Chapter 6
Interface Configuration and Support

6

This chapter describes how to configure and maintain the interfaces supported on the terminal server. You will find information about enabling, shutting down, and displaying statistics about the following interfaces:

- Serial interfaces
- Ethernet interfaces
- Token Ring interfaces

You will also find information about configuring the null interface and the Point-to-Point Protocol (PPP) in this chapter.

To enable an interface, you must be in the configuration command collection mode. To enter this mode, type the EXEC command **configure** at the EXEC prompt. Once in the command collection mode, start configuring the interface by entering the **interface** command. Once an interface is configured, you can check its status by entering EXEC **show** commands at the EXEC prompt.

This chapter provides software configuration information only. For hardware technical descriptions, and for information about installing these interfaces, refer to the hardware reference for your particular product.

Summaries of the interface configuration commands and EXEC monitoring commands described in this chapter are included at the end of the chapter.

Specifying an Interface

The **interface** command is entered in configuration mode and identifies a specific network interface (for example, a serial port, Ethernet port, or a Token Ring port). By entering this command you begin the command collection mode for the specified interface.

The **interface** command has the following syntax:

interface *type unit*

The argument *type* identifies the interface type and the argument *unit* identifies the connector or interface card number. Unit 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** command.

Example:

This example begins interface configuration command collection mode for serial connector zero (interface serial 0).

```
interface serial 0
```

Use the EXEC command **show interfaces** (described later in this chapter), to determine the interface type and unit numbers.

In the interface configuration command collection mode, you enter the interface subcommands for your particular routing or bridging protocol. The interface configuration command collection mode ends when you enter a command that is not an interface subcommand, or when you type the Ctrl-Z sequence.

Adding a Descriptive Name to an Interface

To add a descriptive name to an interface, use the **description** interface subcommand.

description *name-string*
no description

The argument *name-string* is text or a description to help you remember what is attached to this interface. The **description** command is meant solely as a comment to be put in the configuration to help you remember what certain interfaces are used for. The description will appear in the output of the following commands: **show configuration, write terminal**, and **show interfaces**.

Example:

This example describes a 3174 controller on serial 0.

```
interface serial 0
description 3174 Controller for test lab
```

Shutting Down and Restarting an Interface

You disable an interface using the **shutdown** interface subcommand. The full syntax for this command follows:

shutdown
no shutdown

The **shutdown** command disables all functions on the specified interface. The command also marks the interface as unavailable. On serial interfaces, this command causes the DTR signal to be dropped. On Token Ring interfaces, this command causes the interface to be de-inserted from the ring.

To restart a disabled interface, use the **no shutdown** interface subcommand.

To check whether an interface is disabled, use the EXEC command **show interfaces** as described in the next section. An interface that has been shut down is shown as administratively down in the display from this command.

Examples:

These commands turn off the interface Ethernet 0.

```
interface ethernet 0
shutdown
```

These commands turn the interface back on.

```
interface ethernet 0
no shutdown
```

Clearing Interface Counters

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

clear counters [*type unit***]**

The command clears all the current interface counters from the interface unless the optional arguments *type* and *unit* are specified to clear only a specific interface type (serial, Ethernet, Token Ring, and so on) from a specific unit or card number.

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

Displaying Information About an Interface

The Cisco software contains commands that you can enter at the **EXEC** prompt to display different information about the interface including the version of the software and the hardware, the controller status, and some statistics about the different interfaces. These commands begin with the word "show." (The full list of these commands can be displayed by entering the command **show ?** at the EXEC prompt.) A description of interface-specific **show** commands follows.

Displaying Controller Status

The **show controllers** command displays current internal status information for different interface cards. Enter this command at the EXEC prompt:

show controllers {serial | token | mci}

Use the following keywords to display the information about that card:

- **serial**—For the Serial Interface Card
- **token**—For the CSC-R and CSC-R16 Token Ring Interface Cards
- **mci**—For the Multiport Communications Interface Card and Serial Communications Interface Card

Sample output for the MCI controller card follows. Table 1-1 describes the fields seen.

```
MCI 0, controller type 1.1, microcode version 1.8
  128 Kbytes of main memory, 4 Kbytes cache memory
22 system TX buffers, largest buffer size 1520
  Restarts: 0 line down, 0 hung output, 0 controller error
  Interface 0 is Ethernet0, station address 0000.0c00.d4a6
    15 total RX buffers, 11 buffer TX queue limit, buffer size 1520
    Transmitter delay is 0 microseconds
  Interface 1 is Serial0, electrical interface is V.35 DTE
    15 total RX buffers, 11 buffer TX queue limit, buffer size 1520
    Transmitter delay is 0 microseconds
    High speed synchronous serial interface
  Interface 2 is Ethernet1, station address aa00.0400.3be4
    15 total RX buffers, 11 buffer TX queue limit, buffer size 1520
    Transmitter delay is 0 microseconds
  Interface 3 is Serial1, electrical interface is V.35 DCE
    15 total RX buffers, 11 buffer TX queue limit, buffer size 1520
    Transmitter delay is 0 microseconds
    High speed synchronous serial interface
```

Table 1-1 Show Controllers Field Descriptions

Field	Description
MCI (number)	The unit number of the MCI card
controller type	The version number of the MCI card
microcode version	The version number of the MCI card's internal software (in read-only memory)
main memory cache memory	The amount of main and cache memory on the cache memory card
system TX	Number of buffers that hold packets to be transmitted
Restarts line down hung output controller error	Count of restarts due to the following conditions: Communication line down Output unable to transmit Internal error
interface..is	Names of interfaces, by number

Field	Description
electrical interface	Line interface type for serial connections
RX buffers	Number of buffers for received packets
TX queue limit	Maximum number of buffers in transmit queue
Transmitter delay	Delay between outgoing frames
Station address	The hardware address of the interface

Displaying Interface Statistics

The Cisco software also provides the **show interfaces** command which displays statistics for the network interfaces on the network server. Enter this command at the EXEC prompt:

show interfaces [*type unit***]**

Specify the optional arguments *type* and *unit* to display statistics for a particular network interface. The argument *type* can be one of the following: **ethernet**, **serial**, or **tokenring**. Use the argument *unit* to specify the interface unit number.

