes that offer one or more services. In the BEA Tuxedo system, they continually accept requests (from processes acting as clients) and dispatch them to the appropriate services. Services are subroutines of C language code written specifically for an application. BEA Tuxedo's applications are written to make services available and capable of accessing resource managers. Service routines must be written by BEA Tuxedo application programmers.

All bankapp services are coded in C with embedded SQL except for the `TRANSFER` service, which does not interact directly with the database. The `TRANSFER` service is offered by the `XFER` server and is a C program (that is, its source file is a `.c` file rather than a `.ec` file).

All bankapp services of bankapp use functions provided in the Application Transaction Management Interface (ATMI) for performing the following tasks:

- Managing typed buffers
- Communicating synchronously or asynchronously with other services
- Defining global transactions
- Generically accessing a resource manager
- Sending replies back to clients

bankapp Request/Response Servers

Five bankapp servers operate in request/response mode. Four of the five use embedded SQL statements to access a resource manager; the names of the source files for these servers (located in the bankapp sample application subdirectory), include a `.ec` filename extension.

The fifth server, `XFER`, for transfer, makes no calls to the resource manager itself; it calls the `WITHDRAWAL` and `DEPOSIT` services (offered by the `TLR` server) to transfer funds between accounts. The source file for `XFER` is a `.c` file, because `XFER` makes no resource manager calls and contains no embedded SQL statements.

This Server	Provides this Functionality
<code>BTADD.ec</code>	Allows branch and teller records to be added to the appropriate database from any site.

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This Server	Provides this Functionality
ACCT.ec	Provides customer representative services, namely the opening and closing of accounts (OPEN_ACCT and CLOSE_ACCT).
TLR.ec	Provides teller services, namely WITHDRAWAL, DEPOSIT, and INQUIRY. Each TLR process identifies itself as an actual teller in the TELLER file, via the user-defined -T option on the server's command line.
XFER.c	Provides fund transfers for accounts anywhere in the database.
BAL.ec	Calculates the account for all branches of the database or for a specified branch.

bankapp Conversational Server

AUDITC is an example of a conversational server. It offers one service, which is also called AUDITC. The conversational client, `auditcon`, establishes a connection to AUDITC and sends it requests for auditing information.

AUDITC evaluates requests and calls an appropriate service (ABAL, TBAL, ABAL_BID, or TBAL_BID) to get the appropriate information. When a reply is received from the service called, AUDITC sends it back to `auditcon`. A service in a conversational server can make calls to request/response services. It can also initiate connections to other conversational servers, but this functionality is not provided by AUDITC.

bankapp Services

bankapp offers 12 request/response services. The name of each bankapp service matches the name of a C function in the source code of a server.

This Service	Offered by this Server	With This Input	Performs this Function
BR_ADD	BTADD	FML buffer	■ Adds a new branch record

This Service	Offered by this Server	With This Input	Performs this Function
TLR_ADD	BTADD	FML buffer	<ul style="list-style-type: none"> ■ Adds a new teller record
OPEN_ACCT	ACCT	FML buffer	<ul style="list-style-type: none"> ■ Inserts a record into the ACCOUNT file and calls DEPOSIT to add the initial balance ■ Chooses an ACCOUNT_ID for a new account based on the BRANCH_ID of the teller involved
CLOSE_ACCT	ACCT	FML buffer	<ul style="list-style-type: none"> ■ Deletes an ACCOUNT record ■ Validates ACCOUNT_ID ■ Calls WITHDRAWAL to remove the final balance
WITHDRAWAL	TLR	FML buffer	<ul style="list-style-type: none"> ■ Subtracts an amount from the specified branch, teller, and account balance ■ Validates the ACCOUNT_ID and SAMOUNT fields ■ Checks that funds are available from account and tell
DEPOSIT	TLR	FML buffer	<ul style="list-style-type: none"> ■ Adds an amount to specified branch, teller, and account balances ■ Validates the ACCOUNT_ID and SAMOUNT fields
INQUIRY	TLR	FML buffer	<ul style="list-style-type: none"> ■ Retrieves an account balance ■ Validates ACCOUNT_ID
TRANSFER	XFER	FML buffer	<ul style="list-style-type: none"> ■ Issues a tpcall() requesting WITHDRAWAL followed by one requesting DEPOSIT

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This Service	Offered by this Server	With This Input	Performs this Function
ABAL	BAL	VIEW buffer of aud.v	■ Calculates account balances for all branches on a given site
TBAL	BAL	VIEW buffer of aud.v as input	■ Calculates the teller balances for all branches on a given site
ABAL_BID	BAL	VIEW buffer of aud.v as input	■ Calculates the account balances for a specific BRANCH_ID
TBAL_BID	BAL	VIEW buffer of aud.v as input	■ Calculates the teller balances for a specific BRANCH_ID

Algorithms of bankapp Services

The following listings show pseudo-code for the algorithms used for the bankapp services: BR_ADD, TLR_ADD, OPEN_ACCT, CLOSE_ACCT, WITHDRAWAL, DEPOSIT, INQUIRY, TRANSFER, ABAL, TBAL, ABAL_BID, and TBAL_BID. You can use them as road maps through the source code of the bankapp servers.

Listing 3-4 BR_ADD Pseudo-code

```
void BR_ADD (TPSVCINFO *transb)
{
    -set pointer to TPSVCINFO data buffer;
    -get all values for service request from field buffer;
    -insert record into BRANCH;
    -tprturn() with success;
}
```

Listing 3-5 TLR_ADD Pseudo-code

```
void TLR_ADD (TPSVCINFO *transb)
{
    -set pointer to TPSVCINFO data buffer;
    -get all values for service request from fielded buffer;
    -get TELLER_ID by reading branch's LAST_ACCT;
    -insert teller record;
    -update BRANCH with new LAST_TELLER;
    -tpreturn() with success;
}
```

Listing 3-6 OPEN_ACCT Pseudo-code

```
void OPEN_ACCT(TPSVCINFO *transb)
{
    -Extract all values for service request from fielded buffer using Fget()
    and Fvall();
    -Check that initial deposit is positive amount and tpreturn() with
    failure if not;
    -Check that branch ID is a legal value and tpreturn() with failure if it
    is not;
    -Set transaction consistency level to read/write;
    -Retrieve BRANCH record to choose new account based on branch's LAST_ACCT
    field;
    -Insert new account record into ACCOUNT file;
    -Update BRANCH record with new value for LAST_ACCT;
    -Create deposit request buffer with tmalloc(); initialize it for FML with
    Finit();
    -Fill deposit buffer with values for DEPOSIT service request;
    -Increase priority of coming DEPOSIT request since call is from a service;
    -Do tpcall() to DEPOSIT service to add amount of initial balance;
    -Prepare return buffer with necessary information;
    -Free deposit request buffer with tpfree();
    tpreturn() with success;
}
```

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Listing 3-7 CLOSE_ACCT Pseudo-code

```
void CLOSE_ACCT(TPSVCINFO *transb)
{
    -Extract account ID from fielded buffer using Fvall();
    -Check that account ID is a legal value and tpreturn() with failure if it
      is not;
    -Set transaction consistency level to read/write;
    -Retrieve ACCOUNT record to determine amount of final withdrawal;
    -Create withdrawal request buffer with tmalloc(); initialize it for FML
      with Finit();
    -Fill withdrawal buffer with values for WITHDRAWAL service request;
    -Increase priority of coming WITHDRAWAL request since call is from
      a service;
    -Do tpcall() to WITHDRAWAL service to withdraw balance of account;
    -Delete ACCOUNT record;
    -Prepare return buffer with necessary information;
    -Free withdrawal request buffer with tpfree();
    tpreturn with success;
}
```

Listing 3-8 WITHDRAWAL Pseudo-code

```
void WITHDRAWAL(TPSVCINFO *transb)
{
    -Extract account id and amount from fielded buffer using Fvall() and Fget();
    -Check that account id is a legal value and tpreturn() with failure if not;
    -Check that withdraw amount (amt) is positive and tpreturn() with failure
      if not;
    -Set transaction consistency level to read/write;
    -Retrieve ACCOUNT record to get account balance;
    -Check that amount of withdrawal does not exceed ACCOUNT balance;
    -Retrieve TELLER record to get teller's balance and branch id;
    -Check that amount of withdrawal does not exceed TELLER balance;
    -Retrieve BRANCH record to get branch balance;
    -Check that amount of withdrawal does not exceed BRANCH balance;
    -Subtract amt to obtain new account balance;
    -Update ACCOUNT record with new account balance;
    -Subtract amt to obtain new teller balance;
    -Update TELLER record with new teller balance;
    -Subtract amt to obtain new branch balance;
    -Update BRANCH record with new branch balance;
    -Insert new HISTORY record with transaction information;
    -Prepare return buffer with necessary information;
    tpreturn with success;
}
```

Listing 3-9 DEPOSIT Pseudo-code

```
void DEPOSIT(TPSVCINFO *transb)
{
  -Extract account id and amount from fielded buffer using Fvall() and Fget();
  -Check that account ID is a legal value and tpreturn() with failure if not;
  -Check that deposit amount (amt) is positive and tpreturn() with failure if
    not;
  -Set transaction consistency level to read/write;
  -Retrieve ACCOUNT record to get account balance;
  -Retrieve TELLER record to get teller's balance and branch ID;
  -Retrieve BRANCH record to get branch balance;
  -Add amt to obtain new account balance;
  -Update ACCOUNT record with new account balance;
  -Add amt to obtain new teller balance;
  -Update TELLER record with new teller balance;
  -Add amt to obtain new branch balance;
  -Update BRANCH record with new branch balance;
  -Insert new HISTORY record with transaction information;
  -Prepare return buffer with necessary information;
  tpreturn() with success;
}
```

Listing 3-10 INQUIRY Pseudo-code

```
void INQUIRY(TPSVCINFO *transb)
{
  -Extract account ID from fielded buffer using Fvall();
  -Check that account ID is a legal value and tpreturn() with failure if not;
  -Set transaction consistency level to read only;
  -Retrieve ACCOUNT record to get account balance;
  -Prepare return buffer with necessary information;
  tpreturn() with success;
}
```

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Listing 3-11 TRANSFER Pseudo-code

```
void TRANSFER(TPSVCINFO *transb)
{
    -Extract account ID's and amount from fielded buffer using Fvall()
      and Fget();
    -Check that both account IDs are legal values and tpreturn() with
      failure if not;
    -Check that transfer amount is positive and tpreturn() with failure if
      it is not;
    -Create withdrawal request buffer with tmalloc(); initialize it for
      FML with
      Finit();
    -Fill withdrawal request buffer with values for WITHDRAWAL service request;
    -Increase priority of coming WITHDRAWAL request since call is from
      a service;
    -Do tpcall() to WITHDRAWAL service;
    -Get information from returned request buffer;
    -Reinitialize withdrawal request buffer for use as deposit request buffer
      with Finit();
    -Fill deposit request buffer with values for DEPOSIT service request;
    -Increase priority of coming DEPOSIT request;
    -Do tpcall() to DEPOSIT service;
    -Prepare return buffer with necessary information;
    -Free withdrawal/deposit request buffer with tpfree();
    tpreturn() with success;
}
```

Listing 3-12 ABAL Pseudo-code

```
void ABAL(TPSVCINFO *transb)
{
    -Set transaction consistency level to read only;
    -Retrieve sum of all ACCOUNT file BALANCE values for the
      database of this server group (A single ESQL
      statement is sufficient);
    -Place sum into return buffer data structure;
    tpreturn( ) with success;
}
```

Listing 3-13 TBAL Pseudo-code

```
void TBAL(TPSVCINFO *transb)
{
    -Set transaction consistency level to read only;
    -Retrieve sum of all TELLER file BALANCE values for the
      database of this server group (A single ESQL
      statement is sufficient);
    -Place sum into return buffer data structure;
    tpreturn( ) with success;
}
```

Listing 3-14 ABAL_BID Pseudo-code

```
void ABAL_BID(TPSVCINFO *transb)
{
    -Set transaction consistency level to read only;
    -Set branch_ID based on transb buffer;
    -Retrieve sum of all ACCOUNT file BALANCE values for records
      having BRANCH_ID = branch_ID (A single ESQL
      statement is sufficient);
    -Place sum into return buffer data structure;
    tpreturn( ) with success;
}
```

Listing 3-15 TBAL_BID Pseudo-code

```
void TBAL_BID(TPSVCINFO *transb)
{
    -Set transaction consistency level to read only;
    -Set branch_ID based on transb buffer;
    -Retrieve sum of all TELLER file BALANCE values for records
      having BRANCH_ID = branch_ID (A single ESQL
      statement is sufficient);
    -Place sum into return buffer data structure;
    tpreturn( ) with success;
}
```

Utilities Incorporated into Servers

Two C subroutines are included among the source files for bankapp: `appinit.c` and `util.c`:

- `appinit.c` contains application-specific versions of the `tpsvrinit()` and `tpsvrdone()` subroutines. `tpsvrinit()` and `tpsvrdone()` are subroutines included in the standard BEA Tuxedo system `main()`. The default version of `tpsvrinit()` calls two functions: `tpopen()`, to open the resource manager, and `userlog()`, to post a message that the server has started. The default version of `tpsvrdone()` also calls two functions: `tpclose()`, to close the resource manager, and `userlog()`, to post a message that the server is about to shut down. Any application subroutines named `tpsvrinit()` and `tpsvrdone()` can be used in place of the default subroutines, thus enabling an application to provide initialization and pre-shutdown procedures of its own.
- `util.c` contains a subroutine called `getstr()`, which is used in bankapp to process SQL error messages.

Alternative Way to Code Services

In the `bankapp` source files all the services were incorporated into files that are referred to as the source code for servers. These files have the same names as the `bankapp` servers, but are not really servers because they do not contain a `main()` section. A standard `main()` is provided by the BEA Tuxedo system at `buildserver` time.

An alternative organization for a BEA Tuxedo system application is to keep each service subroutine in a separate file. Suppose, for example, that you want to use this alternative structure for the `TLR` server. The `TLR.ec` file contains three services that you maintain in three separate `.ec` files: `INQUIRY.ec`, `WITHDRAW.ec`, and `DEPOSIT.ec`. Follow these steps.

1. Compile each `.ec` file into a `.o` file.
2. Run the `buildserver` command specifying each `.o` file with a separate invocation of the `-f` option.

```
buildserver -r TUXEDO/SQL \  
            -s DEPOSIT -s WITHDRAWAL -s INQUIRY \  
            -s WITHDRAWAL -s INQUIRY \  
            -s DEPOSIT
```

```
-o TLR \  
-f DEPOSIT.o -f WITHDRAW.o -f INQUIRY.o \  
-f util.o -f -lm
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line

As this example illustrates, you do not need to code all the service functions in a single source file. In other words, a server does not need to exist as a source program file at all. It can be derived from various source files and exist as a server executable through the files specified on the `buildserver` command line. This can give you greater flexibility in building servers.

See Also

- “Familiarizing Yourself with bankapp” on page 3-2
- “What You Can Do Using the ATMI” on page 2-4 in *Introducing the BEA Tuxedo System*
- `buildserver(1)` in *BEA Tuxedo Command Reference*
- *BEA Tuxedo Command Reference*

Preparing bankapp Files and Resources

This documentation leads you through the procedures you must complete to create the files and other resources you need to run bankapp.

Click on each task for instructions on completing that task.



Step 1: How to Set the Environment Variables

The environment variables are defined in the `bankvar` file. The file is large (approximately 185 lines) because it includes extensive comments.

1. In a text editor, familiarize yourself with the `bankvar` file.
 - The first key line checks whether `TUXDIR` is set. If it is not set, execution of the file fails with the following message.

