XA Interface Integration Guide for CICS, Encina, and TUXEDO

Adaptive Server Enterprise

Version 12

Document ID: 36123-01-1200-01

Last revised: October 1999

Sybase, Inc., 6475 Christie Avenue, Emeryville, CA 94608.

Contents

About This Book

Audience

This guide serves as a reference manual for:

- System administrators setting up a distributed transaction processing (DTP) environment that includes one or more Adaptive Servers with Distributed Transaction Management features, accessed by transactions from within a CICS, Encina, or TUXEDO TM system.
- Application programmers using Embedded SQL™ or Client-Library™ to access data on one or more Adaptive Servers.

This manual assumes the reader is familiar with:

- The TM operating environment
- Embedded SQL
- Open Client™ Client-Library
- Adaptive Server administration

How to use this book

Use this guide to help configure your environment and code your application in order to access data stored on one or more Adaptive Servers from within a CICS, Encina, or TUXEDO TM.

Chapter 1, “Introduction” summarizes the steps necessary to fully integrate the DTM XA Interface into your environment.

Chapter 2, “The Sybase XA Environment” provides background information designed to help you place the Sybase XA environment into the larger context of distributed transaction processing and transaction management. It reviews the X/Open DTP model of distributed transaction processing and fits the Sybase DTM XA Interface into this model. In addition, it describes how the individual components of the Sybase XA environment work together to allow your application to access Adaptive Server data from a TM.

Chapter 3, “Configuring the XA Environment” gives instructions for configuring your environment to fully integrate your application, Sybase DTM XA Interface, one or more Adaptive Servers, and your TM software.

Chapter 4, “Application Programming Guidelines” explains how to make your Embedded SQL or Client-Library application conform to certain coding constraints that the Sybase XA environment imposes.

Related documents

The *Installation Guide* for your platform explains how to install Adaptive Server and the DTM XA Interface. It also describes how to install licenses for Adaptive Server features such as Distributed Transaction Management.

To use this manual, you should also be familiar with the information described in the following manuals:

- *Using Adaptive Server Distributed Transaction Management Features*
- *X/Open CAE Specification (December 1991) Distributed Transaction Processing: The XA Specification*
- *Open Client Embedded SQL/COBOL Programmer's Guide or Open Client Embedded SQL/C Programmer's Guide*
- *Open Client Embedded SQL Reference Manual*
- *Open Client-Library/C Reference Manual*
- *Open Client-Library/C Programmer's Guide*
- *System Administration Guide*
- Your CICS, Encina, or TUXEDO TM documentation set

Other sources of information

Use the Sybase Technical Library CD and the Technical Library Product Manuals web site to learn more about your product:

- Technical Library CD contains product manuals and technical documents and is included with your software. The DynaText browser (included on the Technical Library CD) allows you to access technical information about your product in an easy-to-use format.

  Refer to the *Technical Library Installation Guide* in your documentation package for instructions on installing and starting Technical Library.

- Technical Library Product Manuals web site is an HTML version of the Technical Library CD that you can access using a standard web browser. In addition to product manuals, you'll find links to the Technical Documents web site (formerly known as Tech Info Library), the Solved Cases page, and Sybase/Powersoft newsgroups.

  To access the Technical Library Product Manuals web site, go to Product Manuals at http://sybooks.sybase.com.

Sybase certifications on the web

Technical documentation at the Sybase web site is updated frequently.

- **For the latest information on product certifications and/or the EBF Rollups:**

  1. Point your web browser to Technical Documents at http://techinfo.sybase.com.
  2. In the Browse section, click on What's Hot.
  3. Select links to Certification Reports and EBF Rollups, as well as links to Technical Newsletters, online manuals, and so on.

- **If you are a registered SupportPlus user:**

  1. Point your web browser to Technical Documents at http://techinfo.sybase.com.
  2. In the Browse section, click on What's Hot.
  3. Click on EBF Rollups.

     You can research EBFs using Technical Documents, and you can download EBFs using Electronic Software Distribution (ESD).
  4. Follow the instructions associated with the SupportPlus^{SM} Online Services entries.

- **If you are not a registered SupportPlus user, and you want to become one:**

  You can register by following the instructions on the Web.

  To use SupportPlus, you need:

  1. A Web browser that supports the Secure Sockets Layer (SSL), such as Netscape Navigator 1.2 or later
  2. An active support license
  3. A named technical support contact
  4. Your user ID and password

- **Whether or not you are a registered SupportPlus user:**

  You may use Sybase's Technical Documents. Certification Reports are among the features documented at this site.

  1. Point your web browser to Technical Documents at http://techinfo.sybase.com
  2. In the Browse section, click on What's Hot.
  3. Click on the topic that interests you.

If you need help

Each Sybase installation that has purchased a support contract has one or more designated people who are authorized to contact Sybase Technical Support. If you cannot resolve a problem using the manuals or online help, please have the designated person contact Sybase Technical Support or the Sybase subsidiary in your area.

CHAPTER 1

Introduction

The DTM XA Interface is Sybase's implementation of the XA interface standard, which is one element of the X/Open Distributed Transaction Processing (DTP) model. The X/Open DTP model provides an industry standard for development of distributed transaction processing applications.

Use the XA Interface to access data stored on Adaptive Server(s) from within a CICS, Encina, or TUXEDO TM. If you wish to use native Adaptive Server Distributed Transaction Management (DTM) features with or without a TM, see *Using Adaptive Server Distributed Transaction Management Features*.

To enable a TM transaction to access data stored on Adaptive Server, you must:

1 Install Adaptive Server, the Distributed Transaction Management feature, and the DTM XA Interface. Software installation and feature licenses are described in the Adaptive Server *Installation Guide* for your platform.

Note Distributed Transaction Management is a separately-licensed Adaptive Server feature. You must purchase and install a valid license for DTM before it can be used.

---

2 Start Adaptive Server with support for the Distributed Transaction Management feature. See *Using Adaptive Server Distributed Transaction Management Features* for information on how to configure the DTM feature.

3 Configure the TM software to run with an Embedded SQL or Client-Library application and Adaptive Server, as described in Chapter 3, "Configuring the XA Environment".

4 Make the Embedded SQL or Client-Library application conform to certain coding constraints, as described in Chapter 4, "Application Programming Guidelines".

5 Start the CICS, Encina, or TUXEDO TM.

Note To administer global recovery manually in the Sybase XA environment, you must invoke XA-specific **dbcc** commands, as described in *Using Adaptive Server Distributed Transaction Management Features*.

Requirements

XA Interface for Adaptive Server version 12 is compatible with:

- Open Client 12.0 or later
- Embedded SQL 12.0 or later
- Adaptive Server 12
- CICS/6000 2.1.1.6
- Encina 2.5/TX Series 4.2
- TUXEDO 6.4 (6.3/6.4 on IBM platforms)

CHAPTER 2

The Sybase XA Environment

This chapter includes these sections:

This chapter describes the X/Open DTP model, and shows how the components of the Sybase XA environment—including the DTM XA Interface, your application program, and Adaptive Server, among others—fit into that model. It also discusses how connections are established and managed in the Sybase XA environment.

Definitions

The X/Open DTP model assumes an understanding of certain terms. The following section defines these fundamental concepts:

- **transaction** – A whole unit of work consisting of one or more computational tasks. Most often, a transaction's tasks manipulate shared resources.
- **committed transaction** – A completed transaction whose changes to any shared resources are permanent.
- **rolled-back transaction** – A complete transaction whose changes to any shared resources are nullified.
- **ACID test** – The test of a true transaction; to pass, the transaction must exhibit the following properties:
    - **Atomicity** – All or none of the results of the transaction take effect.
    - **Consistency** – If a transaction is rolled back, all resources that the transaction affected return to the state they were in prior to the transaction's execution.
    - **Isolation** – A transaction's results are visible only to that transaction until the transaction commits.
    - **Durability** – Permanent resource changes resulting from commitment survive subsequent system failures.
- **transaction processing** – A system of coordinating the transactions that multiple users perform on shared, centralized resources.
- **distributed transaction processing** – A transaction processing model in which the shared resources are located at distinct physical sites on a computer network.
- **local transaction** – A transaction that affects data in a single database and whose tasks a single resource manager performs. See "Overview of the X/Open DTP MODEL" on page 8 for a definition of Resource Managers.
- **global transaction** – A transaction that spans more than one database and multiple resource managers.
- **transaction branch** – A portion of the work that makes up a global transaction.

- **transaction identifier** – An identifier that a TM assigns to a transaction. The transaction monitor uses the transaction identifier to coordinate all activity related to a global transaction. The resource manager uses the global identifier to match the recoverable tasks it performed for the transaction.
- **recovery** – The process of bringing a transaction processing system into a consistent state after a failure. Specifically, this means resolving transactions left in a non-committed state.

Overview of the X/Open DTP MODEL

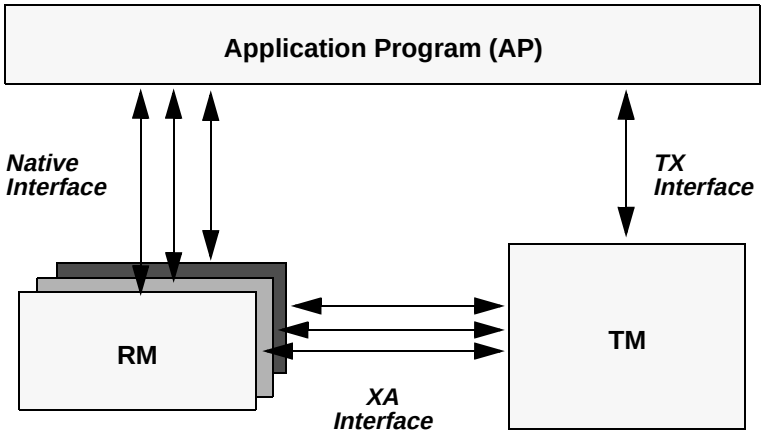
The X/Open DTP model is a model for software architecture that allows multiple application programs to share resources provided by multiple resource managers, and allows their work to be coordinated into global transactions.

The X/Open DTP model identifies the key entities in a distributed transaction processing environment and standardizes their roles and interactions. The entities are:

- The transaction processing monitor (TM)
- The resource manager (RM)
- The application program (AP)

This section discusses the X/Open DTP functional model, including its major components and their interfaces. Figure 2-1 shows the X/Open DTP model.