You will use the **show interfaces** command frequently while configuring and monitoring your modules.

For further explanations and examples about a specific interface, refer to the following sections in this chapter: "Monitoring the Serial Interface," "Monitoring the Ethernet Interface," and "Monitoring the Token Ring Interface."

Serial Interface Support

Support for the serial interface is supplied on one of Cisco Systems' serial network interface cards:

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

Specifying a Serial Interface

To specify a serial interface, use this configuration command:

interface serial *unit*

Specify the serial interface connector number with the argument *unit*.

Follow this command with the interface subcommands for your particular protocol or application as described in the chapters in Part Five.

The SCI and MCI cards can query the appliques to determine their types. However, they do so only at system startup, so the appliques must be attached when the system is started. Issue a **show controllers serial** or **show controllers mci** command to determine how the serial card (either MCI or SCI) has identified them. The command will also show the capabilities of the serial card and report controller-related failures.

Example:

This command begins configuration on interface serial 0.

```
interface serial 0
```

Serial Encapsulation Methods

The serial interfaces support the following kinds of serial encapsulations:

- High-Level Data Link Control (HDLC)
- HDLC Distant Host (HDH)
- Frame Relay
- Point-to-Point Protocol (PPP)
- Switched Multi-megabit Data Services (SMDS)
- X.25-based encapsulations

The HDLC and PPP encapsulation methods are described in this chapter. The Frame Relay encapsulation method is described in the chapter "Frame Relay Configuration and Management," the SMDS encapsulation in the chapter "SMDS Configuration and Management," and the X.25 and LAPB encapsulation methods in the chapter "X.25 Configuration and Management."

The encapsulation method is changed by using the interface configuration subcommand **encapsulation** followed by a keyword that defines the encapsulation method.

encapsulation *encapsulation-type*

The *encapsulation-type* argument is a keyword that identifies one of the following serial encapsulation types that Cisco Systems' software supports:

- **bfex25**—Blacker Front End Encryption X.25 operation
- **ddnx25-dce**—DDN X.25 DCE operation
- **ddnx25**—DDN X.25 DTE operation
- **frame-relay**—Frame Relay
- **hdh**—HDH Protocol

- **hdlc**—Cisco Systems HDLC Protocol
- **lapb-dce**—X.25 LAPB DCE operation
- **lapb**—X.25 LAPB DTE operation
- **multi-lapb-dce**—X.25 LAPB multiprotocol DCE operation
- **multi-lapb**—X.25 LAPB multiprotocol DTE operation
- **ppp**—Point-to-Point Protocol (PPP)
- **smds**—SMDS service
- **x25-dce**—X.25 DCE operation
- **x25**—X.25 DTE operation

HDLC Serial Encapsulation Method

Cisco provides HDLC serial encapsulation for serial lines. This encapsulation method provides the synchronous framing and error detection functions of HDLC without windowing or retransmission. Although HDLC is the default serial encapsulation method, it can be re-installed using the **hdlc** keyword with the **encapsulation** command as follows:

encapsulation hdlc

Maintaining the Serial Interface

Use the command **clear interface** to reset the hardware logic on an interface. Enter this command at the EXEC prompt:

clear interface serial *unit*

The argument *unit* specifies the serial port number.

Note: Under normal circumstances, you do not need to clear the hardware logic on interfaces.

Monitoring the Serial Interface

Use the command **show interfaces serial** to display information about the serial interface and the state of source bridging. Enter this command at the EXEC prompt:

show interfaces serial [*unit***]**

The argument *unit* is the interface unit number. If you do not provide values for the *unit* argument, the command will display statistics for all the network interfaces.

Sample output of this command for Cisco's synchronous serial interfaces is provided below: Table 1-2 describes the fields seen.

```
Serial 0 is up, line protocol is up
  Hardware is MCI Serial
  Internet address is 150.136.190.203, subnet mask is 255.255.255.0
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input 0:00:07, output 0:00:00, output hang never
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  Five minute input rate 0 bits/sec, 0 packets/sec
  Five minute output rate 0 bits/sec, 0 packets/sec
     16263 packets input, 1347238 bytes, 0 no buffer
     Received 13983 broadcasts, 0 runts, 0 giants
     2 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 2 abort
     22146 packets output, 2383680 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets, 0 restarts
     1 carrier transitions
```

Table 1-2 Show Serial Interface Field Descriptions

Field	Description
Serial ... is {up |down} ...is administratively down	Tells whether the interface hardware is currently active (whether carrier detect is present) and if it has been taken down by an administrator.
line protocol is {up | down | administratively down}	Tells whether the software processes that handle the line protocol think the line is usable (are keepalives successful?).
Hardware is	Specifies the hardware type.
Internet address is	Specifies the Internet address and subnet mask, followed by packet size.
MTU	Maximum Transmission Unit of the interface.
BW	Bandwidth of the interface in kilobits per second.
DLY	Delay of the interface in microseconds.
rely	Reliability of the interface as a fraction of 255 (255/255 is 100% reliability), calculated as an exponential average over five minutes.
load	Load on the interface as a fraction of 255 (255/255 is completely saturated), calculated as an exponential average over five minutes.
Encapsulation	Encapsulation method assigned to interface.
loopback	Tells whether loopback is set or not.
keepalive	Tells whether keepalives are set or not.
Last input	The number of hours, minutes, and seconds since the last packet was successfully received by an interface. Useful for knowing when a dead interface failed.