```
TUXDIR: parameter null or not set
```
2. Set `TUXDIR` to the root directory of your BEA Tuxedo system directory structure, and export it.
3. Another line in `bankvar` sets `APPDIR` to the directory `${TUXDIR}/samples/atmi/bankapp`, which is the directory where `bankapp` source files are located. `APPDIR` is a directory where the BEA Tuxedo system looks for your application-specific files. You may prefer to copy the `bankapp` files to a different directory to safeguard the original source files. If you do, enter the directory there. It does not have to be under `TUXDIR`.
4. Set a value for `DIPCKEY`. This is an `IPCKEY` for a BEA Tuxedo system database. The value of `DIPCKEY` must be different from the value of the BEA Tuxedo system `IPCKEY` specified in the `UBBCONFIG` file.

Note: Other variables specified in `bankvar` play various roles in the sample application; you need to be aware of them when you are developing your own application. By including them all in `bankvar`, we provide you with a “template” that you may want to adapt at a later time for use with a real application.

5. When you have made all the required changes to `bankvar`, execute `bankvar` as follows:

```
. ./bankvar
```

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Listing 3-16 bankvar: Environment Variables for bankapp

```
# Copyright (c) 1997, 1996 BEA Systems, Inc.
# Copyright (c) 1995, 1994 Novell, Inc.
# Copyright (c) 1993, 1992, 1991, 1990 Unix System Laboratories, Inc.
# All rights reserved
#
# This file sets all the environment variables needed by the TUXEDO software
# to run the bankapp
#
# This directory contains all the TUXEDO software
# System administrator must set this variable
#
if [ -z "${TUXDIR}" ] ; then
  if [ ! -z "${ROOTDIR}" ] ; then
    TUXDIR=$ROOTDIR
    export TUXDIR
  fi
fi
TUXDIR=${TUXDIR:?}
#
# Reset LANG if necessary
#
if [ ! -d ${TUXDIR}/locale/C -a -d ${TUXDIR}/locale/english_us ] ; then
  export LANG
  LANG=english_us.ascii
fi
#
# This directory contains all the user written code
#
# Contains the full path name of the directory that the application
# generator should place the files it creates
#
APPDIR=${TUXDIR}/apps/bankapp
#
# This path contains the shared objects that are dynamically linked at
# runtime in certain environments, e.g., SVR4.
#
LD_LIBRARY_PATH=${TUXDIR}/lib:${LD_LIBRARY_PATH}
#
# Set the path to shared objects in HP-UX
#
SHLIB_PATH=${TUXDIR}/lib:${SHLIB_PATH}
#
# Set the path to shared objects in AIX
#
LIBPATH=${TUXDIR}/lib:/usr/lib:${LIBPATH}
#
```

Step 1: How to Set the Environment Variables

```
# Logical block size; Database Administrator must set this variable
#
BLKSIZE=512
#
# Set default name of the database to be used by database utilities
# and database creation scripts
#
DBNAME=bankdb
#
# Indicate whether database is to be opened in share or private mode
#
DBPRIVATE=no
#
# Set Ipc Key for the database; this MUST differ from the UBBCONFIG
# *RESOURCES IPCKEY parameter
#
DIPCKEY=80953
#
# Environment file to be used by tmloadcf
#
ENVFILE=${APPDIR}/ENVFILE
#
# List of field table files to be used by mc, viewc, tmloadcf, etc.
#
FIELDTBLS=Usysflds,bankflds,creditflds,eventflds
#
FIELDTBLS32=Usysfl32,evt_mib,tpadm
#
# List of directories to search to find field table files
#
FLDTBLDIR=${TUXDIR}/udataobj:${APPDIR}
#
FLDTBLDIR32=${TUXDIR}/udataobj:${APPDIR}
#
# Universal Device List for database
#
FSCONFIG=${APPDIR}/bankdll
#
# Network address, used in MENU script
#
NADDR=
#
# Network device name
#
NDEVICE=
#
# Network listener address, used in MENU script
#
NLSADDR=
```

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```
#
# Make sure TERM is set
#
TERM=${TERM:?}
#
# Set device for the transaction log; this should match the TLOGDEVICE
# parameter under this site's LMID in the *MACHINES section of the
# UBBCONFIG file
#
TLOGDEVICE=${APPDIR}/TLOG
#
# Device for binary file that gives the BEA Tuxedo system all its information
#
TUXCONFIG=${APPDIR}/tuxconfig
#
# Set the prefix of the file which is to contain the central user log;
# this should match the ULOGPFX parameter under this site's LMID in the
# *MACHINES section of the UBBCONFIG file
#
ULOGPFX=${APPDIR}/ULOG
#
# System name, used by RUNME.sh
#
UNAME=
#
# List of view files to be used by viewwc, tmloadcf, etc.
#
VIEWFILES=aud.V
#
VIEWFILES32=mib_views,tmib_views
#
# List of directories to search to find view files
#
VIEWDIR=${TUXDIR}/udataobj:${APPDIR}
#
VIEWDIR32=${TUXDIR}/udataobj:${APPDIR}
#
# Specify the Q device (if events included in demo)
#
QMCONFIG=${APPDIR}/qdevice
#
# Export all variables just set
#
export TUXDIR APPDIR BLKSIZE DBNAME DBPRIVATE DIPCKEY ENVFILE
export LD_LIBRARY_PATH SHLIB_PATH LIBPATH
export FIELDTBLS FLDTBLDIR FSCONFIG MASKPATH OKXACTS TERM
export FIELDTBLS32 FLDTBLDIR32
export TLOGDEVICE TUXCONFIG ULOGPFX
export VIEWDIR VIEWFILES
```

```
export VIEWDIR32 VIEWFILES32
export QMCONFIG
#
# Add TUXDIR/bin to PATH if not already there
#
a=`echo $PATH | grep ${TUXDIR}/bin`
if [ x"$a" = x ]
then
    PATH=${TUXDIR}/bin:${PATH}
    export PATH
fi
#
# Add APPDIR to PATH if not already there
#
a=`echo $PATH | grep ${APPDIR}`
if [ x"$a" = x ]
then
    PATH=${PATH}:${APPDIR}
    export PATH
fi

#
# Check for other machine types bin directories
#
for DIR in /usr/5bin /usr/ccs/bin /opt/SUNWspro/bin
do
    if [ -d ${DIR} ] ; then
        PATH="${DIR}:${PATH}"
    fi
done
```

Note: If your operating system is Sun Solaris, you must do two things: use `/bin/sh` rather than `csh` for your shell place; and specify `/usr/5bin` at the beginning of your `PATH`, as follows.

```
PATH=/usr/5bin:$PATH;export PATH
```

See Also

- “Preparing bankapp Files and Resources” on page 3-26

Step 2: Building Servers in bankapp

`buildserver(1)` puts together an executable server built on the BEA Tuxedo systems `main()`. Options identify the names of the output file, the input files provided by the application, and various libraries that permit you to run a BEA Tuxedo system application in a variety of ways.

`buildserver` invokes the `cc` command. The environment variables `CC` and `CFLAGS` can be set to name an alternative compile command and to set flags for the compile and link edit phases. The `buildserver` command is used in `bankapp.mk` to compile and build each server in the banking application. The following sections describe the six bankapp servers:

- How to Build ACCT Server
- How to Build the BAL Server
- How to Build the BTADD Server
- How to Build the TLR Server
- How to Build the XFER Server
- Step 3: Editing the bankapp Makefile

How to Build ACCT Server

The ACCT server is derived from a file called `ACCT.ec` that contains the code for the `OPEN_ACCT` and `CLOSE_ACCT` functions. It is created in two steps. `ACCT.ec` is first compiled to an `ACCT.o` file, which is then specified to the `buildserver` command so that any compile-time errors can be identified and resolved.

1. Create the `ACCT.o` file (performed for you in `bankapp.mk`):
 - The `.c` file is generated as follows: `esql ACCT.ec`
 - The `.o` file is generated as follows: `cc -I $TUXDIR/include -c ACCT.c`
 - The ACCT server is created by running the following `buildserver` command line.

```
buildserver -r TUXEDO/SQL \  
-s OPEN_ACCT -s CLOSE_ACCT \  
-o ACCT \  
-f ACCT.o -f appinit.o -f util.o
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line.

Following is an explanation of the `buildserver` command-line options:

- The `-r` option is used to specify which resource manager access libraries should be link edited with the executable server. The choice is specified with the string `TUXEDO/SQL`.
- The `-s` option is used to specify the names of the services in the server that are available to be advertised when the server is booted. If the name of a function that performs a service is different from the corresponding service name, the function name becomes part of the argument to the `-s` option. In `bankapp`, the function name is always the same as the name of the corresponding service so only the service names themselves need to be specified. It is our convention to spell all service names in all uppercase. For example, the `OPEN_ACCT` service is processed by the function `OPEN_ACCT()`. However, the `-s` option to `buildserver` does allow you to specify an arbitrary name for the processing function for a service within a server. Refer to the `buildserver(1)` reference page for details. It is also possible for an administrator to specify that only a subset of the services used to create the server with the `buildserver` command is to be available when the server is booted.
- The `-o` option is used to assign a name to the executable output file. If no name is provided, the file is named `SERVER`.
- The `-f` option specifies the files that are used in the link-edit phase. (For related information, see the description of the `-l` option on the `buildserver(1)` reference page.) The order in which the files are listed depends on function references and the libraries in which those references are resolved. Source modules should be listed before libraries that might be used to resolve their references. If these are `.c` files, they are first compiled. (In the example above, `appinit.o` and `util.o` have been already compiled.) Object files can be either separate `.o` files or groups of files in archive (`.a`) files. If more than one filename is given as an argument to the `-f` option, the list must be enclosed in double quotation marks. Although the `-f` option takes only one file or one list

of files (enclosed in double quotation marks) as an argument, you can include the `-f` option as many times as necessary on a single command line.

To summarize, the options specified on the `buildserver` command line used to create the ACCT server performed the following functions:

- The `-r` option specifies the BEA Tuxedo system SQL resource manager.
- The `-s` option names the `OPEN_ACCT` and `CLOSE_ACCT` services (which are defined by functions of the same name in the `ACCT.ec` file) to be the services that make up the ACCT server.
- The `-o` option assigns the name `ACCT` to the executable output file.
- The `-f` option specifies that the `ACCT.o`, `appinit.o`, and `util.o` files are to be used in the link-edit phase of the build.

Note: The `appinit.c` file contains the system-supplied `tpsvrinit()` and `tpsvrdone()`. (Refer to `tpservice(3c)` reference pages for an explanation of how these routines are used.)

How to Build the BAL Server

The BAL server is derived from a file called `BAL.ec` that contains the code for the `ABAL`, `TBAL`, `ABAL_BID`, and `TBAL_BID` functions. As with `ACCT.ec`, the `BAL.ec` is first compiled to a `BAL.o` file before being supplied to the `buildserver` command so that any compile-time errors can be identified and resolved.

1. Modify the `buildserver` command used to create the BAL server as follows.

```
buildserver -r TUXEDO/SQL \  
            -s ABAL -s TBAL -s ABAL_BID -s TBAL_BID\  
            -o BAL \  
            -f BAL.o -f appinit.o
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line.

- Use the `-r` option to specify the BEA Tuxedo system SQL resource manager.
- Use the `-s` option to name the `ABAL`, `TBAL`, `ABAL_BID`, `TBAL_BID` services that make up the BAL server. The functions in the `BAL.ec` file that define these services have identical names.

- Use the `-o` option to assign the name `BAL` to the executable server.
- Use the `-f` option to specify that the `BAL.o` and the `appinit.o` files are to be used in the link-edit phase.

How to Build the BTADD Server

The BTADD server is derived from a file called `BTADD.ec` that contains the code for the `BR_ADD` and `TLR_ADD` functions. The `BTADD.ec` is compiled to a `BTADD.o` file before being supplied to the `buildserver` command.

1. Modify the `buildserver` command used to create the BTADD server as follows:

```
buildserver -r TUXEDO/SQL \  
            -s BR_ADD -s TLR_ADD \  
            -o BTADD \  
            -f BTADD.o -f appinit.o
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line.

- Use the `-r` option to specify the BEA Tuxedo system SQL resource manager.
- Use the `-s` option to name the `BR_ADD` and `TLR_ADD` services that make up the BTADD server. The functions in the `BTADD.ec` file that define these services have identical names.
- Use the `-o` option to assign the name `BTADD` to the executable server.
- Use the `-f` option to specify that the `BTADD.o` and `appinit.o` files are to be used in the link-edit phase.

How to Build the TLR Server

The TLR server is derived from a file called `TLR.ec` that contains the code for the `DEPOSIT`, `WITHDRAWAL`, and `INQUIRY` functions. The `TLR.ec` is also compiled to a `TLR.o` file before being supplied to the `buildserver` command.

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1. Modify the `buildserver` command used to create the TLR server as follows:

```
buildserver -r TUXEDO/SQL \  
            -s DEPOSIT -s WITHDRAWAL -s INQUIRY \  
            -o TLR \  
            -f TLR.o -f util.o -f -lm
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line.

- Use the `-r` option to specify the BEA Tuxedo system SQL resource manager.
- Use the `-s` option to name the `DEPOSIT`, `WITHDRAWAL`, and `INQUIRY` services that make up the TLR server. The functions in the `TLR.ec` file that define these services have identical names.
- Use the `-o` option to assign the name `TLR` to the executable server.
- Use the `-f` option to specify that the `TLR.o` and the `util.o` files are to be used in the link-edit phase.

Note: In this example, the `-f` option is used to pass an option (`-lm`) to the `cc` command, which is invoked by `buildserver`. The `-lm` argument to `-f` causes the math libraries to be linked in at compile time.

(Refer to `cc(1)` in the *UNIX System V User's Reference Manual* for a complete list of compile-time options.)

How to Build the XFER Server

The XFER server is derived from a file called `XFER.c` that contains the code for the `TRANSFER` function. The `XFER.c` is also compiled to an `XFER.o` file before being supplied to the `buildserver` command.

1. Modify the `buildserver` command used to create the XFER server as follows:

```
buildserver -r TUXEDO/SQL \  
            -s TRANSFER \  
            -o XFER \  
            -f XFER.o -f appinit.o
```

Note: The backslash in the preceding command-line entry is a documentation convention that indicates a line break for presentation purposes only. You should enter the command and options on one line.

- Use the `-r` option to specify the BEA Tuxedo system SQL resource manager.
- Use the `-s` option to name the `TRANSFER` service that makes up the `XFER` server. The function in the `XFER.c` file that defines the `TRANSFER` service has the identical name.
- Use the `-o` option to assign the name `XFER` to the executable server.
- Use the `-f` option to specify that the `XFER.o` and the `appinit.o` files are to be used in the link-edit phase.

Servers Built in the bankapp.mk File

The topics on creating the `bankapp` servers are important to your understanding of how the `buildserver` command is specified. However, in actual practice you are apt to incorporate the build into a makefile; that is the way it is done in `bankapp`.

Step 3: Editing the bankapp Makefile

`bankapp` includes a makefile that makes all scripts executable, converts the view description file to binary format, and does all the precompiles, compiles, and builds necessary to create application servers. It can also be used to clean up when you want to make a fresh start.

As `bankapp.mk` is delivered, there are a few fields you may want to edit, and some others that may benefit from some explanation.