Figure 2-1: A conceptual view of the X/Open DTP model



These components communicate through the native, XA, and TX interfaces as described in “How the Components Communicate” on page 9.

Components of the Model

The X/Open DTP functional model consists of the following components:

- The Application Program (AP)

- The Resource Manager (RM)
- The Transaction Processing Monitor (TM)

The Application Program (AP)

The AP contains the code written to accomplish a particular transaction or portion thereof. As such, it designates the beginning and end of global transactions.

The Resource Manager (RM)

The RM provides access to shared resources. Database servers, file servers, and print servers are examples of RMs. In a typical X/Open DTP environment, a single AP communicates with more than one RM.

The Transaction Processing Monitor (TM)

The TM coordinates the communication between all parties participating in the transaction. The TM assures that the work done by the AP is contained in a global transaction, which will commit or abort atomically.

Specifically, the TM's tasks include:

- Assigning global identifiers to transactions
- Monitoring the progress of global transactions
- Coordinating the flow of transaction information between the AP(s) and the RMs
- Managing the transaction commitment protocol and failure recovery. For details, see "Step 2: Commitment" on page 10.

How the Components Communicate

The application program, the RM, and the TM communicate via three distinct interfaces: native, TX, and XA.

The Native Interface

The native interface is the medium by which the AP makes requests directly to the RM. In the Sybase XA environment, the native interface is either Embedded SQL or Client-Library.

The TX Interface

The TX interface is the medium between the AP and the TM. The AP uses TX calls to delineate transaction boundaries. In other words, the AP requests that the TM start and commit or roll back global transactions, via the TX interface.

The XA Interface

The XA interface is the medium between the RM and the TM. The DTM XA Interface is Sybase's version of the interface for Adaptive Server 12. Using XA calls, the TM tells the RM when transactions start, commit, and roll back. The TM also handles recovery.

How the Components Interact

The components work together to process transactions from initiation through completion.

Step 1: Initiation

The application program delimits transaction boundaries. An AP informs the TM, via TX calls, that a global transaction is beginning. The TM then communicates with all available RMs, via XA calls, to associate a single transaction identifier with any work the RMs will do on behalf of the AP within the bounds of the global transaction.

Step 2: Commitment

When the AP requests that the TM commit the global transaction, the TM and the RMs use the two-phase commit protocol to guarantee transaction atomicity.

The Two-Phase Commit Protocol

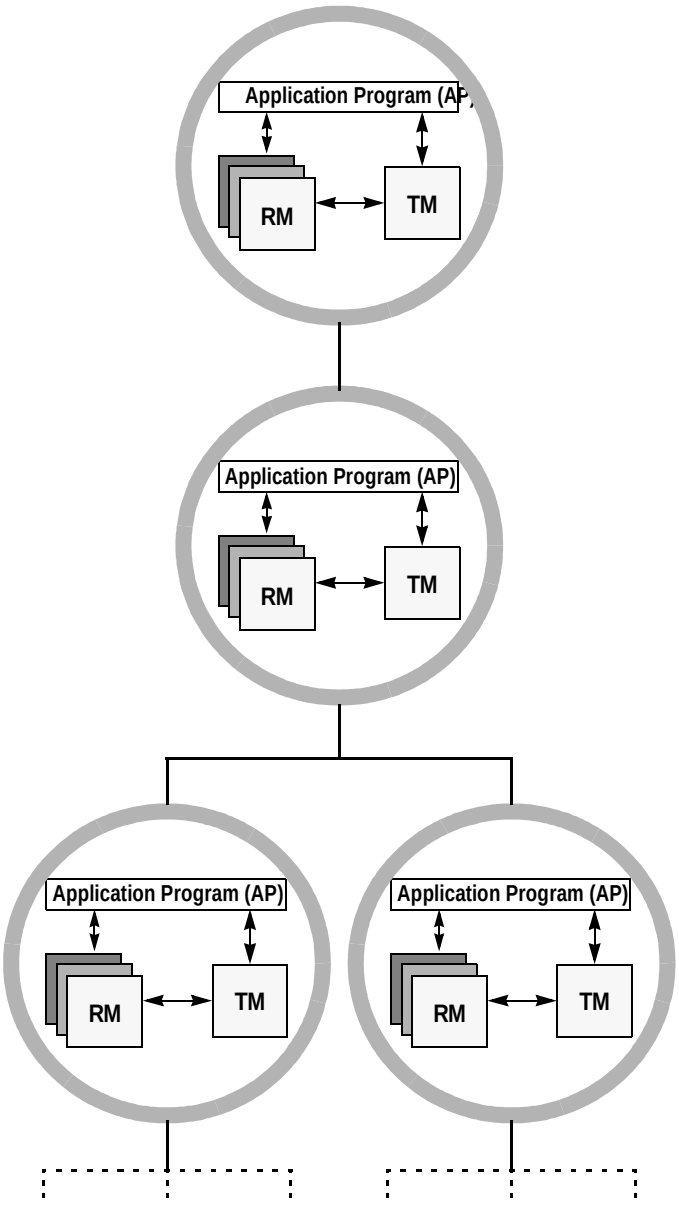
Transaction completion takes place in two phases—the prepare phase and the commit phase. For a detailed description of the two-phase commit protocol, see the *Open Client DB-Library/C Reference Manual*.

In the prepare phase, the TM requests each RM to prepare to commit its portion of the global transaction. This portion is known as a **transaction branch**.

In the commit phase, the TM instructs the RMs to commit or abort their branches of the transaction. If all RMs report back that they have prepared their respective transaction branches, the TM commits the entire transaction. If any RM reports that it was unprepared or fails to respond, the TM rolls back the entire transaction.

Figure 2-2 shows a typical transaction branch structure.

Figure 2-2: Transaction branches



Recovery

The TM is responsible for managing global recovery. In certain situations, an administrator may decide to complete its transaction branch independently of the TM. When this occurs, the administrator's decision is called a *heuristic decision*.

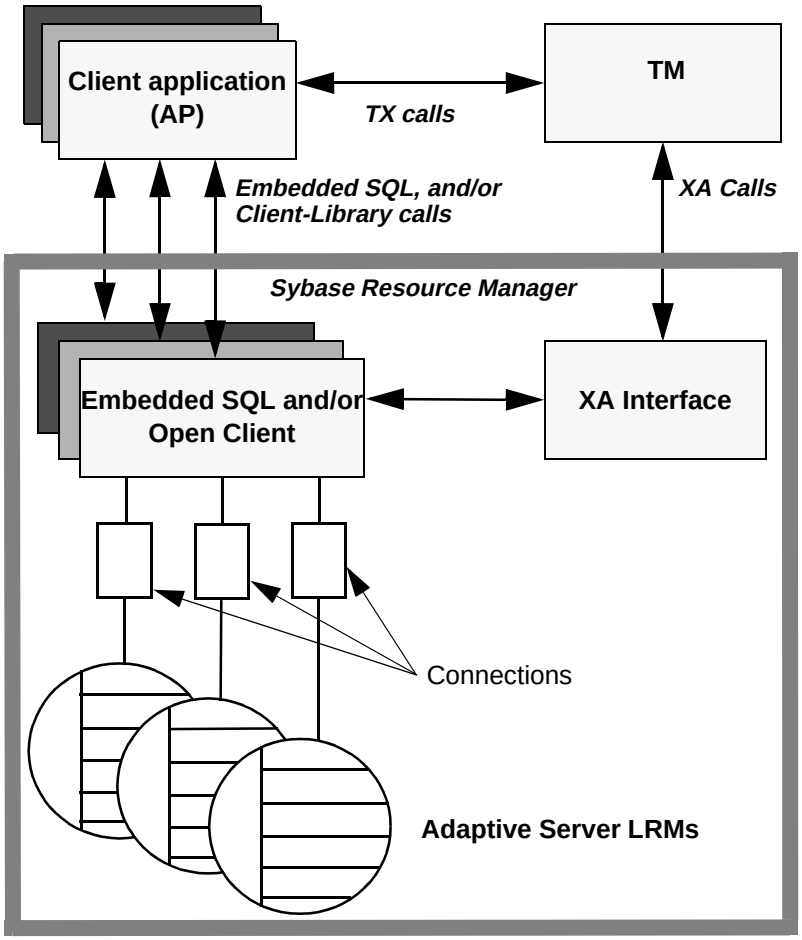
The heuristic decision may be in conflict with the TM's decision. For example, the administrator may commit a transaction branch and the TM may request to abort it.

Such a conflict requires manual intervention from the system administrator. For a discussion of heuristic decisions in the Sybase XA environment, see *Using Adaptive Server Distributed Transaction Management Features.*

The Sybase XA Environment

The DTM XA Interface relies on Sybase's transaction processing model to implement X/Open's DTP model. Adaptive Server is used as an RM, as shown in Figure 2-3.

Figure 2-3: The Sybase XA DTP model



Components of the Sybase XA Environment

The Sybase XA environment consists of:

- The Sybase DTM XA Interface. This is Sybase's implementation of the XA interface for Adaptive Server 12, described in "How the Components Communicate" on page 9.
- The Open Client libraries. Client-Library calls can be part of the "native" interface between your application and the resource manager.
- Embedded SQL/C and Embedded SQL/COBOL. Embedded SQL calls can be part of the "native" interface between your application and the resource manager.
- One or more Adaptive Servers. These play the role of Resource Managers.
- The XA configuration file. This file contains entries that define client/server connections for use with XA.
- A set of XA-specific **dbcc** commands. System administrators use these to manage heuristic transactions.
- TM-specific configuration files and commands.

Chapter 3, "Configuring the XA Environment" explains how to configure these components so that transactions can use the DTM XA Interface to access data stored on Adaptive Server.

Connections in the Sybase XA Environment

The X/Open DTP model has no notion of connections, yet connections are central to the Sybase client/server architecture. The Sybase XA environment must resolve this discrepancy.

To this end, the Sybase XA environment introduces the notion of a logical resource manager (LRM).

Identifying Connections Via LRMs

Each instance of the Sybase RM appears to the TM as one or more LRMs.