Field	Description
output hang	The number of hours, minutes, and seconds (or never) since the interface was last reset because of a transmission that took too long. When the number of hours in any of the "last" fields exceeds 24 hours, the number of days and hours is printed. If that field overflows, asterisks are printed.
Output queue, Input Queue, drops	Number of packets in output and input queues. Each number is followed by a slash, the maximum size of the queue, and the number of packets dropped due to a full queue.
Five minute input rate, Five minute output rate	The average number of bytes and packets transmitted per second in the last five minutes.
packets input	The total number of error-free packets received by the system.
broadcasts	The total number of broadcast or multicast packets received by the interface.
runts	The number of packets which are discarded because they are smaller than the medium's minimum packet size.
giants	The number of packets which are discarded because they exceed the medium's maximum packet size.
input error	The total number of no buffer, runts, giants, CRCs, frame, overrun, ignored, and abort counts. Other input-related errors can also increment the count, so that this sum may not balance with the other counts.
CRC	The Cyclic Redundancy Checksum generated by the originating station or far-end device does not match the checksum calculated from the data received. On a serial link, CRCs usually indicate noise, gain hits, or other transmission problems on the data link.
frame	The number of packets received incorrectly having a CRC error and a noninteger number of octets. On a serial line, this is usually the result of noise or other transmission problems.
overrun	The number of times the serial receiver hardware was unable to hand received data to a hardware buffer because the input rate exceeded the receiver's ability to handle the data.
ignored	The number of received packets ignored by the interface because the interface hardware ran low on internal buffers. These buffers are different than the system buffers mentioned previously in the buffer description. Broadcast storms and bursts of noise can cause the ignored count to be increased.

Field	Description
abort	An illegal sequence of one bits on a serial interface. This usually indicates a clocking problem between the serial interface and the data link equipment.
packets output	Total number of messages transmitted by the system.
bytes output	Total number of bytes, including data and MAC encapsulation, transmitted by the system.
underruns	Number of times that the transmitter has been running faster than the server can handle. This may never happen (be reported) on some interfaces.
output errors	The sum of all errors which prevented the final transmission of datagrams out of the interface being examined. Note that this may not balance with the sum of the enumerated output errors, as some datagrams may have more than one error, and others may have errors that do not fall into any of the specifically tabulated categories.
interface resets	The number of times an interface has been completely reset. This can happen if packets queued for transmission were not sent within several seconds' time. On a serial line, this can be caused by a malfunctioning modem which is not supplying the transmit clock signal, or by a cable problem. If the system notices that the carrier detect line of a serial interface is up, but the line protocol is down, it periodically resets the interface in an effort to restart it. Interface resets can also occur when an interface is looped back down.
restarts	The number of times the controller was restarted because of errors.
carrier transitions	The number of times the carrier detect signal of a serial interface has changed state. Indicates modem or line problems if the carrier detect line is changing state often.

Debugging the Serial Interface

Use the commands **debug serial-interface** and **debug serial-packet** to debug serial interface events. The EXEC commands are as follows:

debug serial-interface
debug serial-packet

Use **debug serial-packet** for detailed debugging information, and **debug serial-interface** for more general information.

Use the **undebug serial-interface** and **undebug serial-packets** to turn off messaging from these **debug** commands.

Ethernet Interface Support

Support for the Ethernet interface is supplied on one of Cisco Systems' Ethernet network interface cards:

- The Multiport Communications Interface (MCI) card provides up to two Ethernet connectors compatible with Ethernet Versions 1 and 2, and the IEEE 802.3 protocol.
- The Multiport Ethernet Controller (MEC) interface card provides two, four, or six high-speed Ethernet connectors compatible with Ethernet Versions 1 and 2, and the IEEE 802.3 protocol.

Specifying an Ethernet Interface

To specify an Ethernet interface, use this configuration command:

interface ethernet *unit*

Specify the Ethernet interface connector number with the argument *unit*.

Follow this command with the interface subcommands for your particular protocol or application as described in the chapters in Part Five.

Example:

This command begins configuration on interface Ethernet 1.

```
interface ethernet 1
```

Ethernet Encapsulation Methods

The Ethernet interface supports a number of encapsulation methods. These methods are assigned by using the interface subcommand **encapsulation** followed by a keyword that defines the encapsulation method. The particular encapsulation method used depends on the protocol. Currently, there are three common Ethernet encapsulation methods:

- The standard Ethernet Version 2.0 encapsulation that uses a 16-bit protocol type code.
- The IEEE 802.3 encapsulation, where 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 syntax of the **encapsulation** command follows:

encapsulation *encapsulation-type*

The *encapsulation-type* is one of the following three keywords:

- **arpa—**Standard Ethernet Version 2.0 encapsulation
- **iso1—**IEEE 802.3 encapsulation
- **snap—**IEEE 802.2 Ethernet media

Example:

These commands enable standard Ethernet Version 2.0 encapsulation on interface Ethernet 0.

```
interface ethernet 0
encapsulation arpa
```

Maintaining the Ethernet Interface

Use the command **clear interface** to reset the hardware logic on an interface. Enter this command at the EXEC prompt:

clear interface ethernet *unit*

The arguments *unit* specifies the Ethernet port number.

Note: Under normal circumstances, you do not need to clear the hardware logic on interfaces.

Monitoring the Ethernet Interface

Use the command **show interfaces ethernet** to display information about the Ethernet interface. Enter this command at the EXEC prompt:

show interfaces ethernet [*unit***]**

The argument *unit* is the interface unit number. If you do not provide values for the *unit* argument, the command will display statistics for all the network interfaces.

