Cisco Network Solutions for the Telco DCN: Transmission Equipment in X.25 Environments

This document is directed to competitive local exchange carriers (CLECs), incumbent local exchange carriers (ILECs), and Post, Telephone, and Telegraphs (PTTs), telephone companies collectively referred to as telcos. This document describes Cisco network solutions for transporting data between various transmission network elements and the Operations Support System (OSS) in a telco's data communications network (DCN). The DCN transports network management traffic between network elements and their respective OSS, making them a vital link between the service network and the network operations center (NOC). The solutions presented in this document will help telcos migrate transmission equipment that use the X.25 protocol to a router-based TCP/IP network. The solutions will help service providers migrate their OSSs with an X.25 interface onto a TCP/IP backbone.

Version History

Version Number	Date	Notes
1	July 15, 2005	This document was created as a joint effort between Don Schriner in the Cisco CTO Consulting Engineering Group and Alliene Turner in Cisco IOS Documentation.
2	September 15, 2007	This document was updated.
3	January 4, 2008	This document was updated.

Contents

This document presents the recommended Cisco architecture for building the router-based DCN. Several methods for implementing and scaling an IP network are included with detailed configuration examples. This document describes routing X.25 over an IP backbone using RFC 1613, or mediating between TCP/IP and X.25. In addition, the document describes ways to migrate the OSS from an X.25 to a TCP/IP interface. These architectures and software features are described in the following main sections:

The solutions described in this document use Cisco routers. Cisco routers can carry multiple protocols on a single DCN and reduce equipment costs, operations costs, and maintenance costs.

Prerequisites

The features described in this document are supported on the Cisco Telco and Enterprise feature sets.

Cisco IOS software is packaged in feature sets that are supported on specific platforms. To get updated information regarding platform support for this feature, access Cisco Feature Navigator at http://www.cisco.com/go/fn.

To access Cisco Feature Navigator, you must have an account on Cisco.com. Qualified users can establish an account on Cisco.com by following the directions at http://www.cisco.com/register. If you have an account but have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you.

The Telco DCN Network: Overview

The telco DCN is an out-of-band operations support network used to connect telco central office equipment to a NOC. As part of the ITU Telecommunications Management Network (TMN) specification defined by ITU-T M.3010, the DCN provides the link between the service network and the NOC. The specification defines the management requirements of DCN administrators to plan, provision, install, maintain, operate, and administer telecommunications networks and services.

The primary function of the DCN is enabling the surveillance and the status of the support network, but it also supports Operations, Administration, Maintenance, and Provisioning (OAM&P) functions including monitoring alarms and the trunk, collecting billing information, and network provisioning tasks.

The regional Bell operating companies (RBOCs) and other ILECs have traditionally used the X.25 protocol to transport monitoring data and provisioning data between their transmission equipment and an OSS in their DCNs.

The Telco DCN Landscape

Figure 1 shows the elements of a typical DCN network.

Figure 1   Typical DCN Network Elements
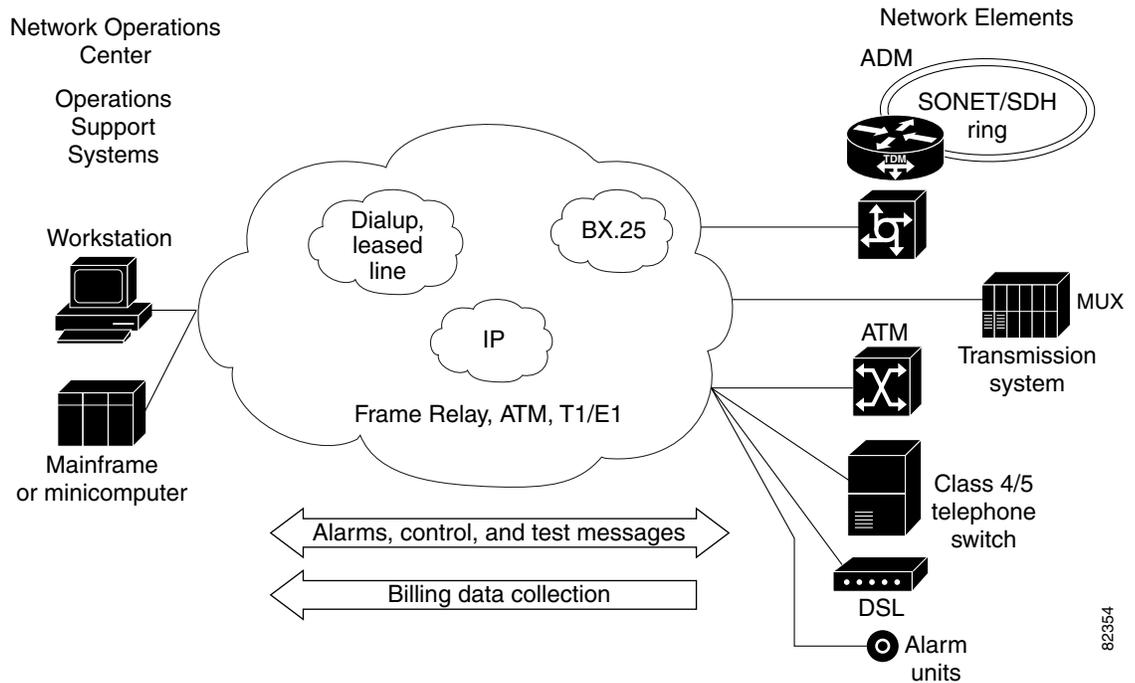
Multiple networks are included in the DCN network cloud. The networks serve to connect a mainframe or minicomputer and workstation configured as an OSS at a NOC, to a large array of devices and systems referred to as network elements.

Network elements in a DCN include alarm units, Class 4 and 5 telephone switches such as the Lucent 5ESS, SONET/Synchronous Digital Hierarchy (SDH) add/drop multiplexers (ADMs), optical repeaters, digital loop carrier systems, digital cross-connect systems, high-data-rate digital subscriber line (HDSL) shelves, test heads, Frame Relay or ATM switches, routers, digital subscriber line access multiplexers (DSLAMs), and remote access switches that make up the provisioned services infrastructure used to deliver services to customers. The OSS controls and stores the network management data collected about and from the various network elements.

The long-term goal of the services providers is to migrate their DCN to TCP/IP. Classic DCNs are typically X.25 networks. Figure 2 shows a traditional X.25 network.

*Figure 2*   *Traditional X.25 DCN*
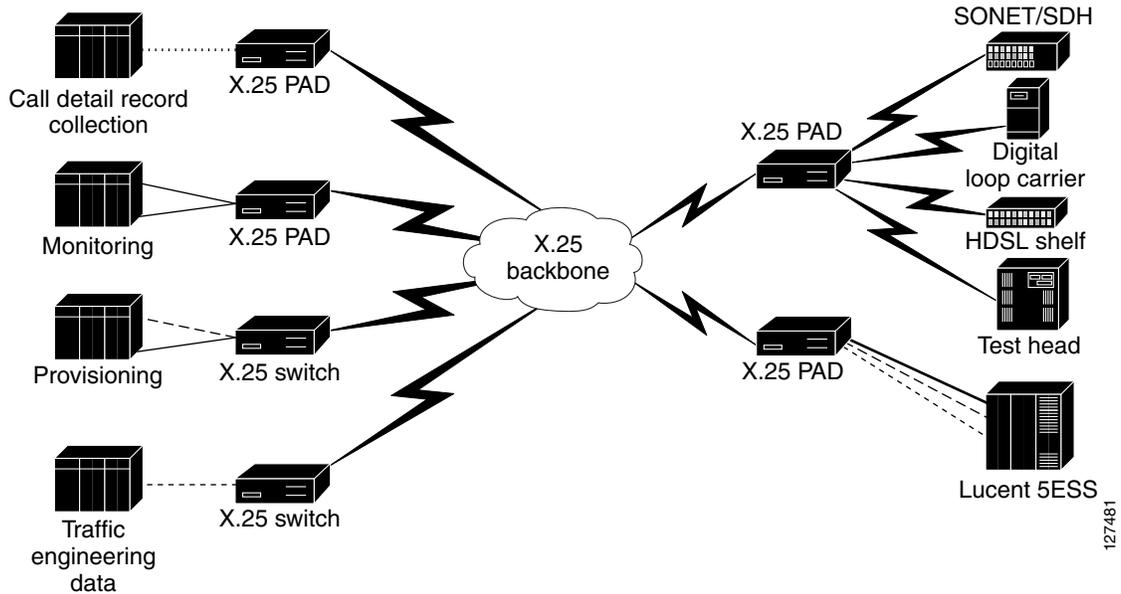
Migration Requirements for a DCN

The first step in migrating to Cisco DCN solutions is to deploy a TCP/IP core network and run X.25 at the edges of the network, as shown in Figure 3. This step allows service providers to remove the X.25 network but leave OSSs and network elements unchanged.

Figure 3   *Cisco XOT DCN Solution*
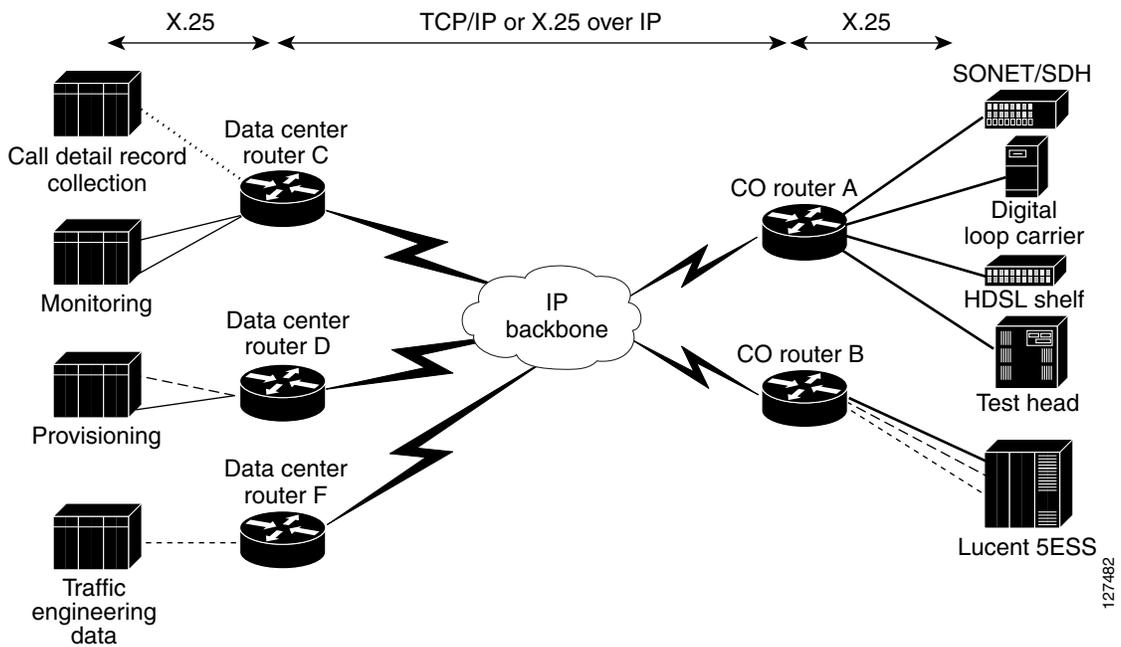
The second step is to migrate the OSS to TCP/IP. Migrating the OSS to TCP/IP is easier than migrating the network elements to TCP/IP, because there are fewer OSSs than network elements. The Cisco IOS software provides X.25-to-TCP/IP mediation functions with its protocol translation and Record Boundary Preservation features. Protocol translation is typically used for mediation with transmission network elements, as shown in Figure 4, and works well with Transaction Language 1 (TL1), which is explained in more detail in the "TL1 in the Cisco Network" section on page 10.

Figure 4　　　*Cisco Protocol Translation Solution*
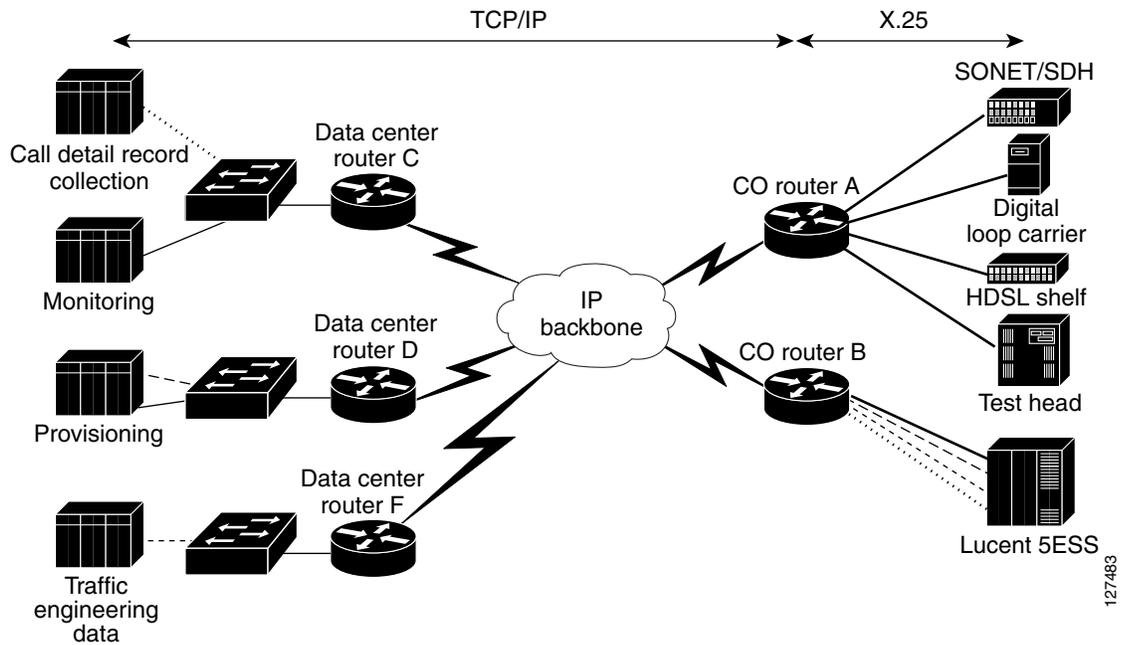
The third step is for the network elements themselves to migrate to Ethernet interfaces with TCP/IP stacks. This step in the migration process is shown in Figure 5.

Figure 5   *Cisco IP End-to-End Solution*
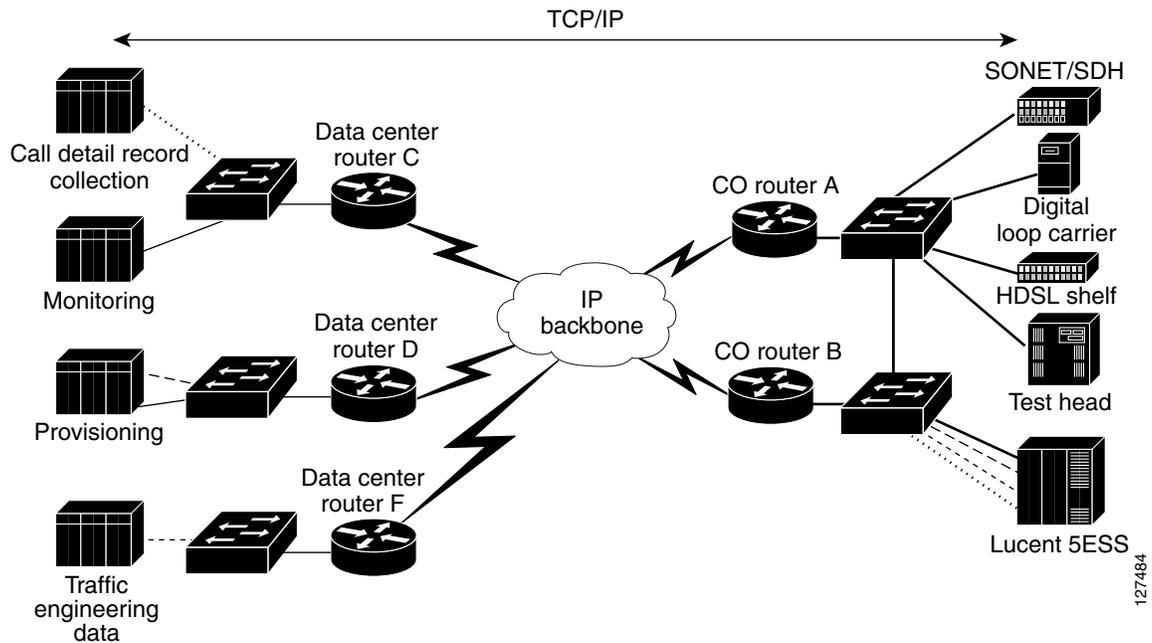
This chapter describes specific solutions for preserving the X.25 connection to transmission equipment as shown in Figure 3 and Figure 4. This chapter also describes how to scale XOT. Specific examples of implementing XOT are described in Chapter 2, "Telephone Switch Environments." This chapter provides examples of connectivity with protocol translation, describes Class 5 switch connectivity, and provides examples of connectivity with XOT.