An LRM associates a symbolic name with a client-server connection. An AP uses the names to identify the specific physical connection to one or more Adaptive Servers. The TM uses the names to open connections on behalf of the AP.

Where Is the Connection Information Stored?

The following components of the Sybase XA environment contain information about LRMs. The system administrator configures these files before starting up the TM. For information on the full configuration process, see Chapter 3, “Configuring the XA Environment”.

The Sybase XA configuration file

The Sybase XA configuration file contains one entry per LRM. The entry associates the LRM with a physical Adaptive Server name, and assigns pre-connection Client-Library capabilities and properties to the LRM. For details on the XA configuration file, see “XA Configuration File for DTM XA Interface” on page 26.

The CICS XA product definition (XAD)

The CICS XAD contains one stanza per LRM. The stanza assigns each LRM a user name and password in the form of an open string. The user name and password enable the Sybase XA environment to control a particular connection’s access to Adaptive Server resources. For details on the CICS XAD file, see “Adding a Sybase Stanza to the CICS Region XAD Definition” on page 35.

The Encina *monadmin create rm* command

The **monadmin create rm** command assigns each LRM a user name and password in the form of an *open string*. The user name and password allow the Sybase XA environment to control a particular connection's access to Adaptive Server resources. For details on the Encina **monadmin** command, see "Assigning an Open String with monadmin create rm" on page 37. Your current version of Encina may have additional commands for specifying RMs.

Note The Encina **enconsole** interactive command can be used instead of the shell **monadmin** command.

For detailed information, see the *Encina Monitor System Administrator's Guide and Reference.*

TUXEDO's UBBCONFIG file

In addition to modifying the Sybase configuration files, integrating TUXEDO requires customizing the TUXEDO configuration file, *UBBCONFIG*. The *open string* is the only portion of the *UBBCONFIG* file that requires modification. It includes the user name and password, which allow XA-Server to control a connection's access to SQL Server resources. See "Setting Up the UBBCONFIG File" on page 42 for details.

Establishing Connections

The TM, together with the XA Interface, establishes connections between applications and RMs in several steps.

CICS Steps

For CICS environments:

1 When the CICS region starts up, it issues an XA open call to each LRM configured in an XAD, using the information contained in each open string.

2 The CICS region passes to the XA Interface library the open string associated with each stanza. The open string contains the LRM name, the user name, and the password.

3 The XA Interface looks up the LRM name in the Sybase XA configuration file and matches it to an actual RM name, that is, an actual physical Adaptive Server. The RM name matches an entry in the Adaptive Server interfaces file.

4 The XA Interface establishes one connection to an Adaptive Server for each LRM entry. The XA Interface confers on any connection the pre-connection properties and capabilities configured for the LRM.

Encina Steps

For Encina environments:

1 An application issues a **mon_RegisterRmi** function, thereby requesting use of an LRM.

2 Using information contained in an open string, the TM issues an XA open call to the LRM (configured in the **monadmin create rm** command) whose name matches that issued in step 1, above.

3 The TM passes the open string associated with each **monadmin create rm** command to the XA Interface. The open string contains the LRM name.

4 The XA Interface looks up the LRM name in the Sybase XA configuration file and matches it to an actual RM name—that is, to an actual physical Adaptive Server. The RM name matches an entry in the Adaptive Server interfaces file.

5 The XA Interface establishes one logical connection to an Adaptive Server for each LRM entry. The XA Interface confers on any connection the pre-connection properties and capabilities configured for the LRM.

TUXEDO Steps

For TUXEDO environments:

1 The application uses the LRM specified in the *UBBCONFIG* file to reference the logical connection for a branch of a global transaction. In using the LRM name, the application implicitly requests and establishes an LRM.

2 The transaction manager passes the appropriate open string to the XA Interface through the LRM whose name matches the one issued in step 1. The XA Interface uses the LRM name, the user name, and the password.

3 The XA Interface looks in the *xa_config* file to find an association between the LRM name and Adaptive Server. The Adaptive Server name matches an entry in the *interfaces* file where its network information is kept.

Distributing Work Across LRMs

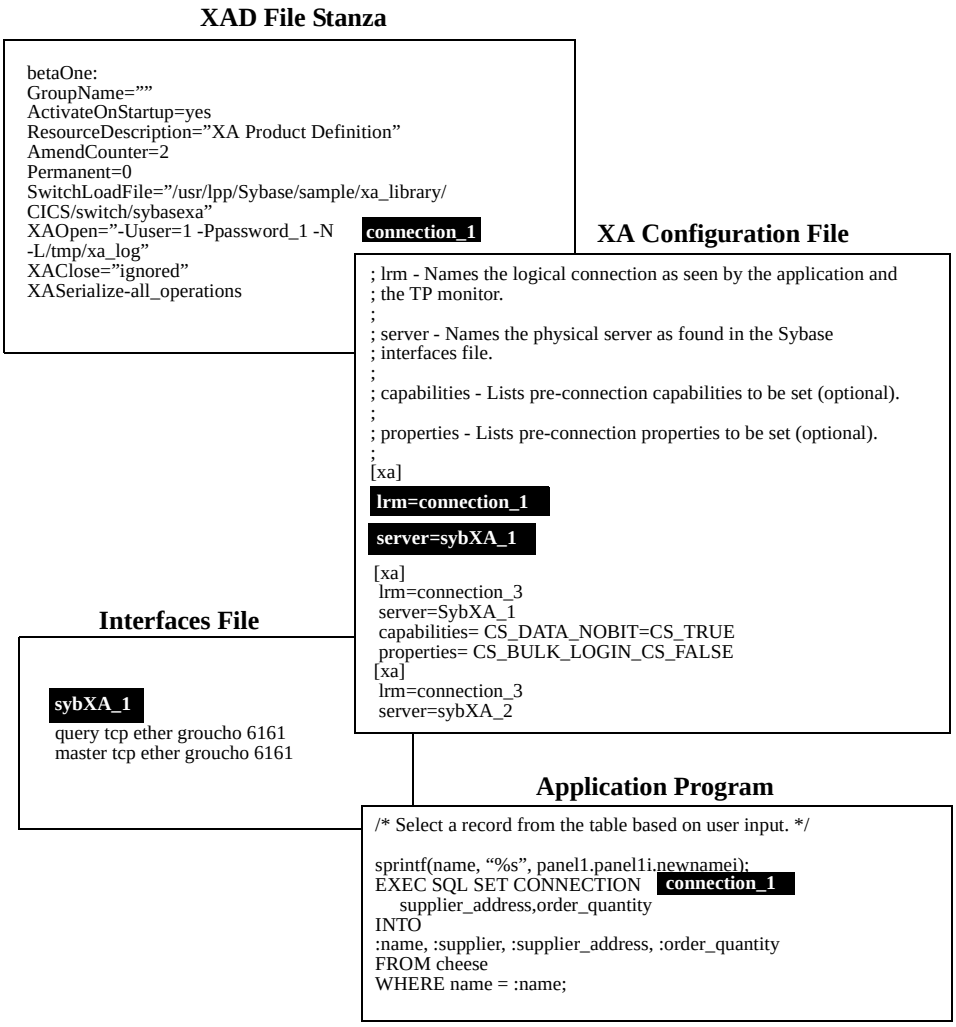
The System Administrator and the application programmer together must agree on the number and names of LRMs that their Sybase XA environment includes.

The system administrator configures the TM and Sybase XA configuration files accordingly. The application programmer invokes a particular LRM name within the application code to send a portion of a global transaction across that connection. The TM coordinates this distribution.

The Sybase XA environment may be configured for more connections than are actually used. That is, the XA configuration file may contain inactive entries.

Figure 2-4 depicts the relationship between the Sybase XA configuration file, TM configuration file, application code, and Adaptive Server interfaces file for a CICS environment.

Figure 2-4: Relating components of the Sybase XA environment for CICS



CHAPTER 3

Configuring the XA Environment

The DTM XA interface provides the same application interface as Sybase's earlier XA-Library and XA-Server products. However, you must link the DTM XA interface library with your X/Open XA-compliant transaction manager to use Adaptive Server version 12 as a resource manager.

This chapter describes how to configure the XA environment for use with CICS, Encina, and TUXEDO TMs. It contains these sections:

Note See also the *README* file under the subdirectories of *$SYBASE/$SYBASE_OCS/sample* for detailed information about configuring the XA DTM interface for your system.

Configuring Adaptive Server

To function in a Sybase XA environment, your Adaptive Server must be licensed and configured to use the Distributed Transaction Management feature. See the *Installation Guide* and *Using Adaptive Server Distributed Transaction Management Features* for more information.

If your Adaptive Server is licensed to use Distributed Transaction Management, you can enable the feature using the **enable dtm** configuration parameter:

```
sp_configure 'enable dtm', 1
```

You must reboot Adaptive Server for this parameter to take effect.

Open String Parameters for DTM XA Interface

The X/Open XA specification allows each resource manager vendor to define an open string and a close string. (The DTM XA interface does not require or use the close string.

The DTM XA interface uses the required and optional open string parameters described below.

Open String Parameters

The format for parameters in the open string for the DTM XA interface is:

-N*lrm_name* -U*username* -P*password* [-Llogfile_name] [-Ttraceflags] [-V11]

Table 3-1 describes each component of the open string.

Table 3-1: Sybase X/Open XA Open String Parameters

Parameter	Meaning
lrm_name	The name of the LRM as defined in the XA configuration file.
username	The user name used to log in to Adaptive Server. See "dtm_tm_role Required for username" on page 23 for more information.
password	The password accompanying the user name.
logfile_name	The fully qualified file name to which the XA Interface writes tracing information (optional). The XA Interface initializes the log file and trace flag settings with the initial xa_open() call. If no *logfile_name* is specified, then the DTM XA interface logs information to a file named *syb_xa_log* in the current directory.
traceflags	Trace flags control the output that is written to the *logfile* (optional). See "Parameters for [all] section of XA configuration file" on page 27 for a list of valid trace flags.
-V11	Specifies Open Client version 11 behavior for backward compatibility (optional).

dtm_tm_role Required for *username*

In the open string for resource managers, the specified *username* must have the *dtm_tm_role* in the corresponding Adaptive Server. The System Security Officer can assign this role using **sp_role** or the **grant** command. For example:

```
sp_role "grant", dtm_tm_role, user_name
```

-C Option Not Supported in Open String

The **-C** option, used to specify the maximum number of connections, cannot be defined in the open string. To set the maximum number of connections for an LRM, define the CS_MAX_CONNECT property in the [all] section of the XA configuration file. See "[all] Section for Defining Common LRM Parameters" on page 26 for more information.

