

Configuring Interfaces

Use the information in this chapter to understand the types of interfaces supported on our communication servers. Our communication servers support two types of interfaces: physical and virtual interfaces. The virtual interfaces our communication servers support include subinterfaces and IP tunnels.

For hardware technical descriptions and information about installing the communication server interfaces, refer to the hardware installation and maintenance publication for your particular product. For command descriptions and usage information, refer to the *Access and Communication Servers Command Reference* publication.

Interface Configuration Task List

You can perform the tasks in the following sections to configure and maintain the interfaces supported on your communication servers. The first section introduces material that you might need to know in advance of the other tasks.

- Understand Supported Interfaces and Encapsulations
- Configure the Interface Type
- Add a Description for an Interface
- Configure Subinterfaces
- Understand Tunneling
- Configure IP Tunneling
- Configure Synchronous Serial Features
- Select the Ethernet Encapsulation
- Configure MOP
- Configure Token Ring Features
- Configure the Point-to-Point Protocol
- Configure Dial Backup Service
- Configure Loopback Detection
- Control Interface Hold-Queue Limits
- Set Bandwidth
- Set Interface Delay

- Adjust Timers
- Limit Size of the Transmit Queue
- Adjust Maximum Packet Size or MTU Size
- Monitor and Maintain the Interface

See the end of this chapter for interface configuration examples.

Understand Supported Interfaces and Encapsulations

The following sections describe the interfaces and encapsulations supported by our communication servers.

- Synchronous Serial
- Asynchronous Serial
- Ethernet
- Token Ring

Synchronous Serial

Support for the synchronous serial interface is supplied on the following serial network interface cards or systems:

- The Multiport Communications Interface (CSC-MCI), a single card that provides up to two high-speed synchronous serial port connectors that support RS-232, V.35, RS-449, and X.21 connections
- The Serial Port Communications Interface (CSC-SCI), a single card that provides up to four high-speed serial ports that support RS-232, V.35, RS-449, and X.21 connections
- The high-speed synchronous serial interface on the Cisco 2500 series access servers

The MCI and SCI cards can query the appliances to determine their types for use in reports displayed by the EXEC **show** commands. However, they do so only at system startup, so the appliances must be attached when the system is started. Use the **show interfaces** and **show controllers mci** EXEC commands to display the serial port numbers. These commands provide a report for each interface supported by the communication server.

Synchronous Serial Encapsulation Methods

By default, synchronous serial lines use the High-level Data Link Control (HDLC) serial encapsulation method, which provides the synchronous framing and error detection functions of HDLC without windowing or retransmission. The synchronous serial interfaces support the following serial encapsulation methods:

- High-level Data Link Control (HDLC)
- Frame Relay
- Point-to-Point Protocol (PPP)
- Switched Multimegabit Data Services (SMDS)
- X.25-based encapsulations

Encapsulation methods are set according to the type of protocol or application you configure on your communication server. HDLC is described later in this chapter in the section “Reenable HDLC Serial Encapsulation.” PPP is described later in this chapter in the section “Configure the Point-to-Point Protocol.” The remaining methods are described in their respective chapters describing the protocols or applications. Serial encapsulation methods are also discussed in the *Access and Communication Servers Command Reference* publication, under the **encapsulation** command.

Synchronous Serial Compression

The synchronous serial interface supports point-to-point compression. Our software implements a predictor compressor (the RAND algorithm). Compression of LAPB data is supported for LAPB.

Asynchronous Serial

Access and communication server platforms provide a number of methods to connect serial devices, including RJ-11, RJ-45, and 50-pin Telco connectors. The 500-CS supports RJ-45 connectors only. The ASM-CS supports Telco and RJ-11 connectors. The 2500 access server supports RJ-45 connectors on “octopus” cable adapters that attach to high-density D-type connectors on the rear panel of the 2500.

Asynchronous Serial Encapsulation Methods

There are two asynchronous serial encapsulation methods:

- SLIP
- Asynchronous PPP

Refer to the chapter “Configuring SLIP and PPP” later in this publication, for more information about these encapsulation methods.

Ethernet

Support for the Ethernet interface is supplied on one of the following Ethernet network interface cards or systems:

- The Multiport Communications Interface (MCI) card in the ASM-CS, which provides one Ethernet connector compatible with Ethernet Versions 1 and 2 and the IEEE 802.3 protocol
- The Multiport Ethernet Controller (CSC-MEC) interface card in the ASM-CS, which provides two, four, or six high-speed Ethernet connectors compatible with Ethernet Versions 1 and 2 and the IEEE 802.3 protocol
- An integrated Ethernet controller on the Cisco 2500 series and 500-CS models.

Use the **show interfaces** and **show controllers mci EXEC** commands to display the Ethernet port numbers. These commands provide a report for each interface supported by the communication server.

Ethernet Encapsulation Methods

Currently, there are three common Ethernet encapsulation methods:

- The standard Ethernet Version 2.0 encapsulation, which uses a 16-bit protocol type code
- The IEEE 802.3 encapsulation, in which the type code becomes the frame length for the IEEE 802.2 LLC encapsulation (destination and source Service Access Points, and a control byte)

- The SNAP method, as specified in RFC 1042, which allows Ethernet protocols to run on IEEE 802.2 media

The encapsulation method you use depends upon the type of Ethernet media connected to the communication server and the routing application you configure. Further detail is provided in the sections “Select the Ethernet Encapsulation” later in this chapter. See also the chapters describing the protocols or applications.

Token Ring

Support for the Token Ring interface is supplied on The 4/16-Mbps Token Ring cards, which interconnect network servers to IEEE 802.5 and IBM-compatible Token Ring media at speeds of 4 or 16 Mbps. These include the 4/16-Mbps cards or CSC-R16M, CSC-1R, and CSC-2R (dual Token Ring card).

Support for the Token Ring MIB variables is provided as described in RFC 1231, “IEEE 802.5 Token Ring MIB,” by K. McCloghrie, R. Fox, and E. Decker, May 1991. The mandatory Interface Table and Statistics Table are implemented, but the optional Timer Table of the Token Ring MIB is not. The Token Ring MIB has been implemented for the TRIP.

Use the **show interfaces** and **show controllers token** EXEC commands to display the Token Ring numbers. These commands provide a report for each ring supported by the communication server.

Note If the system receives an indication of a cabling problem from a Token Ring interface, it puts that interface into a reset state and does not attempt to restart it. It functions this way because periodic attempts to restart the Token Ring interface have a drastic impact on the stability of protocol routing tables. Once you have replugged the cable into the MAU, restart the interface by typing the command **clear interface tokenring *number***, where *number* is the interface number.

Token Ring Encapsulation Methods

The Token Ring interface by default uses the SNAP encapsulation format defined in RFC 1042. It is not necessary to define an encapsulation method for this interface.

Configure the Interface Type

Begin interface configuration in global configuration mode. To configure an interface, follow these steps:

- Step 1** Enter the **configure** EXEC command at the privileged EXEC prompt to enter global configuration mode.
- Step 2** Once in the global configuration mode, start configuring the interface by entering the **interface** command. Identify the interface type followed by the number of the connector or interface card. These numbers are assigned at the factory at the time of installation or when added to a system and can be displayed with the **show interfaces** EXEC command. A report is provided for each interface the communication server supports, as seen in the following partial sample display:

```
Serial 0 is administratively down, line protocol is down
Hardware is MCI Serial
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
Encapsulation HDLC, loopback not set, keepalive set (10 sec)
```

Use the **show hardware** EXEC command to see a list of the system software and hardware.