How to Edit the TUXDIR Parameter

1. Review `bankapp.mk`, about 40 lines into the file, where you come to the following comment and the `TUXDIR` parameter:

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```
#
# Root directory of TUXEDO System. This file must either be edited to set
# this value correctly, or the correct value must be passed via "make -f
# bankapp.mk TUXDIR=/correct/tuxdir", or the build of bankapp will fail.
#
TUXDIR=../..
```

2. Set the TUXDIR parameter to the absolute path name of the root directory of your BEA Tuxedo system installation.

How to Edit the APPDIR Parameter

1. Review the setting of the APPDIR parameter. As bankapp is delivered, APPDIR is set to the directory in which the bankapp files are located, relative to TUXDIR. The following section of bankapp.mk defines and describes the setting of APPDIR.

```
#
# Directory where the bankapp application source and executables reside.
# This file must either be edited to set this value correctly, or the
# correct value must be passed via "make -f bankapp.mk
# APPDIR=/correct/appdir", or the build of bankapp will fail.
#
APPDIR=$(TUXDIR)/samples/atmi/bankapp
#
```

2. If you copied the files to another directory, as suggested in the README file, you should set APPDIR to the name of the directory to which you copied the files. When you run the makefile, the application is built in this directory.

How to Set the Resource Manager Parameters

By default, bankapp is set up to use the BEA Tuxedo/SQL as the database resource manager. This arrangement is based on the assumption that you have the BEA Tuxedo system database on your system. If this is not the case, you should set the RM parameter to the name of your resource manager as listed in TUXDIR/udataobj/RM.

```
#
# Resource Manager
#
RM=TUXEDO/SQL
#
```

Note: The BEA Tuxedo SQL resource manager is included for demonstration purposes only.

How to Run the bankapp.mk File

1. When you have completed the changes you wish to make to `bankapp.mk`, run it with the following command line:

```
nohup make -f bankapp.mk &
```

2. Check the `nohup.out` file to make sure the process completed successfully.

Note: `bankvar` sets a number of parameters that are referenced when `bankapp.mk` is run.

See Also

- “Preparing bankapp Files and Resources” on page 3-26

Step 4: Creating the bankapp Database

This documentation describes the interface between `bankapp` and a resource manager, typically a database management system and how to create the database for `bankapp`. `bankapp` is designed to use the BEA Tuxedo/SQL facilities of the BEA Tuxedo system database, which is an XA-compliant resource manager.

Note: The BEA Tuxedo SQL resource manager is included for demonstration purposes only.

How you create the `bankapp` database depends on whether you bring up the application on a single processor (SHM mode) or on a network of more than one processor (MP mode).

How to Create the Database in SHM Mode

1. Set the environment by typing the following:

```
. ./bankvar
```

2. Execute `crbank`. `crbank` calls `crbankdb` three times, changing some environment variables each time, so that you end up with three database files on a single machine. As a result, you can simulate the multi-machine environment of the BEA Tuxedo system without a network of machines.

How to Create the Database in MP Mode

1. Set the environment by typing the following:

```
. ./bankvar
```

Note: You may have already set your environment variables. For detailed instructions, see “How to Set Environment Variables.”

2. Run `crbankdb` to create the database for this site.
3. On each additional machine in your BEA Tuxedo system network, edit `bankvar` to provide the path name for the `FSCONFIG` variable that is used for that site in the configuration file, `ubbmp`. Then repeat Steps 1 and 2.

See Also

- “Preparing bankapp Files and Resources” on page 3-26

Step 5: Preparing for an XA-Compliant Resource Manager

To run `bankapp` with an alternative XA-compliant resource manager, you must modify various files. This section describes the following:

- How to Change the `bankvar` File
- How to Change the `bankapp` Services
- How to Change the `bankapp.mk` File
- How to Change `crbank` and `crbankdb`
- How to Change the Configuration File

How to Change the `bankvar` File

1. Review the following environment variables that are assigned the values shown here, by default, to create the BEA Tuxedo system database.

```
BLKSIZE=512
DBNAME=bankdb
DEPRIVATE=no
DIPCKEY=80953
FSCONFIG=${APPDIR}/bankd11
```

Note: These environment variables pertain to the BEA Tuxedo system only; you may need to set different environment variables or other mechanisms depending on your specific database management system requirements.

2. Change the value of these variables as needed to create the database for your resource manager.

How to Change the bankapp Services

Because all database access in `bankapp` is performed with embedded SQL statements, if your new resource manager supports SQL, you should have no problem. The utility `appinit.c` includes calls to `tpopen()` and `tpclose()`.

How to Change the bankapp.mk File

1. Edit the RM parameter in `bankapp.mk` to name the new resource manager.
2. Ensure that the following entry is in the RM file.

```
$TUXDIR/udataobj/RM
```

3. If necessary, change the name of the SQL compiler and its options. The name of the source file may or may not include `.ec`. You may have to specify a non-default for compiling the resulting `.c` file.

How to Change crbank and crbankdb

1. `crbank` may be ignored by your alternate resource manager. Its only functions are to reset variables and to run `crbankdb` three times.
2. `crbankdb`, on the other hand, requires close attention. The following code listing is the beginning of the `crbankdb` script. It is followed by an explanation of parts of the code that do not work with a resource manager that is not supplied with the BEA Tuxedo system.

Listing 3-17 Excerpt from the crbankdb Script

```
#Copyright (c) BEA Systems, Inc.  
#All rights reserved  
#  
# Create device list  
#  
dbadmin<<!  
echo
```


Step 5: Preparing for an XA-Compliant Resource Manager

```
crdl
# Replace the following line with your device zero entry
${FSCONFIG}          0          2560
!
#
# Create database files, fields, and secondary indices
#
sql<<!
echo
create database ${DBNAME} with (DEVNAME='${FSCONFIG}',
    IPCKEY=${DIPCKEY}, LOGBLOCKING=0, MAXDEV=1,
    NBLKTBL=200,        NBLOCKS=2048,  NBUF=70,        NFIELDS=80,
    NFILES=20,         NFLDNAMES=60,  NFREPART=40,   NLCKTBL=200,
    NLINKS=80,         NPREDS=10,     NPROCTBL=20,   NSKEYS=20,
    NSWAP=50,          NTABLES=20,    NTRANTBL=20,   PERM='0666',
    STATISTICS='n'
)

create table BRANCH (
    BRANCH_ID          integer not null,
    BALANCE             real,
    LAST_ACCT          integer,
    LAST_TELLER        integer,
    PHONE              char(14),
    ADDRESS             char(60),
    primary key(BRANCH_ID)
) with (
    FILETYPE='hash',   ICF='PI',        FIELDED='FML',
    BLOCKLEN=${BLKSIZE}, DBLKS=8,          OVBLKS=2
)
!
```

The first 40 lines give you an idea of what needs to be changed and what may be kept unchanged. As you can see, `crbankdb` is made up of two documents that provide input to the `dbadmin` and `sql` shell commands. The first `here` file is passed to the BEA Tuxedo system command `dbadmin` to create a device list for the database.

This command does not work with non-BEA Tuxedo resource managers. Other commands may be needed to create table spaces and/or grant the correct privileges.

How to Change the Configuration File

In the GROUPS section, specify appropriate values (that is, values that are recognized by your resource manager) for the TMSNAME and OPENINFO parameters.

How to Integrate bankapp with Oracle 8 (XA RM) for a Windows NT Platform

1. Edit the `nt\bankvar.cmd` and supply suitable values for the following environment variables.

```
TUXDIR : Root directory for the BEA TUXEDO system installation
APPDIR : Application directory in which bankapp files are
located
ORACLE_HOME : Root directory of the Oracle8 installation
ORACLE_SID : Oracle System ID
BLK_SIZE: Logical block size
DBNAME: default name of the database to be used by database
utilities and database creation scripts
DBPRIVATE: indicates whether database is to be opened in share
or private mode (yes or no)
FSCONFIG:Universal Device List for database
PATH=%TUXDIR%\bin;%TUXDIR%\include;%TUXDIR%\lib;%ORACLE_HOME
%\bin;%PATH%
INCLUDE=%ORACLE_HOME%\rdbms80\xa;
%ORACLE_HOME%\pro80\c\include;%include%
NLSPATH=%TUXDIR%\locale\C
PLATFORM=inwnt40
LIB=%TUXDIR%\lib; %ORACLE_HOME%\pro80\lib\msvc;
%ORACLE_HOME%\rdbms80\xa; %lib%;
```

2. Run the script to set up the environment.

```
>bankvar
```

3. Edit the TUXDIR\udataobj\RM file as follows.

- Append the following line to the \$TUXDIR\udataobj\RM file:

```
Oracle_XA;xaosw;%ORACLE_HOME%\pro80\lib\msvc\sqllib80.lib  
%ORACLE_HOME%\RDBMS80\XA\xa80.lib
```

or if Oracle exists over the network:

- Map the machine to a drive, for example, F
- Append the following line to the \$TUXDIR\udataobj\RM file.

```
Oracle_XA;xaosw;f:\orant\pro80\lib\msvc\sqllib80.lib  
f:\orant\RDBMS80\XA\xa80.lib
```

- Remove any previous entry of Oracle_XA in the RM file

4. Build the Transaction Manager Server for Oracle8.

```
cd $APPDIR  
buildtms -r Oracle_XA -o TMS_ORA
```

5. Edit the nt\bankapp.mak file as indicated in the following table.

Task	Value
Specify values for the following environment variables.	TUXDIR=Root directory for the BEA Tuxedo system installation
	APPDIR=Application directory in which bankapp files are located
	RM=Oracle_XA
	ORACLE_LIBS=\$(ORACLE_HOME)\PRO80\LIB
	RMNAME=Oracle_XA
	SQLPUBLIC=\$(ORACLE_HOME)\PRO80\C\INCLUDE
	CFLAGS=\$(HOST) -DNOWHAT=1 \$(CGFLAGS) \$(DFML32)
	CGFLAGS=-DWIN32 -W3 -MD -nologo
	ORACLE_DIR=\$(ORACLE_HOME)\bin

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Task	Value
	INCDIR=\$(TUXDIR)\include
	CC=c1
In the .ec.c section, <i>Edit rules for creating C programs from embedded SQL programs</i> , (use the proc compiler), set the following values.	set TUXDIR=\$(TUXDIR) & \$(ORACLE_DIR)\proc80 mode=ansi release_cursor=yes include=\$(SQLPUBLIC) include=\$(INCDIR) \$(SQL_PLATFORM_INC) -c iname=\$*.ec
In the .c.obj section, <i>Edit rule for creating object files from C programs</i> , set the following values.	\$(CC) -c \$(CFLAGS) \$(SQLPUBLIC) \$(INCLUDE) \$*.c

6. Update the *.ec files. Use Oracle SQL commands.

7. Run the make file.

```
copy nt\bankapp.mak to %APPDIR%  
nmake -f bankapp.mak
```

8. Edit nt\ubbshm as follows:

```
USER_ID=0  
GROUP_ID=0  
UNAME_SITE1=nodename returned by hostname  
TUXDIR=same as specified in bankvar  
APPDIR=same as specified in bankvar
```

9. In the GROUPS section of the configuration file, enter the following changes.

```
TMSNAME=TMS_ORA  
BANKB1 GRPNO=1  
OPENINFO="Oracle_XA:Oracle_XA+Acc=P/user1/PaSsWd1+SesTm=0+LogDir=."  
[  
Oracle_XA +  
  required fields:  
  Acc=P/oracle_user_id/oracle_password +  
  SesTm=Session_time_limit (maximum time a transaction can be  
  inactive) +  
  optional fields:  
  LogDir=logdir (where XA library trace file is located) +  
  MaxCur=maximum_#_of_open cursors +  
  SqlNet=connect_string (if Oracle exists over the network)  
  (eg. SqlNet=hqfin@NEWDB indicates the database with sid=NEWDB
```

```
accessed at host hqfin by TCP/IP)
]
BANKB2 GRPNO=2

OPENINFO="Oracle_XA:Oracle_XA+Acc=P/user2/PaSSWd2+SeS tm=0+LogDi
r=."
BANKB3 GRPNO=3
OPENINFO="Oracle_XA:Oracle_XA+Acc=P/user3/PaSSWd3+SeS tm=0+LogDi
r=."
```

10. Create the BEA Tuxedo configuration binary file.

```
tmloadcf -y nt/ubbsm
```

11. Create the device list and the TLOG device on the master machine.

```
crtlog -m
```

12. Start up the Oracle database instance if not already started.

13. Boot the BEA Tuxedo system servers.

```
tmbboot -y
```

14. Ensure that the view `v$XATRANS$` exists on the database. (The view `v$XATRANS$` should have been created during the XA library installation.)

15. If the `v$XATRANS$` view has not been created, create it as follows:

- Ensure that the environment variables `ORACLE_HOME` and `ORACLE_SID` are set.
- Log in to the database as user `SYS`.

```
Execute the sql script
${ORACLE_HOME}/RDBMS80/ADMIN/XAVIEW.sql
```

- Grant select privileges to this view for all Oracle account applications that will use the XA library.

16. Create the `bankapp` database and database objects for Oracle RM:

- Log in to any of the Oracle utilities `SQL*plus` or `SQL*DBA` as any Oracle user.
- `notepad crbank-ora8.sql`
- When Oracle 8 is installed, a sample database is created. You can use this database for the `bankapp` application. The `sql` script provided, creates a new tablespace in the database to hold all the database objects of `bankapp`. The

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script prompts for the Oracle system user password as well as a full path name of a file to use as the new tablespace.

- Edit `crbank-ora8.sql` as follows:

```
WHENEVER OSERROR EXIT ;
/*Obtain the password for user "system" */
PROMPT
PROMPT
PROMPT -- Some of the operations require "system" user privileges
PROMPT -- Please specify the Oracle "system" user password
PROMPT
ACCEPT syspw CHAR PROMPT 'system passwd:' HIDE ;
CONNECT system/&syspw ;
SHOW user ;
PROMPT
/* Create a new tablespace in the default DB for use with "bankapp" */
DROP TABLESPACE bank1
    INCLUDING CONTENTS
CASCADE CONSTRAINTS;
PROMPT
PROMPT
PROMPT -- Will create a 3MB tablespace for bankapp ;
PROMPT ----- Please specify full pathname below for Datafile ;
PROMPT ----- Ex: %ORACLE_HOME%/dbs/bankapp.dbf
PROMPT
ACCEPT datafile CHAR PROMPT 'Datafile:' ;

CREATE TABLESPACE bank1
    DATAFILE '&datafile' SIZE 3M REUSE
    DEFAULT STORAGE (INITIAL 10K NEXT 50K
        MINEXTENTS 1 MAXEXTENTS 120
        PCTINCREASE 5)
    ONLINE;

/***** Create a user called "user1" *****/
DROP USER user1 CASCADE;

PROMPT Creating user "user1"

CREATE USER user1 IDENTIFIED by PaSswd1
    DEFAULT TABLESPACE bank1
    QUOTA UNLIMITED ON bank1 ;

GRANT CREATE SESSION TO user1 ;
GRANT CREATE TABLE TO user1 ;

CONNECT user1/PaSswd1 ;
SHOW user ;
```

How to Integrate bankapp with Oracle 8 (XA RM) for a Windows NT Platform

PROMPT Creating database objects for user "user1" ;

PROMPT Creating table "branch" ;

```
CREATE TABLE branch (
    branch_id      NUMBER NOT NULL PRIMARY KEY,
    balance        NUMBER,
    last_acct      NUMBER,
    last_teller    NUMBER,
    phone          CHAR(14),
    address        CHAR(60)
)
    STORAGE        (INITIAL 5K   NEXT 2K
                   MINEXTENTS 1 MAXEXTENTS 5   PCTINCREASE 5) ;
```

PROMPT Creating table "account" ;

```
CREATE TABLE account (
    account_id     NUMBER NOT NULL PRIMARY KEY,
    branch_id      NUMBER NOT NULL,
    ssn            CHAR(12) NOT NULL,
    balance        NUMBER,
    acct_type      CHAR,
    last_name      CHAR(20),
    first_name     CHAR(20),
    mid_init       CHAR,
    phone          CHAR(14),
    address        CHAR(60)
)
    STORAGE        (INITIAL 50K NEXT 25K
                   MINEXTENTS 1 MAXEXTENTS 50   PCTINCREASE 5) ;
```

PROMPT Creating table "teller" ;

```
CREATE TABLE teller (
    teller_id      NUMBER NOT NULL PRIMARY KEY,
    branch_id      NUMBER NOT NULL,
    balance        NUMBER,
    last_name      CHAR(20),
    first_name     CHAR(20),
    mid_init       CHAR
)
    STORAGE        (INITIAL 5K   NEXT 2K
                   MINEXTENTS 1 MAXEXTENTS 5   PCTINCREASE 5) ;
```

PROMPT Creating table "history" ;

```
CREATE TABLE history (
    account_id     NUMBER NOT NULL,
    teller_id      NUMBER NOT NULL,
    branch_id      NUMBER NOT NULL,
    amount         NUMBER
```

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)

```
STORAGE          (INITIAL 400K   NEXT 200K  
                  MINEXTENTS 1   MAXEXTENTS 5   PCTINCREASE 5) ;
```

17. Write the code to create *user2* and *user3* with passwords *PaSsWd2* and *PaSsWd3*, respectively, following the method described in the above steps.

