Chapter 4

Configuring Channelized OCx/STMx Interfaces

Use the procedures described in this chapter to configure channelized OC3/STM1 and OC12/STM4 (cOCx/STMx) interfaces on E-series routers.

This chapter contains the following sections:

Overview

Channelized OC3/STM1 and OC12/STM4 interfaces are supported by the modules described in this chapter.

This section describes the features of cOCx/STMx interfaces.

SONET APS and SDH MSP

The router supports Automatic Protection Switching (APS) and Multiplex Section Protection (MSP) on selected I/O modules that provide SONET/SDH connections. This feature provides a redundant connection if a primary SONET/SDH connection fails. For a list of I/O modules that support APS/MSP, see *ERX Module Guide, Appendix A, Module Protocol Support*. For an overview of APS/MSP, see *Bidirectional Switching Mode* in ***Chapter 3, Configuring Unchannelized OCx/STMx Interfaces***.

MDL/FDL Support

Interfaces on cOCx/STMx line modules support maintenance data link (MDL) messages at the T3 level and facilities data link (FDL) messages at the T1 level. For a list of the line modules that support MDL and FDL, see *ERX Module Guide, Appendix A, Module Protocol Support*.

You can use MDL and FDL messages to determine the status of a link and to display statistics for the remote end of a connection. MDL and FDL messages do not interfere with other data transmitted over the link.

MDL Standards

You can configure channelized T3 interfaces to send MDL messages that comply with ANSI T1.107a-1990 Standard for Telecommunications—Digital Hierarchy – Supplement to Formats Specification (August 1990). MDL messages identify a particular link by sharing common codes for data such as the equipment identifier, line identifier, frame identifier, and unit.

FDL Standards

Similarly, you can configure T1 channels to send FDL messages that comply with either or both of the following standards:

- ANSI T1.403-1989 Standard for Telecommunications—Network and Customer Installation Interfaces – DS1 Metallic Interface – Robbed-bit Signaling State Definitions (1989)

  FDL messages that comply with the ANSI standard identify a particular link by sharing common codes for data such as the equipment identifier, line identifier, frame identifier, and unit.

- AT&T Technical Reference 54016—Requirements for Interfacing Digital Terminal Equipment to Services Employing the Extended Superframe Format (September 1989)

  FDL messages that comply with the AT&T standard identify a particular link by sharing performance data and do not use common codes for data such as the equipment identifier, line identifier, frame identifier, and unit.

Timeout of Received MDL and FDL Messages

When a line module receives an MDL or FDL message string, it stores the strings for a period of 10 seconds after the last message was received. If the line module does not receive another message of any type containing the same string within 10 seconds, it erases the local copy of the message.

Most MDL and FDL message strings are common to all three types of messages that can be transmitted: path identifications, idle signals, and test signals. Certain message strings, however, are unique to a particular message type. Table 10 on page 103 briefly describes each MDL/FDL message string and indicates (with an **a**) the types of messages in which it can be sent.

Table 10: MDL and FDL Message Strings and Message Types

Message String	Description	Path Message	Idle Signal Message	Test Signal Message
eic	Equipment identification code	a	a	a
fic	Frame identification code	a	a	a
generator	Generator number	–	–	a
lic	Line identification code	a	a	a
pfi	Facility identification code	a	–	–
port	Equipment port number	–	a	–
unit	Unit identification code	a	a	a

As long as another message of any type containing the same string is received within 10 seconds, the line module retains the local copy of the message string and resets the 10-second timer for that string.

For example, if a line module receives an MDL or FDL test signal message containing an eic string, and then receives a idle signal message within 10 seconds that also contains an eic string, it retains the local copy of the most recent eic string received and resets the 10-second timer for that message. However, if 10 seconds pass without the line module receiving a path identification, test signal, or idle signal message containing an eic string, the line module erases the local copy of the eic message string.

For message strings that are unique to a particular message type, the line module must receive another message of the same type containing this string in order to retain the local copy of the string and reset the timer. For example, if the line module receives a test signal message containing a generator string and does not receive another test signal message within 10 seconds, it erases the local copy of the generator string.

Frequency of FDL Path Messages

E-series routers transmit FDL path identifier messages every second. This behavior complies with the ANSI T1.403 specification (listed in *References* on page 109) and is consistent with the MDL implementation for E-series routers.

Higher-Level Protocols

See *ERX Module Guide*, *Appendix A*, *Module Protocol Support* for information about the higher-level protocols that cOCx/STMx interfaces support.