For example, to begin configuring interface Serial 0, you would add the following line to the configuration file:

```
interface serial 0
```

Note It is not necessary to add a space between the interface type and interface number. For example, in the preceding line you can specify either serial 0 or serial0.

- Step 3** Follow each **interface** command with the interface configuration commands your particular interface requires. These command define the protocols and applications that will run on this interface. The commands are collected and applied to the **interface** command until you enter another **interface** command, a command that is not an interface configuration command, or you type the Ctrl-Z sequence to get out of configuration mode and return to privileged EXEC mode.
- Step 4** Once an interface is configured, you can check its status by entering the EXEC **show** commands described after the task tables that follow.

The following sections show how to begin to configure each interface type as a separate task. Follow this command with the routing or bridging interface configuration commands for your particular protocol or application, as described in subsequent chapters.

See the section “Interface Configuration Examples” at the end of this chapter.

Configure an Asynchronous Serial Interface

To specify an asynchronous interface, perform the following task in global configuration mode.

Task	Command
Specify an asynchronous interface.	interface async unit

For more information on asynchronous interfaces, refer to the chapter “Configuring SLIP and PPP” later in this publication. To use SLIP or PPP to make a connection, see the *Cisco Access Connection Guide*.

Configure a Dialer Interface

To specify a dialer rotary group leader, perform the following task in global configuration mode:

Task	Command
Begin dialer rotary group interface configuration.	interface dialer <i>interface-number</i>

Configure an Ethernet Interface

To configure an Ethernet interface, perform the following task in global configuration mode

Task	Command
Begin Ethernet interface configuration.	interface ethernet <i>interface-number</i>

Configure a Loopback Interface

You can specify a software-only interface called a loopback interface that emulates an interface that is always up. A loopback interface is a virtual interface that allows BGP and RSRB sessions to stay up even if the outbound interface is down, and is supported on all platforms.

You can use the loopback interface as the termination address for BGP sessions, for RSRB connections, or for establishing a Telnet session from the communication server’s console to its auxiliary port when all other interfaces are down. In applications where other communication servers will attempt to reach this loopback interface, you should configure a routing protocol to distribute the subnet assigned to the loopback address.

Packets routed to the loopback interface are rerouted back to the box and processed locally. IP packets routed out the loopback interface but not destined to the loopback interface are dropped. This means the loopback interface also serves as the Null 0 interface.

To configure a loopback interface, perform the following task in global configuration mode:

Task	Command
Begin loopback interface configuration.	interface loopback <i>interface-number</i>

See also the section “Run Interface Loopback Diagnostics” later in this chapter.

Configure a Null Interface

The communication server supports a “null” interface. This pseudo-interface functions similarly to the null devices available on most operating systems. This interface is always up and can never forward or receive traffic; encapsulation always fails. The only interface configuration command that you can specify for the null interface is **no ip redirects**.

The null interface provides an alternative method of filtering traffic. The overhead involved with using access lists can be avoided by directing undesired network traffic to the null interface.

To specify the null interface, perform the following task in global configuration mode:

Task	Command
Begin null interface configuration.	interface null 0

Specify null 0 (or null0) as the interface name and unit. The null interface can be used in any command that has an interface type as an argument. The following example configures a null interface for IP route 127.0.0.0:

```
ip route 127.0.0.0 255.0.0.0 null 0
```

Configure a Synchronous Serial Interface

To configure a synchronous serial interface, perform the following task in global configuration mode:

Task	Command
Begin synchronous serial interface configuration.	interface serial <i>interface-number</i>

For synchronous serial features, see the section “Configure Synchronous Serial Features” later in this chapter.

Configure a Token Ring Interface

To configure a Token Ring interface, perform the following task in global configuration mode:

Task	Command
Begin Token Ring interface configuration.	interface tokenring <i>interface-number</i>

Add a Description for an Interface

You can add a description about an interface to help you remember what is attached to it. This entry is meant solely as a comment to help identify what the interface is being used for. The description will appear in the output of the following commands: **show configuration**, **write terminal**, and **show interfaces**.

To add the description, complete the following task in interface configuration mode:

Task	Command
Add a description for an interface.	description <i>string</i>

For examples of adding a description, see the section “Interface Configuration Examples” at the end of this chapter.

Configure Subinterfaces

Configuring multiple virtual interfaces, or subinterfaces, on a single physical interface allows greater flexibility and connectivity on the network. With subinterfaces, you can provide full connectivity on partially meshed Frame Relay networks.

You can perform the tasks in the following sections to configure subinterfaces:

- Understand Supported Interfaces and Encapsulations
- Configure Subinterfaces on Serial Interfaces Running Frame Relay Encapsulation

To configure an SMDS subinterface, refer to the chapter “Configuring SMDS” later in this publication.

Understand Supported Interfaces and Encapsulations

Subinterfaces can be used to support partially meshed multiprotocol Frame Relay networks over a serial interface.

Table 6-1 lists the commands that are supported on subinterfaces.

Table 6-1 Subinterface Configuration Commands

Command	Interface Type Supported
bandwidth	Serial, Ethernet, Token Ring
delay	Serial, Ethernet, Token Ring
description	Serial, Ethernet, Token Ring
exit	Serial, Ethernet, Token Ring
frame-relay	Serial only
ip	Serial only
ipx	Serial, Ethernet, Token Ring
ntp	Serial only
shutdown	Serial, Ethernet, Token Ring

The commands listed in Table 6-2 support subinterfaces as parameters.

Table 6-2 Commands that Allow Subinterfaces as Parameters

Command	Command Type
ip unnumbered	Interface configuration
tunnel source	Interface configuration
interface	Global configuration
ip route	Global configuration
route-map match interface	Route-map configuration
distribute-list	Router configuration
neighbor address update-source	Router configuration
passive-interface	Router configuration

In the following example, the route to IP network 10.0.0.0 is configured to exit the communication server via subinterface serial 0.1:

```
ip route 10.0.0.0 255.0.0.0 serial 0.1
```

The **show** commands listed in Table 6-3 support subinterfaces as parameters.

Table 6-3 Show Commands that Allow Subinterfaces as Parameters

Command	Command Type
show buffers	EXEC
show interfaces	EXEC
show ip igrp2 neighbors	EXEC
show ip ospf neighbor	EXEC
show ip ospf interface	EXEC
show ip irdp	EXEC
show ip interface	EXEC
show novell	EXEC
show protocols	EXEC

Configure Subinterfaces on Serial Interfaces Running Frame Relay Encapsulation

Frame Relay networks provide multiple point-to-point links, or PVCs (permanent virtual circuits), through the same physical serial interface. Subinterfaces allow blocks of one or more Frame Relay PVCs to be treated as separate subnetworks. Protocols such as IP and IPX view each subinterface as a separate interface with its own address and protocol assignments.

A subinterface with a single Frame Relay PVC is modeled as a point-to-point link. A subinterface with multiple Frame Relay PVCs is modeled as a LAN.

Subinterfaces provide a mechanism for supporting partially meshed Frame Relay networks. In the past, a single network number (such as an IP subnet or an IPX network number) was assigned to an entire Frame Relay network. Most protocols assume transitivity on a logical network; that is, if station A can talk to station B, and station B can talk to station C, then station A should be able to talk to station C directly. This is true on LANs, but is not true on Frame Relay networks unless they are fully meshed.

Subinterfaces address these limitations by providing a way to subdivide a partially meshed Frame Relay network into a number of smaller, fully meshed (or point-to-point) subnetworks. Each subnetwork is assigned its own network number and appears to the protocols as if it is reachable through a separate interface. (Note that point-to-point subinterfaces may be unnumbered for use with IP, reducing the addressing burden that might otherwise result.)