Logfile and Trace Flag Parameters

With the XA DTM interface to Adaptive Server version 12, log file and trace flag parameters can be defined in the [all] section of the XA configuration file, rather than in the X/Open XA open string. See "[all] Section for Defining Common LRM Parameters" on page 26 for more information about the logfile and trace flag components.

Labels for Logfile Entries

The XA DTM interface marks each entry in the logfile with a label indicating the severity or cause of the message. Table 3-2 describes each label.

Table 3-2: Logfile message labels

Label	Type of Entry
Error	An error returned to the transaction manager
Fatal Error	A severe failure in the DTM XA interface, with a possible application or transaction manager error
Message	Additional information about a previous error, or a description of the operational environment
Warning	A condition that may indicate problems with the transactional system
Note	Information that does not indicate a problem, but may be useful if an error occurs
XA trace	Information logged as a result of the xa trace flag setting
RM trace	Information logged as a result of the xl trace flag setting
Connection trace	Information logged as a result of the xc trace flag setting
ASE I/F trace	Information logged as a result of the xs trace flag setting
Misc trace	Information logged as a result of the misc trace flag setting

Label	Type of Entry
Event trace	Information logged as a result of the event trace flag setting
Verbose trace	Information logged as a result of the v trace flag setting
Function trace	Information logged as a result of the cmn trace flag setting
Open Client trace	Information logged as a result of the ct trace flag setting

New xa_open() Function Behavior

The X/Open XA function, **xa_open()**, initiates a single connection to Adaptive Server, rather than the pair of connections required with earlier XA-Library and XA-Server products that relied on SYB2PC protocol. Also, the *username* and *password* defined in the open string must possess the *dtm_tm_role* in the server, as described under “dtm_tm_role Required for username” on page 23.

XA Configuration File for DTM XA Interface

The DTM XA interface to Adaptive Server version 12 introduces several changes to the contents of the XA configuration file, as compared to previous XA-Library and XA-Server products.

Environment Variable for Specifying Configuration File

The DTM XA interface uses the environment variable, XACONFIGFILE, to find the full path and file name of the XA configuration file. You can set this environment variable to specify different locations and names to use for configuration information as necessary.

For example, on UNIX platforms:

```
setenv XACONFIGFILE /usr/u/sybase/xaconfig1.txt
```

If XACONFIGFILE is not defined, or if it does not specify a valid configuration file, the DTM XA interface looks for a file named *xa_config* in the following directories:

- *$SYBASE/$SYBASE_OCS/config*
- *$SYBASE/$SYBASE_OCS*
- *$SYBASE/config*
- *$SYBASE*

The DTM XA interface uses the first *xa_config* file it finds.

[all] Section for Defining Common LRM Parameters

The DTM XA interface uses the [all] section to define certain parameters that were part of the open string in earlier XA-Library and XA-Server products. Parameters in the [all] section apply to all LRMs.

Certain parameters defined in the [all] section—logfile and traceflag definitions—may still be defined in the open string for X/Open XA transaction managers.

Parameter Definitions for [all] Section

Entries for the [all] section in the XA configuration file are as follows:

```
[all]
   logfile=logfile_name
   traceflags=[xa | xl | xc | cm| event | misc | os | ct | all]
   [properties=name=value] [...]
```

Table 3-3 describes each component.

Table 3-3: Parameters for [all] section of XA configuration file

Parameter	Meaning
logfile_name	The fully qualified file name to which the DTM XA interface writes tracing information. The DTM XA interface initializes the logfile and traceflag settings with the initial xa_open() call.
traceflags	The trace flags control the output that is written to the *logfile*. Specify one or more of the following flags: all – all tracing. ct – the ct_debug option with the *CS_DBG_ERROR* flag (ct_debug functionality is available only from within the debug version of Client-Library). cmn – entry and exit point tracing of internal XA interface functions. event – tracing of significant internal events. misc – tracing of activities and information for problem resolution. xa – entry and exit point tracing at the xa_* level. xc – entry and exit point tracing at the xc_* level. xl – entry and exit point tracing at the xl_* level. **Note** Tracing at the xc_*, xl_*, event, misc, and cmn levels is intended to be meaningful only to Sybase development. Specify these tracing levels only when instructed to do so by Sybase Technical Support.

Parameter	Meaning
properties	**Note** The following property must be set in the [all] stanza. You cannot set it in the [xa] stanza as with prior XA-Library and XA-Server releases: CS_LOGIN_TIMEOUT=*timeout* You can define these optional properties in the [all] section of the XA configuration file: PROPERTIES=CS_DISABLE_POLL=[CS_TRUE | CS_FALSE] PROPERTIES=CS_EXTRA_INF=[CS_TRUE | CS_FALSE] PROPERTIES=CS_HIDDEN_KEYS=[CS_TRUE | CS_FALSE] PROPERTIES=CS_MAX_CONNECT=*number_of_connections* PROPERTIES=CS_NOINTERRUPT=[CS_TRUE | CS_FALSE] PROPERTIES=CS_TEXTLIMIT=*textlimit* PROPERTIES=CS_TIMEOUT=*timeout*

Editing the XA Configuration File

You must customize the XA configuration file for the application environment. Use the text editor of your choice to open the XA configuration for editing. The sample contents of an XA configuration file are as follows:

```
; Comment line as first line of file REQUIRED!
 ;
 ; xa_config - sample xa_config file.
 ;
 ; Note that the Adaptive Server names may need
 ; to be customized for your environment.

 ; simprpc.ct sample application entry.

 [all]
   logfile=logfile_name
   traceflags=traceflags
   properties=name=value [, name=value] [...]

 [xa]
         lrm=connection1
         server=sqlserver
```

```
; Rentapp sample xa_config entries.

[xa]
        lrm=FLEET_CON
        server=fleetsrv

[xa]
        lrm=RESERVE_CON
  server=rsrvsrv
```

Note The first line of the *xa_config* file MUST be a comment which is denoted by a semicolon (;) in the first character position.

For each additional LRM, create an entry with the following format. You will need to keep the *connection1* entry for installation verification.

```
[xa]
 <tab> lrm=connection_name
<tab> server=adaptive_server_name
<tab> capabilities=name=value [, name=value] [...]
 <tab> properties=name=value [, name=value] [...]
 <tab> options=name=value [, name=value] [...]
```

The *connection_name* is the symbolic name for the connection between the application and SQL. The *adaptive_server_name* is the name of the Adaptive Server associated with the connection. *adaptive_server_name* must correspond to a server name defined in the interfaces file.

See “Additional Capabilities, Properties, and Options” on page 29 for information a list of capabilities, properties, and options that can be used with the DTM XA interface.

Additional Capabilities, Properties, and Options

XA configuration file entries for capabilities, properties, and options have the following general format:

```
<tab> capabilities=name=value [, name=value] [...]
 <tab> properties=name=value [, name=value] [...]
 <tab> options=name=value [, name=value] [...]
```

Table 3-4, Table 3-5, and Table 3-6 list the names for capabilities, properties, and options that can be defined in the XA configuration file for the DTM XA interface. Unless otherwise specified in these tables, the valid values for each capability, property, or option are CS_TRUE or CS_FALSE.

Note All names and values for these capabilities, properties, and options correspond to CS-Library *keywords*. See the *Open Client Client-Library/C Reference Manual* for specific descriptions.

Table 3-4: XA Interface valid capabilities

Capabilities	
CS_CON_NOINBAND	CS_DATA_NOINT2
CS_CON_NOOOB	CS_DATA_NOINT4
CS_DATA_NOBIN	CS_DATA_NOINT8
CS_DATA_NOVBIN	CS_DATA_NOINTN
CS_DATA_NOLBIN	CS_DATA_NOMNY4
CS_DATA_NOBIT	CS_DATA_NOMNY8
CS_DATA_NOBOUNDARY	CS_DATA_NOMONEYN
CS_DATA_NOCHAR	CS_DATA_NONUM
CS_DATA_NOVCHAR	CS_DATA_NOSENSITIVITY
CS_DATA_NOLCHAR	CS_DATA_NOTEXT
CS_DATA_NODATE4	CS_PROTO_NOBULK
CS_DATA_NODATE8	CS_PROTO_NOTEXT
CS_DATA_NODATETIMEN	CS_RES_NOEED
CS_DATA_NODEC	CS_RES_NOMSG
CS_DATA_NOFLT4	CS_RES_NOPARAM
CS_DATA_NOFLT8	CS_RES_NOTDSDEBUG
CS_DATA_NOIMAGE	CS_RES_NOSTRIPBLANKS
CS_DATA_NOINT1	

Table 3-5: XA Interface valid properties

Properties	
CS_ASYNC_NOTIFS	CS_SEC_NEGOTIATE
CS_DIAG_TIMEOUT	CS_TDS_VERSION= [CS_TDS_40 | CS_TDS_42 | CS_TDS_46 | CS_TDS_50]
CS_DISABLE_POLL	CS_TEXTLIMIT=*textlimit*

Properties	
CS_HIDDEN_KEYS	CS_EXTRA_INF
CS_PACKETSIZE=*packetsize*	CS_MAX_CONNECT=*connections*
CS_SEC_APPDEFINED	CS_NOINTERRUPT
CS_SEC_CHALLENGE	CS_TIMEOUT=*timeout*
CS_SEC_ENCRYPTION	

Table 3-6: XA Interface valid options

Options	
CS_OPT_ANSINULL	CS_OPT_NOEXEC
CS_OPT_ANSIPERM	CS_OPT_PARSEONLY
CS_OPT_ARITHABORT	CS_OPT_QUOTED_IDENT
CS_OPT_ARITHIGNORE	CS_OPT_RESTREES
CS_OPT_DATEFIRST= [CS_OPT_SUNDAY | CS_OPT_MONDAY | CS_OPT_TUESDAY | CS_OPT_WEDNESDAY | CS_OPT_THURSDAY | CS_OPT_FRIDAY | CS_OPT_SATURDAY]	CS_OPT_ROWCOUNT=*rowcount*
CS_OPT_DATEFORMAT= [CS_OPT_FMTMDY | CS_OPT_FMTDMY | CS_OPT_FMTYMD | CS_OPT_FMTYDM | CS_OPT_FMTMYD | CS_OPT_FMTDYM]	CS_OPT_SHOWPLAN
CS_OPT_FIPSFLAG	CS_OPT_STATS_IO
CS_OPT_FORCEPLAN	CS_OPT_STATS_TIME
CS_OPT_FORMATONLY	CS_OPT_STR_RTRUNC
CS_OPT_GETDATA	CS_OPT_TEXTSIZE=*textsize*
CS_OPT_ISOLATION= [CS_OPT_LEVEL1 | CS_OPT_LEVEL3]	CS_OPT_TRUNCIGNORE
CS_OPT_NOCOUNT	

Using the DTM XA Interface with CICS

This section explains how to setup your CICS environment to use the DTM XA interface. See also “XA Configuration File for DTM XA Interface” on page 26 for information on creating an XA configuration file.