X.25 and LAPB Parameters for XOT and Protocol Translation

The "X.25 and LAPB Parameters" section in the "Telephone Switch Environments" chapter contains information about setting X.25 and Link Access Procedure, Balanced (LAPB) parameters and implementing XOT in the Cisco network. Tables in the appendix describe the LAPB and X.25 functions used when configuring a link, and list the Cisco IOS command counterparts next to the functions, along with default values and usage notes, in one place for easy reference.

Adding Cisco XOT to the DCN

The following guidelines offer a conservative approach to implementing XOT. The guidelines provide the ability to fall back to an original configuration if problems occur.

- The first step in implementing an XOT solution is to build an IP core.

- The next steps are to add access routers in the central office (also referred to as the CO), and locate access routers in front of the OSS, as shown in Figure 3. Add access ports for initial deployment, then add ports as the XOT network grows. If an X.25 packet assembler/disassembler (PAD) is in the central office, the service provider may choose to connect the X.25 PAD to the router. Eventually, the X.25 PAD is eliminated and the network element is connected directly to the router.

- Pretest configurations in a lab to determine that the class of Cisco router chosen has the CPU performance desired for each X.25 access point. You can select from Cisco 805, 1720, 2600 series, 2600 XM, 2800 series, 3640, 3660, 3725, 3745, 3825, and 3845 routers. XOT is a process-switched feature, which means the CPU must process every packet. Consider the following requirements and configuration options for each X.25 connection:
  - What is the proposed speed of each X.25 connection?
  - What size X.25 windows are you using (both in and out sizes)?
  - What X.25 packet size are you using?
  - What X.25 options do you want to negotiate?
  - What filters do you want to use?
  - What are the traffic volumes of each transaction, per router?

Before starting this task, you must have a clear idea of what X.25 network services are used on the X.25 public data network (PDN) connections. If the hosts are Cisco platform routers, or if Cisco equipment is providing X.25 switching, it is strongly recommended that the **debug x25** EXEC command output be captured for representative sessions. If possible, similar system debugs should be obtained to gather specific configuration or operational information about the X.25 equipment. You should also review the contract with your X.25 PDN service provider, to determine if any nonstandard services are being used.

Note Because debugging output is assigned high priority in the CPU process, it can render the system unusable. For this reason, use **debug** commands only to troubleshoot specific problems. Moreover, it is best to use **debug** commands during periods of lower network traffic and fewer users. The best situation is to collect the debug information in a lab.

In assessing the suitability of XOT for an implementation, an intermediate step of inserting a Cisco router between X.25 hosts or end devices and the existing X.25 PDN connection, and configuring the Cisco router to switch X.25 traffic, can be performed because, if the connectivity works when switching between two X.25 interfaces, it is likely to work for switched traffic between X.25 and XOT. This intermediate step assumes that the X.25 PDN is not providing a network service that Cisco has not implemented.

Cisco recommends that you introduce XOT in your network in stages while maintaining existing X.25 PDN connections. Depending upon services being used, it would then be possible to configure X.25 routing to use either the X.25 PDN or an XOT session based on a source or destination address or other possible criteria. Then migrate to XOT one class of user or access point at a time while monitoring connections and router performance for any problems. This approach should also provide an early warning if X.25 usage and traffic patterns present a scalability problem for the configured network.

Once it has been determined that XOT can handle the X.25 connectivity needs, the X.25 routing configuration commands that use the X.25 PDN can be removed from the configuration, and the router disconnected from that network.

A few other guidelines to consider are as follows:

- Make certain all X.25 functionality is placed in the access routers. Do not implement X.25 functionality in the core and distribution routers. The network should perform all XOT at the access layer using process switching. The core and distribution routers should perform routing of IP packets only. This architecture facilitates simpler configurations and makes the XOT network easier to manage. Plus, this architecture pushes process switching to the edge of the network, which leaves a clean IP core.

- It is possible to simplify X.25 route statements in the access routers when X.25 addressing is laid out for summarization. What follows is an example of how X.121 addressing could be implemented. The example is based on the U.S. telephone numbering system.

An X.121 address is made up of an area code and a local office exchange. For example, a three-digit **A**rea code, three-digit local code of **E**xchange, and two-digit port number on the **R**outer combines for a total of eight digits in the pattern **AAAEEERR**.

From the data terminal equipment (DTE) address, you can determine the location of the equipment in the network, and two digits for subaddressing are still available. In addition, the addressing scheme allows for summarization of a collection of addresses on a router. This scheme minimizes the number of XOT routes in the router located in front of the OSS. Specifically for a route in a central office, the following addressing uses Area code 317 and the Exchange 855 where the central office resides. The first router in the building is numbered 01 and the ports are numbered XX.

AAAEEERRXX = 31785501XX

All of the routes to the first router can be summarized into one route using the **x25 route** command, as follows:

```
router C# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
router C(config)# x25 route 31785501 xot 192.168.100.1
```

An example network configuration is shown in Figure 6. The OSS is on the left side of the figure connected by X.25 to access routers in the data center. The middle portion of the diagram shows the IP backbone, which comprises a core set of routers and a set of distribution routers. The right side of the figure has two routers connected to various network elements in the central office. The X.121 address for the top router is 31785501. Basically, the router sits in the 317 area code in a central office with a local exchange number of 855 and the assigned router number. The first network element connected to the router is a SONET/SDH gateway network element (GNE) with the X.121 address of 3178550101. The last 01 represents the first connection on router 01.

Figure 6   *Summarizing Routes to a Router*
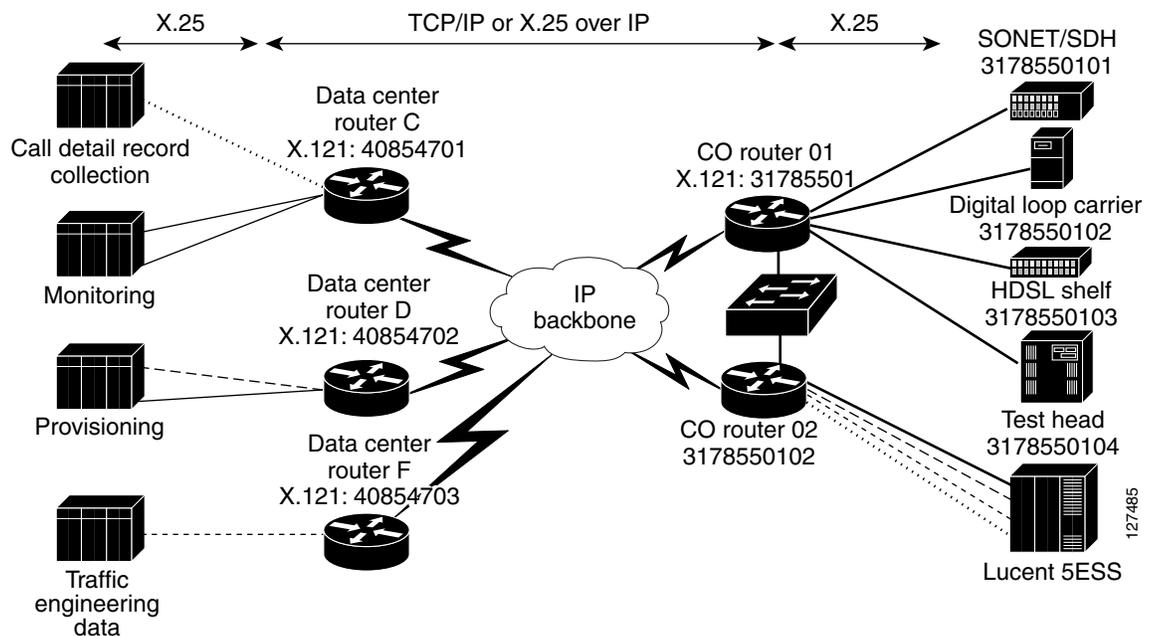
A single X.25 route can be entered into the data center routers to connect to all of the network elements to central office router 01. Following is the X.25 route statement that is configured for data center router 01 in Figure 6:

```
x25 route 31785501 xot 192.168.100.1
```

This statement directs all calls destined to router 01 in central office 317855. The route can be verified using the **show x25 route** EXEC command, as follows:

```
router C# show x25 route

#  Match              Substitute           Route to           match/use
1  dest ^6242232001                        Serial1/0          12/12
2  dest 317816                             xot 192.168.100.1  0/0
3  dest 31785501                           xot 192.168.100.1  0/0
```

Alternatively, you could use a parallel addressing scheme that incorporates both the new addressing scheme previously described and your current X.121 addressing scheme, to fall back on in the interim if needed.

- As implementations of XOT have grown, the number of static X.25 routes that must be maintained in access routers has also grown. The technique previously shown of summarizing routes is a helpful tool in reducing the number of route statements to maintain in a router, but you still must maintain access routes in multiple routers across the network. A feature to centralize the X.25 routing database has been developed for the DCN called DNS-Based X.25 Routing. More information can be found in the Cisco feature module titled "DNS-Based X.25 Routing" at the following URL: http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1830/products_feature_guide09186a00800879c8.html

What follows is an example of how to configure the feature. In the example, the customer can place the X.121 address in the A record of the DNS entry. The router is configured with a global **x25 route** command statement that points the router to the DNS, as follows:

```
x25 route ^.* xot dns \0
```

The **x25 route** command uses pattern matching and substitution. The caret (^) matches the beginning of the input string. The period (.) matches any single character including a space. The asterisk (*) matches zero or more occurrences of the preceding characters. The pattern in this example (^.*) matches the entire X.121 destination address beginning with the first character of the address. The pattern "\0" substitutes the destination X.121 address for the DNS string to look up. A detailed explanation of expression substitution can be found in a Cisco IOS chapter titled "Regular Expressions" at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/ftersv_c/ftsappx/tcfaapre.htm

The DNS address is configured using the **ip name-server** command. The **ip name-server** command identifies the IP address of the DNS that the router should send queries to. You can configure multiple DNS queries, as shown in the following example:

```
ip name-server 192.168.1.104
ip name-server 192.168.20.104
```

- Remember to configure TCP keepalives in and out for the permanent virtual circuits (PVCs) and switched virtual circuits (SVCs) of the access (X.25) devices so that when a route (TCP connection) fails, a CLR message is sent on an SVC and a Reset message sent on a PVC. The following two commands tear down the TCP connection if the X.25 connection idles out or does not perform its clear call sequence appropriately.

```
service tcp-keepalives-in
service tcp-keepalives-out
```

- Make sure that the OSS port, which is an aggregation of X.25 virtual circuits from X.25 terminals in the network, has a high-speed interface to ensure good throughput.

  If you have more questions and can provide your network X.25 PDN details, Cisco support personnel can provide specific guidelines to help you. Also, see the "X.25 over TCP/IP" configuration example available at this link from the Cisco TAC website: http://www.cisco.com/warp/public/133/x25_over_tcpip.html

TL1 in the Cisco Network

In North America, service providers use TL1, a standard machine language, to communicate with network elements. More specifically, TL1 is used by the OSS to communicate to network elements. Bellcore developed the TL1 language and standard back in the early 1980s for the RBOCs, and defined the language in the Bellcore document GR-831-CORE. TL1 is an ASCII-based instruction set and is widely used in the North America for the management of transmission network elements. TL1 is not used for the management of Class 5 switches. A simple explanation of TL1 can be found at the following website: http://www.tl1.com/

For TL1, a semicolon terminates instructions and messages. From a Layer 3 perspective on a Cisco router, the semicolon terminator character can be used for mediating between TCP/IP and X.25. As stated previously, service providers migrate their DCN from an X.25 network to IP DCN in stages. The first stage is to install an IP backbone and run XOT across the DCN as shown in Figure 3. The second stage is to migrate the OSS to IP and mediate between IP and X.25 in the access router as shown in Figure 4.

One implementation issue that service providers encounter is the forwarding of complete TL1 messages. Some network elements will not accept a TL1 message split across multiple packets. The packet assembler/disassembler (PAD) feature in the Cisco IOS software is used in protocol translation sessions. PAD Parameter 3 is the Data Forwarding parameter. Cisco has implemented a value of 128 for this parameter, which causes the router to forward data on receipt of a semicolon. In other words, as shown in Figure 7, the router will buffer incoming TL1 data in the TCP/IP packets and forward out on the X.25 side a complete TL1 message in an X.25 packet when a semicolon is received. (Cisco also implemented a value of 130 for PAD Parameter 3, which forwards data when either a semicolon or an ASCII carriage return is received.)

Figure 7 **TL1 Translation in a Cisco Network**
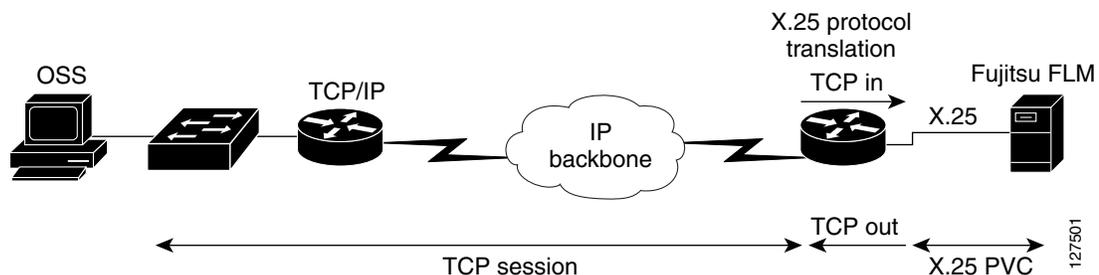
The following example shows the PAD profile for a router connected to a Fujitsu FLM:

```
x29 profile fujitsu 1:0 2:1 3:128 4:0
```

In this profile:

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines if characters are locally echoed. Parameter 2 is set to 1, which sets local echo on.

- Parameter 3 was described earlier and in this profile is set to 128 (router forwards data on receipt of a semicolon).

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. The PAD profile for the router connected to the Fujitsu FLM has Parameter 4 is set to 0, which means that there is no timer; data will wait for the data forwarding character.

Documentation about the Cisco supported PAD parameters can be found in the Cisco IOS chapter "X.3 PAD Parameters" at this URL:

http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1835/products_configuration_guide_chapter09186a00800ca7e7.html#1026177

Protocol Translation as an X.25-to-TCP/IP Mediation Function

Mediation between TCP/IP and X.25 on a Cisco router is done by either protocol translation or record boundary preservation.

Note The Record Boundary Preservation feature was developed specifically for use with Lucent 5ESS and other Class 5 switches. The Class 5 switches do not use TL1 as their machine language, but instead have their own proprietary languages. The Record Boundary Preservation feature is described in Chapter 2, "Telephone Switch Environments."

We have already acknowledged that the long-term goal of service providers is to migrate their DCNs to TCP/IP, and that the first step is to migrate to a TCP/IP core network and run X.25. This first step allows removal of the X.25 network but leaves the OSSs and network elements unchanged.

The second step is to migrate the OSS to TCP/IP, which is easier than migrating the network elements to TCP/IP because, typically, the service provider has a smaller number of OSSs. Of the X.25-to-TCP/IP mediation functions offered by Cisco, protocol translation is used for mediation with transmission network elements, the main reason being that protocol translation works well with network elements using TL1. TL1 is described in the "TL1 in the Cisco Network" section on page 10. This section focuses on protocol translation as an X.25-to-TCP/IP mediation function.

To begin our understanding of protocol translation as an X.25-to-TCP/IP mediation function, we need to remember that every X.25 virtual circuit (VC) is translated to a separate TCP session, and each of those TCP sessions is terminated on the router. Look at the simple example shown in Figure 8.

Figure 8   *Protocol Translation as an X.25-to-TCP/IP Mediation Function*
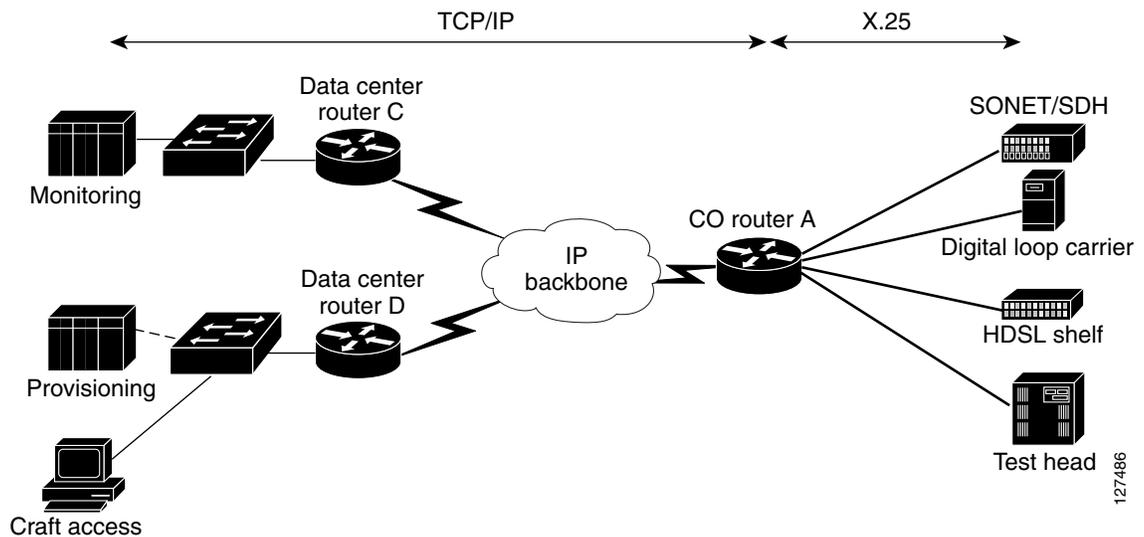
In Figure 8, there are two OSSs and one craft access terminal communicating with four network elements that are connected to central office router A. The craft access terminal is a UNIX host that can connect to the X.25 SVCs configured for administrator access. The administrator access is a direct user interface to enter commands. In North America, those commands are entered using the TL1 language. In this example, there are three potential sessions to each network element for a total of 12 sessions. There could be 12 TCP sessions terminated on central office router A and translated to 12 X.25 VCs. Protocol translation uses a virtual terminal (vty) session to terminate each TCP session, and each translate statement requires a separate vty session.