For example, suppose you have a five-node Frame Relay network that is partially meshed (see Network A in Figure 6-1). If the entire network is viewed as a single subnetwork (with a single network number assigned), most protocols assume that node A can transmit a packet directly to node E, when in fact it must be relayed through nodes C and D. This can be made to work with certain protocols (for example, IP) but will not work at all with other protocols (for example, AppleTalk) because nodes C and D will not relay the packet out the same interface on which it was received. The only way to make this work fully is to create a fully meshed network (see Network B in Figure 6-1), but that requires a large number of PVCs, which may not be economically feasible.

Using subinterfaces, the Frame Relay network can be subdivided into three smaller networks (see Network C in Figure 6-1) with separate network numbers. Nodes A, B, and C are connected to a fully meshed network, and nodes C and D, as well as nodes D and E are connected via point-to-point networks. In this configuration, nodes C and D would see two subinterfaces, allowing them to forward packets without violating split horizon rules.

Figure 6-1 Using Subinterfaces to Provide Full Connectivity on a Partially Meshed Frame Relay Network

To configure a subinterface, perform the following tasks:

Task	Task
Step 1 Configure a serial interface.	interface serial <i>number</i>
Step 2 Configure Frame Relay encapsulation on the serial interface.	encapsulation frame-relay
Step 3 Configure a subinterface.	interface serial <i>numbe.subinterface-number</i> [multipoint point-to-point]

In the following example, subinterface 1 models a point-to-point subnet and subinterface 2 models a broadcast subnet:

```
interface serial 0
encapsulation frame-relay
interface serial 0.1 point-to-point
ip address 10.0.1.1 255.255.255.0
frame-relay interface-dlci 42

interface serial 0.2 multipoint
ip address 10.0.2.1 255.255.255.0
frame-relay map 10.0.2.1 255.255.255.0 17 broadcast
frame-relay map 10.0.2.2 255.255.255.0 18
```

Understand Tunneling

Tunneling provides a way to encapsulate arbitrary packets inside of a transport protocol. This feature is implemented as a virtual interface to provide a simple interface for configuration. The tunnel interface is not tied to specific “passenger” or “transport” protocols, but rather, it is an architecture that is designed to provide the services necessary to implement any standard point-to-point encapsulation scheme.

Tunneling has three primary components:

- Passenger protocol, which is the protocol you are encapsulating (IP, IPX, or AppleTalk)
- Carrier protocol, which is one of the following encapsulation protocols:
 - Generic route encapsulation (GRE), Cisco’s multiprotocol carrier protocol
 - Cayman, a proprietary protocol for AppleTalk over IP
 - NOS, IP over IP compatible with the popular KA9Q program
- Transport protocol, which is the protocol used to carry the encapsulated protocol (IP only)

Figure 6-2 illustrates IP tunneling terminology and concepts.

Figure 6-2 IP Tunneling Terminology and Concepts

To understand the process of tunneling, consider connecting two AppleTalk networks with a non-AppleTalk backbone, such as IP. The relatively high bandwidth consumed by the broadcasting of Routing Table Maintenance Protocol (RTMP) data packets can severely hamper the backbone's network performance. This problem can be solved by tunneling AppleTalk through a foreign protocol, such as IP. Tunneling encapsulates an AppleTalk packet inside the foreign protocol packet, which is then sent across the backbone to a destination communication server. The destination communication server then de-encapsulates the AppleTalk packet and, if necessary, routes the packet to a normal AppleTalk network. Because the encapsulated AppleTalk packet is sent in a directed manner to a remote IP address, bandwidth usage is greatly reduced. Furthermore, the encapsulated packet benefits from any features normally enjoyed by IP packets, including default routes and load balancing.

Advantages of Tunneling

There are several situations where encapsulating traffic in another protocol is useful:

- To provide multiprotocol local networks over a single-protocol backbone
- To provide workarounds for networks containing protocols that have limited hop counts; for example, AppleTalk (see Figure 6-3)
- To connect discontinuous subnetworks
- To allow virtual private networks across wide-area networks (WANs)

Figure 6-3 Providing Workarounds for Networks with Limited Hop Counts

Special Considerations

The following are considerations and precautions to observe when configuring tunneling:

- Encapsulation and decapsulation at the tunnel endpoints are slow operations; currently only processor switching is supported.
- Be cautious in your configuration and take into account security and topology issues. Be careful not to violate access control lists. You can configure a tunnel with a source and destination that is not restricted by firewall access communication servers.
- Tunneling may create problems with transport protocols with limited timers (such as DECnet on the Cisco 2500) due to increased latency.
- Be aware of the environments across which you create tunnels. You might be tunneling across fast FDDI rings or through slow 9600-bps phone lines; some passenger protocols behave poorly in mixed media networks.
- Multiple point-to-point tunnels can saturate the physical link with routing information.
- Routing protocols that make their decisions based solely on hop count will often prefer a tunnel over a multipoint real link. A tunnel might appear to be a one-hop, point-to-point link and have the lowest-cost path, but may actually cost more. For example, in the topology shown in Figure 6-4, packets from Host 1 will travel across networks w, q, and z to get to Host 2 instead of taking the path w, x, y, z because the first path appears shorter.

Figure 6-4 Tunnel Precautions: Hop Counts

- When routing information from the tunneled network mixes with the transport networks' information, the best path to the "tunnel destination" is via the tunnel itself. This is called a recursive route and causes the tunnel interface to shut down temporarily. To avoid recursive routing problems, keep passenger and transport network routing information disjointed:

- Use a different AS number or tag
- Use a different routing protocol
- Use static routes to override the first hop (but watch for routing loops)

If you see line protocol down, as in the following example, it might be because of a recursive route:

```
%TUN-RECURDOWN Interface Tunnel 0  
temporarily disabled due to recursive routing
```

Configure IP Tunneling

If you want to configure IP tunneling, you must perform the tasks in the following sections:

- Configure the Tunnel Interface
- Configure the Tunnel Source
- Configure the Tunnel Destination

The tasks in the following tunnel configuration sections are optional:

- Configure the Tunnel Mode
- Configure End-to-End Checksumming
- Configure a Tunnel Identification Key
- Configure a Tunnel Interface to Drop Out-of-Order Datagrams
- Monitor IP Tunnels

For examples using these commands, see the section "IP Tunneling Examples" at the end of this chapter.

Configure the Tunnel Interface

To configure tunneling, you must configure the tunnel interface by performing the following task in global configuration mode:

Task	Command
Configure the tunnel interface.	interface tunnel <i>interface-number</i>

Configure the Tunnel Source

You must specify the tunnel interface's source address by performing the following task in interface configuration mode:

Task	Command
Configure the tunnel source.	tunnel source { <i>ip-address</i> <i>interface-type interface-number</i> }

Note You cannot have two tunnels using the same encapsulation mode with exactly the same source and destination address. The workaround is to create a loopback interface and source packets off of the loopback interface.

Configure the Tunnel Destination

You must specify the tunnel interface's destination by performing the following task in interface configuration mode:

Task	Command
Configure the tunnel destination.	tunnel destination { <i>hostname</i> <i>ip-address</i> }

Configure the Tunnel Mode

The encapsulation mode for the tunnel interface defaults to generic route encapsulation (GRE), so this task is considered optional. However, if you want a mode other than GRE, you must configure it by performing the following task in interface configuration mode:

Task	Command
Configure the tunnel mode.	tunnel mode { aurp cayman dvmrp eon gre ip nos }

If you are tunneling AppleTalk, you must use either AppleTalk Update Routing Protocol (AURP), Cayman or GRE tunneling mode. Cayman tunneling is designed by Cayman Systems, and enables communication servers to interoperate with Cayman GatorBoxes. You can have our communication servers at either end of the tunnel, or you can have a GatorBox at one end and our communication server at the other end. Use Distance Vector Multicast Routing Protocol (DVMRP) mode when a communication server connects to a mouted communication server to run DVMRP over a tunnel. It is required to configure Protocol-Independent Multicast (PIM) and an IP address on a DVMRP tunnel.