Building the Switch-Load File

Each RM defined in the CICS environment must provide an XA switch-load file. The switch-load file is a component of your CICS configuration; it is referenced in the XAD. It contains the RM’s name, a flag, a version number and a set of non-null pointers to the RM’s entry points, provided by the DTM XA interface.

All of the Sybase XADs share a single switch-load file. You can build your Sybase switch-load file using the file *sybasexa.c*, which is located in:

$SYBASE/$SYBASE_OCS/sample/xa-dtm/cics/switch

The following is a listing of *sybasexa.c*:

```
/*
 **
 ** sybasexa.c
 **
 ** The sybasexa routine references the Sybase xa
 ** switch structure named "sybase_TXS_xa_switch".
 ** The switch structure is part of the
 ** XA product library "libdtmxa.a".
 **
 ** See your CICS documentation for details on the
 ** switch-load file.
 */

 #include <stdio.h>
 #include <tmxa/xa.h>

 extern struct xa_switch_t sybase_TXS_xa_switch;
 extern struct xa_switch_t RegXA_xa_switch;
 extern struct xa_switch_t *cics_xa_switch;

 struct xa_switch_t *sybasexa(void)
 {
     cics_xa_switch = &sybase_TXS_xa_switch;
```

```
        cics_xa_init();

        return(&RegXA_xa_switch);
    }
```

This source code references the Sybase XA switch structure, which is global the DTM XA interface and defined as follows:

```
struct xa_switch_t sybase_TXS_xa_switch =
 {
 “SYBASE_SQL_SERVER”,
 TMNOFLAGS,
 0,
 xa_open,
 xa_close,
 xa_start,
 xa_end,
 xa_rollback,
 xa_prepare,
 xa_commit,
 xa_recover,
 xa_forget,
 xa_complete
 };
```

The use of *TMNOFLAGS* specifies that the DTM XA interface supports thread migration but does not support dynamic registration or asynchronous operations. For a description of these features, see the *X/Open CAE Specification (December 1991) Distributed Transaction Processing: The XA Specification*.

Compiling the Switch-Load File on IBM RISC System/6000 AIX

Compile *sybasexa.c* using the makefile *sybasexa.mk*, which is located in:

$SYBASE/$SYBASE_OCS/sample/xa-dtm/cics/switch

This is a listing of *sybasexa.mk*. Edit it to reflect your configuration.

```
SYB_LIBDIR = $(SYBASE)/$(SYBASE_OCS)/lib
 SYBLIBS = -lxadtm -lct_r.so -lcs_r.so -ltcl_r.so -lcomn_r.so -lintl_r
 -lxdsxom

 all : sybasexa.c
   xlc_r4  -bnoquiet -v -D_THREAD_SAFE \
   -I/usr/lpp/encina/include sybasexa.c  \
   -o sybasexa \
   -esybasexa \
```

```
-L/usr/lpp/cics/lib \
-L$(SYB_LIBDIR) \
$(SYBLIBS) \
-lcicsrt -ldce -lm \
/usr/lpp/cics/lib/regxa_swxa.o
```

Note You must use the shareable versions of CS-Library (libcs_r.so.a) and Common Library (libcom_r.so.a). To make shareable libraries, use *$SYBASE/$SYBASE_OCS/sample/xa-dtm/cics/mkshlibs.sh*.

Compiling the Switch-Load File on HP9000 Series 800 HP-UX

Compile *sybasexa.c* using the makefile *sybasexa.mk.hp800*, which is located in:

$SYBASE/$SYBASE_OCS/sample/xa-dtm/cics/switch

This is a listing of *sybasexa.mk*. Edit it to reflect your configuration.

```
#
 # Makefile to compile the LoadSwitchTable
 # This makefile should be run with the command
 # "make -f sybasexa.mk.hp800"
 #

 CC=/opt/ansic/bin/cc
 CCOPTS= -Aa +z -Dsybasexa=CICS_XA_Init
 ENCINA=/opt/encina
 CICS=/opt/cics
 LD=/usr/ccs/bin/ld

 SYB_LIBDIR = $(SYBASE)/$(SYBASE_OCS)/lib
 CICS_LIBDIR = $(CICS)/lib

 all: sybasexa

 sybasexa: sybasexa.o
 $(LD) -b                                    \
   +e CICS_XA_Init                          \
   -o sybasexa                              \
   sybasexa.o                               \
   $(CICS_LIBDIR)/regxa_swxa.o              \
   -Bimmediate -Bnonfatal +s +b/opt/cics/lib\
   $(SYB_LIBDIR)/libxadtm.a                 \
   $(SYB_LIBDIR)/libct_r.a                  \
```

```
  $(SYB_LIBDIR)/libcs_r.sl                \
  $(SYB_LIBDIR)/libtcl_dce.a              \
  $(SYB_LIBDIR)/libcomn_dce.sl            \
  $(SYB_LIBDIR)/libintl_r.sl              \
  -lm                                     \
  $(CICS_LIBDIR)/libcicsrt.sl             \
  -lc

sybasexa.o: sybasexa.c
$(CC) -c $(CCOPTS)\
-I$(ENCINA)/include sybasexa.c
```

Note *1.* You must use the shareable versions of CS-Library (libcs_r.so.a) and Common Library (libcomn_dce.sl).
2. Building the Load Switch Table requires the ANSI C compiler.

Compiling the Switch-Load File on Sun Solaris 2.x (SPARC)

When compiling the switch-load file, make sure you link to the new DTM XA interface library, *libxadtm.a*, rather than the *libxa.a* file used with the XA-Library product.

Adding a Sybase Stanza to the CICS Region XAD Definition

The CICS TM uses CICS XAD information to communicate with other RMs. The XAD definition contains one Sybase stanza for each LRM. For a description of an XAD stanza's attributes, see your CICS documentation.

Below are two sample Sybase XAD stanzas. Use the **SMIT** utility to add stanzas to your CICS region.

```
betaOne:
GroupName=""
ActivateOnStartup=yes
ResourceDescription="XA Product Definition"
AmendCounter=2
Permanent=no
SwitchLoadFile="/usr/lpp/sybase/sample/xa_library/
         cics/switch/sybasexa"
XAOpen="-Uuser_1 -Ppassword_1 -Nconnection_1"
XAClose="ignored"
XASerialize=all_operations
```

```
betaTwo:
GroupName=""
ActivateOnStartup=yes
ResourceDescription="XA Product Definition"
AmendCounter=2
Permanent=no
SwitchLoadFile="/usr/lpp/sybase/sample/xa_library/
         cics/switch/sybasexa"
XAOpen="-Uuser_2 -Ppassword_2 -Nconnection_2"
XAClose="ignored"
XASerialize=all_operations
```

The following fields are configuration-dependent and must be modified:

- SwitchLoadFile
- XAOpen
- XAClose
- XASerialize

Note All Sybase stanzas can use the same switch-load file.

See “Open String Parameters for DTM XA Interface” on page 23 for information about the contents specified in the XAOpen string of the XAD Definition.

Using the DTM XA Interface with Encina

This section describes how to assign an open string and initialize an RM for use with the Encina. See also "XA Configuration File for DTM XA Interface" on page 26 for information on creating an XA configuration file.

Assigning an Open String with *monadmin create rm*

The **monadmin create rm** command assigns each LRM a user name and password in the form of an *open string*. The user name and password allow the DTM XA interface to control a particular connection's access to Adaptive Server resources. See "Open String Parameters for DTM XA Interface" on page 23 for more information about the contents of the open string.

The following shows sample screen contents of a **monadmin create rm** session:

```
echo "Creating connection_1 resource manager record"
monadmin delete rm connection_1 >>& demo_conf.log
monadmin create rm connection_1\
   -open "-Usa -Psecret -Nconnection_1" \
   -close "not used" >>& \
   demo_conf.log
if ($status) then
   echo "Failed to create lrm_1 resource mgr.";
   exit 1;
endif
```

Your current version of Encina may have additional commands for specifying RMs. For detailed information, see the *Encina Monitor System Administrator's Guide and Reference.*

Note The Encina **enconsole** interactive command can be used instead of the shell **monadmin** command.

Initializing LRMs with *mon_RegisterRmi*

From within your Encina Monitor application server, you must register each LRM with a call to **mon_RegisterRmi**. For example:

```
status = mon_RegisterRmi(&sybase_TXS_xa_switch,
       "connection_1", &rmiID);
```

```
if (status != MON_SUCCESS)
{
   fprintf(stderr, “mon_RegisterRmi
      failed (%s).\n”,
      mon_StatusToString(status));
   bde_Exit(1);
}
fprintf(stderr, “mon_RegisterRmi
   complete\n”);
```

For each LRM registered with a **monadmin create rm** command, there must be a **mon_RegisterRmi** command that initializes the LRM. The *rmname* specified in the **monadmin create rm** command must match the *rmname* in the **mon_RegisterRmi** command.

See the *Encina Monitor Programmer's Guide* for:

- Information about the tasks performed by the registration function and the order in which they must be performed
- Full syntax of the **mon_RegisterRmi** command

Linking Applications with DTM XA interface libraries

Be sure to link applications with the new DTM XA interface library, *libxadtm.a*, rather than the *libxa.a* file used with the XA-Library product.