Note A common mistake made when migrating to environments using protocol translation is to forget to increase the number of vty sessions. The Cisco IOS command parser does not check the number of available vty sessions and compare it to the number required to fulfill the protocol translation statement. There is no way for the Cisco IOS command parser to know how many protocol translation statements are concurrently invoked. When the router runs out of vty sessions, new Telnet sessions are rejected. It can be difficult to determine the source of the problem when a NOC complains that an application cannot connect. Typically, you assume that vty sessions are available, but you will need to add vtys.

Going back to Figure 8, you need to add vty sessions into the configuration to accommodate the protocol translation sessions. The following example shows the command to add 12 vty sessions:

```
line vty 5 12
```

Another potential problem for service providers using protocol translation as an X.25-to-TCP/IP mediation function is for the packet sizes to be different between TCP/IP and X.25. The Cisco IOS software extracts the data from the TCP/IP packet based on the configured output packet size on the X.25 interface and adds a 3-byte header. Cisco IOS software sends the X.25 packet. If the data from the TCP/IP packet cannot be contained in one X.25 packet, the software sets the More bit in the X.25 packet. For example, if the software receives a 471-byte TCP payload and the X.25 interface is configured with an output packet size of 128, the software sends out four X.25 packets (three 128-byte and one 87-byte packet; the first three packets will have the More bit set).

Note The input and output packet sizes can be set within the Cisco IOS software. The commands for changing the X.25 packet sizes are described in the The "X.25 and LAPB Parameters" section in the "Telephone Switch Environments" chapter.

Protocol translation is process switched, so you will need to monitor the router CPU usage as the translation statements are added to the router. Each new connection or translate statement will add packets for the CPU to process.

The TCP sessions in protocol translation are terminated on the router. The IP address used with protocol translation cannot be an IP address assigned to an interface on the router. The Cisco IOS software will not allow this configuration. The IP address must be an unused address from a locally attached subnetwork. Service providers often choose an unused IP address from a locally attached Ethernet. The downside is that the connection will be lost if the Ethernet goes down. A better choice is to set up a subnetwork on a loopback interface and use a free IP address. A sample configuration for doing this follows:

```
interface Loopback0
 ip address 192.168.10.1 255.255.255.252
```

This example creates a small subnetwork. You would use the free IP address 192.168.10.1 for the translation statement. The interface will always be up unless you shut down the interface. You can check the interface status with the **show interfaces** EXEC command, as shown in the following example:

```
Router# show interfaces loopback 0

Loopback0 is up, line protocol is up
  Hardware is Loopback
  Internet address is 192.168.10.1/30
  MTU 1514 bytes, BW 8000000 Kbit, DLY 5000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation LOOPBACK, loopback not set
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/0 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Migration Prerequisites

Before starting the tasks in the configuration sections, read the following paragraphs to understand Cisco software features that will help you configure your network:

- Asynchronous Console Configuration, page 14
- Protocol Translation Ruleset Feature, page 14
- Cisco X.25 Version Feature, page 14

Asynchronous Console Configuration

By default, Cisco routers do not accept incoming network connections to asynchronous ports (TTY lines). You must specify an incoming transport protocol, or specify the **transport input all** command before the line will accept incoming connections. For example, if you are using a Cisco router as a terminal server to make console-to-port connections to routers or other devices, you will not be able to use Telnet to connect to these devices. You will receive the message "Connection Refused." See the Cisco IOS chapter "Configuring Terminal Operating Characteristics for Dial-in Sessions" at http://www.cisco.com/en/US/docs/ios/12_2/termserv/configuration/guide/tcftrmop.html for more information.

Protocol Translation Ruleset Feature

The Protocol Translation Ruleset feature provides an effective method for creating Cisco IOS protocol translation configurations by defining a set of statements called a ruleset. The ruleset applies pattern matching and substitution technology to use incoming protocol elements, such as a destination address and port, to determine the outgoing protocol elements and translation options specified for originated connections. The ruleset also contains options to control the protocol translation sessions. The Protocol Translation Ruleset feature is especially useful for users that need to configure a large number of translate commands, because it makes it easy to create many individual translate configuration commands using a single ruleset-based command. You can learn more about this feature in the Cisco IOS *Protocol Translation Ruleset* feature module at this URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123newft/123t/123t_8/gt_ptagg.pdf

Technical discussions about protocol translation and X.25 are popular threads on the Index of /news/cisco/cs/pt (protocol translation) and x25 (X.25) aliases. See the following links to get started:

http://topic.cisco.com/news/cisco/cs/pt/msg02598.html

http://topic.cisco.com/news/cisco/cs/x25/msg20160.html

Cisco X.25 Version Feature

By default, Cisco IOS X.25 software conforms to the Consultative Committee for International Telegraph and Telephone (CCITT) 1984 X.25 recommendation. The Cisco IOS X.25 implementation was designed to conform to the CCITT 1984 X.25 recommendation, because the 1984 implementation represents the largest set of X.25 devices deployed at that time and because protocol conformance testing to the 1984 standard is readily available.

If your network employs devices that comply with the 1980, 1988, or 1993 X.25 recommendation, you will need to use the **x25 version** command to change the version for both X.25 class services such as X.25 and Connection-Mode Network Service (CMNS), and X.25 configuration profiles.

A common use of the **x25 version** command is to specify the 1980 X.25 behavior set to suppress the signaling of facilities that are not defined by that recommendation. This functionality benefits customers with an attached X.25 device that is not capable of correctly handling one or more of the facilities defined in the subsequent standards.

Note The Cisco IOS implementations of the 1980, 1988, and 1993 X.25 behavior sets have not been tested for compliance with the CCITT recommendations. For example, configuring an interface with the **x25 version 1988** command will not necessarily create an interface that offers an X.25 connection that is in full compliance with the 1988 recommendation; it only enables select features from the 1988 standard

that are supported by the Cisco IOS X.25 implementation. More information about this feature can be found in the Cisco IOS *X.25 Version Configuration* feature module at the following URL:
http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123newft/123t/123t_8/gtx25ver.pdf

TCP-to-X.25 Protocol Translation Between IP-Based Hosts and X.25 Interfaces

This section describes the tasks to configure a Cisco router to perform TCP-to-X.25 protocol translation between IP-based hosts and the following X.25 TL1 messaging maintenance interfaces:

- Fujitsu SONET GNE Protocol Translation Configuration, page 15
- ADC Soneplex Protocol Translation Configuration, page 22
- Alcatel Litespan Protocol Translation Configuration, page 29
- Alcatel 1603 SM Protocol Translation Configuration, page 35
- Alcatel 1633 SX DCS Protocol Translation Configuration, page 41
- Alcatel DCS-DEXCS Protocol Translation Configuration, page 47
- Tellabs Titan 5500 DCS via DCN Protocol Translation Configuration, page 52
- Applied Digital T3AS DCS via DCN Protocol Translation Configuration, page 59
- Wiltron Test System Protocol Translation Configuration, page 65

The Cisco IOS translation feature enables the OSS on the IP network to access an X.25 management interface, despite differences in the native protocol stacks. See the "Troubleshooting Telco Equipment in X.25 Environments" section on page 69 for information about verifying or troubleshooting your configurations.

Fujitsu SONET GNE Protocol Translation Configuration

As shown in Figure 9, the Cisco IOS protocol translation feature enables users on a TCP/IP network to access X.25 network elements, despite differences in the native protocol stacks.

Figure 9   *Protocol Translation Between IP Hosts and Fujitsu X.25 Interfaces*
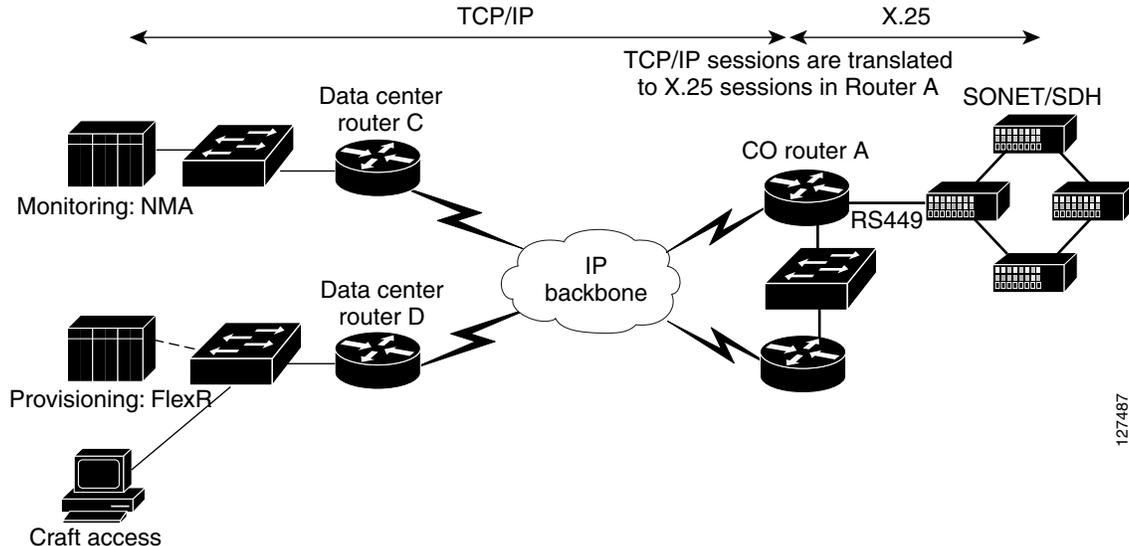
The monitoring OSS applications in this example are Telcordia's Network Management Application (NMA) used for performance monitoring, and FlexR+, an element manager from Fujitsu used for provisioning.

Cable Requirements for the Fujitsu SONET GNE

The OSSI cable connects to (CN9) - FLM150ADM, (CN1) - FLM600ADM, or (CN9) - FLM2400ADM. This cable has a 37-pin (EIA/TIA) RS-449 male (DTE) connector on the Fujitsu end. See Table 1 and the "CONNECT OSS1 CABLES" section in the Fujitsu DLP installation manual for more information.

Table 1   *OSSI Cable Specification*

Device	Connector	Part number	Item number
TL1	CN9 / 37-pin, D-sub female, RS422/449	22-532-XXX 24AWG, 25 pr	999

Set the DIP switch to OS in the SV module that is connected to the Cisco router. This DIP switch will also be set to OS in all other SV modules, unless a back-to-back cable is used to extend the SDCC between routes, although this configuration is not recommended under normal circumstances.

Provisioning the Fujitsu SONET GNE

The following steps show how to provision a Fujitsu SONET GNE to use X.25.

Note   Before entering any command configuration information, contact the NMA database personnel to verify all pertinent information such as the Packet DTN or the IP address, the SCID, and the TIDs at both GNEs, if appropriate.

Step 1 Log in to the element where the operations support system interface (OSSI) gateway will be established (either the primary or alternate GNE) using the following command:

COMMAND: ACT-USER

Tip Although this example uses TL1 commands, either TL1 or FlexR commands can be used for each of the following steps.

Step 2 Enter the following responses to the commands to set up OSSI for the OSSI port:

COMMAND:	ED-OSSI
TYPE:	X.25 Layer 3
K:	7
T1:	3
N1:	1080
N2:	10
IS/OOS:	IS

Changes do not take effect until the INIT-OSSI command is issued, as follows:

COMMAND: INIT-OSSI

When prompted, leave DL and NL blank, which defaults to both.

Step 3 This step sets up the virtual channel for OSSI ports. Ports 1 to 8 are PVCs; ports 9 to 16 could be set up as SVCs. At the primary gateway access, PVC numbers 1 to 4 will be built. At the alternate gateway, PVC numbers 5 to 8 will be built.

COMMAND:	ED-VC
AID:	1 to 4 or 5 to 8 (the number of PVCs being added)
LCGN:	0
LCN:	Logical channel number (LCN) of the VC being added, that is, the same as AID or 1 to 8
PEER:	Peer address is a seven-digit number equal to the LCN being provisioned, for example: LCN1 = 1111111, LCN2 = 2222222, and so on
Type:	PVC

Step 4 All other fields need to be set to null when assigning PVCs. Changes do not take effect until the INIT-OSSI command is issued. This command must be issued after each PVC is added. Repeat this step for each of the PVCs. To delete an LCN, enter 0000000 in the PEER field.

Step 5 Enter the following responses to the commands to set up X.25 for the OSSI port:

COMMAND:	ED-X.25
Addr:	The DTN or IP address with socket number for the NMA address
Size:	128

Wdnw:	2
Dbit:	N
T20:	180
T21:	200
T22:	180
T23:	180
CUG:	Leave blank for PVCs. This field is used only when building SVCs.
LCRL:	1
LCRU:	8 (Note that Step 3 must be completed before this parameter can be changed from 255.)

Step 6 Any changes made do not take effect until the INIT-OSSI command is issued, as follows:

COMMAND: INIT-OSSI

When prompted, leave DL and NL blank, which defaults to both.

Step 7 After setting up the gateway OSSI (either primary or alternate), enter the following commands, and then make and keep a paper copy of the settings for future reference:

COMMAND:	RTRV-X25
COMMAND:	RTRV-OSSI (State should be IS and Type should be X.25)
COMMAND:	RTRV-VC

Step 8 Log out using the following commands (system reply prompts are also shown):

COMMAND: canc-user:(TID):UID:(ctag);

IP BC

<

FUJITSU 99-04-19 07:22:16

M BC COMPLD

This completes the steps for provisioning the Fujitsu SONET equipment for alarm reporting.

Configuring a Cisco Protocol Translation Router for the Fujitsu SONET GNE

This section describes the steps required to configure router A in the central office in . The router is being configured to translate four TCP sessions into four PVCs.

Step 1 Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
```

```
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2   Enter global configuration mode:

```
router A# configure terminal
```

Step 3   Enable X.25 routing:

```
router A(config)# x25 routing
```

Step 4   Set up a PAD profile statement. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session, as follows:

```
router A(config)# x29 profile fujitsu 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. PAD Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented a value of 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. A value of 0 means that there is no timer; data will wait for the data forwarding character.

Step 5   Start interface configuration mode for loopback interface 0 and configure an IP address using the following commands:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6   Start interface configuration mode for serial interface 3/3, which specifies network module 3, port 3:

```
router A(config)# interface serial 3/3
```

Step 7   Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8   Enter a description for the interface:

```
router A(config-if)# description SONET GNE1
```

Step 9   Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10   Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11   Configure X.25 DCE encapsulation on the serial interface:

```
router A(config-if)# encapsulation x25 dce
```

Step 12 Configure the X.121 address on the serial interface. This address is the source X.121 address when a call is placed to the network element. Note that the network element can restrict which X.121 addresses that the network element will accept calls from, so be certain that the address you enter matches the expected source address.

```
router A(config-if)# x25 address 6242232001
```

Step 13 Configure the low two-way channel on the serial interface:

```
router A(config-if)# x25 ltc 9
```

Step 14 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Set up protocol translation statements to create PVCs 1 to 4 in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 2001 x25 6242232001 pvc 1 packetsize 128
128 windowsize 2 2 profile fujitsupvc max-users 1
router A(config)# translate tcp 192.168.10.2 port 2002 x25 6242232001 pvc 2 packetsize 128
128 windowsize 2 2 profile fujitsupvc max-users 1
router A(config)# translate tcp 192.168.10.2 port 2003 x25 6242232001 pvc 3 packetsize 128
128 windowsize 2 2 profile fujitsupvc max-users 1
router A(config)# translate tcp 192.168.10.2 port 2004 x25 6242232001 pvc 4 packetsize 128
128 windowsize 2 2 profile fujitsupvc max-users 1
```

- The protocol translation statement maps the PVCs with IP address 192.168.10.2 and TCP ports 2001 to 2004. The TCP session is terminated on the router.

- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6242232001 is used to map the PAD to serial interface 3/3. Note that the X.121 address is needed even though the translate statement configures a PVC, because this is the Cisco IOS mechanism used to direct the PAD to the correct interface.

- The X.25 packet size is set to 128 in and 128 out. The window size is set to 2 packets in and 2 packets out. The PAD profile name is fujitsupvc.

- The **max-users** option sets the number of simultaneous users that can use the command, and is set to 1.

Step 17 Create a route statement to map X.121 address 6142232001 to serial interface 3/3:

```
router A(config)# x25 route ^6142232001 interface serial 3/3
```

Step 18 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after that number of sessions is exceeded.

✎
Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 19 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 20 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up:

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Fujitsu SONET GNE

This section describes how to establish a direct Telnet session to test the translate TCP port on router A. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 9), the configuration for PVC 1 uses IP address 192.168.10.2 and TCP port 4001.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 2001:

```
router A# telnet 192.168.10.2 2001
Trying ... Open
```

Step 2 Type a TL1 command for this network element. This example uses the retrieve header command, which allows you to verify the connection.

> **Note** The FLM ADM will not respond if the TID is not correct in the TL1 command.