Sample output of this command is provided on the following page. Table 1-3 describes the fields seen.

```
Ethernet 0 is up, line protocol is up
  Hardware is MCI Ethernet, address is aa00.0400.0134 (bia
0000.0c00.4369)
  Internet address is 131.108.1.1, subnet mask is 255.255.255.0
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  ARP type: ARPA, PROBE, ARP Timeout 4:00:00
  Last input 0:00:00, output 0:00:00, output hang never
  Output queue 0/40, 0 drops; input queue 0/75, 2 drops
  Five minute input rate 61000 bits/sec, 4 packets/sec
  Five minute output rate 1000 bits/sec, 2 packets/sec
```

```
2295197 packets input, 305539992 bytes, 0 no buffer
Received 1925500 broadcasts, 0 runts, 0 giants
3 input errors, 3 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
3594664 packets output, 436549843 bytes, 0 underruns
8 output errors, 1790 collisions, 10 interface resets, 0 restarts
```

Table 1-3 Show Ethernet Interface Field Descriptions

Field	Description
Ethernet ... is up ...is administratively down	Tells whether the interface hardware is currently active and if it's been taken down by an administrator.
line protocol is {up | down | administratively down}	Tells whether the software processes that handle the line protocol believe the interface is usable (are keepalives successful?).
Hardware	Specifies the hardware type (for example, MCI Ethernet, cBus Ethernet) and address.
Internet address	Lists the Internet address followed by subnet mask.
MTU	Maximum Transmission Unit of the interface.
BW	Bandwidth of the interface in kilobits per second.
DLY	Delay of the interface in microseconds.
rely	Reliability of the interface as a fraction of 255 (255/255 is 100% reliability), calculated as an exponential average over five minutes.
load	Load on the interface as a fraction of 255 (255/255 is completely saturated), calculated as an exponential average over five minutes.
Encapsulation	Encapsulation method assigned to interface.
ARP type:	Type of Address Resolution Protocol assigned.
loopback	Tells whether loopback was set or not.
output	Number of hours, minutes, and seconds (or never) since the last packet was successfully transmitted by the interface. Useful for knowing when a dead interface failed.
output hang	The number of hours, minutes, and seconds (or never) since the interface was last reset because of a transmission that took too long. When the number of hours in any of the "last" fields exceeds 24 hours, the number of days and hours is printed. If that field overflows, asterisks are printed.
Last Clearing	The time at which the counters that measure cumulative statistics (such as number of bytes transmitted and received) shown in this report were last reset to zero. Note that variables that might affect routing (for example, load and reliability) are not cleared when the counters are cleared.

Field	Description
Output queue, Input queue, drops	Number of packets in output and input queues. Each number is followed by a slash, the maximum size of the queue, and the number of packets dropped due to a full queue.
Five minute input rate, Five minute output rate	The average number of bytes and packets transmitted per second in the last five minutes.
packets input	The total number of error-free packets received by the system.
Received ..broadcasts	The total number of broadcast or multicast packets received by the interface.
runts	The number of packets which are discarded because they are smaller than the medium's minimum packet size. For instance, any Ethernet packet which is less than 64 bytes is considered a runt.
giants	The number of packets which are discarded because they exceed the medium's maximum packet size. For example, any Ethernet packet which is greater than 1518 bytes is considered a giant.
input error	Includes runts, giants, no buffer, CRC, frame, overrun, and ignored counts. Other input-related errors can also cause the input errors count to be increased, and some datagrams may have more than one error; therefore, this sum may not balance with the sum of enumerated input error counts.
CRC	The Cyclic Redundancy Checksum generated by the originating LAN station or far-end device does not match the checksum calculated from the data received. On a LAN, this usually indicates noise or transmission problems on the LAN interface or the LAN bus itself. A high number of CRCs is usually the result of collisions or a station transmitting bad data.
frame	The number of packets received incorrectly having a CRC error and a noninteger number of octets. On a LAN, this is usually the result of collisions or a malfunctioning Ethernet device.
overrun	The number of times the serial receiver hardware was unable to hand received data to a hardware buffer because the input rate exceeded the receiver's ability to handle the data.
ignored	The number of received packets ignored by the interface because the interface hardware ran low on internal buffers. These buffers are different than the system buffers mentioned previously in the buffer description. Broadcast storms and bursts of noise can cause the ignored count to be increased.
packets output	Total number of messages transmitted by the system.

Field	Description
bytes	Total number of bytes, including data and MAC encapsulation, transmitted by the system.
underruns	Number of times that the transmitter has been running faster than the server can handle. This may never happen (be reported) on some interfaces.
output errors	The sum of all errors which prevented the final transmission of datagrams out of the interface being examined. Note that this may not balance with the sum of the enumerated output errors, as some datagrams may have more than one error, and others may have errors that do not fall into any of the specifically tabulated categories.
collisions	The number of messages retransmitted due to an Ethernet collision. This is usually the result of an overextended LAN (Ethernet or transceiver cable too long, more than two repeaters between stations, or too many cascaded multiport transceivers). A packet that collides is counted only once in output packets.
interface resets	The number of times an interface has been completely reset. This can happen if packets queued for transmission were not sent within several seconds time. Interface resets can also occur when an interface is looped back or shut down.
restarts	The number of times a Type 2 Ethernet controller was restarted because of errors.

Debugging the Ethernet Interface

Use the command **debug broadcast** to debug MAC broadcast packets. Enter this command at the EXEC prompt.

debug broadcast

Use the **undebug broadcast** command to turn off messaging.

Use the command **debug packet** to enable a log of packets that the network is unable to classify. Examples of this are packets with unknown link type, or IP packets with an unrecognized protocol field. Enter this command at the EXEC prompt.

debug packet

Use the **undebug packe**t command to turn off messaging.

Token Ring Interface Support

Support for the Token Ring interface is supplied on one of Cisco Systems' Token Ring network interface cards:

- The Cisco Systems Token Ring Card (CSC-R) provides interconnection of Cisco network servers to IEEE 802.5 and IBM-compatible Token Ring media.
- The Cisco Systems 4/16 Mbps Token Ring Card (CSC-R16) provides interconnection of Cisco network servers to IEEE 802.5 and IBM-compatible Token Ring media at speeds of 16 or 4 megabits per second.