Establishing Connections

The TM, together with the DTM XA interface library, establishes connections between applications and RMs in several steps:

1 An application issues a **mon_RegisterRmi** function, thereby requesting use of an LRM.

2 Using information contained in an open string, the TM issues an XA open call to the LRM (configured in the **monadmin create rm** command) whose name matches that issued in step 1, above.

3 The TM passes the open string associated with each **monadmin create rm** command to the DTM XA interface. The open string contains the LRM name.

4 The DTM XA interface looks up the LRM name in the XA configuration file and matches it to an actual RM name—that is, to an actual physical Adaptive Server. The RM name matches an entry in the Adaptive Server interfaces file.

5 The DTM XA interface establishes one logical connection to a Adaptive Server for each LRM entry. It then confers on any connection the pre-connection properties and capabilities configured for the LRM.

Using the DTM XA Interface with TUXEDO

The following sections explain the application-specific steps you need to take to integrate the DTM XA interface with TUXEDO.

Note The DTM XA interface does not implement a separate XA-Server executable for use with TUXEDO.

The application-specific part of the integration involves:

- Linking the application with the application servers
- Setting up the *UBBCONFIG* file
- Building a transaction monitor server (TMS)
- Integrating the application servers with the resource managers

It is assumed that TUXEDO is installed in the *$TUXDIR* directory and that any resource managers are also installed on the system.

Note In the following procedures, replace the environment variables with the actual TUXEDO paths as follows: replace *$TUXDIR* with your actual root directory path and replace *$SYBASE* with the path to the DTM XA interface installation directory.

Table 3-7 provides the Sybase-specific information you need to perform the TUXEDO integration. The *TUXEDO Installation Guide* discusses this information the section “Integrating a Resource Manager With System/T.”

Table 3-7: Information needed to integrate the TUXEDO System

Type of Information	Sybase Specific	Description
RM name	SYBASE_XA_SERVER	The name of the resource manager in the *name* element of the *xa_switch_t* structure.
XA structure name	sybase_TUX_xa_switch	The name of the *xa_switch_t* structure that contains the resource manager identifier, the flags for the resource manager's capabilities, and the function pointers of the XA functions.
Library name	The library files *ct_r*, *cs_r*, *comn_r*, *tcl_dce*, and *intl_dce* which are located in *$SYBASE/$SYBASE_OCS/lib*	The list of files needed to support the DTM XA interface, and a full path name.
Open string contents	See "Open String Parameters for DTM XA Interface" on page 23.	The format of the information string passed to the functions.

Note The DTM XA interface has been fully tested with the reentrant libraries, *ct_r*, *cs_r*, *comn_r*, *tcl_dce*, and *intl_dce*. If you are using the non-reentrant libraries and experience problems, use the reentrant versions of the libraries instead.

See also "XA Configuration File for DTM XA Interface" on page 26 for information on creating an XA configuration file.

Linking

The TUXEDO RM file provides information used by TUXEDO utilities to link TUXEDO servers. Make sure that the RM file contains an appropriate set of specifications for linking Sybase applications.

1 Use the text editor of your choice to open the *$TUXDIR/udataobj/RM* file for editing.

2 Update the file with XA information by adding/verifying entries for Sybase resource managers. For most Sybase applications, including the *simprpc.ct* sample application, one entry for SYBASE_XA_SERVER is all that you need. If you are going to build and run the *rentapp* sample, you may want to go ahead and add the second entry for SCRAP_XA_SERVER, as required for *rentapp*.

Replace *$SYBASE/$SYBASE_OCS* with the fully qualified path to the Sybase installation directory containing the XA Interface:

```
SYBASE_XA_SERVER:sybase_TUX_xa_switch:-t -Bstatic
    -L$SYBASE/$SYBASE_OCS/lib -lcobct -lxadtm -lct_r -lcs_r
    -lcomn_r -ltcl_dce -lintl_dce -Bdynamic -ldl
SCRAP_XA_SERVER:sybase_TUX_xa_switch:-t -Bstatic
    -L$SYBASE/$SYBASE_OCS/lib -lcobct -lxadtm -lct_r -lcs_r
    -lcomn_r -ltcl_dce -lintl_dce -Bdynamic -ldl
```

Note Each entry *must* be a single continuous line.

The *cobct* libraries are only needed if you are building ESQL/COBOL application servers. If you are not using ESQL/COBOL, you can remove the **-lcobct** specification.

If you want your TUXEDO servers to load and execute all Sybase libraries dynamically, you can use entries like the following. Note that dynamic libraries may increase CPU overhead for TUXEDO server execution.

```
 SYBASE_XA_SERVER:sybase_TUX_xa_switch:-L$SYBASE/$SYBASE_OCS/lib
    -lxadtm -lct_r -lcobct -lcs_r -lcomn_r -ltcl_dce -lintl_dce
 SCRAP_XA_SERVER:sybase_TUX_xa_switch:-L$SYBASE/$SYBASE_OCS/lib
    -lxadtm -lct_r -lcobct -lcs_r -lcomn_r -ltcl_dce -lintl_dce
```

Note Each entry *must* be a single continuous line.

You can add a comment line by identifying it with a leading pound sign (#) character.

Setting Up the UBBCONFIG File

This section provides specific examples for setting up the TUXEDO *UBBCONFIG* file with the XA Interface.

The *pubs2* database must be installed on Adaptive Server. Use the installation script in the Adaptive Server directory under *scripts/installpubs2*.

"Open String Parameters for DTM XA Interface" on page 23 explains the open string in the UBBCONFIG file.

1 Use the ASCII text editor of your choice to open *$SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo/simprpc.ct/ubbsimpct* for editing. The file is shown here with line numbers to facilitate the discussion:

```
1  *RESOURCES
 2  IPCKEY          123456
 3
 4  MASTER          sybsite
 5  MAXACCESSERS    5
 6  MAXSERVERS      5
 7  MAXSERVICES     10
 8  MODEL           SHM
 9
10 MAXGTT          5
11
12 *MACHINES
13 yourmachine     LMID=sybsite
14                 TUXDIR="$TUXDIR"
15                 APPDIR="$SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo
       /simprpc.ct"
16                TLOGDEVICE="$SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo
       /simprpc.ct/tuxlog"
17                 TLOGNAME=TLOG
18                 TUXCONFIG="$SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo
       /simprpc.ct/tuxconfig"
19                 ULOGPFX="$SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo
       /simprpc.ct/ULOG"
20
21 *GROUPS
22 DEFAULT:        TMSNAME=simprpccttms TMSCOUNT=2
23
24 GROUP1          LMID=sybsite    GRPNO=1
25                 OPENINFO="SYBASE_XA_SERVER: -Uuserid1 -Ppassword1
                     -Nconnection1"
26
27 *SERVERS
28 simpsrv         SRVGRP=GROUP1   SRVID=1
29
30 *SERVICES
```

2 Replace entries in the file with entries appropriate for your environment as shown in this table:

Line Number	Entry	Replace With
13	*yourmachine*	Replace with the name of the machine that contains the XA Interface installation. Remember that the machine name is case-sensitive.
14	*$TUXDIR*	Replace with the actual TUXEDO root directory path.
15, 16, 18, 19	*$SYBASE/$SYBASE_OCS*	Replace with the XA Interface installation directory.
22	simprpccttms	This parameter is specific to the *simprpc.ct* example. In general, this parameter should relate to the value specified in the -o parameter of the buildtms command described on *** 'Building the TMS' on page 45 ***.
25	Open string parameters	See "Open String Parameters for DTM XA Interface" on page 23 for more information.

Note See the *TUXEDO Installation Guide* for a detailed discussion of the *UBBCONFIG* file.

Creating the TUXEDO Configuration File

Set the $TUXCONFIG environment variable to a value that matches the entry in *ubbsimpct* by issuing this command:

```
setenv TUXCONFIG $SYBASE/$SYBASE_OCS/sample/xa-dtm/tuxedo/
    simprpc.ct/tuxconfig
```

Create a TUXEDO configuration file from the *UBBCONFIG* file by executing this command:

```
$TUXDIR/bin/tmloadcf -y ubbconfig_file_name
```

For this verification, using the *simprpc.ct* sample, replace *ubbconfig_file_name* with *ubbsimpct*.

Building the TMS

Build the transaction monitor server (TMS) by executing this command:

```
$TUXDIR/bin/buildtms -r SYBASE_XA_SERVER -o $TUXDIR/bin/output_filetms
```

where *output_file* is a name you choose for the transaction monitor server program. It is helpful to append *tms* to the name as shown here, so it is easily identified. Choose a unique name for the program so that it does not conflict with TMS programs for other resource managers (*TMS*, *TMS_D*, and *TMS_SQL* are reserved).

For the *simprpc.ct* example verification, the *UBBCONFIG* file uses *simprpccttms*, which is Line 18 in the table on page 10.

The program is stored in *$TUXDIR/bin* so that the TUXEDO System/T boot program can find it.

Build COBOL Runtime Environment (COBOL users only)

In CICS transactions, COBOL transactions use the COBOL runtime, which must be modified to communicate with the Sybase XA environment.

To configure CICS to support Sybase XA COBOL transactions:

1 Log in as root.

2 Set the COBDIR environment variable to the directory path for the MicroFocus COBOL installation.

3 Set the PATH environment variable to include the MicroFocus COBOL binary directory.

4 Change directory to:

$SYBASE/$SYBASE_OCS/sample/xa-dtm/cics

5 Run *xa_make_cobol_runtime*.

Warning! This script assumes that the CICS COBOL runtime file is installed in */usr/lpp/cics/v1.1/bin*. If you have installed CICS somewhere else, you must edit this script to reflect your installation.

This script builds a MicroFocus COBOL runtime environment with CICS and Sybase XA support. It allows CICS transactions written in COBOL to reference XA Interface and Open Client functions at run time. The script takes several minutes to run. For more information, see your CICS documentation.

Note You must use MicroFocus COBOL 3.1 or higher.

CHAPTER 4

Application Programming Guidelines

This chapter includes these sections:

Embedded SQL and Client-Library applications must conform to certain coding constraints in order to function within the Sybase XA environment. This chapter summarizes these constraints and provides a Client-Library code fragment and two Embedded SQL code fragments.