```
rtrv-hrd:(TID)::(CTAG);
```

The output from the FLM is not displayed.

Step 3 Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4 The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn     Host               Address         Byte  Idle  Conn Name
* 1      192.168.10.2       192.168.10.2    0     0     192.168.10.2
```

Step 5 Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect

router A# show sessions

Conn     Host               Address         Byte  Idle  Conn Name
```

The testing for PVC 1 is complete. Repeat steps 1 through 4 for the other three PVCs.

ADC Soneplex Protocol Translation Configuration

This section describes the steps required to configure a Cisco router to perform TCP-to-X.25 protocol translation between an IP-based OSS and the X.25-TL1 messaging maintenance interface on an ADC Soneplex. Figure 10 shows Soneplex connectivity in a Cisco network.

Figure 10   *ADC Soneplex Connectivity*
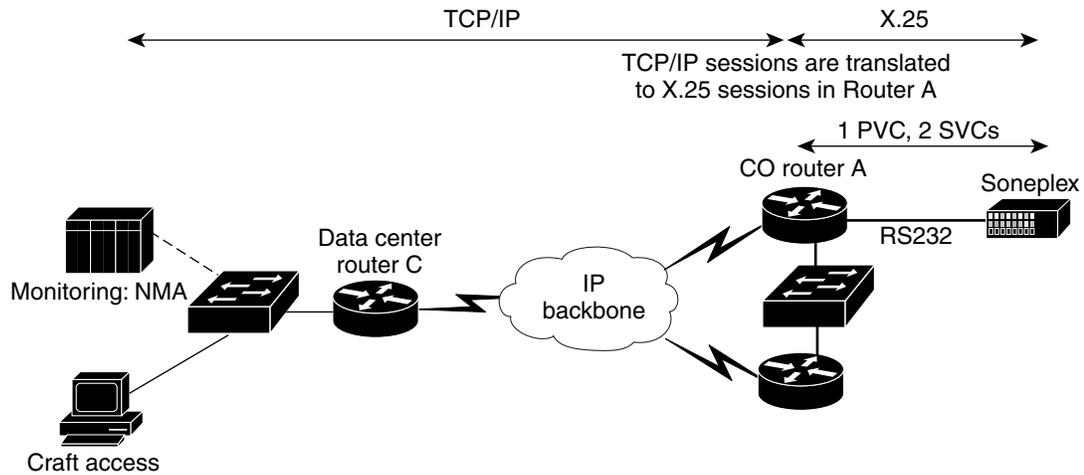
ADC Soneplex Cable Requirement

Figure 11 and Figure 12 show the front and back view of a Soneplex shelf. Port 3 on the back of the Soneplex is the Craft port that supports TL1 over X.25. Port 3 is used in the following configuration example, and is a standard (EIA/TIA) RS-232 interface. Table 2 lists the cable pinout for port 3.

Figure 11   *ADC Soneplex Front View*
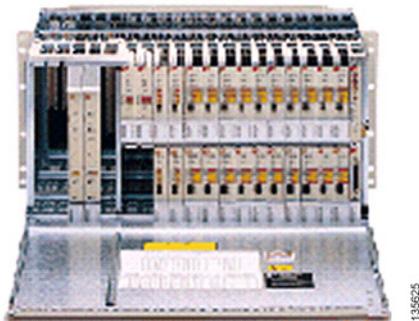
Figure 12   *ADC Soneplex Rear View*
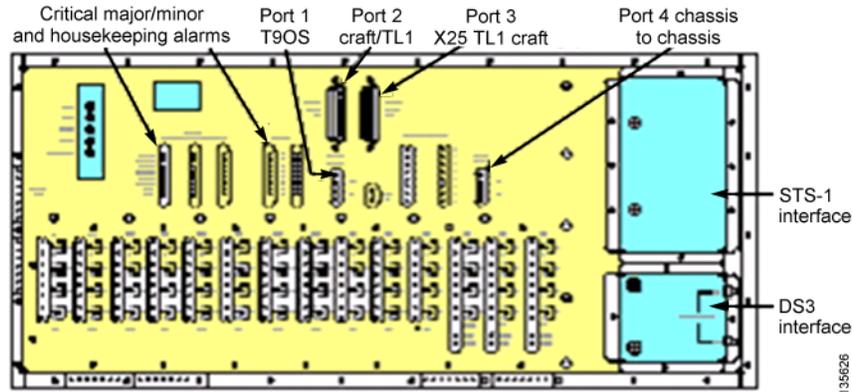
Table 2   *ADC Soneplex Port-3 Pinout*

Connection Numbers at Port-3 Equipment End	
Pin Number	**Lead Designation**
1	FG
2	TD
3	RD
4	RTS
5	CTS
6	DSR
7	SG
8	DCD
15	TC
17	RC
20	DTR

For this configuration, monitoring of the network element is done by an NMA from Telcordia. The Soneplex in this example is assumed to be running version 5.x . A PVC is set up for monitoring the host NMA. Two SVCs are set up for Craft access.

Provisioning the ADC Soneplex

The following steps show how to provision the X.25 interface on an ADC Soneplex. Use communication port 3 on the Soneplex shelf for X.25 connectivity (reference ADC practice ADCP-61-311, DLP523).

Step 1   Start the task for provisioning the Soneplex X.25 interface by entering the main menu and logging in using the following username and password (all capital letters are required for these words):

```
User Name: SONEPLEX
Password : SONEPLEX1
```

Note the firmware version displayed on the Logon screen.

The system responds with the Soneplex main menu, as follows:

SONEPLEX MAIN MENU

1. Alarms

2. Display Status

3. Unit Configuration

4. System Administration

5. System Configuration

6. System Maintenance

7. Performance Monitoring

Step 2   From the main menu, choose 5, System Configuration. This action displays the following system configuration choices:

SYSTEM CONFIGURATION

1. System TID/Date/Time

2. Serial Port Configuration

3. X.25 Port Configuration

4. Shelf Housekeeping Labels

Step 3   Choose 3, X.25 Port Configuration. In this example, the data link or LAPB and X.25 layers are set up as follows:

Table 0-3

X.25 CONFIGURATION

Address Field Assignment	DTE
Window Size	7
Frame Size	1080 bits
N2	7
T1	3 seconds

Table 4 lists the network layer parameters that must be set for the Soneplex shelves running firmware versions 3.x. Version 3 of the firmware supports only *one* Craft port.

Table 4   ***Network Layer Parameters for Firmware Version 3.x***

Parameter	Virtual Circuit and Logical Channel 1	Virtual Circuit and Logical Channel 2
Application	TL1	Craft
Packet Size	128	128
Window Size	2	2
D-bit Support	No	No
Keyboard Timeout	Not applied	30 minutes

Table 5 lists the network parameters for the Soneplex shelves running firmware 5.x. Version 5 firmware supports one PVC and two SVCs. The two SVCs are Craft ports.

Table 5   *Network Layer Parameters for Firmware Version 5.x or Later Versions*

Virtual Circuit	1	2	3
Circuit Type	PVC	SVC	SVC
Logical Channel	1	—	—
Application	TL1	Not set	Not set
Packet Size	128	128	128
Window Size	2	2	2
D-bit Support	No	No	No
Keyboard Timeout	Not set	30 minutes	30 minutes
SVC CRAFT ADDRESS	6142234000 Craft Dtn.	—	—
SVC TL1 ADDRESS	Leave blank	—	—

Configuring a Cisco Protocol Translation Router for the ADC Soneplex

This section describes the steps required to configure the central office router A in Figure 10. The router is being configured to convert one TCP session to PVC 1, and multiple TCP sessions to multiple SVCs.

Step 1   Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text) :

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2   Enter global configuration mode.

```
router A# configure terminal
```

Step 3   Enable X.25 routing.

```
router A(config)# x25 routing
```

Step 4 Set up a PAD profile statement for the PVC that is used by the NMA. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile soneplexpvc 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. PAD Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. The value of 0 means that there is no timer; data will wait for the data forwarding character.

Step 5 Set up a PAD profile statement for the PVC that is used by NMA. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile soneplexsvc 1:0 2:1 3:2 4:2
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter and is set to 2, which will cause the router to forward data on receipt of an ASCII carriage return.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. The value 2 means that the Cisco IOS software waits 2/20ths of a second before forwarding the data.

Step 6 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 7 Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 8 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 9 Enter a description for the interface:

```
router A(config-if)# description Soneplex (RR and shelf)
```

Step 10 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 11 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 12 Configure X.25 DCE encapsulation on the serial interface. The Soneplex is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 13 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 14 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6242235000
```

Step 15 Configure the low two-way channel on the serial interface:

```
router A(config-if)# x25 ltc 2
```

Step 16 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is in minutes.

```
router A(config-if)# x25 idle 5
```

Step 17 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 18 Set up a protocol translation statement to create PVC 1 in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 4001 x25 6242235000 pvc 1 packetsize 128
128 windowsize 2 2 profile soneplexpvc max-users 1
```

- The protocol translation statement maps PVC 1 with IP address 192.168.10.2 and TCP port 4001. The TCP session is terminated on the router.

- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6242235000 is used to map the PAD to serial interface 1/1. Note that the X.121 address is needed even though the translate statement configures a PVC, because this is the Cisco IOS mechanism used to direct the PAD to the correct interface.

- The X.25 packet size is set to 128 in and 128 out. The window size is set to 2 packets in and 2 packets out. The PAD profile name is soneplexpvc.

- The **max-users** option sets the number of simultaneous users that can use the command, which is set to 1.

Step 19 Set up a protocol translation statement to create an SVC:

```
router A(config)# translate tcp 192.168.10.2 port 4002 x25 6142234000 profile soneplexsvc
```

- The protocol translation statement maps an SVC with IP address 192.168.10.2 and TCP port 4002. The TCP session is terminated on the router.

- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6242234000 is used to map the PAD to serial interface 1/1. The X.121 address is the Cisco IOS mechanism used to direct the PAD to the correct serial interface.

- The PAD profile name is soneplexsvc.

Step 20 Create a route statement to map X.121 address 6142234000 to serial interface 1/1:

```
router A(config)# x25 route ^6142234000 interface serial 1/1
```

Step 21 Create a route statement to map X.121 address 6142235000 to serial interface 1/1:

```
router A(config)# x25 route ^6242235000 interface serial 1/1
```

Step 22 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after that number of sessions is exceeded.

Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 23 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 24 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the ADC Soneplex

This section describes how to establish a direct Telnet session to test the translate TCP port on router A. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 10), the configuration for PVC 1 uses IP address 192.168.10.2 and TCP port 4001.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 4001:

```
Router# telnet 192.168.10.2 4001
Trying 192.168.10.2 ... Open
```

Step 2 Type a TL1 command for this network element. Begin by typing a semicolon (;):

```
;
```

The response should be as follows:

```
TID DATE TIME
M   0 DENY
IPNV
```

Step 3 Log in by entering the following commands (use all capital letters when indicated):

```
act-user::SONEPLEX:CTAG::SONEPLEX1;
```

The response should be as follows:

```
TID DATE TIME
ctag COMPLD
"SONEPLEX"
```

Step 4   Log out of the Soneplex by entering the following commands (use all capital letters when indicated):

```
canc-user::SONEPLEX:ctag::SONEPLEX1;
```

Step 5   Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key):

Step 6   The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn      Host               Address        Byte   Idle   Conn Name
* 1       192.168.10.2       192.168.10.2   0      0      192.168.10.2
```

Step 7   Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect

router A# show sessions

Conn      Host               Address        Byte   Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

Alcatel Litespan Protocol Translation Configuration

This section describes the steps to configure a Cisco router to perform TCP-to-X.25 protocol translation when you connect equipment to the X.25 maintenance port on an Alcatel Litespan digital loop carrier. Figure 13 shows a sample configuration.

Figure 13   ***Alcatel Litespan Protocol Translation***
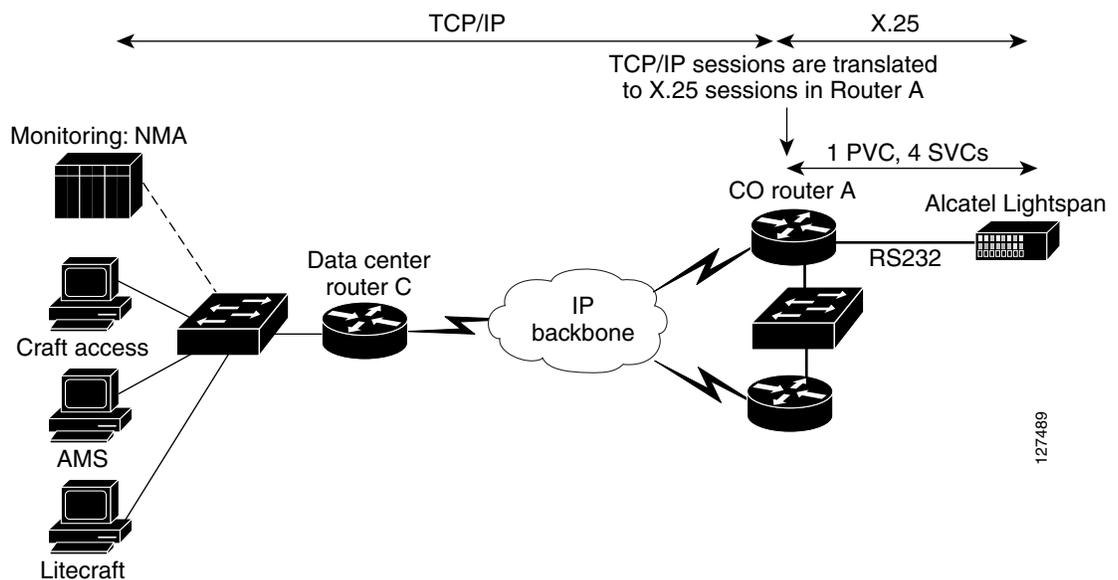
The OSS is connected to the network via TCP/IP. The following section describes how to configure an Alcatel Litespan X.25-TL1 messaging maintenance interface. The Cisco IOS translation feature enables OSS users on one network to access network elements on another network, despite differences in the native protocol stacks.

The OSSs connecting to the Litespan are NMA, AMS, and Litecraft. The NMA system collects and analyzes information and alarms from the Litespan. The AMS and Litecraft applications use GUIs with the Litespan platform. Both interfaces provide a full complement of management functions for Operations, Administration, Maintenance, and Provisioning (OAM&P) using either a TCP/IP or an X.25 interface. The following procedure is based on the legacy X.25 management interface.

Provisioning the Alcatel Litespan

The following steps show how to provision the X.25 management port on the Alcatel Litespan device for one PVC and four SVCs.

Step 1 Log in to the Litespan 2000 by entering the following command:

ACT-USER::OPTILINK:::OPTILINK;

Step 2 Provision lower-level X.25 by entering the following commands:

ED-LLX25::COT-1-AUX2::::EXTERNAL,RS232,96,7,20,200,40,20,auto,active,10,10,disable,enable,,dte,on,standard;

CLOCK=EXTERNAL,

PHYSICALINTERFACE=RS232,

LINESPEED=96,

WINDOWSIZE=2,

TIMERT1=20,

TIMERT3=200,

TIMERT4=40,

COUNTERN2=20,

STARTMODE=AUTO,

CONNECTMODE=ACTIVE,

DCDPOLLTIMER=10,

DCDPOLLRETRY=10,

AUTOCALLMODE=DISABLE,

AUTOANSWERMODE=ENABLE,

DIALSTRING=,

TERMINALMODE=DTE,

AUTOCONFIG=ON,

NETWORKTYPE=STANDARD

Step 3 Provision upper level X.25 by entering the following commands. The Xs represent the X.25 DTN of the Litespan system.