Caution Do not configure a Cayman tunnel with an AppleTalk network address.

If you use GRE, you must have only our communication servers at both ends of the tunnel connection. When using GRE to tunnel AppleTalk, you must configure an AppleTalk network address and a zone. Perform the following tasks to tunnel AppleTalk using GRE:

Task	Command
Step 1 Enable tunneling on the interface.	interface tunnel <i>n</i>
Step 2 Assign a cable range to an interface.	appletalk cable-range <i>start-end</i> [<i>network.node</i>] ¹
Step 3 Set a zone name for the connected AppleTalk network.	appletalk zone <i>zone-name</i> ²
Step 4 Specify the interface out which the encapsulated packets will be sent, or specify the communication server's IP address.	tunnel source [<i>interface</i> <i>ip-address</i>]
Step 5 Specify the IP address of the communication server at the far end of the tunnel.	tunnel destination <i>ip-address</i>
Step 6 Enable GRE tunneling.	tunnel mode gre ip

1. This command is documented in the “AppleTalk Commands” chapter of the *Router Products Command Reference* publication.

2. This command is documented in the “AppleTalk Commands” chapter of the *Router Products Command Reference* publication.

Configure End-to-End Checksumming

Some passenger protocols rely on media checksums to provide data integrity. By default, the tunnel does not guarantee packet integrity. By enabling end-to-end checksums, the communication servers will drop corrupted packets. To enable such checksums on a tunnel interface, perform the following task in interface configuration mode:

Task	Command
Configure end-to-end checksumming.	tunnel checksum

Configure a Tunnel Identification Key

You can optionally enable an ID key for a tunnel interface. This key must be set to the same value on the tunnel endpoints. Tunnel ID keys can be used as a form of *weak* security to prevent misconfiguration or injection of packets from a foreign source.

The tunnel ID key is available with GRE only.

Note When using GRE, the ID key is carried in each packet. We do *not* recommend relying on this key for security purposes.

To configure a tunnel ID key, perform the following task in interface configuration mode:

Task	Command
Configure a tunnel identification key.	tunnel key <i>key-number</i>

Configure a Tunnel Interface to Drop Out-of-Order Datagrams

You can optionally configure a tunnel interface to drop datagrams that arrive out of order. This is useful when carrying passenger protocols that behave poorly when they receive packets out of order (for example, LLC2-based protocols). This option is available with GRE only.

To use this option, perform the following task in interface configuration mode:

Task	Command
Configure a tunnel interface to drop out-of-order datagrams.	tunnel sequence-datagrams

Monitor IP Tunnels

Complete any of the following tasks in EXEC mode to monitor the IP tunnels you have configured:

Task	Command
List tunnel interface information.	show interfaces tunnel unit [accounting]
List the routes that go through the tunnel.	show protocol route¹
List the route to the tunnel destination.	show ip route²

1. This command is documented in the “System Management Commands” chapter in the *Access and Communication Servers Command Reference* publication.

2. This command is documented in the “IP Routing Protocols Commands” chapter in the *Access and Communication Servers Command Reference* publication.

Configure Synchronous Serial Features

The optional tasks in the following sections configure features on a synchronous serial interface:

- Reenable HDLC Serial Encapsulation
- Configure Compression of LAPB Data
- Ignore DCD and Monitor DSR as Line Up/Down Indicator
- Set Transmit Delay
- Configure DTR Signal Pulsing
- Configure the Clock Rate on DCE Appliques
- Configure Snapshot Routing

Reenable HDLC Serial Encapsulation

The communication server provides HDLC encapsulation for serial lines by default. This encapsulation method provides the synchronous framing and error detection functions of HDLC without windowing or retransmission. Although it is the default, it can be reenabled as the encapsulation method, if necessary, by performing the following task in interface configuration mode:

Task	Command
Reenable HDLC encapsulation.	encapsulation hdlc

Configure Compression of LAPB Data

You can configure point-to-point software compression on serial interfaces that use LAPB or multi-LAPB encapsulation. Compression reduces the size of a LAPB or multi-LAPB frame via lossless data compression. The compression algorithm used is a predictor algorithm (the RAND algorithm), which uses a compression dictionary to predict the next character in the frame.

Compression is performed in software and may significantly affect system performance. We recommend that you disable compression if CPU load exceeds 65%. To display the CPU load, use the **show process cpu EXEC** command.

If the majority of your traffic is already compressed files, we recommend that you do not use compression.

To configure compression over LAPB, perform the following tasks in interface configuration mode:

Task	Command
Step 1 Enable encapsulation of a single protocol on the serial line.	encapsulation lapb or encapsulation lapb dce
Step 2 Enable compression.	compress predictor

To configure compression over multi-LAPB, perform the following tasks in interface configuration mode:

Task	Command
Step 1 Enable encapsulation of multiple protocols on the serial line.	encapsulation lapb multi or encapsulation lapb dce multi
Step 2 Enable compression.	compress predictor

When using compression, be sure to adjust the MTU for the serial interface and the LAPB N1 parameter as in the following example to avoid informational diagnostics regarding excessive MTU or N1 sizes:

```
interface serial 0
encapsulation lapb
compress predictor
mtu 1509
lapb n1 12072
```

To adjust the MTU and LAPB N1 parameters, perform the following tasks in interface configuration mode:

Task	Command
Step 1 Identify the interface.	interface serial <i>number</i>
Step 2 Enable encapsulation of a single protocol on the serial line.	encapsulation lapb or encapsulation lapb dce
Step 3 Enable compression.	compress predictor
Step 4 Adjust the maximum packet size of MTU size.	mtu <i>bytes</i>

Task	Command
Step 5 Set the maximum bits per frame (N1).	lapb n1 bits ¹

1. This command is documented in the “X.25 Configuration Commands” chapter of the *Access and Communication Servers Command Reference*.

Ignore DCD and Monitor DSR as Line Up/Down Indicator

This task applies to Quad Serial NIM interfaces on the Cisco 4000 series and Hitachi-based serial interfaces on the Cisco 2500 series and Cisco 3000 series.

By default, when the serial interface is operating in DTE mode, it monitors the Data Carrier Detect (DCD) signal as the line up/down indicator. By default, the attached DCE device sends the DCD signal. When the DTE interface detects the DCD signal, it changes the state of the interface to up.