The Cisco Token Ring interface supports both routing (Level 3 switching) and source-route bridging (Level 2 switching).

Specifying a Token Ring Interface

To configure a Token Ring interface, use this configuration command:

interface tokenring *unit*

Specify *the card number* with the argument *unit*.

Follow this command with the interface subcommands for your particular protocol or application as described in the chapters in Part Five.

Example:

This command begins configuration on the first Token Ring interface.

```
interface tokenring 0
```

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

Use the **ring-speed** interface subcommand to set ring speed for a Token Ring interface. The command syntax follows:

ring-speed *speed*

The argument *speed* can be either **4** or **16**. When specified as **4**, ring speed is set for 4 Mbps operation; when specified to **16**, ring speed is set for 16 Mbps operation. The default is **16**.

Example:

The following commands set a Token Ring interface ring speed to four Mbps.

```
interface tokenring 0
ring-speed 4
```

Token Ring Encapsulation Methods

Cisco's 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.

Maintaining the Token Ring Interface

Use the command **clear interface** to reset the hardware logic on an interface. Enter this command at the EXEC prompt:

clear interface token ring *unit*

The argument *unit* specifies the Token Ring *card number*.

Note: Under normal circumstances, you do not need to clear the hardware logic on interfaces.

To maintain the Routing Information Field (RIF) cache for terminal servers with Token Ring interfaces, use the **clear rif-cache** command. The command syntax is:

clear rif-cache

This command clears all entries from the RIF cache. It applies only to Token Ring interfaces.

Monitoring the Token Ring Interface

Use the command **show interface** to display information about the Token Ring interface and the state of source bridging. Enter this command at the EXEC prompt:

show interfaces tokenring [*unit***]**

The argument *unit* is the interface unit number.

Sample output of this command is provided below. Table 1-4 describes the fields seen.

```
TokenRing 0 is up, line protocol is up
  Hardware is 16/4 Token Ring, address is 5500.2000.dc27 (bia
0000.3000.072b)
  Internet address is 150.136.230.203, subnet mask is 255.255.255.0
  MTU 8136 bytes, BW 16000 Kbit, DLY 630 usec, rely 255/255, load 1/255
  Encapsulation SNAP, loopback not set, keepalive set (10 sec)
  ARP type: SNAP, ARP Timeout 4:00:00
  Ring speed: 16 Mbps
  Single ring node, Source Route Bridge capable
  Group Address: 0x00000000, Functional Address: 0x60840000
  Last input 0:00:01, output 0:00:01, output hang never
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  Five minute input rate 0 bits/sec, 0 packets/sec
  Five minute output rate 0 bits/sec, 0 packets/sec
     16339 packets input, 1496515 bytes, 0 no buffer
```

```
Received 9895 broadcasts, 0 runts, 0 giants
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
32648 packets output, 9738303 bytes, 0 underruns
0 output errors, 0 collisions, 2 interface resets, 0 restarts
5 transitions
```

Table 1-4 Show Token Ring Interface Field Descriptions

Field	Description
Token Ring is up | down	The interface is currently active and inserted into ring (up) or inactive and not inserted (down).
Token Ring is Reset	Hardware error has occurred.
Token Ring is Initializing	Hardware is up, in the process of inserting the ring.
Token Ring is Administratively Down	Hardware has been taken down by an administrator.
line protocol is {up | down | administratively down}	Tells whether the software processes that handle the line protocol believe the interface is usable (are keepalives successful?).
Hardware	Specifies the hardware type (Token Ring or 16/4 Token Ring) and provides the address.
Internet address	Lists the Internet address followed by subnet mask.
MTU	Maximum Transmission Unit of the interface.
BW	Bandwidth of the interface in kilobits per second.
DLY	Delay of the interface in microseconds.
rely	Reliability of the interface as a fraction of 255 (255/255 is 100% reliability), calculated as an exponential average over five minutes.
load	Load on the interface as a fraction of 255 (255/255 is completely saturated), calculated as an exponential average over five minutes.
Encapsulation	Encapsulation method assigned to interface.
loopback	Tells whether loopback is set or not.
keepalive	Tells whether keepalives are set or not.
ARP type:	Type of Address Resolution Protocol assigned.
Ring speed:	Speed of Token Ring—4 or 16 Mbps.
{Single ring | multiring node}	Indicates whether a node is enabled to collect and use source routing information (RIF) for routable Token Ring protocols.
Group Address:	The interface's group address, if any. The group address is a multicast address; any number of interfaces on the ring may share the same group address. Each interface may have at most one group address.
Last input	The number of hours, minutes, and seconds since the last packet was successfully received by an interface. Useful for knowing when a dead interface failed.

Field	Description
output hang	The number of hours, minutes, and seconds (or never) since the interface was last reset because of a transmission that took too long. When the number of hours in any of the "last" fields exceeds 24 hours, the number of days and hours is printed. If that field overflows, asterisks are printed.
Output queue, Input Queue, drops	Number of packets in output and input queues. Each number is followed by a slash, the maximum size of the queue, and the number of packets dropped due to a full queue.
Five minute input rate, Five minute output rate	The average number of bytes and packets transmitted per second in the last five minutes.
packets input	The total number of error-free packets received by the system.
broadcasts	The total number of broadcast or multicast packets received by the interface.
runts	The number of packets which are discarded because they are smaller than the medium's minimum packet size.
giants	The number of packets which are discarded because they exceed the medium's maximum packet size.
CRC	The Cyclic Redundancy Checksum generated by the originating LAN station or far-end device does not match the checksum calculated from the data received. On a LAN, this usually indicates noise or transmission problems on the LAN interface or the LAN bus itself. A high number of CRCs is usually the result of a station transmitting bad data.
frame	The number of packets received incorrectly having a CRC error and a noninteger number of octets.
overrun	The number of times the serial receiver hardware was unable to hand received data to a hardware buffer because the input rate exceeded the receiver's ability to handle the data.
ignored	The number of received packets ignored by the interface because the interface hardware ran low on internal buffers. These buffers are different than the system buffers mentioned previously in the buffer description. Broadcast storms and bursts of noise can cause the ignored count to be increased.
packets output	Total number of messages transmitted by the system.
bytes output	Total number of bytes, including data and MAC encapsulation, transmitted by the system.