ED-ULX25::COT-1-AUX2::::DTE,1,0,4,0,1,2,0,0,128,512,1984,3,0,XXXXXXXXXX
,2,1800,2000,1800,1800,0,0,0,1800;

LINETYPE=DTE,

NUMPVC=1,

NUMSVC2W=0,

NUMSVCIN=4,

NUMSVCOUT=0,

PVCLCNLOW=1,

SVCLCNLOWIN=2,

SVCLCNLOW2W=0,

SVCLCNLOWOUT=0,

DFLTPKLEN=128,

MAXPKLEN=512,

CCITTCONFORM=1984,

THROUGHCLSNEGO=3,

SETCUG=0,

DTEADDRESS=XXXXXXXXXX

L3WINDOWSIZE=2,

TIMERT20=1800,

TIMERT21=2000,

TIMERT22=1800,

TIMERT23=1800,

TIMERT24=0,

TIMERT25=0,

Step 4   Make the VCs active by entering the following command:

CONN-LLX25::COT-1-AUX2;

Step 5   Verify the VCs are active by entering the following command:

RTRV-COND-X25;

Step 6   Change the mode of the lower layer X.25 after the VCs have been made active by entering the following command:

ED-LLX25::COT-1-AUX2::::,,,,,,startmode=auto;

Step 7   Retrieve all parameters by entering the following commands, then make and keep a paper copy of the settings for future reference:

RTRV-LLX25::COT-1-AUX2;

RTRV-ULX25::COT-1-AUX2;

RTRV-COND-X25;

Step 8   Log out of the Litespan 2000 by entering the following command:

CANC-USER;

Configuring a Cisco Protocol Translation Router for the Alcatel Litespan

This section describes the steps required to configure router A in the central office in Figure 13. Router A is being configured to convert one TCP session to one PVC, and four TCP sessions to four SVCs.

Step 1 Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2 Enter global configuration mode.

```
router A# configure terminal
```

Step 3 Enable X.25 routing.

```
router A(config)# x25 routing
```

Step 4 Set up a PAD profile statement for the PVC that is used by NMA. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile Litespanpvc 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. PAD Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer; the data will wait for the data forwarding character.

Step 5 Set up a PAD profile statement for the SVC that is used by NMA. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile Litespansvc 1:0 2:1 3:130 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 130, which causes the router to forward data on receipt of a semicolon or an ASCII carriage return.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. When Parameter 4 is enabled and a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer; the data will wait for the data forwarding character.

Step 6 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 7 Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 8 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 9 Enter a description for the interface:

```
router A(config-if)# description Litespan
```

Step 10 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 11 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 12 Configure X.25 DCE encapsulation on the serial interface. The Litespan is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 13 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 14 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142233001
```

Step 15 Configure the low two-way channel on the serial interface:

```
router A(config-if)# x25 ltc 2
```

Step 16 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 17 Set up a protocol translation statement to create PVC 1 in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 4001 x25 6242233001 pvc 1 packetsize 128
128 windowsize 2 2 profile Litespanpvc max-users 1
```

- The protocol translation statement maps PVC 1 with IP address 192.168.10.2 and TCP port 4001. The TCP session is terminated on the router.

- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6242233001 is used to map the PAD to serial interface 1/1. Note that the X.121 address is needed even though the translate statement configures a PVC, because this is the Cisco IOS mechanism used to direct the PAD to the correct interface.

- The X.25 packet size is set to 128 in and 128 out. The window size is set to 2 packets in and 2 packets out.

- The PAD profile name is Litespanpvc.

- The **max-users** option sets the number of simultaneous users that can use the command, which is set to 1.

Step 18 Set up a protocol translation statement to create an SVC.

```
router A(config)# translate tcp 192.168.10.2 port 3001 x25 6142234000 profile Litespansvc
```

- The protocol translation statement maps an SVC with IP address 192.168.10.2 and TCP port 3001. The TCP session is terminated on the router.

- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6142234000 is used to map the PAD to serial interface 1/1. The X.121 address is the Cisco IOS mechanism used to direct the PAD to the correct serial interface.

- The PAD profile name is Litespansvc.

Step 19 Create a route statement to map X.121 address 6142234000 to serial interface 1/1.

```
router A(config)# x25 route ^6142234000 interface serial 1/1
```

Step 20 Create a route statement to map X.121 address 6142233001 to serial interface 1/1.

```
router A(config)# x25 route ^6142233001 interface serial 1/1
```

Step 21 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

✎
Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 22 Exit the configuration modes and return to the EXEC prompt.

```
router A(config-line)# end
```

Step 23 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Alcatel Litespan

This section describes how to establish a direct Telnet session to test protocol translation and X.25 connectivity to the network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 13), the configuration uses IP address 192.168.10.2 and TCP port 4001.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 4001:

```
router A# telnet 192.168.10.2 4001
Trying 192.168.10.2 ... Open
```

Step 2 Type a TL1 command for this network element. The following example uses a semicolon (;), and system reply prompts are also shown:

```
;
<
<
< RTRV-HRD:TID:::CTAG;
```

Step 3 Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4 The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn      Host                 Address            Byte   Idle   Conn Name
* 1       192.168.10.2         192.168.10.2       0      0      192.168.10.2
```

Step 5 Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect

router A# show sessions

Conn      Host                 Address            Byte   Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

Alcatel 1603 SM Protocol Translation Configuration

This section describes the steps required for a Cisco router to perform TCP-to-X.25 protocol translation between an IP-based OSS and an Alcatel 1603 SM X.25-TL1 messaging maintenance interface, as shown in Figure 14.

Figure 14   *Alcatel 1603 SM Protocol Translation*
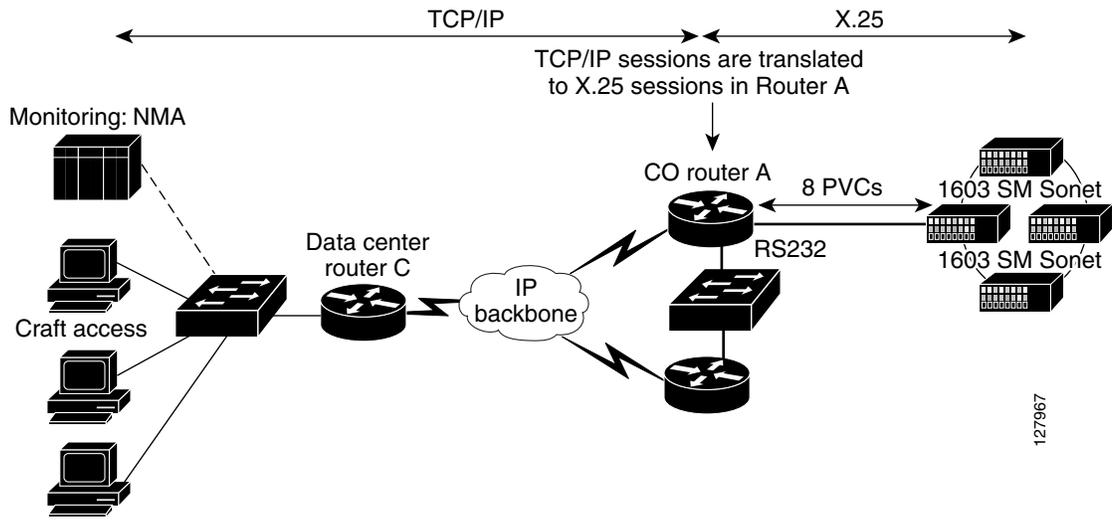
Figure 15 is a photo of the Alcatel 1603 SM OC-3/12 SONET multiplexer that can be configured to support OC-3 and OC-12 line rates from a single, compact, 10.5-inch shelf.

Figure 15   *Alcatel 1603 SM OC-3/12 SONET Transport System*

The management port is TL1 over X.25. The OSS in this example uses NMA for monitoring performance. NMA is a Telcordia product.

Cable Requirements for the Alcatel 1603 SM

The electrical interface to the Alcatel 1603 SM is an (EIA/TIA) RS-232 cable. Cisco cable part number CAB-232FC is required for the router end if the network module is an NM-4A/S or NM-8A/S. Because the Alcatel 1603 SM end is wire-wrapped, one end of the M25B will need a pig-tail cable, part number CAB2812F/BARE-1.5-SP. Wrap the wire according to the drawing in Alcatel practice 363-203-452, DLP124, page 4.

Provisioning the Alcatel 1603 SM

The following steps show how to provision an Alcatel 1603 SM to use X.25.

Step 1 Set up the OSS port as follows:

```
PORT::x25PORT:CTAG:::BAUD=9600,BITS=8,PAR=NONE,SBITS=1,LWID=80, TYPE=VT100,ECHO=N:IS;
```

Step 2 Enter X.25 incoming service information:

```
ED-X25::X25:CTAG::::IS;
```

Step 3 Enter login information for NMA and TST at the local and remote nodes.

```
ENTER-SECU-USER::    followed by:
NMAHOSP:CTAG::NMAHOS#1,,PCMAINT=7,PCPROV=,PCSECU=0,PCT EST=0:PAGE=0,UAGE=0,TDMIS=Y;
then repeat with the following:
ANTST:CTAG::ANTST%1,,PCMAINT=7,PCPROV=7,PCSECU=7,PCTEST=7:PAGE=0,UAGE=0, TDMIS=N;
```

Step 4 Edit the timeout information for the X.25 connection.

```
ED-SECU-CID::MAINT-OS:CTAG::,,,:TMOUT=0;
```

Step 5 Retrieve all parameters by entering the following statements:

```
RTRV-ATTR-PORT::ALL:CTAG;
RTRV-ATTR-SDCC::ALL:CTAG;
RTRV-COND-PORT::ALL:CTAG;
RTRV-SECU-USER::ALL:CTAG;
RTRV-SECU-CID::ALL:CTAG;
RTRV-X25::X25:CTAG;
```

Configuring a Cisco Protocol Translation Router for the Alcatel 1603 SM

This section describes the steps required to configure router A in the central office in Figure 14. The router is configured to translate eight TCP sessions into eight PVCs.

Step 1 Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2 Enter global configuration mode.

```
router A# configure terminal
```

Step 3 Enable X.25 routing.

```
router A(config)# x25 routing
```

Step 4 Set up a PAD profile statement for the PVCs that are used by the NMA and other applications. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile Alcatelpvc 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer, so the data will wait for the data forwarding character.

Step 5 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6 Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 7 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8 Enter a description for the interface:

```
router A(config-if)# description Alcatel 1603
```

Step 9 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11 Configure X.25 DCE encapsulation on the serial interface. The Alcatel 1603 SM is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 12 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 13 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142232001
```

Step 14 Configure the low two-way channel on the serial interface. The following command defines a PVC range from 1 to 8 and the start of the SVC range at 9:

```
router A(config-if)# x25 ltc 9
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Set up protocol translation statements to create eight PVCs in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 2001 x25 6242232001 pvc 1 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2002 x25 6242232001 pvc 2 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2003 x25 6242232001 pvc 3 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2004 x25 6242232001 pvc 4 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2005 x25 6242232001 pvc 5 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2006 x25 6242232001 pvc 6 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2007 x25 6242232001 pvc 7 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1

router A(config)# translate tcp 192.168.10.2 port 2008 x25 6242232001 pvc 8 packetsize 128
128 windowsize 2 2 profile Alcatelpvc max-users 1
```

- The protocol translation statements map PVCs 1 to 8 with IP address 192.168.10.2, and to TCP ports 2001 to 2008. The TCP session is terminated on the router.
- The IP address is a free address on the subnetwork associated with the loopback interface. The IP address is used now by the router for protocol translation.
- The X.121 address of 6242232001 is used to map the PAD to serial interface 1/1. The X.121 address is the Cisco IOS mechanism used to direct the PAD to the correct serial interface.
- The X.25 packet size is set to 128 in and 128 out. The window size is set to 2 packets in and 2 packets out. The PAD profile name is Alcatelpvc.
- The **max-users** option sets the number of simultaneous users that can use the command, which is set to 1.

Step 17 Create a route statement to map X.121 address 6142232001 to serial interface 1/1:

```
router A(config)# x25 route ^6142232001 interface serial 1/1
```

Step 18 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 19 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 20   Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Alcatel 1603 SM

This section describes how to establish a direct Telnet session to test protocol translation and X.25 connectivity to the network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 14), the configuration uses IP address 192.168.10.2 and TCP port 2001.

Step 1   Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 2001:

```
router A# telnet 192.168.10.2 2001
Trying 192.168.10.2 ... Open
```

Step 2   Type a TL1 command for this network element. This example uses the retrieve header command, which allows you to verify the connection:

```
rtrv-hrd:(TID)::(CTAG);
```

The output from the Alcatel 1603 SM is not displayed.

Step 3   Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4   The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn      Host              Address          Byte    Idle    Conn Name
* 1       192.168.10.2      192.168.10.2     0       0       192.168.10.2
```

Step 5   Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect

router A# show sessions

Conn      Host              Address          Byte    Idle    Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

Alcatel 1633 SX DCS Protocol Translation Configuration

This section describes the steps required to configure a Cisco router to perform TCP-to-X.25 protocol translation between an IP-based OSS and an Alcatel 1633 SX Digital Cross-Connect System (DCS) X.25-TL1 messaging maintenance interface, as shown in Figure 16.

Figure 16   Alcatel 1633 SX Protocol Translation
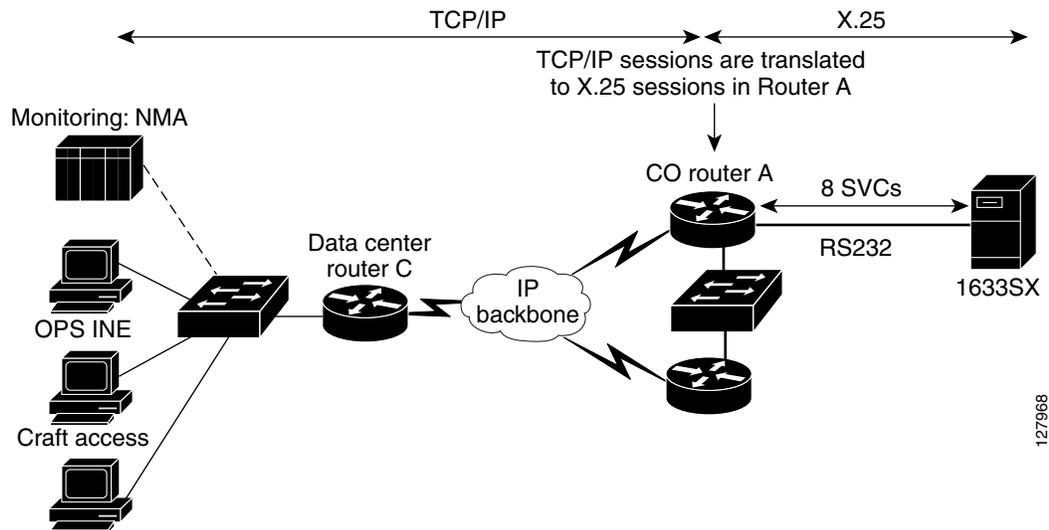
The Alcatel 1633 SX is a broadband DCS.

Cable Requirements for the Alcatel 1633 SX DCS

The Alcatel 1633 SX DCS is a DTE device with a 25-pin (EIA/TIA) RS-232 female connector. The tasks in this section assume an NM-4/AS or NM-8/AS network module is used. The network module requires Cisco cable part number CAB-232FC, or an equivalent synchronous null modem pinout cable when connected to the Cisco router. Only communication ports 2 and 3 can be configured for X.25. The Alcatel 1633 SX requires a 50-foot, 8-pair shielded cable (Alcatel part number 694-8483-00X).

Provisioning the Alcatel 1633 SX DCS

The following steps show how to provision an Alcatel 1633 SX DCS to use X.25. The steps set up eight SVCs. The command interface for the Alcatel 1633 SX DCS is case-sensitive and, unless otherwise indicated, requires commands be entered in capital letters.

Step 1   Set up the link:

```
COMMAND      ED-CID
CPORT:   3
OS:   Y
BAUD:   9600
AUTOIN:   %
```

Step 2   Set up the communication port:

```
COMMAND:      ED-CID-OSPORT
```

```
CPORT:   3
MODEM:   NO
SIZE:    128
L3-WINDOW:   2
K-WINDOW:   7
HI-PVC:   0
LO-IC-SVC:   1
HI-IC-SVC:   8
LO-2W-SVC:   8
HI-2W-SVC:   8
LO-OG-SVC:   8
HI-OG-SVC:   8
CTAG:   (your initials)
```

Step 3   Set up the OS channel for SVCs 1 to 3:

```
COMMAND:       ENT-CID-OSCHAN or ED-CID-OSCHAN
PORT:   3
CHANNEL:   1
PROTOCOL:   SVC
LCN:   (blank for SVC)
AUTOLOGIN:   %
CTAG:   (your initials)


COMMAND:       ENT-CID-OSCHAN or ED-CID-OSCHAN
PORT:   3
CHANNEL:   2
PROTOCOL:   SVC
LCN:v(blank for SVC)
AUTOLOGIN:   %
CTAG:   (your initials)


COMMAND:       ENT-CID-OSCHAN or ED-CID-OSCHAN
PORT:   3
CHANNEL:   3
PROTOCOL:   SVC
LCN:   (blank for SVC)
AUTOLOGIN:   %
CTAG:   (your initials)
```

Step 4   Place the link in service:

```
COMMAND:RST-CID
CPORT:   3
```

Step 5   Configure NMA Logon Security:

```
COMMAND:       ENT-USER
UID:   nmahos   (lower case only)
PWD:   nmahost   (lower case only)
UCFCI:   F
UFCFO:vF
Auth Level:   30
OMODE:   C
OSL:   CMEPS
UNAM:   NMA
RUSURE:   NO
DSKBFIND:   ALWAYS
TYPE:   TTY
DM:   NOECHO
OSTYPE:   NMA
LNKTMR:   0
LOTO:   N
KAMINTVL:   0
MIPINTVL:   0
```

Step 6   Configure Operations System/Intelligent Network Elements (OPS/INE) Logon Security:

```
COMMAND:      ENT-USER
UID:   opsine  (lower case only)
PWD:   opsine#1  (lower case only)
UCFCI:   Z
UFCFO:   Z
Auth Level:   28
OMODE:   C
OSL:   B
UNAM:   OPSINE
RUSURE:   NO
DSKBFIND:   ALWAYS
TYPE:   TTY
DM:   NOECHO
OSTYPE:   OPSINE
LNKTMR:   0
LOTO:   N
KAMINTVL:   0
MIPINTVL:   0
```

Step 7   Set up the OS address for the NMA:

```
Command:      ENT-OSADDR-SITE
ADDR:    (Use main DTN address or CONET IP address and socket)

Autoin:   nmahos (Automatically logs on to NMA when the link comes up and a call request
is received, and a call clear is returned.)
```

Step 8   Set up the OS address for OPS/INE:

```
Command:      ENT-OSADDR-SITE
ADDR:   1111111

Autoin:   ospine (Automatically logs in OPS-INE when link comes up and a call request  is
received and a call clear is returned.)
```

Step 9   Set up the OS address setup for Craft:

```
Command:      ENT-OSADDR-SITE
ADDR:   0
Autoin:   % (Requires manual logon when link comes up and a call request is received and a
call clear is returned.)
```

Step 10   Enter the following commands to obtain the current parameter settings:

```
RTRV-CID:::ctag;   (Retrieves link setups)
RTRV-OSADDR-SITE::ctag;   (Retrieves the site addresses entered)
RTRV-PRVG-USER:::ctag;   (Retrieves all user IDs and  privileges for logon)
```

Step 11   Log off the system by entering the following command:

```
canc-user;
```

Configuring a Cisco Protocol Translation Router for the Alcatel 1633 SX DCS

This section describes the steps required to configure router A in the central office in Figure 16. The router is being configured to translate eight TCP sessions into eight SVCs.

Step 1   Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2   Enter global configuration mode:

```
router A# configure terminal
```

Step 3   Enable X.25 routing:

```
router A(config)# x25 routing
```

Step 4   Set up a PAD profile statement for the PVCs that are used by NMA and other applications. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session. The name of the PAD profile is 1633SXSVC.

```
router A(config)# x29 profile 1633SXSVC 1:0 2:1 3:130 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 130, which causes the router to forward data on receipt of a semicolon or ASCII carriage return.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer, so the data will wait for the data forwarding character.

Step 5   Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6   Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 7   Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8   Enter a description for the interface:

```
router A(config-if)# description Alcatel 1633SX
```

Step 9   Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11 Configure X.25 DCE encapsulation on the serial interface. The Alcatel 1633 SX DCS is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 12 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 13 Configure the X.121 address on the serial interface. This allows the calling address to be used when SVCs are created.

```
router A(config-if)# x25 address 6142233000
```

Step 14 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is in minutes.

```
router A(config-if)# x25 idle 5
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Set up a protocol translation statement to create the SVC in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 3000 x25 6142233001 profile 1633SXSVC
```

- The translate statement maps an SVC with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.
- The IP address is a free address on the subnet associated with the loopback interface. The IP address is used now by the router for protocol translation.
- The X.121 address of 6242233001 is used to map the PAD to serial interface 1/1.
- The PAD profile name is 1633SXSVC.

Step 17 Create a route statement to map X.121 address 6142233001 to serial interface 1/1 in global configuration mode:

```
router A(config)# x25 route ^6142233001 interface serial 1/1
```

Step 18 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

✎

Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 19 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 20 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Alcatel 1633 SX DCS

This section describes how to establish a direct Telnet session to test protocol translation and X.25 connectivity to the network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 16), the configuration uses IP address 192.168.10.2 and TCP port 3000.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 3000:

```
router A# telnet 192.168.10.2 3000
Trying 192.168.10.2 ... Open
```

Step 2 Type a TL1 command for this network element. This example uses the retrieve header command, which allows you to verify the connection.

```
rtrv-hrd:(TID)::(CTAG);
```

The output from the Alcatel 1633 SX DCS is not displayed.

Step 3 Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4 The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn      Host                Address             Byte   Idle   Conn Name
* 1       192.168.10.2        192.168.10.2        0      0      192.168.10.2
```

Step 5 Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect

router A# show sessions

Conn      Host                Address             Byte   Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

The final test is to have the NMA or OPS/INE establish a call, make a connection, and complete a command to the Alcatel 1633 SX DCS.

Alcatel DCS-DEXCS Protocol Translation Configuration

This section describes the steps required for a Cisco router to perform TCP-to-X.25 protocol translation between an IP-based OSS and an Alcatel DCS-DEXCS X.25-TL1 messaging maintenance interface, as shown in Figure 17.

Figure 17   Alcatel DCS-DEXCS Protocol Translation
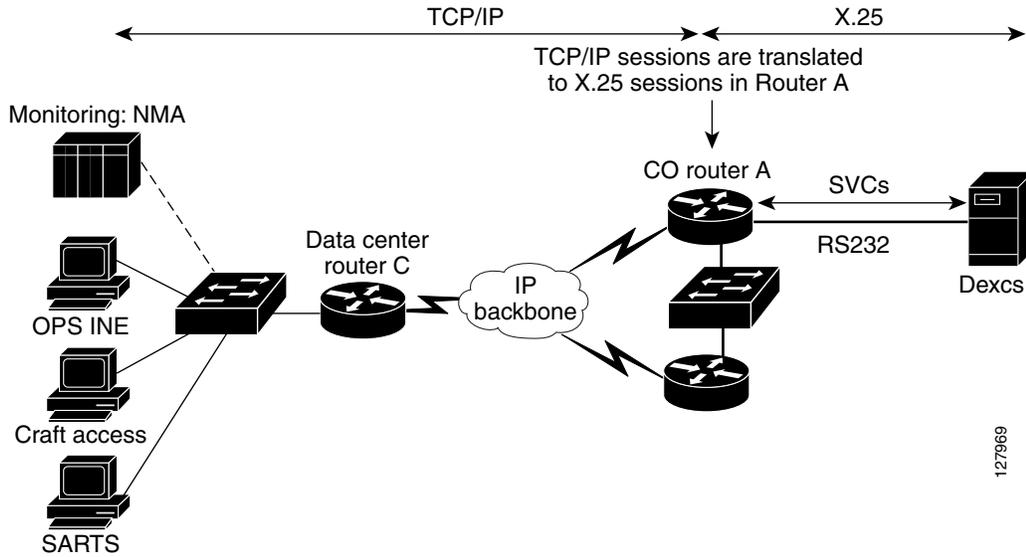
The DSC-DEXCS is a family of products that provide cross-connect capability at the DS0 level for DS1, DS3, and STS1 signals; see Figure 18.

Figure 18   Alcatel DCS-DEXCS
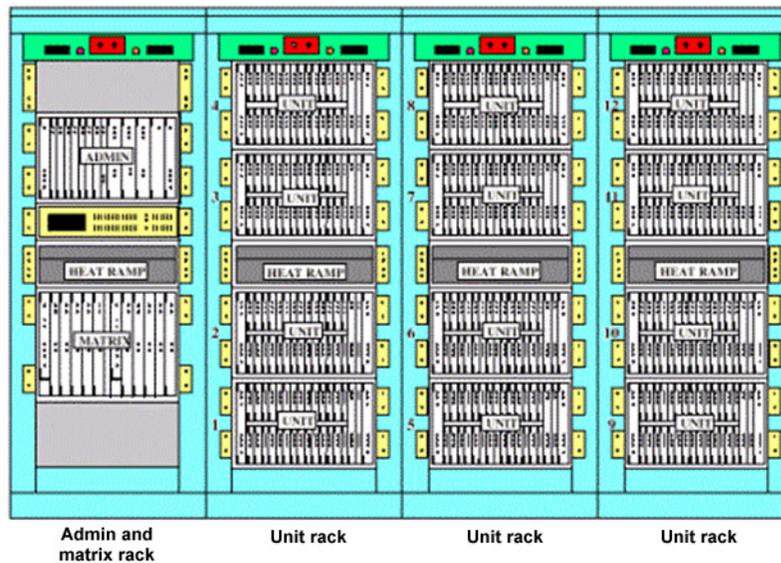
The monitoring host in this example is running Telcordia's NMA application. The provisioning host is running Telcordia's Operations System/Intelligent Network Elements (OPS/INE) application. Switched Access Remote Test System (SARTS) provides the test access and control links that interface to Digital Cross-Connect Systems or Digital Test Access Units.

Cable Requirement for the Alcatel DCS-DEXCS

Connect LINK J42 (a DTE male connector) from the Alcatel DCS-DEXCS using a Cisco CAB-232 FC cable or equivalent null modem cable to the router X.25 (EIA/TIA) RS-232 port. Table 6 lists the specifications and part numbers.

Table 6   Alcatel DCS-DEXCS Cable Specification

Device	Connector	Cable
TL1	J42 (DTE) or J43 (DCE) / RS-232C	DB25-pin P/N 452-0000-097

Provisioning the Alcatel DCS-DEXCS

The following steps show how to provision an Alcatel DCS-DEXCS to use X.25. The steps set up SVCs. The Alcatel DCS-DEXCS system software is case-sensitive and requires that commands be entered in capital letters.

Step 1   Enable the X.25 feature:

```
Command: UTL SET FEATURE SIO1 X25
```

Step 2   Provision (grow) the links:

```
Command: GRTH LINK 6 9600 0 0 0 SVC<CR>
Command: UTL SET LINK 17 9600 0 0 0<CR>
Command: UTL SET LINK 18 9600 0 0 0<CR>
Command: UTL SET LINK 19 9600 0 0 0<CR>
Command: UTL SET LINK 20 9600 0 0 0<CR>
```

Step 3   Reboot the Alcatel DCS-DEXCS so the X.25 configuration takes effect:

```
 Command: RMV MS
 Command: RST MS CLR
```

Note   If the Alcatel DCS-DEXCS is carrying traffic, this procedure *must* be performed only during the maintenance window.

Step 4   Set the Alcatel DCS-DEXCS internal and external addresses::

```
Command: UTL SET DTEADR INT SIO1 adr;
ADR: USE DTN or IP address and socket# ASSIGNED TO NMA for DEXCS
Command: UTL SET DTEADR EXT NMA adr;
ADR: ENTER ADDRESS USED IN AI ALIAS FOR CALLER'S NUMBER IN LINE 7, MENU 9 (MAIN DTN# OF
Router)

Command: UTL SET DTEADR EXT OPSINEADR;1111111<CR>


Command: UTL SET DTEADR EXT CRAFT ADR;123<CR>
```

Step 5   Set the SARTS protocol features in the Alcatel DCS-DEXCS:

```
Command: UTL SET FEATURE LINKS EOMT<CR>
 UTL SET FEATURE SIOCMD DKPT<CR>
 RMV SIO 1
 RST SIO 1
```

Step 6   Configure NMA Logon Security:

```
Command: ASN USER 102 LOGON nma nma134<CR>
Command: ASN USER 102 POOL 1-255<CR>
Command: UTL SET USER 102 CLASS 7,8,9,11,12,13,14,15,16< cr >
```

Step 7   Configure OPS/INE Logon Security:

```
Command: ASN USER 101 LOGON opsine opsine
Command: ASN USER 101 POOL 1-255
Command: UTL SET USER 101 CLASS 2,3,4,5,6,7,8,9,10,11,12,13,14,15,16<CR>
```

Step 8   Configure SARTS Logon Security:

```
Command: ASN USER 103 LOGON sarts sarts<CR>
Command: ASN USER 103 POOL 1-255
Command: UTL SET USER 103 CLASS 9,10,11,12,13,16<CR>
```

Step 9   Enter the following commands to retrieve settings. Make and keep a paper copy of the settings for future reference.

```
DISPLAY LINK 1-6<CR>
 DISPLAY LINK 17 20
 UTL QRY ASN USER 101-103<CR>
 UTL SET FEATURE STATUS ALL<CR>
 UTL QRY ASN USER 101-103<CR>
 UTL QRY DTEADR ALL
```

Configuring a Cisco Protocol Translation Router for the Alcatel DCS-DEXCS

This section describes the steps required to configure router A in the central office in Figure 17. The router is being configured to translate TCP sessions into SVCs.

Step 1   Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2   Enter global configuration mode:

```
router A# configure terminal
```

Step 3   Enable X.25 routing:

```
router A(config)# x25 routing
```

Step 4   Set up a PAD profile statement for the SVCs that are used by NMA, SARTS, and OPS/INE applications. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile DEXCS 1:0 2:1 3:64 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter, and is set to a value of 64, which will cause the router to forward data upon receipt of an ASCII special character other than ESCAPE, BEL, ENQ, ACK, DEL, CAN, DC2, ETX, EOT HT, LT, VT, or FF.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer, so data will wait for the data forwarding character.

Step 5   Start interface configuration mode for loopback interface 0 and configure an IP address using the following commands:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6   Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 7   Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8   Enter a description for the interface:

```
router A(config-if)# description Alcatel DEXCS
```

Step 9   Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10   Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11   Configure X.25 DCE encapsulation on the serial interface. The Alcatel DCS-DEXCS is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 12   The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 13 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142233000
```

Step 14 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is set in minutes.

```
router A(config-if)# x25 idle 5
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Set up a protocol translation statement to create SVCs in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 3000 x25 6142233000 profile DEXCS
```

- The protocol translation statement maps an SVC with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.
- The IP address is a free address on the subnet associated with the loopback interface. The IP address is used now by the router for protocol translation.
- The X.121 address of 6242233000 is used to map the PAD to serial interface 1/1.
- The PAD profile name is DEXCS.

Step 17 Create a route statement to map X.121 address 6142233000 to serial interface 1/1:

```
router A(config)# x25 route ^6142233000 interface serial 1/1
```

Step 18 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

✎
Note Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 19 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 20 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up:

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Alcatel DCS-DEXCS

This section describes how to establish a direct Telnet session to test protocol translation and X.25 connectivity to the network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 17), the configuration uses IP address 192.168.10.2 and port number 3000.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 3000:

```
router A#  telnet 192.168.10.2 3000
Trying 192.168.10.2 ... Open
```

Step 2 Type TL1 commands for the network element.

```
DISPLAY LINK 1-6<CR>
DISPLAY LINK 17 20
UTL QRY ASN USER 101-103<CR>
UTL SET FEATURE STATUS ALL<CR>
UTL QRY ASN USER 101-103<CR>
UTL QRY DTEADR ALL
```

Step 3 Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4 The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions
```

```
Conn      Host                 Address           Byte   Idle   Conn Name
* 1       192.168.10.2         192.168.10.2      0      0      192.168.10.2
```

Step 5 Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected, as follows:

```
router A# disconnect
```

```
router A# show sessions
```

```
Conn      Host                 Address           Byte   Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

The final test is to have NMA and OPS/INE establish a call, make a connection, and complete a command to the DEXCS.

Tellabs Titan 5500 DCS via DCN Protocol Translation Configuration

This section describes the steps required for a Cisco router to perform TCP-to-X.25 protocol translation. For this task, the OSS is connected via TCP/IP to the DCN. The Tellabs Titan 5500 DCS is connected to the DCN via the X.25-TL1 messaging maintenance interface, as shown in Figure 19.

Figure 19   *Tellabs Titan 5500 Protocol Translation*
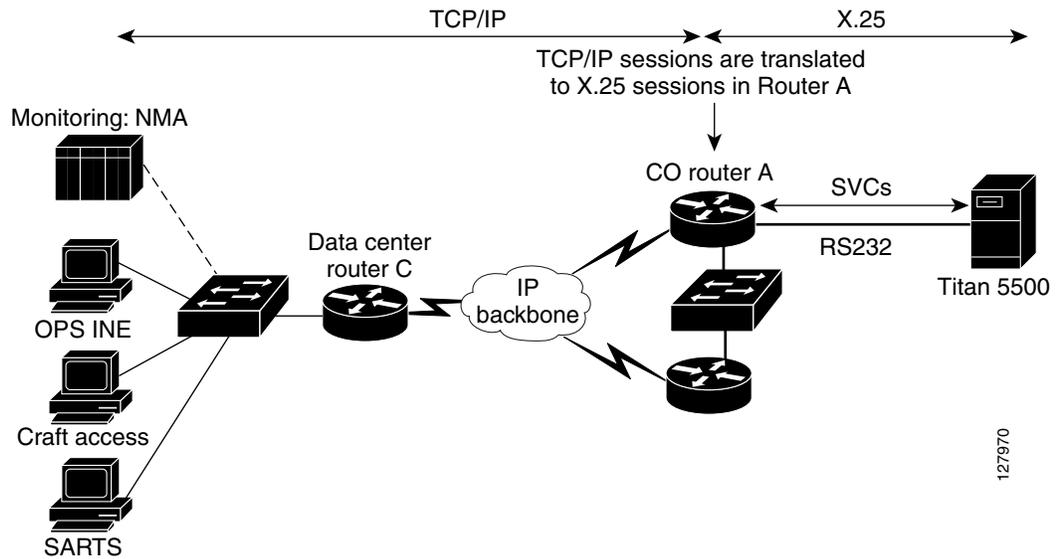
The TITAN 5500 is a DCS that can terminate any mix of DS1, DS3, STS-1, OC-3, and OC-12 signals.