Platform Considerations

You can configure cOCx/STMx interfaces on the following E-series routers:

- ERX-1440 router
- ERX-1410 router
- ERX-710 router
- ERX-705 router
- ERX-310 router

For detailed information about the modules that support cOCx/STMx interfaces on ERX-7xx models, ERX-14xx models, and the ERX-310 router:

- See *ERX Module Guide, Table 1, Module Combinations* for detailed module specifications.
- See *ERX Module Guide, Appendix A, Module Protocol Support* for information about the protocols and applications that cOCx/STMx modules support.

cOCx/STMx FO Line Module

The cOCx/STMx F0 line module pairs with either a cOC3/STM1 I/O module or a cOC12/STM4 I/O module to support channelized T3 (DS3), T1, E1, FT1, and FE1 signaling. Each connection is made through standard SC connectors.

The cOCx/STMx line module supports the following:

- 3 unchannelized/channelized DS3s per OC3
- 84 framed T1s per OC3/STM1
- 63 framed/unframed E1s per OC3/STM1
- 500 fractional T1/E1s per OC3/STM1

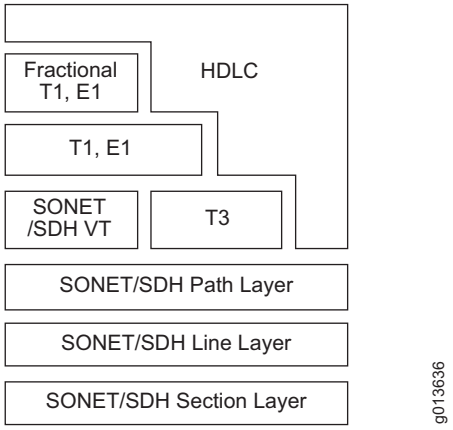
You can combine the cOCx/STMx line module with four-port cOC3/STM1 I/O modules or one-port cOC12/STM4 I/O modules. cOC3/STM1 I/O modules support one OC3/STM1 per port. cOC12/STM4 I/O modules support all four OC3/STM1s on one port.

The cOCx/STMx line module and its corresponding I/O modules can support either E1 or T1 operation. These modules cannot support E1 and T1 operation simultaneously.

Interface Stack

Figure 8 shows the stack for cOCx/STMx interfaces.

Figure 8: Stack for cOCx/STMx Interfaces



NOTE: For a detailed description of interface types and specifiers, see *JUNOSe Command Reference Guide, About This Guide*. For information about interfaces, see *JUNOSe System Basics Configuration Guide, Chapter 1, Planning Your Network*.

The *section* layer manages the transport of STS/STM frames across the physical path. This layer is responsible for frame alignment, scrambling, error detection, error monitoring, signal reception, and signal regeneration.

The *line* layer manages the transport of SONET/SDH payloads, which are embedded in a sequence of STS/STM frames in the physical medium. This layer is responsible for multiplexing and synchronization.

The *path* layer maps the user payload into a SONET/SDH format suitable for the line layer. This layer transports the actual network services (such as T1s and T3s) between SONET/SDH multiplexing devices and provides end-to-end transmission.

When you configure a cOCx/STMx interface, be sure you understand its position in the SONET or SDH hierarchy. This implementation of SONET and SDH uses the term *path* to identify an STS-1 or STM-1 line. You must know how to identify the path for the configuration and the higher-level *controllers*, such as T3 or unframed E1 over SONET VT.

SONET/SDH VT Controllers

SONET/SDH VT on cOCx/STMx interfaces support these options:

- A fractional T1 or E1 line

  You assign *channel groups* of *timeslots* to configure fractional T1 or E1 over SONET/SDH VT on cOCx/STMx interfaces. A channel group is the fraction of the T1 or E1 line and comprises up to 24 T1 timeslots or up to 31 E1 timeslots. The default channel group speed for both T1 and E1 is 64 Kbps; 56 Kbps is also available.

- An unframed E1 line

  Unframed E1 lines have no timeslots reserved for framing. The router creates one channel for an unframed E1 line and assigns the number one to that channel.

NOTE: To configure a whole T1 or E1 line, assign 24 T1 or 31 E1 timeslots to a channel group or configure an unframed E1 line.

To identify a controller over SONET/SDH VT, you must consider the multiplexing for SONET and SDH *virtual tributaries*. In SONET, an STS-1 frame can be divided into seven virtual tributary (VT) groups. Similarly, for SDH, an STM-0 frame can be divided into seven tributary units (TUs). Each group or unit contains a number of virtual tributaries; that number depends on the VT type or TU name. Table 11 lists the VT types and TU names that the router supports.