```
SQL*plus> start $APPDIR/ crbank-ora8.sql
```

18. Populate the database.

```
nt\populate
```

19. Generate transactions against the database.

```
driver
```

20. Run the bankapp client.

```
run
```

21. Shut down the application.

```
tmshutdown -y
```

See Also

- “Preparing bankapp Files and Resources” on page 3-26

Step 6: How to Edit the Configuration File

A configuration file defines how an application runs. *bankapp* is delivered with two configuration files in the text format described in `UBBCONFIG(5)`: `ubbsh`, which defines an application on a single computer, and `ubbmp`, which defines a networked application.

Initialization scripts are provided in the sample applications. In addition, you can generate completed configuration files by `.sh` for any number up to 10 for your configuration and machines.

1. In a text editor, familiarize yourself with the ubbshrn and ubbmrp configuration files for bankapp.

Listing 3-18 ubbmrp Configuration File

```
#Copyright (c) 1999 BEA Systems, Inc.
#All rights reserved

*RESOURCES
IPCKEY                80952
001 UID                <user id from id(1)>
002 GID                <group id from id(1)>
    PERM                0660
    MAXACCESSERS        40
    MAXSERVERS          35
    MAXSERVICES         75
    MAXCONV             10
    MAXGTT              20
    MASTER              SITE1,SITE2
    SCANUNIT            10
    SANITYSCAN          12
    BBLQUERY            180
    BLOCKTIME          30
    DBBLWAIT            6
    OPTIONS              LAN,MIGRATE
    MODEL               MP
    LDBAL                Y
##SECURITY            ACL
#
*MACHINES
003 <SITE1's uname>    LMID=SITE1
004                   TUXDIR=" <TUXDIR> "
005                   APPDIR=" <APPDIR> "
                   ENVFILE=" <APPDIR>/ENVFILE "
                   TLOGDEVICE=" <APPDIR>/TLOG "
                   TLOGNAME=TLOG
                   TUXCONFIG=" <APPDIR>/tuxconfig"
006                   TYPE=" <machine type> "
                   ULOGPFX=" <APPDIR>/ULOG "
007 <SITE2's uname>    LMID=SITE2
                   TUXDIR=" <TUXDIR> "
                   APPDIR=" <APPDIR> "
                   ENVFILE=" <APPDIR>/ENVFILE "
                   TLOGDEVICE=" <APPDIR>/TLOG "
                   TLOGNAME=TLOG
                   TUXCONFIG=" <APPDIR>/tuxconfig"
```

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```

                                TYPE="<machine type>"
                                ULOGPFX="<APPDIR>/ULOG"
#
*GROUPS
#
# Group for Authentication Servers
#
Group for Application Queue (/Q) Servers
#
##QGRP1          LMID=SITE1      GRP=102
##              TMSNAME=TMS_QM   TMSCOUNT=2
##              OPENINFO="TUXEDO/QM:<APPDIR>/qdevice:QSP_BANKAPP"
#
# Group for Event Broker Servers
#
##EVBGRP1       LMID=SITE1      GRPNO=104

DEFAULT: TMSNAME=TMS_SQL      TMSCOUNT=2
BANKB1   LMID=SITE1          GRPNO=1

008 OPENINFO="TUXEDO/SQL:<APPDIR>/bankd11:bankdb:readwrite"
BANKB2   LMID=SITE2          GRPNO=2
OPENINFO="TUXEDO/SQL:<APPDIR>/bankd12:bankdb:readwrite"
*NETWORK
009 SITE1      NADDR="<network address of SITE1>"
010           NLSADDR="<network listener address of SITE1>"
011 SITE2      NADDR="<network address of SITE2>"
012           NLSADDR="<network listener address of SITE2>"
```

2. To enable the application password feature, add the following line to the RESOURCES section of ubbshrm or ubbamp:

```
SECURITY    APP_PW
```

3. In both configuration files, you may notice that the values of some parameters are enclosed in angle brackets (<>). Values shown in angle brackets are generic; you need to replace them with values that pertain to your installation. All of these fields occur within the RESOURCES, MACHINES, and GROUPS sections in both files. In ubbamp, the NETWORK section also has values you must replace. The following table shows the ubbamp through the NETWORK section and illustrates all the changes you need to make in the RESOURCES, MACHINES, and GROUPS sections if you are bringing up a single-machine application.

Table 3-3 Explanation of Values

Line	String to Be Replaced	Description
001	UID	The effective user ID (UID) for the owner of the bulletin board IPC structures. In a multiprocessor configuration, the value must be the same on all machines. To avoid problems, use the same UID as that of the owner of the BEA Tuxedo system software.
002	GID	The effective group ID (GID) for the owner of the bulletin board IPC structures. In a multiprocessor configuration, the value must be the same on all machines. Users of the application should share this group ID.
003	SITE1 name	The name of the machine. (For UNIX platforms, use the value produced by the UNIX command: <code>uname -n</code>)
004	TUXDIR	The absolute path name of the root directory for the BEA Tuxedo software. Replace all occurrences of <code><TUXDIR></code> in the file with the specified path name.
005	APPDIR	The absolute path name of the directory in which the application runs. Make this a global change so that all occurrences of <code><APPDIR></code> in the file are replaced by the specified path name.
006	machine type	An identifying string used in networked applications that include machines of different types. The BEA Tuxedo system checks the value of machine type for each machine communicating with another. If the system identifies two machines with different machine types trying to communicate, it invokes the message encode and decode routines to convert the data being transmitted to a form recognizable by both machines.
007	SITE2 name	The name of the second machine. (For UNIX platforms, use the value produced by the UNIX command: <code>uname -n</code>)

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Line	String to Be Replaced	Description
008	OPENINFO	The statement here and in the following entry are in a format understood by BEA Tuxedo system resource managers. They need to be changed (or removed) to meet the requirements of other resource managers.
009	Network address of SITE1	The full address of the network listener for the BRIDGE process on this machine.
010	Network listener address of SITE1	The address of the network listener for the tlisten process on this machine.
011	Network address of SITE2	The full address of the network listener for the BRIDGE process on this machine. This value must be different on each machine.
012	Network listener address of SITE2	The address of the network listener for the tlisten process on this machine.

See Also

- “Preparing bankapp Files and Resources” on page 3-26
- `UBBCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*
- “What Is the Configuration File” on page 2-1 in *Setting Up a BEA Tuxedo Application*

Steps 7 and 8: Creating a Binary Configuration File and Transaction Log File

Before Creating the Binary Configuration File

Before creating the binary configuration file, you need to be in the directory in which your `bankapp` files are located and you must set the environment variables. Complete the following tasks.

1. Go to the directory in which your `bankapp` files are located.
2. Set the environment variables by entering

```
./bankvar
```

Note: If you bring up `bankapp` in `SHM` mode, you do not have to create the `tlisten` process or create a transaction log on another machine.

How to Load the Configuration File

Once you have finished editing the configuration file, you must load it into a binary file on your `MASTER` machine. The name of the binary configuration file is `TUXCONFIG`; its path name is defined in the `TUXCONFIG` environment variable. The file should be created by a person with the effective user ID and group ID of the BEA Tuxedo system administrator, which should be the same as the `UID` and `GID` values in your configuration file. If this requirement is not met, you may have permission problems in running `bankapp`.

1. To create `TUXCONFIG`, enter the following command.

```
tmloadcf ubbmp
```

While the configuration file is being loaded, you are prompted several times to confirm that you want to install this configuration, even if doing so means an existing configuration file must be overwritten. If you want to suppress such prompts, include the `-y` option on the command line.

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2. If you want the amount of IPC resources needed by your application to be calculated by the BEA Tuxedo system, include the `-c` option on the command line.

TUXCONFIG can be installed only on the MASTER machine; it is propagated to other machines by `tmboot` when the application is booted.

If you have specified `SECURITY` as an option for the configuration, `tmloadcf` prompts you to enter an application password. The password you select can be up to 30 characters long. Client processes joining the application are required to supply the password.

`tmloadcf` parses the text configuration file (`UBBCONFIG`) for syntax errors before it loads it, so if there are errors in the file, the job fails.

How to Create the Transaction Log (TLOG) File

The TLOG is the transaction log used by the BEA Tuxedo system in the management of global transactions. Before an application can be booted, an entry for the TLOG must be created in every file on every machine in the application, and a file for the log itself must be created on the MASTER machine.

`bankapp` provides a script called `crctlog` that creates a device list and a TLOG for you. The device list is created using the `TLOGDEVICE` variable from `bankvar`.

1. To create your TLOG and device list, enter the command on the MASTER machine as follows.

```
crctlog -m
```

Note: In a production environment, the device list may be the same as that used for the database.

2. On all other machines, do not specify `-m`; when the system is booted; the BBL on each non-MASTER machine creates the log.

If you are using a non-XA resource manager, you do not need a transaction log.

See Also

- “Preparing bankapp Files and Resources” on page 3-26

Step 9: How to Create a Remote Service Connection on Each Machine

`tlisten` is the listener process that provides a remote service connection for processes such as `tmboot` between machines in a BEA Tuxedo application. It must be installed on all the machines in your network as defined in the `NETWORK` section of the configuration file.

Instructions for starting `tlisten` are provided in the “Starting the `tlisten` Process on a UNIX System” on page 6-11 in *Installing the BEA Tuxedo System*.

1. We recommend starting a separate `tlisten` process for `bankapp`. To do so, enter the following command.

```
tlisten -l nlsaddr
```

The `nlsaddr` value must be the same as that specified for the `NLSADDR` parameter for this machine in your configuration file. Because this value changes from one machine to another, it is important that your `tlisten` argument agrees with your configuration file specification.

Note: Detection of an error in this specification is not easy. `tmloadcf` does not check for agreement between your configuration file and your `tlisten` command. If the two addresses do not match, then the application will probably fail to boot on the machine with the mismatched value of `nlsaddr` or on which the `tlisten` process has not been started.

The logfile used by `tlisten` is separate from all other BEA Tuxedo system log files, but one log can be used by more than one `tlisten` process. The default filename is `TUXDIR/udataobj/tlog`.

How to Stop the Listener Process (`tlisten`)

`tlisten` is designed to run as a daemon process. For suggestions about incorporating it in startup scripts or running it as a cron job, see `tlisten(1)` in the *BEA Tuxedo Reference Manual*.

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For bankapp, you may prefer simply to start it and bring it down as you need it. To bring it down, send it a SIGTERM signal such as the following.

```
kill -15 pid
```

Note: In an NT environment, you can start and stop the listener process in two ways: using the `tlisten` on the command line or using the Control Panel.

Sample tlisten Error Messages

If no remote `tlisten` is running, the boot sequence is displayed on your screen as follows.

```
Booting admin processes
exec DBBL -A :
    on MASTER -> process id=17160Started.
exec BBL -A :
    on MASTER -> process id=17161Started.
exec BBL -A :
    on NONMAST2 -> CMDTUX_CAT:814: cannot propagate TUXCONFIG file
tmboot: WARNING: No BBL available on site NONMAST2.
    Will not attempt to boot server processes on that site.
exec BBL -A :
    on NONMAST1 -> CMDTUX_CAT:814: cannot propagate TUXCONFIG file
tmboot: WARNING: No BBL available on site NONMAST1.
    Will not attempt to boot server processes on that site.
2 processes started.
and messages such as these will be in the ULOG:
133757.mach1!DBBL.17160: LIBTUX_CAT:262: std main starting
133800.mach1!BBL.17161: LIBTUX_CAT:262: std main starting
133804.mach1!BRIDGE.17162: LIBTUX_CAT:262: std main starting
133805.mach1!tmboot.17159: LIBTUX_CAT:278: Could not contact NLS on NONMAST2
133805.mach1!tmboot.17159: LIBTUX_CAT:276: No NLS available for remote
    machine NONMAST2
133806.mach1!tmboot.17159: LIBTUX_CAT:276: No NLS available for remote
    machine NONMAST2
133806.mach1!tmboot.17159: CMDTUX_CAT:850: Error sending TUXCONFIG
    propagation request to TAGENT on NONMAST2
133806.mach1!tmboot.17159: WARNING: No BBL available on site NONMAST2.
    Will not attempt to boot server processes on that site.
133806.mach1!tmboot.17159: LIBTUX_CAT:278: Could not contact NLS on NONMAST1
133806.mach1!tmboot.17159: LIBTUX_CAT:276: No NLS available for
    remote machine NONMAST1
133806.mach1!tmboot.17159: LIBTUX_CAT:276: No NLS available for
    remote machine NONMAST1
```


Step 9: How to Create a Remote Service Connection on Each Machine

```
133806.mach1!tmboot.17159: CMDTUX_CAT:850: Error sending TUXCONFIG
propagation request to TAGENT on NONMAST1
133806.mach1!tmboot.17159: WARNING: No BBL available on site NONMAST1.
Will not attempt to boot server processes on that site.
```

If `tlisten` is started with the wrong machine address, the following messages appear in the `tlisten` log.

```
Mon Aug 26 10:51:56 1991; 14240; BEA TUXEDO System Listener Process Started
Mon Aug 26 10:51:56 1991; 14240; Could not establish listening endpoint
Mon Aug 26 10:51:56 1991; 14240; Terminating listener process, SIGTERM
```

See Also

- “Preparing bankapp Files and Resources” on page 3-26
- `tlisten(1)`
- `tmadmin(1)`
- `tmloadcf(1)`

Running bankapp

This documentation leads you through the procedures for booting `bankapp`, testing it by running various client programs and transactions, and shutting it down when you have finished. Click on any of the following tasks for instructions on completing that task.



Step 1: How to Prepare to Boot

1. Before booting `bankapp`, verify that your machine has enough IPC resources to support your application. To generate a report on IPC resources, run the `tmboot` command with the `-c` option.

Note: Because insufficient IPC resources may lead to a boot failure, it is imperative that you ensure you have appropriate values specified for your configuration.