Field	Description
underruns	Number of times that the far-end transmitter has been running faster than the near-end server's receiver can handle. This may never happen (be reported) on some interfaces.
output errors	The sum of all errors which prevented the final transmission of datagrams out of the interface being examined. Note that this may not balance with the sum of the enumerated output errors, as some datagrams may have more than one error, and others may have errors that do not fall into any of the specifically tabulated categories.
collisions	Since a Token Ring cannot have collisions, this statistic is nonzero only if an unusual event occurred when frames were being queued or dequeued by the system software.
interface resets	The number of times an interface has been reset. The interface may be reset by the administrator or automatically when an internal error occurs.
restarts	Should always be zero for Token Ring interfaces.
transitions	The number of times the ring made a transition from up to down, or vice versa. A large number of transitions indicates a problem with the ring or the interface.

Debugging the Token Ring Interface

Use the EXEC commands described in this section to troubleshoot the Token Ring interface.

Use the **debug rif** command to enable logging of route information.

debug rif

The command enables logging of information about the route information fields (RIF) in Token Ring packets.

Use the **debug token-event** command to enable logging of Token Ring events.

debug token-event

This command provides a display of low-volume output.

Use the EXEC command **debug token-ring** to display messages about the Token Ring interface activity. This command reports several lines of information for each packet sent or received and is intended for low traffic, detailed debugging.

debug token-ring

The Token Ring interface records detailed information regarding the current state of the ring. These messages are only displayed when **debug token-event** is enabled.

Enter the **undebug** command with the appropriate keyword to turn off the messages.

The last ring status message is displayed in the EXEC command **show interfaces** display for a Token Ring interface. Table 1-5 describes the messages displayed by this command.

Table 1-5 Debug Token Ring Messages

Message	Description
Signal Loss	The controller detected loss of signal on the interface. Several situations can cause this to happen, but the most likely is that another station has just inserted, causing a disruption in service that is reported as signal loss.
Hard Error	This error indicates a significant problem that is preventing transmission of data. There may be a break in the physical cabling or an inserted interface may have died. This message is displayed when the interface is either transmitting or receiving beacon frames.
Soft Error	The interface has detected an aberration on the ring and is transmitting a Report Error MAC frame. These frames are used to report the following types of errors: • Line Error (code violation, token code violation, CRC violation) • Burst Error • MAC AC Set Error • Lost Frame Error • Frame Copied • Receiver Congestion • Token Error These errors are described more fully in the IEEE 802.5 standard.
Ring Beacon	The interface is transmitting beacon frames onto the ring. Something is wrong with the ring.
Wire Fault	The interface has detected an open or short circuit in the lobe data path. The data path starts at the edge of the chipset, and includes the Token Ring transition cable and any other cabling connection on the Multistation Access Unit.
HW Removal	The interface has detected an internal hardware error and has removed itself from the ring.
Remote Removal	The interface received a Remove Ring Station MAC frame from another station on the ring. The interface has removed itself from the ring.
Counter Overflow	Indicates an internal counter is close to reaching its maximum value. The Token Ring monitor firmware automatically reads and clears this condition.

Message	Description
Only Station	The interface has detected that it is the only interface connected and inserted on the ring.
Ring Recovery	The interface is either transmitting or receiving Claim Token MAC frames. This condition is cleared when an Active Monitor has been determined and it transmits a Ring Purge MAC frame.

Configuring RIFs in Source-Route Bridging Environments

This section explains how to build routing information fields (RIFs). Terminal servers on a Token Ring network in a source-route bridging environment must support the collection and use of RIF information, to provide necessary path information to the host.

A RIF is built up of ring and bridge numbers. A *ring* is a single Token Ring network segment. Each ring in the extended Token Ring network is designated by a unique 12-bit ring number. Each bridge between two Token Rings is designated by a unique 4-bit bridge number. Bridge numbers must be unique only between bridges that connect the same two Token Rings.

Figure 1-1 illustrates the basic format for the Routing Information Field.

Figure 1-1 Basic RIF Format

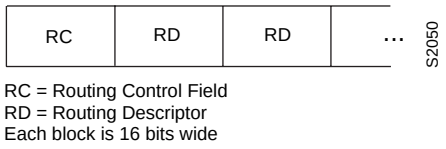
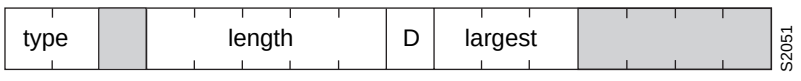


Figure 1-2 illustrates the routing control format for the RIF. Descriptions of each field follow.

Figure 1-2 RIF Routing Control Format



- Shaded fields are reserved.
- type—RIF type, as follows:
  - 00: Specific route
  - 10: All rings, all routes

  - 11: All rings, spanning routes (limited broadcast)
- length—Total length in bytes of the RIF.
- D—Direction, indicated as follows:
  - 0: Interpret route left to right (forward)
  - 1: Interpret route right to left (reverse)
- largest—Largest frame that can be handled by this route, as follows:
  - 000: 516 bytes (DDN 1822)
  - 001: 1500 bytes (Ethernet)
  - 010: 2052 bytes
  - 011: 4472 bytes (Token Ring at 4-Mb speed)
  - 100: 8144 bytes (Token Bus and Token Ring at 16-Mb maximum)
  - 101: 11407 bytes
  - 110: 17800 bytes
  - 111: 65535 bytes (initial values)

Figure 1-3 describes the routing descriptor format of the RIF string. Definitions of each field follow the figure.