The monitoring host in this example is running Telcordia's NMA application. The provisioning host is running Telcordia's OPS/INE application. SARTS provides the test access and control links that interface Digital Cross-Connect Systems or Digital Test Access Units.

Cable Requirements for the Tellabs Titan 5500 DCS

The cabling assumes that the service provider is connecting to a NM-4/AS or NM-8/AS. If you use a different Cisco network module, a different Cisco cable will be required. The Tellabs cable, part number 50-0493, is required if the Admin backplane is revision D or lower. This cable swaps pins 14 and 16 to 15 and 17 for timing. Connect the 50-0493 cable to the router cable (CAB-232FC) between Link 4A (J13) on the Tellabs Titan 5500 DCS and available X.25/RS-232 ports on the router. Use the other 50-0493 cable and CAB-232FC cable for Link 8B (J13) on the Tellabs Titan 5500 DCS.

Note   P1 on the 50-0493 must be connected to the Tellabs Titan 5500 DCS end, with P2 connected to the router cable.

Verify that jumpers J6 and J7 on the APM Module (81.5501A) have pins 2 and 3 jumpered together. Check both Admin complexes APMs A and B.

Provisioning the Tellabs Titan 5500 DCS

The following steps show how to provision the X.25 management link on a Tellabs Titan 5500 DCS and set up SVCs.

Step 1   Set up the link:

```
Command:   ED-LINK
 LINK#  LINK-4  (and repeat for LINK-8)
 SYBAUD: 9600
```

```
PVCS:  0
SVCS:  8
SYCLK: TERE
FMWIN: 7
T1:  30
T4:  20
N2:  7
FMMODE: DTE
PKWIND: 2
PKWINM: 2
PKSIZD: 128
PKSIZM: 128
DBIT:  OFF
PKMODE: DTE
PST:  IS
```

Step 2   Set up the X.25 channel:

```
COMMAND: ED-SECU-CHAN
 CHAN#  CHAN-4-1&&-8   (Repeat for CHAN-8-1&&-8)
 CAPC:  A9
 CTYPE: OSS-SECURE
```

Step 3   Set up the X.25 links in service:

```
COMMAND: ED-LINK::LINK-4:CTAG:::IS;   (Repeat for Link 8)
```

Step 4   Enter logons for NMA, SARTS, and OPS/INE:

```
COMMAND: ENT-SECU-USER
 UID:  NMAHOS
 PWD:  NMAHOS%1
 UPC:  A6

 ENT-SECU-USER::NMAHOS:CTAG::NMAHOS%1,,UPC=A6;

COMMAND: ENT-SECU-USER
 UID:  OPSINE
 PWD:  OPSINE#1
 UPC:  A6

 ENT-SECU-USER::OPSINE:CTAG::OPSINE#1,,UPC=A6

COMMAND: ENT-SECU-USER
 UID:  ANTST
 PWD:  ANTST%1
 UPC:  A9

 ENT-SECU-USER::ANTST:CTAG::ANTST%1,,UPC=A9

COMMAND: ENT-SECU-USER
 UID:  TCENTER
 PWD:  CENTER%1
 UPC:  A2

 ENT-SECU-USER::TCENTER:CTAG::CENTER%1,,A2;

COMMAND: ENT-SECU-USER
 UID:  SARTS
 PWD:  SARTS%1
 UPC:  A4

 ENT-SECU-USER::SARTS:CTAG::SARTS%1,,UPC=A4;
```

Step 5 Retrieve all setups by entering the following commands. Make and keep a paper copy of the settings for future reference:

```
RTRV-LINK::LINK-4:CTAG;
RTRV-LINK::LINK-8:CTAG;
RTRV-SECU-USER:::CTAG;
RTRV-SECU-CHAN::CHAN-4-1&&-8:CTAG;
RTRV-SECU-CHAN::CHAN-8-1&&-8:CTAG;
```

Configuring a Cisco Protocol Translation Router for the Tellabs Titan 5500 DCS

This section describes the steps required to configure router A in the central office in Figure 19. The router is being configured to translate TCP sessions into SVCs. The Tellabs Titan 5500 DCS has two ports for Operation, Administration, and Maintenance (OAM). The ports back up each other.

Step 1 Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2 Enter global configuration mode:

```
router A# configure terminal
```

Step 3 Enable X.25 routing.

```
router A(config)# x25 routing
```

Step 4 Set up a PAD profile statement for the SVCs that are used by NMA, SARTS, and OPS/INE applications. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session. The name of the PAD profile is Titan.

```
router A(config)# x29 profile Titan 1:0 2:1 3:64 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter, and is set to a value of 64, which will forward data upon receipt of an ASCII special character other than ESCAPE, BEL, ENQ, ACK, DEL, CAN, DC2, ETX, EOT HT, LT, VT, or FF.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer, so data will wait for the data forwarding character.

Step 5 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6 Start interface configuration mode for serial interface 1/1, which specifies network module 1, port 1:

```
router A(config)# interface serial 1/1
```

Step 7 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8 Enter a description for the interface:

```
router A(config-if)# description Tellab Titan 5500
```

Step 9 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11 Configure X.25 DCE encapsulation on the serial interface. The Tellabs Titan 5500 DCS is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 12 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 13 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142233000
```

Step 14 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is configured in minutes.

```
router A(config-if)# x25 idle 5
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Start interface configuration mode for serial interface 1/2, which specifies network module 1, port 2. This port backs up serial interface port 1/1.

```
router A(config)# interface serial 1/2
```

Step 17 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 18 Enter a description for the interface:

```
router A(config-if)# description Tellab Titan 5500 backup port
```

Step 19 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 20 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 21 Configure X.25 DCE encapsulation on the serial interface. The Tellabs Titan 5500 is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.).

```
router A(config-if)# encapsulation x25 dce
```

Step 22 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 23 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142234000
```

Step 24 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is set in minutes.

```
router A(config-if)# x25 idle 5
```

Step 25 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 26 Set up a protocol translation statement to create SVCs in global configuration mode:

```
router A(config)# translate tcp 192.168.10.2 port 3000 x25 6142233001 profile Titan
```

- The protocol translation statement maps an SVC with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.
- The IP address is a free address on the subnet associated with the loopback interface. The IP address is now used by the router for protocol translation.
- The X.121 address of 6242233001 is used to map the PAD to serial interface 1/1.
- The PAD profile name is Titan.

Step 27 Set up a second protocol translation statement to create SVCs:

```
router A(config)# translate tcp 192.168.10.2 port 3000 x25 6142234001 profile Titan
```

- This second translate statement allows serial interface 1/2 to back up serial interface 1/1. The first translate statement ensures that Cisco IOS hosts will be executed. If serial interface 1/1 is down, this second translate statement is executed (once serial interface 1/2 is up).
- The translate statement also maps an SVC with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.
- The IP address is a free address on the subnet associated with the loopback interface. The IP address is used now by the router for protocol translation.
- The X.121 address of 6242234001 is used to map the PAD to serial interface 1/2.
- The PAD profile name is Titan.

Step 28 Create a route statement to map X.121 address 6142233001 to serial interface 1/1:

```
router A(config)# x25 route ^6142233001 interface serial 1/1
```

Step 29   Create a route statement to map X.121 address 6142234001 to serial interface 1/2:

```
router A(config)# x25 route ^6142234001 interface serial 1/2
```

Step 30   Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

Note   Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 31   Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 32   Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Tellabs Titan 5500 DCS

This section describes how to establish a direct Telnet session to test protocol translation and X.25 connectivity to the network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 19), the configuration uses IP address 192.168.10.2 and port number 3000.

Step 1   Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 3000:

```
router A#  telnet 192.168.10.2 3000
Trying 192.168.10.2 ... Open
```

Step 2   Type a TL1 command for the network element:

```
RTRV-LINK::LINK-4:CTAG;
```

Step 3   Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4   The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn      Host                 Address           Byte   Idle   Conn Name
* 1       192.168.10.2         192.168.10.2      0      0      192.168.10.2
```

Step 5   Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected:

```
router A# disconnect
```

```
router A# show sessions

Conn    Host              Address        Byte  Idle  Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

The final test is to have NMA and OPS/INE establish a call, make a connection, and complete a command to the Tellabs Titan 5500 DCS.

Applied Digital T3AS DCS via DCN Protocol Translation Configuration

This section describes the steps required for a Cisco router to perform TCP-to-X.25 protocol translation. For this task, the OSS is connected via TCP/IP to the DCN. The Applied Digital T3AS DCS is connected to the DCN via the X.25-TL1 messaging maintenance interface, as shown in Figure 20.

Figure 20   Applied Digital T3AS Protocol Translation
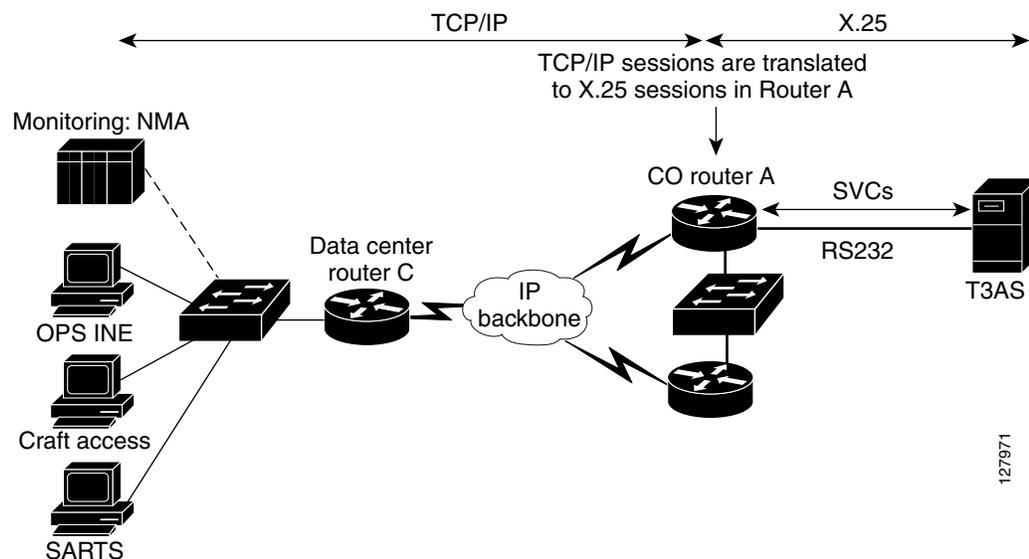
The Applied Digital T3AS Digital Cross-Connect System (DCS) Test and Performance Monitoring System is designed to enable both Local Exchange Carriers (LECs) and Inter-exchange Carriers (IECs) to focus attention on enhancement of network quality, revenue generation from new services, and reduction of overall network management expense. The system provides detailed performance monitoring of DS3, DS2, and DS1 signals, and supports DS1, DS0, and subrate signal intrusive and nonintrusive testing.

The NMA system collects and analyzes information on network alarms and performance data. SARTS provides the test access and control links that interface to Digital Cross-Connect Systems or Digital Test Access Units; see Figure 21.

Figure 21   SARTS Switched Access Remote Test System
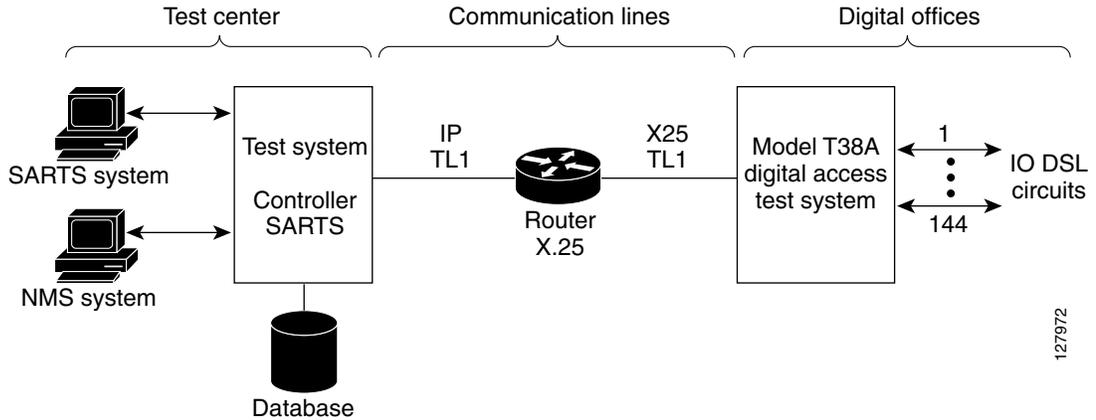
The setup shown in Figure 21 is for a synchronous TL1 interface between the Applied Digital T3AS DCS and a Cisco router. Figure 22 shows the central office configuration using a Cisco 3662 router.

Figure 22   Applied Digital T3AS DCS Central Office Configuration
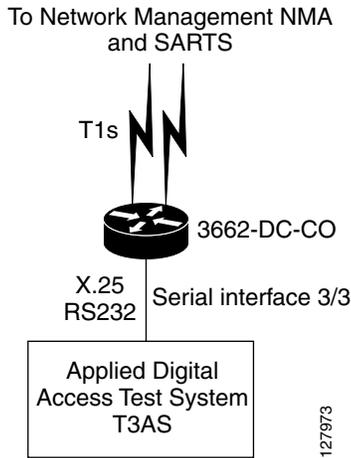
Cable Requirements for the Applied Digital T3AS DCS

Use a Cisco CAB-232-FC cable connected to port 9 on the Applied Digital T3AS DCS as shown in Table 7.

Table 7   Applied Digital T3AS DCS Cable Specification

Cable Type	Specification
DB25 (Male)	RS-232/ASYNC or SYNCH25 conductor cable

Table 8 lists the TL1-to-X.25 pin arrangement.

Table 8   *TL1-to-X.25 Pin Arrangement*

J920 (Connector Number at Equipment End) Pin Number	Lead Designation	P9-12 (Connector Number at CA Assembly End to X.25 Network) Pin Number
1	SHLD	1
15	TXC	15
16	—	—
4	RTS	4
17	RXC	17
5	CTS	5
18	—	—
6	DSR	6
7	TXCOM	7
20	DTR	20
9	—	—
22	—	—
10	—	—
11	—	—
24	—	—
12	—	—
25	—	—
8	RLSD	8
3	+RXD	3
2	+TXD	2

An asynchronous port is used for configuration of X.25.

Table 9 indicates the TL1 asynchronous 25-pin arrangement.

Table 9   *TL1 Asynchronous 25-pin Arrangement*

Pin Number	Lead Designation	Connection Number	Pin Number
1	SHLD	P1-4	1
2	+TXD	P1-4	2
3	+RXD	P1-4	3
4	RTS	P5-8	4
5	CTS	P5-8	5
6	DSR	P5-8	6

Table 9   TL1 Asynchronous 25-pin Arrangement

Pin Number	Lead Designation	Connection Number	Pin Number
7	SGND	P5-8	7
20	DTR	P5-8	20
1	SHLD	P5-8	1
2	+TXD	P5-8	2
3	+RXD	P5-8	3

Provisioning the Applied Digital T3AS DCS

The following steps show how to provision the X.25 management link on an Applied Digital T3AS DCS and set up SVCs.

Step 1   Log in to the Applied Digital T3AS DCS:

```
< logon; system
Password: GOLD3+
```

Step 2   Edit the local network address for the NMA:

```
< ed-local-netaddr::50::::,50;
< ed-local-netaddr::50::::,,xxxxxxxxxx; (DTN# or IP address and socket#)
```

Step 3   Edit the local network address for the SARTS:

```
< ed-local-netaddr::56::::,56;
< ed-local-netaddr::56::::,,xxxxxxxxxx; (DTN# or IP address and socket #)
```

Step 4   Edit the local network address for Craft access:

```
< ed-local-netaddr::42::::,42;
< ed-local-netaddr::42::::,,xxxxxxxxxx; (Craft alias T3ASRRxxxxxxx(where xxxxxx is RR,
floor, and bay information)
```

Step 5   Retrieve the Applied Digital T3AS DCS parameters. Make and keep a paper copy for future reference.

```
rtrv-packet::9;
rtrv-eqpt::2-3;;
rtrv-port::9;
rtrv-local-netaddr::42&&56;
rtrv-peer::50; (NMA)
rtrv-peer::52; (SARTS)
rtrv-peer::55; (VDT)
```

Configuring a Cisco Protocol Translation Router for the Applied Digital T3AS DCS

This section describes the steps required to configure the central office router A in Figure 20. The router is being configured to translate TCP sessions into SVCs.