Listing 3-19 IPC Report

```

Ipc sizing (minimum /T values only)
      Fixed Minimums Per Processor
SHMMIN: 1
SHMALL: 1
SEMMAP: SEMMNI

      Variable Minimums Per Processor
SEMUME,      A      SHMMAX
SEMNU,      *
Node      SEMMNS  SEMMSL  SEMMSL  SEMMNI  MSGMNI  MSGMAP  SHMSEG
-----
sfpup      60      1      60      A + 1   10      20      76K
sfsup      63      5      63      A + 1   11      22      76K
where 1 <= A <= 8.

```

2. Add the number of application clients used per processor to each MSGMNI value. MSGMAP should be twice MSGMNI.
3. Compare the minimum IPC requirements to the parameters set for your machine. The location of these parameter settings is platform-dependent:
 - On many UNIX system platforms, machine parameters are defined in `/etc/conf/cf.d/mtune`.
 - On Windows NT platforms, machine parameters are set and displayed through a control panel.

See Also

- “Running bankapp” on page 3-60

Step 2: How to Boot bankapp

1. Set the environment.

```
. ./bankvar
```

2. Boot the application by entering the following:

```
tmboot
```

The following prompt is displayed.

```
Boot all admin and server processes? (y/n): y
```

A running report such as the following is displayed.

```
Booting all admin and server processes in
/usr/me/appdir/tuxconfig
Booting all admin processes
exec BBL -A:
    process id=24223 Started.
```

The report continues until all servers in the configuration have been started. It ends with a count of the number of servers started.

If you prefer, you can boot only a portion of the configuration. For example, to boot only administrative servers, include the `-A` option. If no options are specified, the entire application is booted.

In addition to reporting on the number of servers booted, `tmboot` also sends messages to the `ULOG`.

See Also

- “Running bankapp” on page 3-60

Step 3: How to Populate the Database

The `populate.sh` script is provided to put records into the database so you can run `bankapp` and test its functionality. `populate` is a one line script that pipes records from a program called `gendata` to the system server, `ud`. The `gendata` program creates records for 10 branches, 30 tellers, and 200 accounts. A record of the files created is kept in `pop.out`, so you can use values in the database when forming your sample service requests.

To run the script, enter `populate`.

Note: The output file that was created by the `populate` script, `pop.out`, can be used to provide account numbers, branch IDs, and other fields you can specify, so your service requests produce some output.

See Also

- “Running `bankapp`” on page 3-60
- `tmboot(1)` in *BEA Tuxedo Command Reference*
- `ud`, `wud(1)` in *BEA Tuxedo Command Reference*
- `userlog(3c)` in *BEA Tuxedo C Function Reference*
- “What Is the User Log (ULOG)” on page 2-17 in *Administering a BEA Tuxedo Application at Run Time*
- “How to Boot the Application” on page 1-9 in *Administering a BEA Tuxedo Application at Run Time*
- “How to Shut Down Your Application” on page 1-11 in *Administering a BEA Tuxedo Application at Run Time*

Step 4: How to Test bankapp Services

1. If you are logging in cold to a running system, you must set your environment for bankapp. To do so, enter the following command.

```
. ./bankvar
```

2. Run the `audit` client program. To execute the `audit` client program, enter the following command.

```
audit {-a | -t} [branch_id]
```

specifying either `-a` for account balances or `-t` for teller balances. If you specify a `branch_id`, the report is limited to the branch specified; if you do not, the report includes data for all branches. For sample account numbers, branch IDs, and other values that you can provide as input to `audit`, use values listed in `pop.out`, the output of the `populate` program.

3. Run `auditcon`. To start the conversational version of the `audit` program, enter the following command.

```
auditcon
```

The program displays the following message on your terminal.

```
to request a TELLER or ACCOUNT balance for a branch,  
type the letter t or a, followed by the branch id,  
followed by <return>  
for ALL TELLER or ACCOUNT balances, type t or a <return>  
q <return> quits the program
```

When you have typed your request and pressed `return`, the requested information is displayed on your terminal followed by the following message.

```
another balance request ??
```

4. The program continues to offer you this service until you enter a `q`.
5. Use the driver program. By default, the driver program generates 300 transactions. You can change that number with the `-n` option, as in the following example. The command

```
driver -n1000
```

specifies that the program should run for 1,000 loops.

driver is a script that generates a series of transactions to simulate activity on the system. It is included as part of bankapp so you can get realistic-looking statistics by running `tmadmin` commands.

See Also

- “Running bankapp” on page 3-60

Step 5: How to Shut Down bankapp

To bring down bankapp, enter the `tmshutdown(1)` command with no arguments, from the MASTER machine, as follows:

```
$ tmshutdown
Shutdown all server processes? (y/n): y
Shutting down all server processes in /usr/me/BANKAPP/TUXCONFIG
Shutting down server processes ...
```

```
Server Id = 1 Group Id = BANKB1 Machine = Site1: shutdown succeeded.
```

Running this command (or the shutdown command of `tmadmin`) causes the following results:

- All application servers, gateway servers, TMS’s, and administrative servers, are shut down.
- All associated IPC resources are removed.

See Also

- “Running bankapp” on page 3-60
- `tmadmin(1)` in *BEA Tuxedo Command Reference*
- “Performing Dynamic Operations Using `tmadmin(1)`” on page 3-26 in *Introducing the BEA Tuxedo System*
- `tmshutdown(1)` in *BEA Tuxedo Command Reference*

3 *Tutorial for bankapp, a Full C Application*

4 Tutorial for CSIMPAPP, a Simple COBOL Application

- What Is CSIMPAPP
- Preparing CSIMPAPP Files and Resources
 - Step 1: How to Copy the CSIMPAPP Files
 - Step 2: Examining and Compiling the Client
 - Step 3: Examining and Compiling the Server
 - Step 4: Editing and Loading the Configuration File
 - Step 5: How to Boot the Application
 - Step 6: How to Test the Run-time Application
 - Step 7: How to Monitor the Run-time Application
 - Step 8: How to Shut Down the Application

What Is CSIMPAPP

CSIMPAPP is a basic sample application delivered with the BEA Tuxedo system. While instructions are written for the Microfocus COBOL compiler, these may vary depending on your specific compiler. To find out which COBOL platforms are supported by the BEA Tuxedo system, consult the Platform Data Sheets in *Installing the BEA Tuxedo System*.

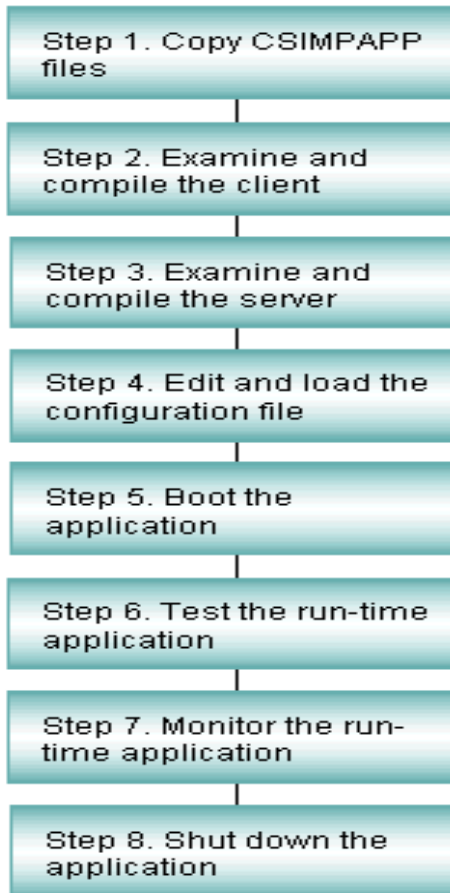
CSIMPAPP includes one client and one server. The server performs only one service: it accepts a string from the client and returns the same string in upper case.

Preparing CSIMPAPP Files and Resources

This topic leads you through the procedures you must complete to develop CSIMPAPP. The following flow chart summarizes this procedure.

Click on each task for instructions on completing that task.

Figure 4-1 CSIMPAPP Development Process



Before You Begin

Before you can run this tutorial, the BEA Tuxedo system software must be installed so that the files and commands referred to are available. If you are responsible for installing the BEA Tuxedo system software, refer to the *Installing the BEA Tuxedo System* Guide for installations instructions. If the installation has already been done by someone else, you need to find out the path name of the directory in which the software is installed (TUXDIR). You also need to have read and execute permissions on the directories and files in the BEA Tuxedo system directory structure so you can copy CSIMPAPP files and execute BEA Tuxedo system commands.

What You Will Learn

After you complete this procedure, you will be able to understand the tasks clients and servers can perform, edit a configuration file for your own environment, and invoke `tadmin` to check on the activity of your application. In short, you will understand the basic elements of all BEA Tuxedo applications—client processes, server processes, and a configuration file—and you will know how to use BEA Tuxedo system commands to manage your application.

Step 1: How to Copy the CSIMPAPP Files

1. Make a directory for CSIMPAPP and change the directory to it.

```
mkdir CSIMPDIR
cd CSIMPDIR
```

Note: This step is suggested so you can see the CSIMPAPP files you have at the start and the additional files you create along the way. Use the standard shell (`/bin/sh`) or the Korn shell; do not use `csh`.

2. Set and export environment variables.

```
TUXDIR=<pathname of the BEA Tuxedo System root directory>
APPDIR=<pathname of your present working directory>
TUXCONFIG=$APPDIR/TUXCONFIG
```

```
COBDIR=<pathname of the COBOL compiler directory>
COBCPY=$TUXDIR/cobinclude
COBOPT="-C ANS85 -C ALIGN=8 -C NOIBMCOMP -C TRUNC=ANSI -C OSEXT=cbl"
CFLAGS="-I$TUXDIR/include"
PATH=$TUXDIR/bin:$APPDIR: $PATH
LD_LIBRARY_PATH=$COBDIR/coblib:${LD_LIBRARY_PATH}
export TUXDIR APPDIR TUXCONFIG UBBCONFIG COBDIR COBCPY
export COBOPT CFLAGS PATH LD_LIBRARY_PATH
```

You need TUXDIR and PATH to be able to access files in the BEA Tuxedo directory structure and to execute BEA Tuxedo commands:

- On Sun Solaris, /usr/5bin must be the first directory in your PATH.
- On an AIX platform on the RS/6000, use LIBPATH instead of LD_LIBRARY_PATH.
- On an HP-UX platform on the HP 9000, use SHLIB_PATH instead of LD_LIBRARY_PATH. You need to set TUXCONFIG to be able to load the configuration file as shown in Step 4.

3. Copy the CSIMPAPP files.

```
cp TUXDIR/samples/atmi/CSIMPAPP/* .
```

Note: Later, you will edit some files and make them executable, so we recommend using copies of the files rather than the originals delivered with the software.

4. List the files.

```
$ ls
CSIMPCL.cbl
CSIMPSRV.cbl
README
TPSVRINIT.cbl
UBBCSIMPLE
WUBBCSIMPLE
envfile
ws
$
```

The files that make up the application are:

- CSIMPCL.cbl—the source code for the client program
- CSIMPSRV.cbl—the source code for the server program
- TPSVRINIT.cbl—the source code for the server initialization program

- UBBCSIMPLE—the text form of the configuration file for the application
- WUBBCSIMPLE—the configuration file for the Workstation example
- ws—a directory with .MAK files for client programs for three workstation platforms

Step 2: Examining and Compiling the Client

How to Examine the Client

Review the client program source code.

```
$ more CSIMPCL.cbl
```

The output is shown in the following list.

Listing 4-1 Source Code for CSIMPCL.cbl

```
1 IDENTIFICATION DIVISION.
2 PROGRAM-ID. CSIMPCL.
3 AUTHOR. Tuxedo DEVELOPMENT.
4 ENVIRONMENT DIVISION.
5 CONFIGURATION SECTION.
6 WORKING-STORAGE SECTION.
7 *****
8 * Tuxedo definitions
9 *****
10 01 TPTYPE-REC.
11 COPY TPTYPE.
12 *
13 01 TPSTATUS-REC.
14 COPY TPSTATUS.
15 *
16 01 TPSVCDEF-REC.
17 COPY TPSVCDEF.
18 *
19 01 TPINFDEF-REC VALUE LOW-VALUES.
20 COPY TPINFDEF.
21 *****
22 * Log messages definitions
23 *****
24 01 LOGMSG.
```

Step 2: Examining and Compiling the Client

```
25         05 FILLER      PIC X(8) VALUE "CSIMPCL:".
26         05 LOGMSG-TEXT PIC X(50).
27     01 LOGMSG-LEN      PIC S9(9) COMP-5.
28 *
29     01 USER-DATA-REC   PIC X(75).
30     01 SEND-STRING    PIC X(100) VALUE SPACES.
31     01 RECV-STRING    PIC X(100) VALUE SPACES.
32 *****
33 * Command line arguments
34 *****
35 * Start program with command line args
36 *****
37
38 PROCEDURE
39 START-CSIMPCL.
40     MOVE LENGTH OF LOGMSG TO LOGMSG-LEN.
41     ACCEPT SEND-STRING FROM COMMAND-LINE.
42     DISPLAY "SEND-STRING:" SEND-STRING.
43
44     MOVE "Started" TO LOGMSG-TEXT.
45     PERFORM DO-TPINIT.
46     PERFORM DO-TPCALL.
47     DISPLAY "RECV-STRING:" RECV-STRING.
48     PERFORM DO-TPTERM.
49     PERFORM EXIT-PROGRAM.
50 *****
51 * Now register the client with the system.
52 *****
53 DO-TPINIT.
54     MOVE SPACES TO USRNAME.
55     MOVE SPACES TO CLTNAME.
56     MOVE SPACES TO PASSWD.
57     MOVE SPACES TO GRPNAME.
58     MOVE ZERO TO DATALEN.
59     SET TPU-DIP TO TRUE.
60
61     CALL "TPINITIALIZE" USING TPINFDEF-REC
62         USER-DATA-REC
63         TPSTATUS-REC.
64
65     IF NOT TPOK
66         MOVE "TPINITIALIZE Failed" TO LOGMSG-TEXT
67         PERFORM DO-USERLOG
68         PERFORM EXIT-PROGRAM
69     END-IF.
70
71 *****
72 * Issue a TPCALL
73 *****
```

4 Tutorial for CSIMPAPP, a Simple COBOL Application

```
74 DO-TPCALL.
75     MOVE 100 to LEN.
76     MOVE "STRING" TO REC-TYPE.
77     MOVE "CSIMPSRV" TO SERVICE-NAME.
78     SET TPBLOCK TO TRUE.
79     SET TPNOTRAN TO TRUE.
80     SET TPNOTIME TO TRUE.
81     SET TPSIGRSTRT TO TRUE.
82     SET TPCHANGE TO TRUE.
83
84     CALL "TPCALL" USING TPSVDEF-REC
85         TPTYPE-REC
86         SEND-STRING
87         TPTYPE-REC
88         RECV-STRING
89         TPSTATUS-REC.
90
91     IF NOT TPOK
92         MOVE "TPCALL Failed" TO LOGMSG-TEXT
93         PERFORM DO-USERLOG
94     END-IF.
95
96     *****
97     * Leave Tuxedo
98     *****
99 DO-TPTERM.
100     CALL "TPTERM" USING TPSTATUS-REC.
101     IF NOT TPOK
102         MOVE "TPTERM Failed" TO LOGMSG-TEXT
103         PERFORM DO-USERLOG
104     END-IF.
105
106     *****
107     * Log messages to the userlog
108     *****
109 DO-USERLOG.
110     CALL "USERLOG" USING LOGMSG
111         LOGMSG-LEN
112         TPSTATUS-REC.
113
114     *****
115     *Leave Application
116     *****
117 EXIT-PROGRAM.
118     MOVE "Ended" TO LOGMSG-TEXT.
119     PERFORM DO-USERLOG.
120     STOP RUN.
```


Table 4-1 Significant Lines in the CSIMPCL.cbl Source Code

Line(s)	File/Function	Purpose
11, 14, 17, 20	COPY	Command used to replicate files needed whenever BEA Tuxedo ATMI functions are used.
61	TPINITIALIZE	The ATMI function used by a client program to join an application.
84	TPCALL	The ATMI function used to send the message record to the service specified in <code>SERVICE-NAME</code> . <code>TPCALL</code> waits for a return message. <code>STRING</code> is one of the three basic BEA Tuxedo record types. An argument, <code>LEN</code> IN <code>TPTYPE-REC</code> , specifies the length of the record in <code>USER-DATA-REC</code> .
100	TPTERM	The ATMI function used to leave an application. A call to <code>TPTERM</code> is used to exit an application before performing a <code>STOP RUN</code> .
110	USERLOG	The function that displays the message returned from the server, the successful conclusion of <code>tpcall</code> .