In some configurations, such as an SDLC multidrop environment, the DCE device sends the Data Set Ready (DSR) signal instead of the DCD signal, which prevents the interface from coming up. To tell the interface to monitor the DSR signal instead of the DCD signal as the line up/down indicator, perform the following task in interface configuration mode:

Task	Command
Configure the serial interface to monitor the DSR signal as the line up/down indicator.	ignore-dcd

Set Transmit Delay

It is possible to send back-to-back data packets over serial interfaces faster than some hosts can receive them. You can specify a minimum dead time after transmitting a packet to alleviate this condition. This setting is available for serial interfaces on the MCI and SCI interface cards. Perform one of the following tasks, as appropriate for your system, in interface configuration mode:

Task	Command
Set the transmit delay on the MCI and SCI synchronous serial interfaces.	transmitter-delay <i>microseconds</i>

Configure DTR Signal Pulsing

You can configure pulsing DTR signals on all serial interfaces. When the serial line protocol goes down (for example, because of loss of synchronization) the interface hardware is reset and the DTR signal is held inactive for at least the specified interval. This function is useful for handling encrypting or other similar devices that use the toggling of the DTR signal to resynchronize. To configure DTR signal pulsing, perform the following task in interface configuration mode:

Task	Command
Configure DTR signal pulsing.	pulse-time <i>seconds</i>

Configure the Clock Rate on DCE Appliques

You can configure the clock rate for appliques (connector hardware) on the serial interface of the MCI and SCI cards to an acceptable bit rate. To do so, perform the following task in interface configuration mode:

Task	Command
Configure the clock rate on serial interfaces.	clock rate <i>bps</i>

Configure Snapshot Routing

Snapshot routing, which is available on serial lines, is a method of learning remote routes dynamically and then keeping the routes available for a period of time while regular routing updates are not being exchanged. This might be during periods when a remote site is not dialed into the local site or when a remote site has a dedicated connection to the local but wishes to avoid the overhead of exchanging routing updates. Snapshot routing allows you to avoid configuring static routes when using dial-on-demand routing. It also eliminates the overhead required for sending periodic updates over dedicated serial lines.

When configuring snapshot routing, you choose one router on the interface to be the client router and one or more other routers to be server routers. The client router determines the frequency at which routing information is exchanged between routers.

Routing information is exchanged during an active period. At the end of this period, the router takes a snapshot of the entries in the routing table. These entries remain frozen during a quiet period. At the end of the quiet period, another active period starts during which routing information is again exchanged. See Figure 6-5.

Figure 6-5 Active and Quiet Periods in Snapshot Routing

When the router transitions from the quiet period to the active period, the line might not be available for a variety of reasons. For example, the line might be down or busy, or the PVC might be down. If this happens, the router has to wait through another entire quiet period before it can update its routing table entries. This might be a problem if the quiet period is very long, for example, around 12 hours. To avoid having to wait through the quiet period, you can configure a retry period. If the line is not available when the quiet period ends, the router waits for the amount of time specified by the retry period and then transitions to an active period. See Figure 6-6.

Figure 6-6 Retry Period in Snapshot Routing

Snapshot routing is useful in two command situations:

- Configuring static routes for DDR interfaces
- Reducing the overhead of periodic updates sent by routing protocols to remote branch offices over a dedicated serial line

The following routing protocols support snapshot routing. Note that these are all distance-vector protocols.

- AppleTalk—RTMP
- Banyan VINES—RTP
- IP—RIP, IGRP
- Novell IPX—RIP, SAP

To configure snapshot routing, perform the tasks described in the following sections. The tasks in the first two sections are required; those in the remaining section are optional:

- Configure the Client Router
- Configure the Server Router
- Monitor and Maintain Snapshot Routing

Configure the Client Router

To configure snapshot routing on the client router that is connected to a dedicated serial line, perform the following steps starting in global configuration mode:

Task	Command
Step 1 Specify a serial interface.	interface <i>serial number</i>
Step 2 Configure the client router.	snapshot client <i>active-time quiet-time</i> [suppress-statechange-updates] [dialer]

To configure snapshot routing on the client router connected to an interface configured for DDR, perform the following steps starting in global configuration mode:

Task	Command
Step 1 Specify a serial interface.	interface <i>serial number</i>
Step 2 Configure a dialer rotary group.	dialer rotary-group <i>number</i>

Select the Ethernet Encapsulation

Task	Command
Step 3 Specify a dialer interface.	interface dialer <i>number</i>
Step 4 Configure the client router.	snapshot client <i>active-time quiet-time</i> [suppress-statechange-updates] [dialer]
Step 5 Define a dialer map.	dialer map snapshot <i>sequence-number dial-string</i>

Repeat step 5 for each map you want to define.

Configure the Server Router

To configure snapshot routing on the server router that is connected to a dedicated serial line, perform the following steps starting in global configuration mode:

Task	Command
Step 1 Specify a serial interface.	interface serial <i>number</i>
Step 2 Configure the server router.	snapshot server <i>active-time</i> [dialer]

The active period for the client router and its associated server routers should be the same.

Monitor and Maintain Snapshot Routing

To monitor and maintain snapshot routing, perform one or both of the following tasks in EXEC mode:

Task	Command
Terminate the quiet period on the client router within two minutes.	clear snapshot quiet-time <i>interface</i>
Display information about snapshot routing parameters.	show snapshot <i>interface</i>

Select the Ethernet Encapsulation

Ethernet interfaces on the communication server support several encapsulation methods, depending upon the application type code and media type, as follows:

- Standard ARPA Ethernet Version 2.0 encapsulation (default)
- SAP IEEE 802.3 encapsulation
- The SNAP method, as specified in RFC 1042

Establish Ethernet encapsulation by selecting one of the Ethernet encapsulation methods, using the appropriate command in interface configuration mode, as follows:

Task	Command
Select ARPA Ethernet encapsulation.	encapsulation arpa
Select SAP Ethernet encapsulation.	encapsulation sap
Select SNAP Ethernet encapsulation.	encapsulation snap

Configure MOP

Perform the tasks in this section to configure the Maintenance Operation Protocol (MOP).

Enable MOP

You can enable MOP on an interface by performing the following task in interface configuration mode:

Task	Command
Enable MOP.	mop enabled

Enable MOP Message Support

You can enable an interface to send out periodic MOP system identification messages on an interface by performing the following task in interface configuration mode:

Task	Command
Enable MOP message support.	mop sysid

Configure Token Ring Features

Perform the tasks in this section to configure Token Ring features.

Select the Token Ring Speed

The Token Ring interface on the CSC-1R and CSC-2R can run at either 4 or 16 Mbps. Token Ring interfaces do not default to any particular ring speed; you must select the speed the first time you use them.



Caution Configuring a ring speed that is wrong or incompatible with the connected Token Ring causes the ring to beacon, which effectively takes the ring down and makes it nonoperational.

Configure the ring speed on the CSC-1R or CSC-2R Token Ring interfaces by performing the following task in interface configuration mode:

Task	Command
Select the ring speed.	ring-speed <i>speed</i>

You do not need to select the ring speed for the CSC-R16 Token Ring interface card.

Enable Early Token Release

Our Token Ring interfaces support early token release, a method whereby the interface releases the token back onto the ring immediately after transmitting rather than waiting for the frame to return. This feature can help to increase the total bandwidth of the Token Ring. To configure the interface for early token release, perform the following task in interface configuration mode:

Task	Command
Enable early token release.	early-token-release

Configure the Point-to-Point Protocol

The Point-to-Point Protocol (PPP), described in RFCs 1331 and 1332, is a method of encapsulating network layer protocol information over point-to-point links.

The current implementation of PPP supports option 3, authentication using CHAP or PAP, option 4, Link Quality Monitoring, and option 5, Magic Number configuration options. The software always sends option 5 and will negotiate for options 3 and 4 if so configured. All other options are rejected.

IP and IPX upper-layer protocols are supported.

The software provides PPP as an encapsulation method. It also provides the Challenge Handshake Authentication Protocol (CHAP) and Password Authentication Protocol (PAP) on serial interfaces running PPP encapsulation. The following sections describe the tasks to configure these features.

Enable PPP Encapsulation

You can enable the Point-to-Point Protocol on serial lines to encapsulate IP and SLIP datagrams. To do so, perform the following task in interface configuration mode:

Task	Command
Enable the PPP encapsulation.	encapsulation ppp

PPP echo requests are used as keepalives to minimize disruptions to the end users of your network. Use the **no keepalive** command to disable echo requests.