Figure 1-3 Routing Descriptor Format

- Ring Number—Unique hexadecimal ring number within the bridged network.
- Bridge Number—Unique hexadecimal bridge number between any bridges connecting the same two rings.

Determining the RIF Timeout Interval

RIF information is maintained in a cache whose entries are aged. The global configuration command **rif timeout** determines the number of minutes an inactive RIF entry is kept. The full command syntax follows:

rif timeout *minutes*
no rif timeout

The default interval is 15 minutes. The minimum value is one minute. Assign a new interval value using the *minutes* argument.

The **no rif timeout** command restores the default.

The EXEC command **show rif** displays the contents of the RIF cache. The EXEC command **clear rif-cache** clears the contents of RIF cache. See the sections "Maintaining the Source-Route Bridge" and "Monitoring the Source-Route Bridge" later in this chapter for more information about these commands.

Example

This command changes the timeout period to five minutes.

```
rif timeout 5
```

Configuring a Static RIF Entry

If a Token Ring host does not support the use of IEEE 802.2 TEST or XID datagrams as explorer packets, you may need to add static information to the RIF cache of the router/bridge.

To enter static source-route information into the RIF cache, use the following variation of the **rif** global configuration command:

rif *MAC-address* [*RIF-string*] [*interface-name*]
no rif *MAC-address* [*interface-name*]

The argument *MAC-address* is a 12-digit hexadecimal string written as a dotted triple, for example 0010.0a00.20a6.

Using the command **rif** *MAC-address* without any of the optional arguments puts an entry into the RIF cache indicating that packets for this MAC address should not have RIF information.

The command **no rif** *MAC-address* removes an entry from the cache.

The optional argument *RIF-string* is a series of 4-digit hexadecimal numbers separated by a dot (.). This RIF string is inserted into the packets sent to the specified MAC address.

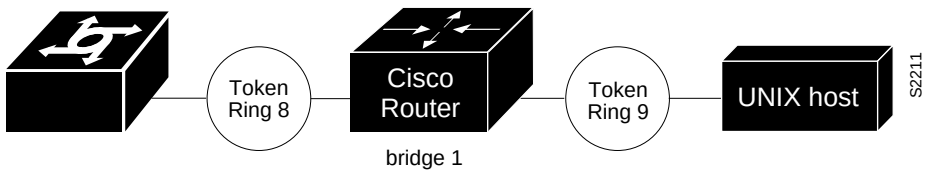
An interface name (for example, tokenring0) can be specified with the optional *interface-name* argument, to indicate the origin of the RIF.

Do not configure a static RIF with any of the *all rings* type codes. Doing so causes traffic for the configured host to appear on more than one ring and leads to unnecessary congestion. The format of a RIF string is illustrated in Figure 1-1, Figure 1-2, and Figure 1-3.

Example

In this example configuration, the path between rings 8 and 9 connected via source-route bridge 1 is described by the route descriptor 0081.0090. A full RIF, including the route control field, would be 0630.0081.0090. The static RIF entry would be submitted to the leftmost router as shown in Figure 1-4.

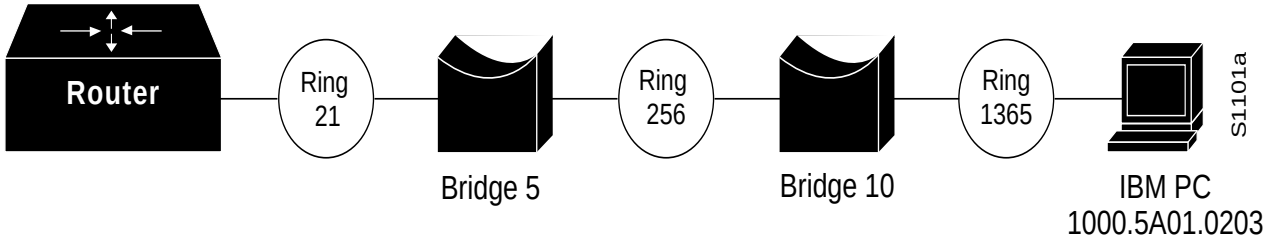
Figure 1-4 Assigning a RIF to a Source-Route Bridge




```
rif 1000.5A12.3456 0630.0081.0090
```

As another example, assume a datagram was sent from a Cisco router/bridge on ring 21 (15 hexadecimal), across bridge 5 to ring 256 (100 hexadecimal), and then across bridge 10 (A hexadecimal) to ring 1365 (555 hexadecimal) for delivery to a destination host on that ring. See Figure 2.

Figure 2 Assigning a RIF to a Two-Hop Path



The RIF in the leftmost router describing this two-hop path is 0830.0155.100a.5550 and is entered as follows:

```
rif 1000.5A01.0203 0830.0155.100a.5550
```

Maintaining the Source-Route Bridge

Use this EXEC command to maintain the source-route bridge cache:

clear rif-cache

The **clear rif-cache** command clears the entire RIF cache.

Displaying the RIF Cache

The **show rif** EXEC command displays the current contents of the RIF cache. Enter this command at the EXEC prompt:

show rif

The following is a sample display of **show rif**:

```
Codes: * interface, - static, + remote
```

```
Hardware Addr  How   Idle (min)  Routing Information Field
5C02.0001.4322 rg5           -   0630.0053.00B0
5A00.0000.2333 TR0           3   08B0.0101.2201.0FF0
5B01.0000.4444 -             -   -
0000.1403.4800 TR1           0   -
0000.2805.4C00 TR0           *   -
0000.2807.4C00 TR1           *   -
0000.28A8.4800 TR0           0   -
0077.2201.0001 rg5          10   0830.0052.2201.0FF0
```

Collecting and Using Routing Information Field (RIF) Information

ASM-CSs on a Token Ring network in a source-route bridging environment must support the collection and use of RIF information, to provide necessary path information to the host.