Step 1 Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2 Enter global configuration mode:

```
router A# configure terminal
router A(config)#
```

Step 3 Enable X.25 routing:

```
router A(config)# x25 routing
```

Step 4 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 5 Start interface configuration mode for serial interface 3/3, which specifies network module 3, port 3:

```
router A(config)# interface serial 3/3
```

Step 6 Enter a description for the interface:

```
router A(config-if)# description T3SA
```

Step 7 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 8 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 9 Configure X.25 DCE encapsulation on the serial interface. The Applied Digital T3AS DCS is the DTE. (Note that the encapsulation is at the X.25 layer, not the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 10 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142233000
```

Step 11 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear an SVC. The idle timer value is configured in minutes.

```
router A(config-if)# x25 idle 5
```

Step 12 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 13 Exit interface configuration mode:

```
router A(config if)# exit
```

Step 14 Set up a PAD profile statement for the SVCs in global configuration mode. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session. The name of the PAD profile is Titan.

```
router A(config)# x29 profile T3SAsvc 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether the characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter. Cisco has implemented value 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. The value 0 means that there is no timer, so data will wait for the data forwarding character.

Step 15 Set up a protocol translation statement to create SVCs:

```
router A(config)# translate tcp 192.168.10.2 port 3000 x25 6142233001 profile T3SAsvc
```

- The protocol translation statement maps an SVC with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.

- The IP address is a free address on the subnet associated with the loopback interface. The IP address is now used by the router for protocol translation.

- The X.121 address of 6142233001 is used to map the PAD to serial interface 3/3.

- The PAD profile name is T3SAsvc.

Step 16 Create a route statement to map X.121 address 6142233001 to serial interface 3/3:

```
router A(config)# x25 route ^6142233001 interface serial 3/3
```

Step 17 Exit the configuration modes and return to the EXEC prompt::

```
router A(config-line)# end
```

Step 18 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Applied Digital T3AS Digital Cross-Connect

This section describes how to establish a direct Telnet session to test the translate TCP port on router A. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 20), the configuration uses IP address 192.168.10.2 and port number 3000.

Step 1   Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 3000:

```
router A#  telnet 192.168.10.2 3000
Trying 192.168.10.2 ... Open
```

Step 2   Type a TL1 command for this network element. This example uses the retrieve header command, which allows you to verify the connection.

```
RTRV-HRD::::CTAG;
```

Step 3   Escape out of the Telnet session using the key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4   The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions

Conn     Host                 Address          Byte    Idle   Conn Name
* 1      192.168.10.2         192.168.10.2     0       0      192.168.10.2
```

Step 5   Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected, as follows:

```
router A# disconnect

router A# show sessions

Conn     Host                 Address          Byte    Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

Wiltron Test System Protocol Translation Configuration

This section describes the steps required to configure a Cisco router to perform TCP-to-X.25 protocol translation between an IP-based OSS and X.25-TL1 messaging maintenance interface on a Wiltron test system. The Cisco IOS protocol translation feature enables the OSS on the IP network to access an X.25 management interface, despite differences in the native protocol stacks.

Wilton's Centralized Maintenance Test System (CMTS) provides the equipment needed to remotely and locally access, test, and monitor special service circuits and subscriber loops; see Figure 23.

Figure 23   *Wilton Test System Protocol Translation Configuration*
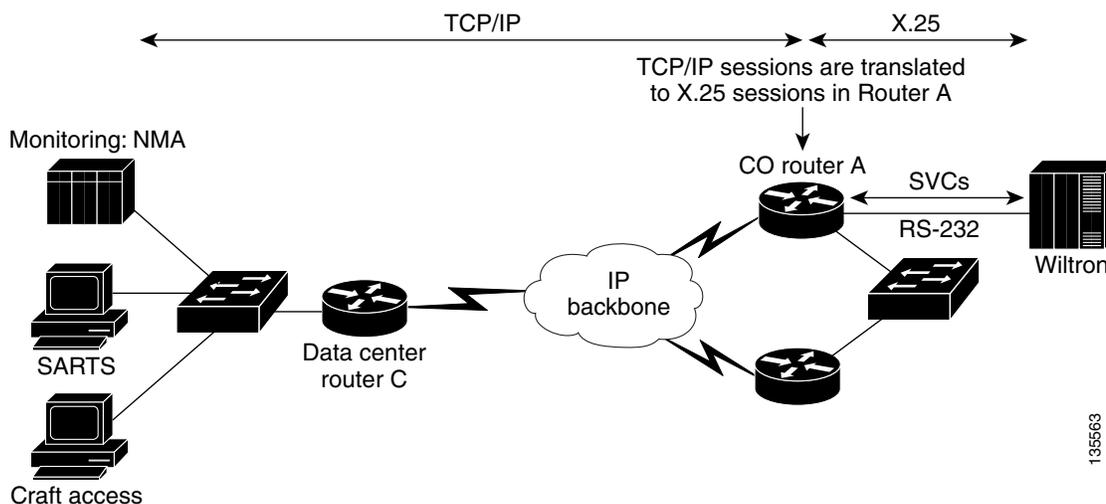
Configuring a Cisco Router for Protocol Translation to Wiltron

This section describes the steps required to configure the central office router designated router A in Figure 23. The router is being configured to convert one TCP session to one SVC.

Step 1   Use the **show version** EXEC command to verify that you are running Cisco IOS Release 12.1(16) or later release software that supports the Telco DCN functions. Protocol translation is supported in the Telco and Enterprise feature sets. The following partial example indicates that the router is running Cisco IOS Release 12.3(12) of a Telco DCN feature set (see bold text):

```
router A# show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-TELCO-M), Version 12.3(12), RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 29-Nov-04 15:40 by kellythw
Image text-base: 0x80008098, data-base: 0x81237034
.
.
.
```

Step 2   Enter configuration mode:

```
router A# configure terminal
```

Step 3   Enable X.25 routing:

```
router A(config)# x25 routing
```

Step 4   Set up a PAD profile statement for the PVC that is used by SARTs. The PAD profile defines the control of information from the terminal to the PAD, which in this case is from the TCP session to the X.25 session.

```
router A(config)# x29 profile wiltronsvc 1:0 2:1 3:128 4:0
```

- Parameter 1 is PAD Recall Using a Character and determines whether the start-stop mode of the DTE is allowed to escape from data transfer mode to send PAD command signals. Parameter 1 is not supported for Telnet, so this parameter is set to the minimum of 0 (the default is 1).

- Parameter 2 is the Echo parameter, which determines whether characters are to be echoed locally. Parameter 2 is set to 1, which sets the local echo on.

- Parameter 3 is the Data Forwarding parameter and is set to 128, which causes the router to forward data on receipt of a semicolon.

- Parameter 4 is the Selection of Idle Timer Delay and selects the amount of time the PAD waits in 20ths of a second for additional data before forwarding data. If a data forwarding character is received, the data packet is forwarded immediately. Setting the value to 0 means that the Cisco IOS must wait indefinitely for the semicolon character.

Step 5 Start interface configuration mode for loopback interface 0 and configure an IP address:

```
router A(config)# interface loopback 0
router A(config-if)# ip address 192.168.10.1 255.255.255.252
```

Step 6 Start interface configuration mode for serial interface 3/3, which specifies network module 3, port 3:

```
router A(config)# interface serial 3/3
```

Step 7 Shut down the interface:

```
router A(config-if)# shutdown
```

Step 8 Enter a description for the interface:

```
router A(config-if)# description Wiltron
```

Step 9 Remove the IP address from the interface, if it has one:

```
router A(config-if)# no ip address
```

Step 10 Remove IP-directed broadcasts from the interface:

```
router A(config-if)# no ip directed-broadcast
```

Step 11 Configure X.25 DCE encapsulation on the serial interface. The Wiltron is the DTE device. (Note that this is at Layer 1, or the physical layer.)

```
router A(config-if)# encapsulation x25 dce
```

Step 12 The router is functioning as the DCE device and must supply clock signaling to the DTE device. Set the clock rate to 9600 baud:

```
router A(config-if)# clockrate 9600
```

Step 13 Configure the X.121 address on the serial interface. This is the calling address used when SVCs are created.

```
router A(config-if)# x25 address 6142233000
```

Step 14 Configure the X.25 idle timer, which is the period of inactivity after which the router can clear a switched virtual circuit. The idle timer value is set in minutes.

```
Router(config-if)# x25 idle 5
```

Step 15 Restart the interface:

```
router A(config-if)# no shutdown
```

Step 16 Set up a protocol translation statement to create PVC 1 in global configuration mode:

```
Router(config)# translate tcp 192.168.10.2 port 3000 x25 6142233000 profile wltronsvc
```

- The protocol translation statement maps PVC 1 with IP address 192.168.10.2 and TCP port 3000. The TCP session is terminated on the router.

- The IP address is a free address on the subnet associated with the loopback interface. The IP address is used now by the router for protocol translation.

- The X.121 address of 6142233000 is used to map the PAD to serial interface 3/3:

Step 17 Create a route statement to map X.121 address 6142233000 to serial interface 3/3.

```
router A(config)# x25 route ^6142233000 interface serial 3/3
```

Step 18 Create additional vty sessions for the translate statements to use. The Cisco defaults are vty 0 to 4. Additional TCP sessions are denied after the number of sessions is exceeded.

✎ **Note** Each vty consumes about 800 bytes of memory. Each translate statement requires a vty when open. The preferred transport protocol is Telnet.

```
router A(config)# line vty 5 15
router A(config-line)# transport preferred telnet
```

Step 19 Exit the configuration modes and return to the EXEC prompt:

```
router A(config-line)# end
```

Step 20 Copy the running configuration to the startup configuration. This step saves the configuration in nonvolatile memory so that it is available the next time the router boots up.

```
router A# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Testing Protocol Translation on the Wiltron

This section describes how to establish a direct Telnet session and test protocol translation and X.25 connectivity to the Wiltron network element. To establish a direct Telnet session for protocol translation, determine the IP address and TCP port number configured with the translate statement. In this example (see Figure 23), the configuration uses IP address 192.168.10.2 and port number 3000.

Step 1 Initiate a Telnet session to IP address 192.168.10.2 and TCP port number 3000:

```
router A# telnet 192.168.10.2 3000
Trying 192.168.10.2 ... Open
```

Step 2 Enter the TL1 command that retrieves the header for the Wiltron Test Head:

```
RTRV-HRD:TID:::CTAG;
```

Step 3 Escape out of the Telnet session using the escape key sequence Ctrl-shift-^-x (simultaneously press and release the Ctrl, Shift, and 6 keys and then press the x key).

Step 4   The Telnet session is still active. Display active sessions on the router using the **show sessions** EXEC command:

```
router A# show sessions
Conn   Host          Address             Byte   Idle   Conn Name
*  1   192.168.10.2  192.168.10.2          0     0     192.168.10.2
```

Step 5   Use the **disconnect** command to disconnect the Telnet session from the translate IP address and port, and issue the **show sessions** command again to verify the connection is disconnected, as follows:

```
router A# disconnect

router A# show sessions

Conn     Host                 Address          Byte   Idle   Conn Name
```

The test is complete when the output of the **show sessions** command indicates that there are no connections.

Troubleshooting Telco Equipment in X.25 Environments

Following are Cisco IOS EXEC commands that may be useful in maintaining a network with X.25 and protocol translation enabled. The Cisco IOS command references contain explanations of the displays provided by these commands.

- **debug x25 xot**—Displays information about traffic to or from a specific XOT host.
- **debug x25**—Displays information about all X.25 traffic or a specific X.25 service class, including XOT.
- **show interfaces**—Displays statistics and useful information about the interfaces configured on the router.
- **show sessions**—Displays information about open Telnet connections.
- **show tcp brief**—Displays a concise description of TCP connection endpoints.
- **show translate**—Displays translation sessions that have been configured.
- **show x25 route**—Displays the X.25 routing table.

Search for these commands in the "Cisco IOS Master Commands List" at
http://www.cisco.com/univercd/cc/td/doc/product/software/ios124/124mindx/124index.htm.

⚠️

Caution   Take care in issuing the Cisco IOS **debug** commands, because they can consume CPU cycles and interfere with the normal operation of the network.

Using Network Management Application Alarms to Identify System Problems

The NMA system collects and analyzes information from network alarms and network performance data. The NMA system receives network element messages and analyzes them within the context of the entire communications network, so that trouble indications can be generated for the causes, not the symptoms,

of network failures. The analyzed network problems are routed to a maintenance center and identify the network entity requiring service maintenance or restoration. The incoming alarms are associated to an office equipment entity created in the NMA database. A single office equipment entity is created to represent the central office plant. The receipt of any alarm will result in a trouble ticket being created by the NMA against the office equipment entity. Multiple alarm conditions for the same central office plant will result in additional alarm conditions on the NMA trouble ticket.

Additional References

This section provides the following additional reference information:

- Related Documents, page 70
- Related Websites, page 70
- RFCs, page 71
- Technical Assistance, page 71

Related Documents

Related Topic	Document Title
DNS-based X.25 routing	*DNS-Based X.25 Routing,* Cisco IOS Release 12.0(1)T feature module
Transaction Language 1 (TL1)	GR-831-CORE, *Operations Application Messages - Language For Operations Application Messages*
X.25 configuration	*Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.4T
X.25 PAD configuration	*Cisco IOS Terminal Services Configuration Guide*, Release 12.4
X.25 regular expressions	"Regular Expressions" chapter in the *Cisco IOS Dial Technologies Configuration Guide*, Release 12.2
X.25 version selection	*X.25 Version Configuration,* Cisco IOS Release 12.3(8)T feature module
X.3 PAD parameters	"X.3 PAD Parameters" appendix in the *Cisco IOS Terminal Services Configuration Guide*, Release 12.2

Related Websites

Related Topic	Link
Alcatel 1633 SX multiplexer Information	http://www.findarticles.com/p/articles/mi_m0TPY/is_6_234/ai_59667749
Alcatel 1603 SM OC-3 (155 Mbps) SONET Transport System	http://www.alcatel.com/products/productsummary.jhtml?relativePath=/com/en/appxml/opgproduct/alcatel1603smoc3155mbpssonettransportsystemustcm228114621635.jhtml
Litespan products	http://www.usa.alcatel.com/products/productsbyreference.jhtml?productRange=LITESPAN&pageNumber=1

RFCs

RFC	Title
RFC 1381	*SNMP MIB Extension for X.25 LAPB*
RFC 1382	*SNMP MIB Extension for the X.25 Packet Layer*
RFC 1613	*Cisco Systems X.25 over TCP (XOT)*

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Glossary

ADM—add/drop multiplexer

ASCII—American Standard Code for Information Interchange

ATM—Asynchronous Transfer Mode

CCITT—Consultative Committee for International Telegraph and Telephone

CLECs—competitive local exchange carriers

CMTS—centralized maintenance test system

CO—central office

CPU—central processing unit

DCC—data communications channel

DCE—data communications equipment (EIA expansion); data circuit-terminating equipment (ITU-T expansion)

DCN—data communications network

DCS—digital cross-connect system

DNS—Domain Name System

DSLAMs—digital subscriber line access multiplexers

DTE—data terminal equipment

EIA/TIA—Electronic Industries Alliance/Telecommunications Industry Alliance

GNE—gateway network element

GUI—graphical user interface

IECs—inter-exchange carriers

ILECs—incumbent local exchange carriers

ITU—International Telecommunication Union

LAPB—Link Access Procedure, Balanced

LECs—local exchange carriers

LCN—logical channel number

MIB—Management Information Base

MUX—multiplexer

NMA—Network Management Application (Telcordia)

NOC—network operations center

OAM—Operation, Administration, and Maintenance

OAM&P—operations, administration, maintenance, and provisioning

OSS—operations support systems

OSSI —operations support system interface (DOCSIS specification)

PAD—packet assembler/disassembler

PDN—public data network

PTT—Post, Telephone, and Telegraph

PVC—permanent virtual circuit

RBOCs—regional Bell operating companies

SARTS—Switched Access Remote Test System

SCID—system-called identifier

SDH—Synchronous Digital Hierarchy

SNMP—Simple Network Management Protocol

SONET—Synchronous Optical Network

SVC—switched virtual circuit

TCP/IP—Transmission Control Protocol/Internet Protocol

telco—telephone company

TID—target identifier

TL1—Transaction Language 1

TMN—Telecommunications Management Network

TTL—Time-to-Live field

UID—user or unique identifier

URC—update remote cache

VC—virtual circuit; virtual connections (XOT)

vty—virtual terminal

X.121—ITU-T standard

X.25—ITU-T standard

XOT—X.25 over TCP