Enable CHAP or PAP Authentication

Access control using Challenge Handshake Authentication Protocol (CHAP) or Password Authentication Protocol (PAP) is available on all serial interfaces that use PPP encapsulation. The authentication feature reduces the risk of security violations on your communication server. You can configure either CHAP or PAP for the interface.

Note To use CHAP, you must be running PPP encapsulation.

When CHAP is enabled is enabled on an interface, the local communication server sends a CHAP packet and the remote device (a PC, workstation, router, or communication server) attempting to connect to the local communication server or router is requested, or “challenged,” to respond.

The challenge consists of an ID, a random number, and either the host name of the local communication server or the name of the user on the remote device. This challenge is transmitted to the remote device.

The required response consists of two parts:

- An encrypted version of the ID, a secret password (or secret), and the random number
- Either the host name of the remote device or the name of the user on the remote device

When the local communication server receives the challenge response, it verifies the secret by looking up the name given in the response and performing the same encryption operation. The secret passwords must be identical on the remote device and the local communication server or router.

By transmitting this response, the secret is never transmitted, preventing other devices from stealing it and gaining illegal access to the system. Without the proper response, the remote device cannot connect to the local communication server.

CHAP transactions occur only at the time a link is established. The local communication server does not request a password during the rest of the call. (The local communication server can, however, respond to such requests from other devices during a call.)

To use CHAP, you must perform the following tasks:

- 1 Enable CHAP on the interface.

Once you have enabled CHAP, the local communication server requires a password from remote devices. If the remote device does not support CHAP, no traffic will be passed to that device.

- 2 Configure server host name or username authentication.

Configure the secret or password for each remote system with which authentication is required. As an alternative, you could also configure TACACS.

Perform the following tasks in interface configuration mode:

Task	Command
Step 1 Enable CHAP or PAP.	ppp authentication {chap pap} [if-needed]
Step 2 Configure host authentication or configure TACACS.	username name password secret¹ ppp use-tacacs [single-line]¹

1. These commands are documented in the “System Management Commands” chapter of the *Access and Communication Servers Command Reference* publication.

For an example of CHAP, see the section “CHAP with an Encrypted Password Example” at the end of this chapter. CHAP is specified in the IETF RFC 1334 “The PPP Authentication Protocols” by Brian Lloyd of Lloyd and Associates and William A. Simpson of Computer Systems Consulting Services. CHAP is specified as an additional authentication phase of the PPP Link Control Protocol.

Enable Link Quality Monitoring

Link Quality Monitor (LQM) is available on all serial interfaces running PPP. LQM monitors the link quality and takes the link down when the quality drops below a configured percentage. The percentages are calculated for both the incoming and outgoing directions. The outgoing quality is calculated by comparing the total number of packets and bytes sent with the total number of packets and bytes received by the peer. The incoming quality is calculated by comparing the total number of packets and bytes received with the total number of packets and bytes sent by the peer.

When LQM is enabled, Link Quality Reports (LQRs) are sent every keepalive period. LQRs are sent in place of keepalives. All incoming keepalives are responded to properly. If LQM is not configured, keepalives are sent every keepalive period and all incoming LQRs are responded to with an LQR.

LQR is specified in the IETF RFC-1333, “PPP Link Quality Monitoring” by William A. Simpson of Computer Systems Consulting Services. The latest version is dated May 1992.

To enable LQM on the interface, perform the following task in interface configuration mode:

Task	Command
Enable LQM on the interface.	ppp quality percentage

The *percentage* argument specifies the link quality threshold. That percentage must be maintained, or the link is deemed to be of poor quality and taken down.

PPP Magic Number Support

Magic Number support is available on all serial interfaces. When using PPP, PPP will always attempt to negotiate for Magic Numbers, which are used to detect looped-back nets. The link might or might not be taken down upon looped-back detection, depending on the use of the **down-when-looped** command.

Configure Dial Backup Service

The dial backup service provides protection against WAN downtime by allowing you to configure a backup serial line via a circuit-switched connection.

To configure dial backup, associate a secondary serial interface as a backup to a primary serial interface. This feature requires that an external modem or CSU/DSU device attached to a circuit-switched service be connected on the secondary serial interface. The external device must be capable of responding to a DTR signal (DTR active) by automatically dialing a connection to a preconfigured remote site.

The dial backup software keeps the secondary line inactive (DTR inactive) until one of the following conditions is met:

- The primary line goes down.
- The transmitted traffic load on the primary line exceeds a defined limit.

These conditions are defined using the interface configuration commands described later in this section.

When the software detects a lost Carrier Detect signal from the primary line device or finds that the line protocol is down, it activates DTR on the secondary line. At that time, the modem or CSU/DSU device must be set to dial the remote site. When that connection is made, the routing protocol defined for the serial line will continue the job of transmitting traffic over the dialup line.

You also can configure the dial backup feature to activate the secondary line based upon traffic load on the primary line.

The software monitors the traffic load and computes a five-minute moving average. If this average exceeds the value you set for the line, the secondary line is activated, and depending upon how the line is configured, some or all of the traffic will flow onto the secondary dialup line.

Perform the following tasks in interface configuration mode:

Task	Command
Step 1 Select a serial interface as a backup line.	backup interface <i>interface-name</i>
Step 2 Enter the load as a percentage of the primary line's available bandwidth.	backup load { <i>enable-threshold</i> never } { <i>disable-load</i> never }
Step 3 Set the line delay for the backup line.	backup delay { <i>enable-delay</i> never } { <i>disable-delay</i> never }

See the section “Dial Backup Service Examples” at the end of this chapter for examples of dial backup configuration.

For more information about dial backup, refer to the chapter “Configuring Dial-on-Demand Routing” later in this manual.

Ignore DCD and Monitor DSR as Line Up/Down Indicator

This task applies to Quad Serial NIM interfaces on the Cisco 2500 series access servers.

By default, when the serial interface is operating in DTE mode, it monitors the Data Carrier Detect (DCD) signal as the line up/down indicator. By default, the attached DCE device sends the DCD signal. When the DTE interface detects the DCD signal, it changes the state of the interface to up.

In some configurations, such as an SDLC multidrop environment, the DCE device sends the Data Set Ready (DSR) signal instead of the DCD signal, which prevents the interface from coming up. To tell the interface to monitor the DSR signal instead of the DCD signal as the line up/down indicator, perform the following task in interface configuration mode:

Task	Command
Configure the serial interface to monitor the DSR signal as the line up/down indicator.	ignore-dcd

Configure Loopback Detection

When an interface has a backup interface configured, it is often desirable that the backup interface be enabled when the primary interface is either down or in loopback. By default, the backup is only enabled if the primary interface is down. By using the **down-when-looped** command, the backup interface will also be enabled if the primary interface is in loopback. To achieve this condition, perform the following task in interface configuration mode:

Task	Command
Configure an interface to tell the system it is down when loopback is detected.	down-when-looped

If testing an interface with the loopback command, **down-when-looped** should not be configured, or packets will not be transmitted out the interface that is being tested.

Control Interface Hold-Queue Limits

Each interface has a hold-queue limit. This limit is the number of data packets that the interface can store in its hold queue before rejecting new packets. When the interface empties one or more packets from the hold queue, the interface can accept new packets again. You can specify the hold-queue limit of an interface in interface configuration mode as follows:

Task	Command
Specify the maximum number of packets allowed in the hold queue.	hold-queue <i>length</i> { in out }

Set Bandwidth

Higher-level protocols use bandwidth information to make operating decisions. For example, IGRP uses the minimum path bandwidth to determine a routing metric. The TCP protocol adjusts initial retransmission parameters based on the apparent bandwidth of the outgoing interface. Perform the following task in interface configuration mode to set a bandwidth value for an interface:

Task	Command
Set a bandwidth value.	bandwidth <i>kilobits</i>

The bandwidth setting is a routing parameter only; it does not affect the physical interface.