How to Compile the Client

1. Run `buildclient` to compile the client program.

```
buildclient -C -o CSIMPCL -f CSIMPCL.cbl
```

The output file is `CSIMPCL` and the input source file is `CSIMPCL.cbl`.

2. Check the results.

```
$ ls CSIMPCL*  
CSIMPCL  CSIMPCL.cbl  CSIMPCL.idy  CSIMPCL.int  CSIMPCL.o
```

You now have an executable module called `CSIMPCL`.

See Also

- `buildclient(1)` in *BEA Tuxedo Command Reference*
- `TPINITIALIZE(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `TPTERM(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `TPCALL(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `USERLOG(3cbl)` in *BEA Tuxedo COBOL Function Reference*

Step 3: Examining and Compiling the Server

How to Examine the Server

1. Review the source code from the CSIMPSRV server program.

```
$ more CSIMPSRV.cbl
```

Listing 4-2 Source Code for CSIMPSRV.cbl

```
1 IDENTIFICATION DIVISION.  
2 PROGRAM-ID. CSIMPSRV.  
3 AUTHOR. BEA Tuxedo DEVELOPMENT.  
4 ENVIRONMENT DIVISION.  
5 CONFIGURATION SECTION.  
6 WORKING-STORAGE SECTION.  
7 *****  
8 * Tuxedo definitions  
9 *****  
10 01 TPSVCRET-REC.  
11 COPY TPSVCRET.  
12 *  
13 01 TPTYPE-REC.  
14 COPY TPTYPE.  
15 *  
16 01 TPSTATUS-REC.
```

```
17 COPY TPSTATUS.
18 *
19 01 TPSVCDEF-REC.
20 COPY TPSVCDEF.
21 *****
22 * Log message definitions
23 *****
24 01 LOGMSG.
25     05 FILLER          PIC X(10) VALUE
26         "CSIMPSRV :".
27     05 LOGMSG-TEXT    PIC X(50).
28 01 LOGMSG-LEN        PIC S9(9) COMP-5.
29 *****
31 * User defined data records
32 *****
33 01 RECV-STRING        PIC X(100).
34 01 SEND-STRING       PIC X(100).
35 *
36 LINKAGE SECTION.
37 *
38 PROCEDURE DIVISION.
39 *
40 START-FUNDUPSR.
41     MOVE LENGTH OF LOGMSG TO LOGMSG-LEN.
42     MOVE "Started" TO LOGMSG-TEXT.
43     PERFORM DO-USERLOG.
44
45 *****
46 * Get the data that was sent by the client
47 *****
48     MOVE LENGTH OF RECV-STRING TO LEN.
49     CALL "TPSVCSTART" USING TPSVCDEF-REC
50         TPTYPE-REC
51         RECV-STRING
52         TPSTATUS-REC.
53
54     IF NOT TPOK
55         MOVE "TPSVCSTART Failed" TO LOGMSG-TEXT
56         PERFORM DO-USERLOG
57         PERFORM EXIT-PROGRAM
58     END-IF.
59
60     IF TPTRUNCATE
61         MOVE "Data was truncated" TO LOGMSG-TEXT
62         PERFORM DO-USERLOG
63         PERFORM EXIT-PROGRAM
64     END-IF.
65
66     INSPECT RECV-STRING CONVERTING
```

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```
67     "abcdefghijklmnopqrstuvwxy" TO
68     "ABCDEFGHIJKLMNPOQRSTUVWXYZ".
69     MOVE "Success" TO LOGMSG-TEXT.
70     PERFORM DO-USERLOG.
71     SET TPSUCCESS TO TRUE.
72     COPY TPRETURN REPLACING
73         DATA-REC BY RECV-STRING.
74
75     *****
76     * Write out a log err messages
77     *****
78     DO-USERLOG.
79         CALL "USERLOG" USING LOGMSG
80             LOGMSG-LEN
81             TPSTATUS-REC.
82     *****
83     * EXIT PROGRAM
84     *****
85     EXIT-PROGRAM.
86     MOVE "Failed" TO LOGMSG-TEXT.
87     PERFORM DO-USERLOG.
88     SET TPFALL TO TRUE.
89     COPY TPRETURN REPLACING
90         DATA-REC BY RECV-STRING.
```

Table 4-2 Significant Lines in the CSIMPSRV.cbl Source Code

Line(s)	Routine	Purpose
49	TPSVCSTART	Routine used to start this service and to receive the service's parameters and data. After a successful call, the RECV-STRING contains the data sent by the client.
66-68	INSPECT statement	Statement that converts the input to uppercase (Microfocus-specific).
72	COPY TPRETURN	Command line that returns the converted string to the client with TPSUCCESS set.
79	USERLOG	Routine that logs messages used by the BEA Tuxedo system and applications.

2. During server initialization (that is, before the server starts processing service requests), the BEA Tuxedo system calls the TPSVRINIT subroutine. To familiarize yourself with TPSVRINIT, page through the source code for it.

```
$ more TPSVRINIT.cbl
```

Listing 4-3 Source Code for TPSVRINIT.cbl

```
1  IDENTIFICATION DIVISION.
2  PROGRAM-ID. TPSVRINIT.
3  ENVIRONMENT DIVISION.
4  CONFIGURATION SECTION.
5  *
6  DATA DIVISION.
7  WORKING-STORAGE SECTION.
8  *
9  01 LOGMSG.
10     05 FILLER                PIC X(11) VALUE "TPSVRINIT :".
11     05 LOGMSG-TEXT           PIC X(50).
12  01 LOGMSG-LEN               PIC S9(9) COMP-5.
13  *
14  01 TPSTATUS-REC.
15  COPY TPSTATUS.
16  *****
17  LINKAGE SECTION.
18  01 CMD-LINE.
19     05 ARGC PIC 9(4) COMP-5.
20     05 ARG.
21     10 ARGS PIC X OCCURS 0 TO 9999 DEPENDING ON ARGC.
22  *
23  01 SERVER-INIT-STATUS.
24  COPY TPSTATUS.
25  *****
26  PROCEDURE DIVISION USING CMD-LINE SERVER-INIT-STATUS.
27  A-000.
28  MOVE LENGTH OF LOGMSG TO LOGMSG-LEN.
29  *****
30  * There are no command line parameters in this TPSVRINIT
31  *****
32  IF ARG NOT EQUAL TO SPACES
33      MOVE "TPSVRINIT failed" TO LOGMSG-TEXT
34      CALL "USERLOG" USING LOGMSG
35          LOGMSG-LEN
36          TPSTATUS-REC
37  ELSE
38      MOVE "Welcome to the simple service" TO LOGMSG-TEXT
39      CALL "USERLOG" USING LOGMSG
```

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```
40             LOGMSG-LEN
41             TPSTATUS-REC
42     END-IF.
43 *
44     SET TPOK IN SERVER-INIT-STATUS TO TRUE.
45 *
46     EXIT PROGRAM.
```

A default is provided by the BEA Tuxedo system that writes a message to USERLOG indicating that the server has been booted.

How to Compile the Server

1. Run `buildserver` as follows to compile the server program.

```
buildserver -C -o CSIMPSRV -f CSIMPSRV.cbl -f TPSVRINIT.cbl -s CSIMPSRV
```

The executable file to be created is named `CSIMPSRV` and `CSIMPSRV.cbl` and `TPSVRINIT.cbl` are the input source files. The service being offered by the server `CSIMPSRV` is indicated by `-s CSIMPSRV`.

2. Check the results by displaying a list of the files in your current directory.

```
$ ls
CSIMPCL      CSIMPCL.int   CSIMPSRV.cbl   CSIMPSRV.o     TPSVRINIT.int
CSIMPCL.cbl  CSIMPCL.o    CSIMPSRV.idy   TPSVRINIT.cbl  TPSVRINIT.o
CSIMPCL.idy  CSIMPSRV     CSIMPSRV.int   TPSVRINIT.idy  UBESIMPLE
```

You now have an executable module called `CSIMPSRV`.

See Also

- `buildserver(1)` in *BEA Tuxedo Command Reference*
- `TPSVCSTART(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `TPSVRINIT(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `TPRETURN(3cbl)` in *BEA Tuxedo COBOL Function Reference*
- `USERLOG(3cbl)` in *BEA Tuxedo COBOL Function Reference*

Step 4: Editing and Loading the Configuration File

How to Edit the Configuration File

1. In a text editor, familiarize yourself with the configuration file for CSIMPAPP.

Listing 4-4 CSIMPAPP Configuration File

```
#Skeleton UBBCONFIG file for the BEA Tuxedo COBOL Simple Application.
#Replace the <bracketed> items with the appropriate values.

*RESOURCES
IPCKEY          <Replace with a valid IPC Key>

#Example:
#IPCKEY          123456

DOMAINID       UBBCSIMPLE
MASTER         simple
MAXACCESSERS   5
MAXSERVERS     5
MAXSERVICES    10
MODEL          SHM
LDBAL          N

*MACHINES
DEFAULT:
                APPDIR="<Replace with the current pathname>"
                TUXCONFIG="<Replace with TUXCONFIG Pathname>"
                TUXDIR="<Root directory of BEA Tuxedo (not /)>"
                ENVFILE="<pathname of file of environment vars>"

#Example:
#                APPDIR="/home/me/simpapp"
#                TUXCONFIG="/home/me/simpapp/TUXCONFIG"
#                TUXDIR="/usr/tuxedo"
#                ENVFILE="/home/me/simpapp/envfile"
<Machine-name> LMID=simple

#Example:
#usltux         LMID=simple
```

4 Tutorial for CSIMPAPP, a Simple COBOL Application

```
*GROUPS
GROUP1                LMID=simple      GRPNO=1      OPENINFO=NONE

*SERVERS
DEFAULT:              CLOPT=" -A "

CSIMPSRV              SRVGRP=GROUP1    SRVID=1

*SERVICES
CSIMPSRV
```

2. For each *string* (that is, for each string shown in *italic* between angle brackets), substitute an appropriate value:
 - `IPCKEY`—Use a value that will not conflict with any other users.
 - `TUXCONFIG`—Provide the full path name of the binary `TUXCONFIG` file.
 - `TUXDIR`—The full path name of your BEA Tuxedo system root directory.
 - `APPDIR`—The full path name of the directory in which you intend to boot the application; in this case, the current directory.
 - `ENVFILE`—The full path name for the environment file to be used by `mc`, `viewc`, `tmloadcf`, and so on.
 - *machine-name*—The machine name as returned by the `uname -n` command on a UNIX platform.

Note: The path names for `TUXCONFIG` and `TUXDIR` must be identical to those you set and exported earlier. You must specify actual path names; references to path names through environment variables (such as `TUXCONFIG`) are not acceptable. Do not forget to remove the angle brackets.

How to Load the Configuration File

1. Run `tmloadcf` to load the configuration file.

```
$ tmloadcf UBBCSIMPLE
Initialize TUXCONFIG file: /usr/me/CSIMPDIR/TUXCONFIG [y, q] ? y
$
```


2. Check the results by displaying a list of the files in your current directory.

```
$ ls
CSIMPCL          CSIMPCL.o      CSIMPSRV.int   TPSVRINIT.int
CSIMPCL.cbl     CSIMPSRV      CSIMPSRV.o     TPSVRINIT.o
CSIMPCL.idy     CSIMPSRV.cbl  TPSVRINIT.cbl  TUXCONFIG
CSIMPCL.int     CSIMPSRV.idy  TPSVRINIT.idy  UBBCSIMPLE
```

We now have a file called `TUXCONFIG` (a new file system under the control of the BEA Tuxedo system).

See Also

- `tmloadcf(1)` in *BEA Tuxedo Command Reference*
- `UBBCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*

Step 5: How to Boot the Application

Execute `tmboot` to bring up the application.

```
$ tmboot
Boot all admin and server processes? (y/n): y
Booting all admin and server processes in /usr/me/CSIMPDIR/TUXCONFIG

Booting all admin processes ...

exec BBL -A:
    process id=24223 ... Started.

Booting server processes ...

exec CSIMPSRV -A :
    process id=24257 ... Started.
2 processes started.
$
```

The BBL is the administrative process that monitors the shared memory structures in the application. `CSIMPSRV` is the `CSIMPAPP` server that runs continuously, awaiting requests.

See Also

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

Step 6: How to Test the Run-time Application

To test CSIMPAPP, have the client submit a request.

```
$ CSIMPCL "hello world"  
HELLO WORLD
```

Step 7: How to Monitor the Run-time Application

As the administrator, you can use the `tmadmin` command interpreter to check an application and make dynamic changes. To run `tmadmin`, you must set the `TUXCONFIG` variable

`tmadmin` can interpret and run over 50 commands. For a complete list, see `tmadmin(1)` in *BEA Tuxedo Command Reference*. Here we demonstrate two of the many `tmadmin` commands.

1. Enter the following command.

```
tmadmin
```

The following lines are displayed.

```
tmadmin - Copyright (c) 1999 BEA Systems Inc.; 1991 USL. All  
rights reserved.
```

```
>
```

Note: The greater-than sign (>) is the `tmadmin` prompt.

2. Enter the `printserver(psr)` command to display information about servers.

```
> psr
a.out Name   Queue Name   Grp Name   ID   RqDone   Load Done   Current Service
-----
BBL          531993      simple     0    0         0           (IDLE)
CSIMPSRV    00001.00001  GROUP1     1    0         0           (IDLE)
>
```

3. Enter the `printservice(psc)` command to display information about services.

```
> psc
Service Name Routine Name  a.out Name  Grp Name  ID  Machine #  Done  Status
-----
CSIMPSRV    CSIMPSRV    CSIMPSRV    GROUP1    1   simple     -    AVAIL
>
```

4. Leave `tmadmin` by entering a `q` at the prompt. (You can boot and shut down the application from within `tmadmin`.)

See Also

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

Step 8: How to Shut Down the Application

1. Run `tmshutdown` to bring down the application.

```
$ tmshutdown
Shutdown all admin and server processes? (y/n): y
Shutting down all admin and server processes in /usr/me/CSIMPDIR/TUXCONFIG
Shutting down server processes ...
Server Id = 1 Group Id = GROUP1 Machine = simple: shutdown succeeded.
Shutting down admin processes ...
```

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```
Server Id = 0 Group Id = simple Machine = simple: shutdown succeeded.  
2 processes stopped.  
$
```

2. Check the ULOG

```
$ cat ULOG*  
$  
140533.usltux!BBL.22964: LIBTUX_CAT:262: std main starting  
140540.usltux!CSIMPSRV.22965: COBAPI_CAT:1067: INFO: std main starting  
140542.usltux!CSIMPSRV.22965: TPSVRINIT :Welcome to the simple service  
140610.usltux!?proc.22966: CSIMPCL:Started  
140614.usltux!CSIMPSRV.22965: CSIMPSRV :Started  
140614.usltux!CSIMPSRV.22965: CSIMPSRV :Success  
140614.usltux!?proc.22966: switch to new log file  
/home/usr_nm/CSIMPPDIR/ULOG.112592  
140614.usltux!?proc.22966: CSIMPCL:Ended
```

Each line of the ULOG for this session is significant. First look at the format of a ULOG line:

```
time (hhmmss).machine_undef!process_name.process_id: log message
```

Now look at an actual line.