X/Open DTP Versus Traditional Sybase Transaction Processing

The X/Open DTP model of transaction processing differs substantially from the traditional Sybase model. The traditional Sybase TP environment is connection oriented. Programs set up connections directly between the application program and SQL Server using connection management SQL statements. In the XA-Server environment, the XA-Server, using LRMs, sets up connections for the application.

Table 4-1 summarizes the differences.

Table 4-1: Traditional TP and X/Open DTP model differences

Traditional TP Model	X/OPEN DTP Model
There is one or more transaction per client/server connection.	There is no notion of connections. Components communicate through interfaces.
Transactions are usually local, with each transaction confined to a single Adaptive Server.	Transactions are global. They span resource managers. The work done within a transaction is accomplished using more than one resource manager.
Each Adaptive Server is responsible for the recovery of the data it contains.	The transaction manager is responsible for recovering the data stored in all of the resource managers.

Transaction and Connection Management

Applications must pay special attention to commands related to:

- Transaction management
- Connection management
- Establishment of the current connection

Note The XA Interface uses an ANSI default isolation level of 3. To minimize read-only locking, programs can set the transaction isolation level in the XA configuration file, or they can use **select xxx from table noholdlock** in individual SQL operations. See the *Transact-SQL User's Guide* for additional information on transaction isolation levels.

Transaction Management

The CICS, Encina, or TUXEDO TM is responsible for transaction management. This includes creating a global transaction in which all of an application's work is either committed or rolled back. Consequently, applications cannot issue SQL statements that manage transactions.

Specifically, applications cannot invoke the following Embedded SQL commands:

- **begin transaction**
- **commit**
- **rollback**

Client-Library applications cannot execute (via **ct_command**, **ct_dynamic**, or **ct_cursor**) any of these Transact-SQL commands:

- **begin transaction**
- **commit transaction**
- **rollback transaction**
- **set (chained, noexec, isolation, parseonly, statistics io, statistics time)**
- **save transaction**

Connection Management

Applications rely on the Sybase XA environment for management of client/server connections. Connection management occurs transparently to the application. Consequently, Embedded SQL applications cannot invoke the following commands:

- **connect**
- **disconnect**

Client-Library applications cannot call these Client-Library commands:

- **ct_close**
- **ct_con_alloc**
- **ct_con_drop**
- **ct_con_props**
- **ct_config** with the parameters
  - *CS_ENDPOINT*
  - *CS_EXPOSE_FMTS*
  - *CS_HIDDENKEYS*
  - *CS_MAX_CONNECT*
  - *CS_NETIO*
  - *CS_TRANSACTION_NAME*
- **ct_connect**
- **ct_exit**
- **ct_getloginfo**
- **ct_init**
- **ct_options** with the parameters
  - *CS_OPT_CHAINXACTS*
  - *CS_OPT_FORCEPLAN*
  - *CS_OPT_FORMATONLY*
  - *CS_OPT_NOEXEC*
  - *CS_OPT_PARSEONLY*

•*CS_OPT_STATS_IO*

- **ct_remote_pwd**
- **ct_setloginfo**
- *CS_OPT_STATS_TIME*

In addition, Client-Library applications cannot call these CS-Library commands:

- **cs_ctx_drop** (with global context handle)
- **cs_objects** (*CS_CLEAR*, *CS_SET*)

The Current Connection

The notion of a default connection, as described in the Open Client Embedded SQL documentation, does not exist in the Sybase XA environment. Consequently, applications must always explicitly specify a current connection.

There are two ways to specify the current connection in Embedded SQL. They are:

- The **set connection** command
- The *at connection name* clause

A current connection does not span transactions. For example, an application must reset the current connection after each CICS **SYNCPOINT**command or Encina **onCommit** command. To avoid confusion about the scope of the current connection, we recommend that you use the *at connection_name* clause with all Embedded SQL statements.

Deallocate Cursor Function with Client Library

Application programs use and reuse connections which have been allocated for them via the XA Interface. Sybase's implementation of cursors starting with SQL Server version 10.1 requires cursor structures on both the client (TM/RM program) side and Adaptive Server side.

When a client explicitly "deallocates a cursor," or when the client connection is closed, Adaptive Server deallocates the server cursor structures.

When the first iteration of a program opens or closes a cursor but the connection stays allocated (as it does with XA-Library), the second iteration of the same program fails, as it attempts to open the same cursor name. Adaptive Server informs us that it already has a cursor by this name at the same nesting level.

The application program must explicitly "close and deallocate the cursor" before it commits or aborts its transaction. This must be done in the transaction program that allocates the cursor. Embedded SQL records information about cursors which allows the XA Interface to perform the de-allocation.

With Client-Library, care must be taken to handle error paths so that cursors are deallocated before a TM abort code is called. That is, if the open cursor works, deallocate it.

Use **ct_cursor( )** with type **CS_CURSOR_CLOSE** and option **CS_DEALLOC**.

Dynamic SQL

The use of dynamic SQL statements has many characteristics in common with cursors, with the additional complexity that temporary stored procedures are sometimes placed into Adaptive Server. The use of dynamic SQL is not recommended in transactional applications, but if they are used the following guidelines must be adhered to:

- In Embedded SQL use “Method 3: Prepare and Fetch with a Cursor” (see the ESQL document or a description of this method) if possible. When this method is used, Embedded SQL places information in the system which allows XA-Library to locate and deallocate all dynamic SQL and cursors.
- In all other cases, the dynamic SQL statements and all associated cursors must be closed and de-allocated to avoid adverse effects on other transactions. Any associated client library command structures should be dropped to avoid memory leaks. See the Open Client and ESQL documentation for information on how to drop these command structures.

Getting a Client-Library Connection Handle

Obtaining a connection handle is an issue specific to Client-Library applications.

When the TM opens a connection to Adaptive Server, the XA Interface allocates a CS_CONNECTION structure for its own use. Once control passes to the application, that application must use the connection handle contained in this structure.

To get the connection handle, specify CS_GET for the **cs_object** routine's *action* parameter with an object type of CS_CONNECTION. **cs_object's** *objdata* parameter returns a structure containing a *connection* field. This field contains the handle to the CS_CONNECTION structure.

Warning! The XA Interface also allocates a CS_COMMAND structure whose handle is returned in the *command* field of the structure to which the *objdata* parameter points. An application may *not* use this command handle, as the XA Interface continues to use this handle, itself.

The following code fragment demonstrates how to retrieve the handle to the CS_CONNECTION structure:

```
/*
 ** Arguments:
 **connectionnull-terminated name of the
 **connection (ESQL) or LRM
 **
 **connHloaded with the CS_CONNECTION
 **handle if the lookup is
 **successful
 **
 ** Returns:
 **CS_SUCCEEDconnection handle found
 **successfully
 **
 **CS_FAILunable to find connection
 **handle for given connection
 */

#include <stdio.h>
 #include <strings.h>
 #include <cspublic.h>

CS_RETCODEgetConn(connection, connH)
 CS_CHARconnection[128];
 CS_CONNECTION**connH;
 {
 CS_INTretcode;
 CS_CONTEXT*ctx;
 CS_OBJNAMEname;
 CS_OBJDATAdata;
 CS_THREADthread_functions;
 CS_INToutlen;
 #define THREADID_SIZE8
 CS_BYTEthread_id[THREADID_SIZE];

/* Check arguments */

if (strlen(connection) >= 128)
 {
 /* Connection name is too long */
 return(CS_FAIL);
 }

/* Get the global context handle */

retcode = cs_ctx_global(CS_VERSION_100, &ctx);
 if (retcode != CS_SUCCEED)
```

```
 {
 /* Major environment problems! */
 return(CS_FAIL)
 }

/*
 ** Initialize the CS_OBJNAME structure to look
 ** for the specified connection name.
 */

name.thinkexists = CS_FALSE;
 name.object_type = CS_CONNECTNAME;
 strcpy(name.last_name, connection);
 name.fnlen = CS_UNUSED;
 name.lnlen = CS_NULLTERM;
 name.scopelen = CS_UNUSED;

/*
 ** Set the current thread-id so we get the
 ** instance of this connection that this
 ** thread should be using.
 */

retcode = cs_config(ctx, CS_GET,
 CS_THREAD_RESOURCE, &thread_functions,
 CS_UNUSED, &outlen);
 if (retcode != CS_SUCCEED)
 {
 /*
 ** Even in an non-threaded environment,
 ** this should be successful.
 */

return(CS_FAIL);
 }
 name.thread = (CS_VOID *) thread_id;
 retcode = (*thread_functions.thread_id_fn)(
 name.thread, THREADID_SIZE,
 &name.threadlen);
 if (retcode != CS_SUCCEED)
 {
 return(CS_FAIL);
 }

/*
 ** Initialize the CS_OBJDATA structure to
 ** receive the connection handle for this
 ** connection name
 */
```

```
data.actuallyexists = CS_FALSE;
 data.connection = (CS_CONNECTION *) NULL;
 data.command = (CS_COMMAND *) NULL;
 data.buffer = (CS_VOID *) NULL;
 data.buflen = CS_UNUSED;

/* Retrieve the connection information */

retcode = cs_objects(ctx, CS_GET, &name,
 &data);
 if (retcode == CS_SUCCEED)
 {
 if (data.actuallyexists == CS_TRUE)
 {
 *connH = data.connection;
 return(CS_SUCCEED);
 }
 else
 {
 /* No connection by that name exists */

return(CS_FAIL);
 }
 }
 else

{
 /*
 ** The global CS_CONTEXT handle is probably
 ** not initialized with connection
 ** information yet
 */

return(CS_FAIL);
 }
 }
```

Multiple-Thread Environment Issues

Threads are multiple, simultaneous paths of execution in a single operating system process, and share access to the resources allocated to that process.

Some application programming interfaces (APIs) allow an application developer to effectively use threads in the transaction environment. In turn, Sybase's XA Interface supports a maximum level of concurrency, enabling it to take advantage of those environments.

However, this raises several issues for an application developer. For background information and a complete discussion of the issues, see the OSF's *DCE Application Developer's Guide*.

The *Open Client Reference Manual* contains a section on thread-safe programming. XA Interface assigns connections to threads at the request of the TM. These assignments ensure that only one thread at a time is working on the connection and is the reason the thread ID is included in the **cs_object** request described in "Getting a Client-Library Connection Handle" on page 54. As long as connections assigned by XA Interface are used in the thread to which they are assigned and the restrictions on their use are followed, there should be no Open Client or ESQL threading-related problems.