Set Interface Delay

Higher-level protocols might use delay information to make operating decisions. For example, IGRP can use delay information to differentiate between a satellite link and a land link. To set a delay value for an interface, perform the following task in interface configuration mode:

Task	Command
Set a delay value for interfaces.	delay <i>tens-of-microseconds</i>

Specifying the delay value sets an informational parameter only; you cannot adjust the actual delay of an interface with this configuration command.

Adjust Timers

To adjust the frequency of update messages, perform the following the following task in interface configuration mode:

Task	Command
Adjust the frequency with which the communication server sends messages to itself (Ethernet and Token Ring) or to the other end (HDLC-serial and PPP-serial links) to ensure that a network interface is alive for a specified interface.	keepalive [<i>seconds</i>]

You also can configure the *keepalive* interval, the frequency at which the communication server sends messages to itself (Ethernet and Token Ring) or to the other end (HDLC-serial, PPP-serial) to ensure that a network interface is alive. The interval in some previous software versions was 10 seconds; it is now adjustable in one-second increments down to one second. An interface is declared down after three update intervals have passed without receiving a keepalive packet.

When adjusting the keepalive timer for a very low bandwidth serial interface, large packets can delay the smaller keepalive packets long enough to cause the line protocol to go down. You might need to experiment to determine the best value.

Limit Size of the Transmit Queue

You can control the size of the transmit queue available to a specified interface on the MCI and SCI cards. To limit the size, perform the following task in interface configuration mode:

Task	Command
Limit the size of the transmit queue.	tx-queue-limit <i>number</i>

Adjust Maximum Packet Size or MTU Size

Each interface has a default maximum packet size or maximum transmission unit (MTU) size. This number generally defaults to 1500 bytes. On serial interfaces, the MTU size varies, but cannot be set smaller than 64 bytes. To adjust the maximum packet size, perform the following task in interface configuration mode:

Task	Command
Adjust the maximum packet size or MTU size.	mtu <i>bytes</i>

Monitor and Maintain the Interface

You can perform the tasks in the following sections to monitor and maintain the interfaces:

- Monitor Interface Status
- Clear and Reset the Interface
- Shut Down and Restart an Interface
- Run Interface Loopback Diagnostics

Monitor Interface Status

The software contains commands that you can enter at the EXEC prompt to display information about the interface, including the version of the software and the hardware, the controller status, and statistics about the interfaces. The following table lists some of the interface monitoring tasks. (The full list of **show** commands can be displayed by entering the **show ?** command at the EXEC prompt.) These commands are fully described in the *Access and Communication Servers Command Reference* publication.

Perform the following commands in EXEC mode:

Task	Command
Display the status of an asynchronous interface.	show async status
Display compression statistics on a serial interface.	show compress
Display current internal status information for the interface controller cards.	show controllers {mci serial token}
Display the number of packets of each protocol type that have been sent through the interface.	show interfaces [<i>type</i> { <i>unit</i> }] [accounting]
Display the number of packets of each protocol type that have been sent through the asynchronous serial line.	show interfaces async [<i>unit</i>] [accounting]
Display the current contents of the Token Ring routing information field (RIF) cache.	show rif
Display the hardware configuration, software version, the names and sources of configuration files, and the boot images.	show version ¹

1. This command is documented in the “System Image, Microcode Image, and Configuration File Load Commands” chapter of the *Access and Communication Servers Command Reference* publication.

Clear and Reset the Interface

To clear the interface counters shown with the **show interfaces** command, enter the following command at the EXEC prompt:

Task	Command
Clear the interface counters.	clear counters [<i>type number</i>]

Note This command will not clear counters retrieved using SNMP, but only those seen with the EXEC **show interfaces** command.

Complete the following tasks in EXEC mode to clear and reset interfaces. Under normal circumstances, you do not need to clear the hardware logic on interfaces.

Task	Command
Reset the hardware logic on an interface.	clear interface <i>type number</i>
Reset the hardware logic on an asynchronous serial line.	clear line [<i>number</i>]
Clear the entire Token Ring RIF cache.	clear rif-cache

Shut Down and Restart an Interface

You can disable an interface. Doing so disables all functions on the specified interface and marks the interface as unavailable on all monitoring command displays. This information is communicated to other network servers through all dynamic routing protocols. The interface will not be mentioned in any routing updates. On serial interfaces, this command causes the DTR signal to be dropped. On Token Ring interfaces, this command causes the interface to deinsert from the ring.

To shut down an interface and then restart the disabled interface, perform the following tasks in interface configuration mode:

Command	Task
Shut down an interface.	shutdown
Reenable an interface.	no shutdown

To check whether an interface is disabled, use the EXEC command **show interfaces**. An interface that has been shut down is shown as administratively down in the **show interfaces** command display. See examples in the section “Interface Shutdown Examples” at the end of this chapter.

Run Interface Loopback Diagnostics

You can use a loopback test on lines to detect and distinguish equipment malfunctions between line and modem or Channel Service Unit/Digital Service Unit (CSU/DSU) problems on the network server. If correct data transmission is not possible when an interface is in loopback mode, the interface is the source of the problem. The DSU might have similar loopback functions you can use to isolate the problem if the interface loopback test passes. If the device does not support local loopback, this function will have no effect.

You can specify hardware loopback tests on the Ethernet and synchronous serial interfaces, and all Token Ring interfaces (except the CSC-R 4-megabit card) that are attached to CSU/DSUs, and that support the local loopback signal. The CSU/DSU acts as a data communications equipment (DCE) device; the communication server acts as a data terminal equipment (DTE) device. The local loopback test generates a CSU loop—a signal that goes through the CSU/DSU to the line, then back through the CSU/DSU to the communication server. The **ping** command can also be useful during loopback operation.

The loopback tests are available on the following interfaces:

- Cisco Multiport Communications Interface (MCI) and Cisco Serial Communication Interface (SCI) synchronous serial interfaces
- MCI and Cisco Multiport Ethernet Controller (MEC) Ethernet interfaces; an Ethernet loopback server is also provided on the Ethernet interfaces
- Token Ring interfaces

The following sections describe each test.

Note Loopback does not work on an X.21 DTE because the X.21 interface definition does not include a loopback definition.

Enable Loopback on MCI and SCI Serial Cards

The MCI and SCI serial interface cards support the loopback function when a CSU/DSU or equivalent device is attached to the communication server. Perform the following task in interface configuration mode:

Task	Command
Enable loopback through a CSU/DSU to configure a CSU loop on the MCI and SCI synchronous serial interfaces.	loopback

Enable Loopback on MCI and MEC Ethernet Cards

The Ethernet interfaces on the MCI and MEC cards support loopback mode. To enable loopback mode on them, perform the following task in interface configuration mode:

Task	Command
Enable loopback to verify that the interface receives back every packet it sends.	loopback

Configure the Ethernet Loopback Server

The communication server software provides an Ethernet loopback server that supports Digital, Intel, and Xerox systems specified by the “blue book,” a joint specification written by Digital, Intel, and Xerox that defines the Ethernet protocol. The loopback server responds to forward data loopback messages sent either to the server’s MAC address or to the broadcast address. Currently, the Ethernet loopback server does not respond to the loopback assistance multicast address.

Use the Ethernet loopback server to test communications between your internetworking products and Digital systems that do not support the IP **ping** command, such as DECnet-only VMS systems.

To originate a loop test on your VMS system with a Cisco server, use the Digital Network Control Program (NCP) command **Loop Circuit**. For more information about the **Loop Circuit** command, consult the DECnet VAX documentation. Cisco network servers support all options that can be specified by the VMS hosts.