```
140542. Message from TPSVRINIT in CSIMPSRV
```

See Also

- `tmsshutdown(1)` in *BEA Tuxedo Command Reference*
- `USERLOG(3cb1)` in *BEA Tuxedo COBOL Function Reference*

5 Tutorial for STOCKAPP, a Full COBOL Application

- What Is STOCKAPP
- Familiarizing Yourself with STOCKAPP
- Preparing STOCKAPP Files and Resources
 - Step 1: How to Set Environment Variables
 - Step 2: Building Servers in STOCKAPP
 - Step 3: Editing the STOCKAPP.mk File
 - Step 4: How to Edit the Configuration File
 - Step 5: Creating a Binary Configuration File
- Running STOCKAPP

What Is STOCKAPP

STOCKAPP is a sample stocks application that is provided with the BEA Tuxedo system software. The application performs the following stock brokering functions: validates and updates a customer's account information, and executes buy and sell orders for stocks and/or funds.

This documentation leads you, step by step, through the procedure you must perform to develop the `STOCKAPP` application. Once you have “developed” `STOCKAPP` through this tutorial, you will be ready to start developing applications of your own.

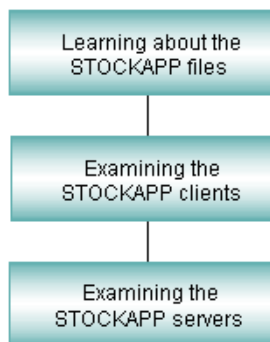
The `STOCKAPP` tutorial is presented in three sections:

- “Familiarizing Yourself with `STOCKAPP`” on page 5-2
- “Preparing `STOCKAPP` Files and Resources” on page 5-10
- “Running `STOCKAPP`” on page 5-23

Note: This information is focused on system users with some experience in application development, administration, or programming. We assume some familiarity with the BEA Tuxedo system software. A development license is required to build BEA Tuxedo applications.

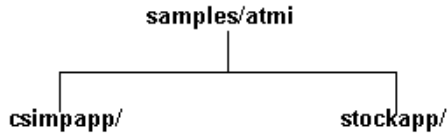
Familiarizing Yourself with `STOCKAPP`

This documentation provides a tour of the files, client, and services that make up the `STOCKAPP` application. Click on any of the following activities for more information about that part of the tour.



Learning About the STOCKAPP Files

The files that make up the STOCKAPP application are delivered in a directory called STOCKAPP, which is positioned as follows.



Exploring the Stock Application Files

The STOCKAPP directory contains the following files:

- Eight .cbl files
- Four clients: BUY.cbl, SELL.cbl, FUNDPD.cbl and FUNDDUP.cbl
- One conversational server: FUNDDUPSR.cbl
- Three files that are servers or are associated with servers
- Two servers to generate data or transactions for the application
- Files provided to facilitate the use of STOCKAPP as an example

The following table lists the files that make up STOCKAPP. The table lists the source files delivered with the BEA Tuxedo system software, files that are generated when the stock application is built, and a summary of the contents of each file.

Table 5-1 Purpose of the Stock Application Files

Source File	Generated File	Contents
BUY.cbl	BUY.o BUY	Client
BUYSR.cbl	BUYSR.o BUYSR	Contains BUY service
ENVFILE		ENVFILE used by tmloadcf
FILES		Descriptive list of all the files in STOCKAPP
FUNDPR.cbl	FUNDPR.o FUNDPR	Client
FUNDPRSR.cbl	FUNDPRSR.o FUNDPRSR	Contains PRICE QUOTE service
FUNDUP.cbl	FUNDUP.o FUNDUP	Client
FUNDUPSR.cbl	FUNDUPSR.o FUNDUPSR	Contains FUND UPDATE service
README		On-line version of the installation and boot procedures
SELL.cbl	SELL.o SELL	Client
SELLSR.cbl	SELLSR.o SELLSR	Contains SELL service
STKVAR		Contains variable settings, except for those within ENVFILE
STOCKAPP.mk		Application makefile
UBBCBSHM	TUXCONFIG	Sample UBBCONFIG file for use in a SHM-mode configuration
cust	CUST.cbl cust.V cust.h	View used to define the structure passed between the BUY and SELL clients and the BUYSR and SELLSR servers

Source File	Generated File	Contents
quote	QUOTE.cbl quote.V quote.h	View used to define the structure passed between the FUNDPR and FUNDUP clients and all the servers

See Also

- “Familiarizing Yourself with STOCKAPP” on page 5-2

Examining the STOCKAPP Clients

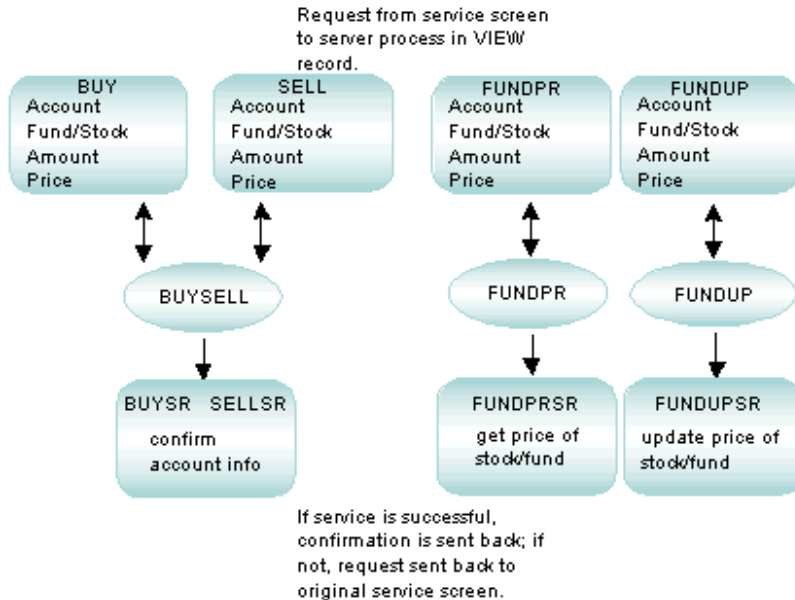
In the client-server architecture of the BEA Tuxedo system, there are two modes of communication:

- Request/response mode, which is characterized by the sending of a single request for a service to be performed by the server and getting back a single response.
- Conversational mode; in this mode a dedicated connection is established between a client (or a server acting like a client) and a server. The connection remains active until terminated. While the connection is active, messages containing service requests and responses can be sent and received between the two participating processes.

System Client Programs

The following figure shows the hierarchy for STOCKAPP. The user selects one of the four service requests. The oval shapes in the illustration represent application services.

Figure 5-1 STOCKAPP Requests



Typed Buffers

Typed buffers are an essential part of the BEA Tuxedo system. In the BEA Tuxedo system, a typed buffer is designed to hold a specific data type. Six types are defined: VIEW, STRING, CARRAY, X_OCTET, X_COMMON, and XML. Applications have the ability to define additional types.

A Request/Response Client: BUY.cbl

BUY is an example of a client program. It makes account inquiries that call on the service BUYSR. As an executable, it is invoked as follows:

```
BUY
```

BUY.cbl Source Code

Review the following sections of the BUY.cbl program.

```
* Now register the client with the system
* Issue a TPCALL
* Clean up
```

The indicated sections contain all of the places in BUY.cbl where the BEA Tuxedo ATMI functions are used. Similar to csimpl.cbl, BUY.cbl needs to call TPINITIALIZE to join the application; call TPCALL to make an RPC request to a service; and call TPTERM to leave an application. Note also that BUY.cbl is an example of a program that uses a VIEW typed record and a structure that is defined in the cust file. The source code for the structure can be found in the view description file, cust.v.

Building Clients

View description files, of which cust is an example, are processed by the view compiler, viewc(1). Run view(c) to compile the view.

```
viewc-C-n
```

```
    cust.v
```

where viewc has three output files: a COBOL file (CUST.cbl), a binary view description file (cust.v), and a header file (cust.h).

The client programs, BUY.cbl, FUNDPR.cbl, FUNDUP.cbl, and SELL.cbl, are processed by buildclient(1) to compile them and/or link edit them with the necessary BEA Tuxedo libraries.

You can use any of these commands individually, if you choose, but rules for all these steps are included in STOCKAPP.mk.

See Also

- “What You Can Do Using the ATMI” on page 2-4 in *Introducing the BEA Tuxedo System*
- “What Are Typed Buffers” on page 2-24 in *Introducing the BEA Tuxedo System*
- ATMI commands and functions in *BEA Tuxedo Command Reference* and *BEA Tuxedo C Function Reference*
- “Familiarizing Yourself with STOCKAPP” on page 5-2

Examining the STOCKAPP Servers

This topic provides the following information:

- A description of a service that is part of the stock application
- A description of the relationships between the STOCKAPP services and servers
- Information on the `buildserver` command options used to compile and build each server

Servers are executable processes that offer one or more services. In the BEA Tuxedo system, they continually accept requests (from processes acting as clients) and dispatch them to the appropriate services. Services are subroutines of COBOL language code written specifically for an application. It is the services accessing a resource manager that provide the functionality for which your BEA Tuxedo system transaction processing application is being developed. Service routines are one part of the application that must be written by the BEA Tuxedo system programmer (user-defined clients being another part).

All STOCKAPP services use functions provided in the Application Transaction Management Interface (ATMI) for performing the following tasks:

- Communicating synchronously or asynchronously with other services
- Defining global transactions
- Sending replies back to clients

STOCKAPP Services

There are four services in STOCKAPP. Each STOCKAPP service matches a COBOL function name in the source code of a server as shown in the following list:

BUYSR

buys a fund/stock record; offered by the BUYSELL server; accepts a VIEW record as input, inserts a CUSTFILE record

SELLSR

sells a fund/stock record; offered by the BUYSELL server; accepts a VIEW record as input, inserts a CUSTFILE record

FUNDPRSR

price quote; offered by the PRICEQUOTE server; accepts a VIEW record as input

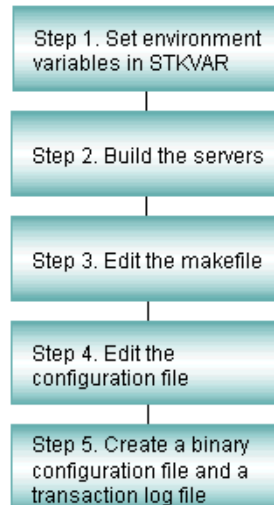
FUNDUPSR

fund update; conversational service; offered by FUNDUPDATE server; accepts a VIEW record as input

Preparing STOCKAPP Files and Resources

This documentation leads you through the procedures you must complete to create the files and other resources you need to run STOCKAPP.

Click on each task for instructions on completing that task.



Step 1: How to Set Environment Variables

Environment variables required for STOCKAPP are defined in the STKVAR file. The file is large (approximately 100 lines) because it includes extensive comments.

1. In a text editor, familiarize yourself with the STKVAR file. Line 9 ensures that TUXDIR is set. If it is not set, execution of the file fails with the following message.

```
TUXDIR: parameter null or not set
```

2. Set `TUXDIR` to the root directory of your BEA Tuxedo system directory structure, and export it.
3. Another line in `STKVAR` sets `APPDIR` to the directory `{TUXDIR}/samples/atmi/STOCKAPP` which is the directory where `STOCKAPP` source files are located: `APPDIR` is a directory where the BEA Tuxedo system looks for your application-specific files. You might prefer to copy the `STOCKAPP` files to a different directory to safeguard the original source files. If you do, then enter the directory there. It does not have to be under `TUXDIR`.
Note: Other variables specified in `STKVAR` play various roles in the sample application; you need to be aware of them when you are developing your own application. By including them in `STKVAR`, we provide you with a template that you may want to adapt at a later time for use with a real application.
4. When you have made all necessary changes to `STKVAR`, execute `STKVAR` as follows.

```
. ./STKVAR
```

Listing 5-1 STKVAR: Environment Variables for STOCKAPP

```
#ident      "@(#)samples/atmi:STOCKAPP/STKVAR
#
# This file sets all the environment variables needed by the TUXEDO software
# to run the STOCKAPP
#
# This directory contains all the TUXEDO software
# System administrator must set this variable
#
TUXDIR=${TUXDIR:?}
#
# This directory contains all the user written code
#
# Contains the full path name of the directory that the application
# generator should place the files it creates
#
APPDIR=${HOME}/STOCKAPP
#
# Environment file to be used by tmloadcf
#
COBDIR=${COBDIR:?}
#
# This directory contains the cobol files needed
```

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```
# for compiling and linking.
#
LD_LIBRARY_PATH=${COBDIR}/coblib:${LD_LIBRARY_PATH}
#
# Add coblib to LD_LIBRARY_PATH
#
ENVFILE=${APPDIR}/ENVFILE
#
# List of field table files to be used by CBLVIEWWC, tmlloadcf, etc.
#
FIELDTBLS=fields,Usysflds
#
# List of directories to search to find field table files
#
FLDTBLDIR=${TUXDIR}/uataobj:${APPDIR}
#
# Set device for the transaction log; this should match the TLOGDEVICE
# parameter under this site's LMID in the *MACHINES section of the
# UBBCBSHM file
#
TLOGDEVICE=${APPDIR}/TLOG
#
# Device for the configuration file
#
UBBCBSHM=${APPDIR}/UBBCBSHM
#
# Device for binary file that gives /T all its information
#
TUXCONFIG=${APPDIR}/TUXCONFIG
#
# Set the prefix of the file which is to contain the central user log;
# this should match the ULOGPFX parameter under this site's LMID in the
# *MACHINES section of the UBBCONFIG file
#
ULOGPFX=${APPDIR}/ULOG
#
# List of directories to search to find view files
#
VIEWDIR=${APPDIR}
#
# List of view files to be used by CBLVIEWWC, tmlloadcf, etc.
#
VIEWFILES=quote.V,cust.V
#
# Set the COBCPY
#
COBCPY=${TUXDIR}/cobinclud
#
# Set the COBOPT
```



```
#
COBOPT="-C ANS85 -C ALIGN=8 -C NOIBMCOMP -C TRUNC=ANSI -C OSEXT=cbl"
#
# Set the CFLAGS
#
CFLAGS="-I$TUXDIR/include -I$TUXDIR/sysinclude"
#
# Export all variables just set
#
export TUXDIR APPDIR ENVFILE
export FIELDTBLS FLDTBLDIR TLOGDEVICE
export UBBCBSHM TUXCONFIG ULOGPFX LD_LIBRARY_PATH
export VIEWDIR VIEWFILES COBDIR COBCPY COBOPT CFLAGS
#
# Add TUXDIR/bin to PATH if not already there
#
a=`echo $PATH | grep ${TUXDIR}/bin`
if [ x"$a" = x ]
then
PATH=${TUXDIR}/bin:$PATH
export PATH
fi
#
# Add APPDIR to PATH if not already there
#
a=`echo $PATH | grep ${APPDIR}`
if [ x"$a" = x ]
then
PATH=${PATH}:${APPDIR}
export PATH
fi
#
# Add COBDIR to PATH if not already there
#
a=`echo $PATH | grep ${COBDIR}`
if [ x"$a" = x ]
then
PATH=${PATH}:${COBDIR}
export PATH
fi
```

Additional Requirements

- On AIX, set `LIBPATH` instead of `LD_LIBRARY_PATH`.
- On HP-UX, set `SHLIB_PATH` instead of `LD_LIBRARY_PATH`.
- If your operating system is Sun Solaris, you need to: put `/usr/5bin` at the beginning of your `PATH`. The following command can be used:

```
PATH=/usr/5bin:$PATH;export PATH
```

Use `/bin/sh` rather than `csh` for your shell.