Level 3 routers that use protocol-specific information rather than MAC information to route datagrams must be able to collect and use RIF information to ensure that the Level 3 routers can transmit datagrams across a source-route bridge. The Cisco software default is to not collect and use RIF information for routed protocols. This allows operation with software that does not understand or properly use RIF information.

To enable collection and use of RIF information, use the **multiring** interface subcommand. The full command syntax follows:

multiring ip
no multiring ip

When it is enabled, the router will source packets that include information used by source-route bridges. This allows a terminal server with Token Ring interfaces to connect to a source-bridged Token Ring network.

The **no multiring ip** subcommand with the appropriate keyword disables the use of RIF information for the protocol specified.

Example

These commands enable a Token Ring interface for the IP protocol. RIFs will be generated for IP frames.

```
interface tokenring 0
multiring ip
ip address 131.108.183.37  255.255.255.0
```

Configuring the Point-to-Point Protocol

The Point-to-Point Protocol (PPP), described in RFC 1134, is designed as a method of encapsulating Internet Protocol (IP) datagrams and other Network Layer protocol information over point-to-point links. The document “Point-to-Point Initial Configuration Options” defines the set of options that are negotiated during startup.

Cisco Systems' current implementation of PPP supports no configuration options. The software sends no options and any proposed options are rejected.

Of the possible upper layer protocols, only IP is supported at this time. Thus, the only upper-level protocol that can be sent or received over a point-to-point link using PPP encapsulation is IP. Refer to RFC 1134 for definitions of the codes and protocol states.

The Point-to-Point Protocol is enabled on an interface using the **encapsulation** interface subcommand followed by the **ppp** keyword.

encapsulation ppp

Example:

These commands enable PPP encapsulation on serial interface zero.

```
interface serial 0
encapsulation ppp
```

Configuring the Null Interface

Cisco provides support for 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 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, specify "null 0" (or "null0") as the interface name and unit. The null interface may be used in any command that has an interface type as a parameter.

Example:

This command configures a null interface for IP route *127.0.0.0*.

```
ip route 127.0.0.0 null 0
```

Interface Support Subcommand Summary

Following are alphabetically arranged summaries of the interface subcommands for interface support.

[no] description *name-string*

Adds a descriptive name to an interface. The argument *name-string* is a comment to be put in the configuration.

encapsulation *encapsulation-type*

Assigns encapsulation method. The *encapsulation-type* argument is a keyword that identifies one of the following serial encapsulation types that Cisco Systems' software supports:

- **arpa**—Ethernet version 2.0 encapsulation
- **bfex25**—Blacker Front End Encryption X.25 operation
- **ddnx25-dce**—DDN X.25 DCE operation
- **ddnx25**—DDN X.25 DTE operation
- **frame-relay**—Frame Relay
- **hdh**—HDH Protocol
- **hdlc**—HDLC Protocol
- **iso1—**IEEE 802.3 encapsulation
- **lapb-dce**—X.25 LAPB DCE operation
- **lapb**—X.25 LAPB DTE operation
- **multi-lapb-dce**—X.25 LAPB multiprotocol DCE operation
- **multi-lapb**—X.25 LAPB multiprotocol DTE operation
- **ppp**—Point-to-Point Protocol (PPP)
- **snap**—IEEE 802.2 Ethernet media
- **smds**—SMDS service
- **x25-dce**—X.25 DCE operation
- **x25**—X.25 DTE operation

interface *type unit*

Specifies a serial interface. The argument type specifies the interface type—**serial**, **ethernet**, or **tokenring**—and the argument *unit* specifies the interface number or card number.

ring-speed *speed*

Sets operational ring speed for interface.

The argument *speed* can be either **4** or **16**. When specified as **4**, ring speed is set for 4 Mbps operation; when specified to **16**, ring speed is set for 16 Mbps operation. The default is **16**.

[no] shutdown

Disables and enables an interface.

Interface Support EXEC Command Summary

Following is an alphabetically arranged summary of the EXEC interface support commands.

clear counters [*type unit***]**

Resets all interface counters listed in **show interface** statistics. The arguments *type* and *unit* specify the interface type and unit or card number (such as, ethernet 0, serial 0, or tokenring 0).

clear interface *type unit*

Resets the hardware logic on an interface.The arguments *type* and *unit* specify the interface type and unit or card number (such as, ethernet 0, serial 0, or tokenring 0).

clear rif-cache

Maintains the Routing Information Field (RIF) cache for terminal servers with a Token Ring interface. This command clears all entries from the RIF cache. It applies only to terminal servers with Token Ring interfaces.

[un]debug broadcast

Enables you to log all Level 2 (MAC) broadcast packets received. This information is useful for finding the source of a broadcast storm.

[un]debug packet

Enables logging of packets that the networ k server is unable to classify. Examples of this are packets with an unknown Ethernet link type, or IP packets with an unrecognized protocol field.

[un]debug rif

Enables logging of route information about the route information fields (RIF) in Token Ring packets.

[un]debug serial-interface

Enables general logging of serial-interface events for network servers equipped with serial network interfaces.

[un]debug serial-packet

Enables detailed logging of serial-interface events for network servers equipped with serial network interfaces.

[un]debug token-event

Enables logging of Token Ring events and provides a display of low-volume output.

[un]debug token-ring

Enables logging of Token Ring interface activity. This command reports several lines of information for each packet sent or received and is intended for low traffic, detailed debugging.

show controllers {serial|token|mci}

Displays current internal status information for different interface cards.

show interfaces [*type unit***]**

Displays statistics for the network interfaces on the network server. The optional argument *type* can be one of the following: **ethernet**, **serial**, or **tokenring**. The argument *unit* specifies the interface unit or card number.