Enable Loopback on Token Ring Cards

You can place all of the Token Ring interface cards except the 4-MB CSC-R card into loopback mode by performing the following task in interface configuration mode:

Task	Command
Enable loopback to verify that the Token Ring interface receives back every packet it sends.	loopback

Interface Configuration Examples

Use the configuration examples in the following sections to understand some aspects of interface configuration:

- Enabling Interface Configuration Example
- Restricted Access on the Asynchronous Interface Example
- PPP Connection Example

- SLIP Connection Examples
- Enabling Interface Configuration Example
- Interface Description Examples
- Interface Shutdown Examples
- IP Tunneling Examples
- CHAP with an Encrypted Password Example
- Dial Backup Service Examples
- Snapshot Routing Examples

Enabling Interface Configuration Example

The following example illustrates how to begin interface configuration. It assigns Point-to-Point (PPP) encapsulation to serial interface 0.

```
interface serial 0
encapsulation ppp
```

Restricted Access on the Asynchronous Interface Example

The following example assumes that users are restricted to certain servers designated as asynchronous servers, but that normal terminal users can access anything on the local network:

```
! access list for normal connections
access-list 1 permit 131.108.0.0 0.0.255.255
!
access-list 2 permit 131.108.42.55
access-list 2 permit 131.108.111.1
access-list 2 permit 131.108.55.99
!
interface async 1
async dynamic address
ip access-group 1 out
ip access-group 2 in
```

PPP Connection Example

In the following example, a line that is in asynchronous mode is using PPP encapsulation (see Figure 6-7). The IP address of the PC is ntpc (assuming that the name ntpc is in the DNS so that it can be resolved to a real IP address). The person typing this command is on a PC running a terminal emulator program.

```
Router> ppp ntpc@server1 /routing /compressed
```

Figure 6-7 Using the PPP EXEC Command

SLIP Connection Examples

The following example shows how to make a connection when a permanent address has been assigned and dynamic addressing is not allowed. An authentication request is sent to the TACACS server, and if it is approved, the line is placed in SLIP mode and the IP address is displayed.

```
Router> slip
Entering SLIP mode.
Your IP address is 192.31.7.28, MTU is 1500 bytes
```

The following example illustrates the prompts displayed and the response required when dynamic addressing is used to assign the SLIP address:

```
Router> slip
IP address or hostname? 192.31.6.15
Password:
Entering SLIP mode
Your IP address is 192.31.6.15, MTU is 1500 bytes
```

The following example illustrates the implementation of header compression on the interface with the IP address 128.66.2.1:

```
Router> slip /compressed 128.66.2.1
Password:
Entering SLIP mode.
Interface IP address is 128.66.2.1, MTU is 1500 bytes.
Header compression is On.
```

In the following example, header compression is configured as passive, so the status of header compression will be assigned by the user-level **slip** or **ppp** command:

```
Router> slip 1.0.0.1@check
Password:
Entering SLIP mode.
Interface IP address is 1.0.0.1, MTU is 1500 bytes
Header compression will match your system.
```

Interface Description Examples

The following example illustrates how to add a description about an interface that will appear in configuration files and monitoring command displays:

```
interface ethernet 0
description First Ethernet in network 1
ip address 101.13.15.78 255.255.255.0
```

Interface Shutdown Examples

The following example turns off Ethernet interface 0:

```
interface ethernet 0
shutdown
```

The following example turns the interface back on:

```
interface ethernet 0
no shutdown
```

The following example illustrates how to shut down a Token Ring interface:

```
interface tokenring 0
shutdown
```

IP Tunneling Examples

Figure 6-8 shows a configuration that will route a private IP network and a Novell network across a Public Service Provider. The configurations for communication servers A and B follow Figure 6-8.

Figure 6-8 Creating Virtual Private Networks across WANs

Communication Server A

```
interface ethernet 0
description boston office
ip address 10.1.1.1 255.255.255.0
novell network 1e

interface serial 0
description connection to NEARnet
ip address 192.13.2.1 255.255.255.0

interface tunnel 0
tunnel source serial 0
tunnel destination 131.108.5.2
ip address 10.1.2.1 255.255.255.0
novell network 1f
```

Communication Server B

```
interface ethernet 0
description menlo park office
ip address 10.1.3.1 255.255.255.0
novell network 31

interface serial 4
description connection to BARRnet
ip address 131.108.5.2 255.255.255.0

interface tunnel 0
tunnel source serial 4
tunnel destination 192.13.2.1
ip address 10.1.2.2 255.255.255.0
novell network 1f
```

CHAP with an Encrypted Password Example

The following configuration examples enable CHAP on serial interface 0 of three communication servers.

Communication Server yyy

```
hostname yyy
interface serial 0
encapsulation ppp
ppp authentication chap
username xxx password secretxy
username zzz password secretzzy
```

Communication Server xxx

```
hostname xxx
interface serial 0
encapsulation ppp
ppp authentication chap
username yyy password secretxy
username zzz password secretxz
```

Communication Server zzz

```
hostname zzz
interface serial 0
encapsulation ppp
ppp authentication chap
username xxx password secretxz
username yyy password secretzzy
```

When you look at the configuration file, the passwords will be encrypted and the display will look similar to the following:

```
hostname xxx
interface serial 0
encapsulation ppp
ppp authentication chap
username yyy password 7 121F0A18
username zzz password 7 1329A055
```

Dial Backup Service Examples

The dial backup service examples show configurations for the following conditions:

- When the Primary Line Goes Down
- When the Primary Line Reaches Threshold
- When the Primary Line Exceeds Threshold

When the Primary Line Goes Down

The following example configures serial 1 as a secondary line that activates only when the primary line (serial 0) goes down. The secondary line will not be activated due to load of the primary.

```
interface serial 0
backup interface serial 1
backup delay 30 60
```

The secondary line is configured to activate 30 seconds after the primary line goes down and to remain on for 60 seconds after the primary line is reactivated.

When the Primary Line Reaches Threshold

The following example configures the secondary line (serial 1) to be activated only when the load of the primary line reaches a certain threshold:

```
interface serial 0
backup interface serial 1
backup load 75 5
```

In this case, the secondary line will not be activated when the primary goes down. The secondary line will be activated when the load on the primary line is greater than 75 percent of the primary's bandwidth. The secondary line will then be brought down when the aggregate load between the primary and secondary lines fits within 5 percent of the primary bandwidth.

When the Primary Line Exceeds Threshold

This example configures the secondary line to activate once the traffic threshold on the primary line exceeds 25 percent:

```
interface serial 0
backup interface serial 1
backup load 25 5
backup delay 10 60
```

Once the aggregate load of the primary and the secondary lines return to within 5 percent of the primary bandwidth, the secondary line is deactivated. The secondary line waits 10 seconds after the primary goes down before activating, and remains active for 60 seconds after the primary returns and becomes active again.

Snapshot Routing Examples

The following example configures snapshot routing on a DDR interface on the client router. In this configuration, a single client router can call multiple server routers. The absence of the **suppress-statechange-updates** keyword means that routing updates will be exchanged each time

the line protocol goes from “down” to “up” or from “dialer spoofing” to “fully up.” The **dialer** keyword allows the client router to dial the server router in the absence of regular traffic if the active period time expires.

```
interface serial 0
dialer rotary-group 3
!
interface dialer 3
dialer in-band
snapshot client 5 360 dialer
snapshot retry-interval 5
dialer map snapshot 2 4155556734
dialer map snapshot 3 7075558990
```

The following commands configure the server router:

```
interface serial 2
snapshot server 5 dialer
```