See Also

- “Preparing STOCKAPP Files and Resources” on page 5-10

Step 2: Building Servers in STOCKAPP

`buildserver` is used to put together an executable server. Options identify the names of the output file, the input files provided by the application, and various libraries that permit you to run a BEA Tuxedo system application in a variety of ways.

`buildserver` with the `-C` option invokes the `cobcc` command. The environment variables `ALTCC` and `ALTCFLAGS` can be set to name an alternative compile command and to set flags for the compile and link edit phases. The key `buildserver` command line options are illustrated in the examples that follow.

The `buildserver` command is used in `STOCKAPP.mk` to compile and build each server in the stock application. (Refer to the `buildserver(1)` in *BEA Tuxedo Command Reference* for complete details.)

How to Build the BUYSELL Server

The BUYSELL server is derived from files that contain the code for the BUYSR and SELLSR functions. The BUYSELL server is first compiled to a BUYSELL.o file before supplying it to the `buildserver` command so that any compile-time errors can be clearly identified and dealt with before this step.

1. Create the BUYSELL.o file (performed for you in STOCKAPP.mk). The `buildserver` command that was used to build the BUYSELL server follows:

```
buildserver -C -v -o BUYSELL -s SELLSR -f SELLSR.cbl -s BUYSR -f BUYSR.cbl
```

The explanation of the command line options follows:

- The `-C` option is used to build servers with COBOL modules.
- The `-v` option is used to specify the verbose mode. It writes the `cc` command to its standard output.
- The `-o` option is used to assign a name to the executable output file. If no name is provided, the file is named `SERVER`.
- The `-s` option is used to specify the service names in the server that are available to be advertised when the server is booted. If the name of the function that performs a service is different from the service name, the function name becomes part of the argument of the `-s` option. In the STOCKAPP, the function name is the same as the name of the service so only the service names themselves need to be specified. It is our convention to specify all uppercase for the service name. However, the `-s` option of `buildserver` does allow you to specify an arbitrary name for the processing function for a service within a server. Refer to the `buildserver(1)` in *BEA Tuxedo Command Reference* for details. It is also possible for the administrator to specify that only a subset of the services that were used to create the server with the `buildserver` command is to be available when the server is booted. For more information, refer to the *Administering a BEA Tuxedo Application at Run Time* and *Setting Up a BEA Tuxedo Application*.
- The `-f` option specifies the files that are used in the link-edit phase. Also refer to the `-l` option on the `buildserver` reference page. For more detail information on both of these options refer to the “Building Servers” on page 5-32 in *Programming a BEA Tuxedo Application Using COBOL*. There is a significance to the order in which the files are listed. The order is dependent on function references and in what libraries the references are resolved.

Source modules should be listed ahead of libraries that might be used to resolve their references. If these are `.cbl` files, they are first compiled. Object files can be either separate `.o` files or groups of files in archive (`.a`) files. If more than a single filename is given as an argument to a `-f`, the syntax calls for a list enclosed in double quotes. You can use as many `-f` options as you need.

- The `-s` option names the `SELLSR` and `BUYSR` services to be the services that comprise the `BUYSELL` server. The `-o` option assigns the name `BUYSELL` to the executable output file and the `-f` option specifies that the `SELLSR.cbl` and the `BUYSR.cbl` files are to be used in the link edit phase of the build.

Servers Built in STOCKAPP.mk

The topics on creating the `STOCKAPP` servers are important to your understanding of how the `buildserver` command is specified. However, in actual practice you are apt to incorporate the build into a makefile; that is the way it is done in `STOCKAPP`.

See Also

- “Familiarizing Yourself with `STOCKAPP`” on page 5-2
- `buildserver(1)`

Step 3: Editing the STOCKAPP.mk File

`STOCKAPP` includes a `makefile` that makes all scripts executable, converts the view description file to binary format, and does all the precompiles, compiles, and builds necessary to create the application servers. It can also be used to clean up when you want to make a fresh start.

As `STOCKAPP.mk` is delivered, there are a few fields you may want to edit, and some others that may benefit from some explanation.

How to Edit the TUXDIR Parameter

Go to the following comment in STOCKAPP.mk and to the TUXDIR parameter:

```
#
# Root directory of TUXEDO System. This file must either be edited to set
# this value correctly, or the correct value must be passed via "make -f
# STOCKAPP.mk TUXDIR=/correct/rootdir", or the build of STOCKAPP will fail.
#
TUXDIR=../..
```

You should set the TUXDIR parameter to the absolute path name of the root directory of your BEA Tuxedo system installation.

How to Edit the APPDIR Parameter

You may want to give some thought to the setting of the APPDIR parameter. As STOCKAPP is delivered, APPDIR is set to the directory in which the STOCKAPP files are located, relative to TUXDIR. The following section of STOCKAPP.mk defines and describes the setting of APPDIR.

```
#
# Directory where the STOCKAPP application source and executables live.
# This file must either be edited to set this value correctly, or the
# correct value must be passed via "make -f STOCKAPP.mk
# APPDIR=/correct/appdir", or the build of STOCKAPP will fail.
#
APPDIR=$(TUXDIR)/samples/atmi/STOCKAPP
#
```

If you have copied the files to another directory, as suggested in the README file, you should set APPDIR to the name of the directory to which you copied the files. When you run the makefile, the application will be built in this directory.

How to Run the STOCKAPP.mk File

1. When you have completed the changes you wish to make to STOCKAPP.mk, run it with the following command line.

```
nohup make -f STOCKAPP.mk install &
```

2. Check the nohup.out file to make sure the process completed successfully.

See Also

- “Preparing STOCKAPP Files and Resources” on page 5-10

Step 4: How to Edit the Configuration File

The STOCKAPP configuration file defines how an application runs on a set of machines. STOCKAPP is delivered with a configuration file in text format described in UBBCONFIG(5). UBBCBSHM, defines an application on a single computer.

1. In a text editor, familiarize yourself with the configuration file for STOCKAPP.

Listing 5-2 UBBCBSHM Configuration File Fields to Be Replaced

```
#Copyright (c) 1992 Unix System Laboratories, Inc.
#All rights reserved
#Skeleton UBBCONFIG file for the TUXEDO COBOL Sample Application.
*RESOURCES
IPCKEY                5226164
DOMAINID              STOCKAPP
001 UID                <user id from id(1)>
002 GID                <group id from id(1)>
MASTER               SITE1
PERM                  0660
MAXACCESSERS         20
MAXSERVERS           15
MAXSERVICES          30
MODEL                SHM
LDBAL                Y
MAXGTT               100
MAXBUFTYPE           16
MAXBUFSTYPE          32
SCANUNIT             10
SANITYSCAN           12
DBBLWAIT             6
BBLQUERY             180
BLOCKTIME            10
TAGENT               "TAGENT"
#
```

Step 4: How to Edit the Configuration File

```
*MACHINES
003 <SITE1's uname>      LMID=SITE1
004                     TUXDIR=" <TUXDIR1>"
005                     APPDIR=" <APPDIR1>"
                           ENVFILE=" <APPDIR1>/ENVFILE"
                           TUXCONFIG=" <APPDIR1>/TUXCONFIG"
                           TUXOFFSET=0
006                     TYPE=" <machine type>"
                           ULOGPFX=" <APPDIR>/ULOG"
                           MAXWSCLIENTS=5
#
*GROUPS
COBAPI                  LMID=SITE1          GRPNO=1
#
#
*SERVERS
FUNDUPSR SRVGRP=COBAPI  SRVID=1 CONV=Y ENVFILE=" <APPDIR1>/ENVFILE"
FUNDPRSR SRVGRP=COBAPI  SRVID=2 ENVFILE=" <APPDIR1>/ENVFILE"
BUYSELL  SRVGRP=COBAPI  SRVID=3 ENVFILE=" <APPDIR1>/ENVFILE"
#
#
*SERVICES
```

2. To enable the application password feature, add the following line to the `RESOURCES` section of `UBBCBSHM`.

```
SECURITY APP_PW
```

3. You may notice that the values of some parameters are enclosed in angle brackets (`<>`). Values shown in angle brackets are generic; you need to replace them with values that pertain to your installation. All of these fields occur within the `RESOURCES`, `MACHINES`, and `GROUPS` sections in the file. The following table describes the values with which you must replace the angle-bracketed strings. For each `string`, substitute an appropriate value.

Table 5-2 Explanation of Values

Line	String to Be Replaced	Purpose
001	UID	The effective user ID for the owner of the bulletin board IPC structures. In a multiprocessor configuration, the value must be the same on all machines. You avoid problems if this is the same as the owner of the BEA Tuxedo software.
002	GID	The effective group ID for the owner of the bulletin board IPC structures. In a multiprocessor configuration, the value must be the same on all machines. Users of the application should share this group ID.
003	SITE1 name	The node name of the machine. Use the value produced by the UNIX command: uname -n
004	TUXDIR	The absolute path name of the root directory for the BEA Tuxedo system software. Make this a global change to put the value in all occurrences of <TUXDIR1> in the file.
005	APPDIR	The absolute path name of the directory where the application runs. Make this a global change to put the value in all occurrences of <APPDIR1> in the file.
006	<i>machine type</i>	This parameter is important in a networked application where machines of different types are present. The BEA Tuxedo system checks for the value on all communication between machines. Only if the values are different are the message encode/decode routines called to convert the data.

See Also

- “Preparing STOCKAPP Files and Resources” on page 5-10
- `UBBCONFIG(5)` in *BEA Tuxedo File Formats and Data Descriptions Reference*

Step 5: Creating a Binary Configuration File

Before Creating the Binary Configuration File

Before creating the binary configuration file, you need to be in the directory in which your `STOCKAPP` files are located and you must set the environment variables. Complete the following tasks.

1. Go to the directory in which your `STOCKAPP` files are located.
2. Set the environment variables by entering

```
. ./STKVAR
```

How to Load the Configuration File

Once you have finished editing the configuration file, you must load it into a binary file on your `MASTER` machine. The name of the binary configuration file is `TUXCONFIG`; its path name is defined in the `TUXCONFIG` environment variable. The file should be created by a person with the effective user ID and group ID of the BEA Tuxedo system administrator, which should be the same as the `UID` and `GID` values in your configuration file. If this requirement is not met, you may have permission problems in running `STOCKAPP`.

1. To create `TUXCONFIG`, enter the following command.

```
tmloadcf UBECBSHM
```

While the configuration file is being loaded, you are prompted several times to confirm that you want to install this configuration, even if doing so means an existing configuration file must be overwritten. If you want to suppress such prompts, include the `-y` option on the command line.

2. If you want the amount of IPC resources needed by your application to be calculated by the BEA Tuxedo system, include the `-c` option on the command line.

`TUXCONFIG` can be installed only on the `MASTER` machine; it is propagated to other machines by `tmboot` when the application is booted.

If you have specified `SECURITY` as an option for the configuration, `tmloadcf` prompts you to enter an application password. The password you select can be up to 30 characters long. Client processes joining the application are required to supply the password.

`tmloadcf` parses the text configuration file (`UBBCONFIG`) for syntax errors before it loads it, so if there are errors in the file, the job fails.

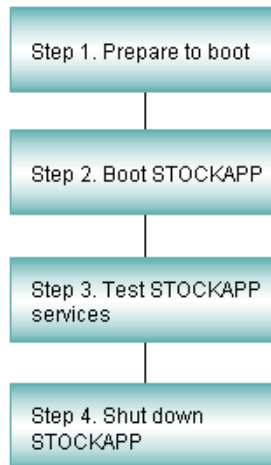
See Also

- “Preparing STOCKAPP Files and Resources” on page 5-10
- `tmloadcf(1)` in *BEA Tuxedo Command Reference*

Running STOCKAPP

This documentation leads you through the procedures for booting STOCKAPP, testing it by running various client programs and transactions, and shutting it down when you have finished.

Click on each task for instructions on completing that task.



Step 1: How to Prepare to Boot

1. Before booting STOCKAPP, verify that your machine has enough IPC resources to support your application. To generate a report on IPC resources, run the `tmboot` command with the `-c` option.

Listing 5-3 IPC Report

```

Ipc sizing (minimum /T values only)
      Fixed Minimums Per Processor
SHMMIN: 1
SHMALL: 1
SEMMAP: SEMMNI

      Variable Minimums Per Processor
SEMUME,      A      SHMMAX
SEMNU,      *      *
Node      SEMMNS  SEMMNSL  SEMMNSL  SEMMNI  MSGMNI  MSGMAP  SHMSEG
-----
machine 1      60      1      60  A + 1      10      20      76K
machine 2      63      5      63  A + 1      11      22      76K
where 1 <= A <= 8.

```

2. You should add the number of application client used per processor to each MSGMNI value. MSGMAP should be twice MSGMNI.
3. Compare the minimum IPC requirements to the parameters set for your machine. The location of these parameter settings is platform-dependent:
 - On many UNIX system platforms, machine parameters are defined in `/etc/conf/cf.d/mtune`.
 - On Windows NT platforms, machine parameters are set and displayed through a control panel.

See Also

- “Running STOCKAPP” on page 5-23

Step 2: How to Boot STOCKAPP

1. Set the environment.

```
../STKVAR
```

2. Boot the application by entering the following.

```
tmbboot
```

The following prompt is displayed.

```
Boot all admin and server processes? (y/n): y
```

When you enter `y` after the prompt, a running report, such as the following, is displayed on the screen.

```
Booting all admin and server processes in
/usr/me/appdir/tuxconfig
Booting all admin processes
exec BBL -A:
        process id=24223 Started.
```

The report continues until all servers in the configuration have been started. It ends by reporting the total number of servers started.

If you prefer, you can boot only a portion of the configuration. For example, to boot only administrative servers, include the `-A` option. If no options are specified, the entire application is booted.

In addition to reporting on the number of servers booted, `tmbboot` also sends messages to the `ULOG`.

See Also

- “Running STOCKAPP” on page 5-23
- `tmbboot(1)` in *BEA Tuxedo Command Reference*
- `USERLOG(3cbl)` in *BEA Tuxedo COBOL Function Reference*

Step 3: How to Test STOCKAPP Services

1. If you are logging in cold to a running system, you must set your environment for STOCKAPP. To do so, enter the following command.

```
.. /STKVAR
```

2. Run the BUY client program. To execute the BUY client program, enter the following command.

```
BUY
```

3. Monitor STOCKAPP. While STOCKAPP is running, run the `tmadmin` subcommands and try various commands with it to see the kind of status information you can produce.

See Also

- “Running STOCKAPP” on page 5-23

Step 4: How to Shut Down STOCKAPP

To bring down STOCKAPP, enter the `tmshutdown(1)` command with no arguments, from the MASTER machine, as follows.

```
tmshutdown
```

Running this command (or the shutdown command of `tmadmin`) causes the following results:

- All application servers, gateway servers, TMS's, and administrative servers are shut down.
- All associated IPC resources are removed.

See Also

- “Running STOCKAPP” on page 5-23
- `tadmin(1)` in *BEA Tuxedo Command Reference*
- `tmsshutdown(1)` in *BEA Tuxedo Command Reference*