Caveats of Thread Use

Client-Library uses a connection state machine to verify that applications call Client-Library routines in a logical sequence. See Chapter 2, "Program Structure" in the *Open Client Client-Library/C Programmer's Guide* for an explanation of the steps involved in structuring a Client-Library application.

The assumption underlying the use of threads is that when a thread disassociates from a transaction branch, it leaves the state machine in an inactive state. By default, all Embedded SQL statements leave the connection quiescent. With Client-Library, that is true only in the following circumstances:

- When **ct_results** returns CS_END_RESULTS, or CS_SUCCEED with a result type of CS_CURSOR_RESULT
- After an application calls **ct_cancel** with *type* as CS_CANCEL_ALL

- When an application returns CS_CANCELED. The APIs that return CS_CANCELED include *ct_send()*, *ct_results()*, and *ct_get_data()*.

Warning! If connections are not left in an inactive state, the consequences may include transaction rollbacks, extra overhead as the XA Interface cleans up the connection (which may require full connection close and reopen), and the possible failure of subsequent transactions. In such a situation, XA Interface attempts to maintain application operation while it minimizes failure.

Embedded SQL Thread-Safe Code

Thread-safe code is code that protects the use of shared resources with a mutex (MUTual EXclusion semaphore). A mutex protects shared resources, such as files and global variables, by preventing them from being accessed by more than one thread at a time.

Use the **-h** (UNIX) or **/threadsafe** (VMS) precompiler option to generate thread-safe code.

Linking with CT Library

The XA Interface requires that the application be linked with the threaded versions of the Open Client Libraries. See the *Open Client/Server Supplement* for your platform to identify the libraries you must specify. If you don't link the proper thread-safe libraries, you may experience a variety of Open Client failures.

Sample Embedded SQL COBOL Fragment

This code fragment:

- Sets the current connection, and
- Inserts data into an Adaptive Server database.

```
*REMARKS. TRANSACTION-ID IS 'POPS'.
*         THIS TRANSACTION POPULATES A DATABASE'S
*         DATA TABLE WITH STOCK DATA ENTRIES.


ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.
    COPY DFHBMSCA.
    COPY DFHAID.
    COPY AIXCSET.
    EXEC SQL INCLUDE SQLCA END-EXEC.
77  RESPONSE            PIC 9(8) COMP.
01  MSG-LIST.
    02  MSG-1           PIC X(70) VALUE
        'Transaction Failed: Unable To Prime Stock'
-       'Table.'.
    02  MSG-2           PIC X(70) VALUE
        'Stock Records Added Successfully.'.
01  TRANSFAIL           PIC X(70).

    EXEC SQL BEGIN DECLARE SECTION END-EXEC.
01  STOCK-RECORD.
    02  STOCK-NUM       PIC X(5).
    02  ITEM-DESC       PIC X(30).
    02  STOCK-QTY       PIC X(7).
    02  UNIT-PRICE PIC S9(4)V99 VALUE ZEROES.
    EXEC SQL END DECLARE SECTION END-EXEC.

PROCEDURE DIVISION.
* CHECK BASIC REQUEST TYPE
*
    IF EIBAID = DFHCLEAR
    EXEC CICS SEND CONTROL FREEKB
        END-EXEC
    EXEC CICS RETURN
        END-EXEC
    END-IF.
```

```
* MAIN PROCESSING
*    SET UP STOCK RECORD DETAILS AND THEN WRITE OUT
*    STOCK RECORD.
*
    MOVE ’31421’TO STOCK-NUM.
    MOVE ’Widget (No.7)’TO ITEM-DESC.
    MOVE ’0050035’TO STOCK-QTY.
    MOVE 25.55TO UNIT-PRICE.
    PERFORM WRITE-STOCKREC.

    MOVE ’43567’TO STOCK-NUM.
    MOVE ’Splunkett ZR-1’ TO ITEM-DESC.
    MOVE ’0005782’TO STOCK-QTY.
    MOVE 143.79TO UNIT-PRICE.
    PERFORM WRITE-STOCKREC.

    EXEC CICS SYNCPOINT
                RESP(RESPONSE)
                END-EXEC.

    IF RESPONSE NOT = DFHRESP(NORMAL)
        MOVE MSG-1 TO TRANSFAIL
        PERFORM FAIL-TRANS
    END-IF.

    MOVE MSG-2 TO MSGOUTO.
    EXEC CICS SEND MAP(’MSGLINE’)
                    MAPSET(’AIXCSET’)
                    FREEKB
                END-EXEC.
    EXEC CICS RETURN
                END-EXEC.
    GOBACK.


* ATTEMPT TO WRITE OUT NEW STOCK RECORD.
*
WRITE-STOCKREC.
EXEC SQL SET CONNECTION connection_2
    END-EXEC

    IF SQLCODE NOT = 0
        MOVE MSG-1 TO TRANSFAIL
        PERFORM FAIL-TRANS
    END-IF.
```

```
EXEC SQL INSERT INTO STOCK VALUES (:STOCK-RECORD)
    END-EXEC

    IF SQLCODE NOT = 0
        MOVE MSG-1 TO TRANSFAIL
        PERFORM FAIL-TRANS
    END-IF.


* IF UNABLE TO APPLY CREATE, END TRANSACTION
* AND DISPLAY REASON FOR FAILURE.
*
FAIL-TRANS.
    MOVE TRANSFAIL TO MSGOUTO
EXEC CICS SEND MAP('MSGLINE')
           MAPSET('AIXCSET')
           FREEKB
           END-EXEC
EXEC CICS RETURN
           END-EXEC.
```

Sample Embedded SQL C Fragment

This code fragment:

- Sets the current connection, and
- Accesses data stored on Adaptive Server.

```
EXEC SQL INCLUDE sqlca;

int rcode;

EXEC SQL BEGIN DECLARE SECTION;

    char name[15];
    char supplier[30];
    char supplier_address[30];
    int order_quantity;

EXEC SQL END DECLARE SECTION;

main()
{
    char errmsg[400];
    char qmsg[400];
    short mlen;

    EXEC SQL WHENEVER SQLERROR GOTO :errexit;
    EXEC SQL WHENEVER SQLWARNING GOTO :errexit
    EXEC SQL WHENEVER NOT FOUND GOTO :errexit

    /* Get addressability for EIB... */

    /*
    ** Write record to CICS temporary storage
    ** queue...
    */

    /* Send the first map */

    EXEC CICS SEND MAP("PANEL1") MAPSET("UXA1")
            FREEKB ERASE RESP(rcode);
    if (rcode != DFHRESP(NORMAL))
            EXEC CICS ABEND ABCODE("X001");

    /* Receive the response */
```

```
EXEC CICS RECEIVE MAP("PANEL1") MAPSET("UXA1")
    RESP(rcode);
if (rcode != DFHRESP(NORMAL))
    EXEC CICS ABEND ABCODE("X002");

/* Select a record from the table based on user
** input.
*/

sprintf(name, "%s", panel1.panel1i.newnamei);
EXEC SQL SET CONNECTION connection_1;
EXEC SQL SELECT name, supplier,
           supplier_address,order_quantity
INTO
:name, :supplier, :supplier_address, :order_quantity
FROM cheese
WHERE name = :name;

/* Handle "no rows returned" from SELECT */

if (sqlca.sqlcode == 100)
{
    sprintf(panel4.panel4o.messageo, "%s",
           NOCHEESE);
    EXEC CICS SEND MAP("PANEL4") MAPSET("UXA1")
           FREEKB ERASE RESP(rcode);
    if (rcode != DFHRESP(NORMAL))
        EXEC CICS ABEND ABCODE("X009");

    EXEC CICS SEND CONTROL FREEKB;
    EXEC CICS RETURN;

}
/* Fill in and send the second map */

memset ( &panel2.panel2o, '0',
        sizeof(panel2.panel2o));
sprintf(panel2.panel2o.nameo, "%s", name);
sprintf(panel2.panel2o.supplo, "%s",supplier);
sprintf(panel2.panel2o.addresso, "%s",
        supplier_address);
sprintf(panel2.panel2o.ordero, "%d",
        order_quantity);

EXEC CICS SEND MAP("PANEL2") MAPSET("UXA1")
```

```
        FREEKB ERASE RESP(rcode);
if (rcode != DFHRESP(NORMAL))
    EXEC CICS ABEND ABCODE("X003");

/* Receive the response */

if (panel2.panel2i.questi == 'y')

{

    /* Send the third map... */

    /* Receive the response... */

    /* Update the database */

    order_quantity = atoi(panel3.panel3i.newordi);

    EXEC SQL UPDATE cheese
    set order_quantity = :order_quantity
    where name = :name;

    /* Write a record to the temporary queue */

    sprintf(qmsg, "%s", "The cheese table was
            updated");
    mlen = strlen(qmsg);


    EXEC CICS WRITEQ TS QUEUE("TEMPXAQ1")
            FROM(qmsg) LENGTH(mlen) RESP(rcode);
    if (rcode != DFHRESP(NORMAL))
        EXEC CICS ABEND ABCODE("X010");
    }
    else
    {

        /*
        ** The user does not wish to update so
        ** free the keyboard and return...
        */
    }
        /* Commit the update */

    EXEC CICS SYNCPOINT RESP(rcode);
    if (rcode != DFHRESP(NORMAL))
```

```
            EXEC CICS ABEND ABCODE("X011");

            /*
            ** Send the fourth map confirming
            ** successful update...
            */

        EXEC CICS RETURN;

errexit:
        fprintf(stderr,"error in cheeseland
                %d\n",sqlca.sqlcode);

        /* Handle general errors */

        sprintf(errmsg,
                "%.60s\n",sqlca.sqlerrm.sqlerrmc);
        strncpy(panel4.panel4o.messageo, errmsg, 60);
        sprintf(panel4.panel4o.codeo, "%d",
                sqlca.sqlcode);

        /*
        ** Send the fourth map with appropriate
        ** message...
        */

        /* Rollback the transaction */

        EXEC CICS SYNCPOINT ROLLBACK;

        EXEC CICS SEND CONTROL FREEKB;
        EXEC CICS RETURN;
 }
```

Index

Symbols

A

B

C

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

X