Table 11: Tributary Standards That cOCx/STMx Interfaces Support

VT Type (SONET)	TU Name (SDH)	Number of Tributaries in a Group	Signal Standard
VT1.5	TU-11	4	T1
Not supported	TU-12	3	E1

Figure 9 shows the structure for SONET, and Figure 10 shows the structure for SDH.

Figure 9: SONET Multiplexing

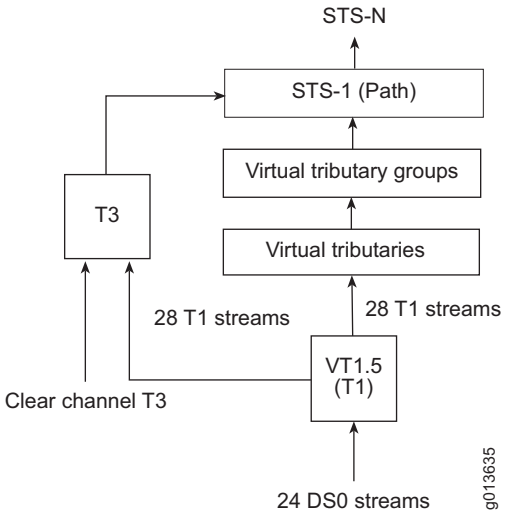
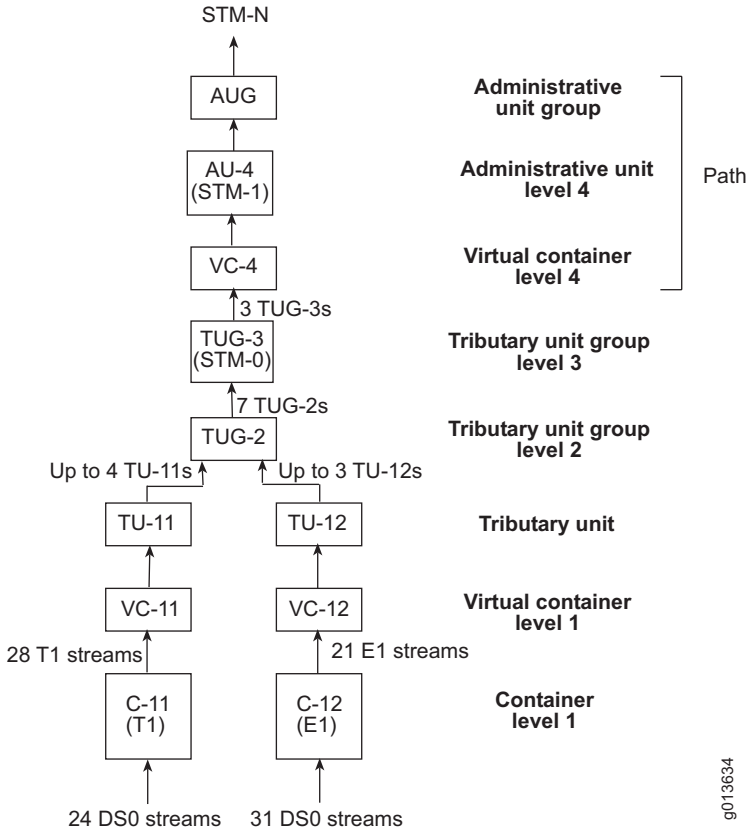


Figure 10: SDH Multiplexing



For both SONET/SDH VT configurations, you must identify the path and controllers above the path layer. Table 12 shows the identifiers for these configurations, and Table 13 provides definitions for the identifiers.

Table 12: Identifiers for SONET/SDH VT Controllers

Configuration	Identifier	Example
Unframed E1	*pathChannel/pathPayload/tributaryGroup/tributaryNumber/channelNumber*	10/1/2/2/1
NOTE: The router automatically assigns the channel number one to an unframed E1 line.		
Fractional T1 or E1	*pathChannel/pathPayload/tributaryGroup/tributaryNumber/channelGroup*	10/1/2/2/1

Table 13: Definitions for Identifiers for SONET/SDH VT Controllers

Identifier	Definition	Value
pathChannel	An STS-1 or STM-1 line	A number in the range 1–2147483648
pathPayload	Number of the payload within the path	In SONET mode, *pathPayload* is always 1. In SDH mode, *pathPayload* is the number of the TUG-3 group.
tributaryGroup	Number of the tributary group within the path	In SONET mode, *tributary group* is the number of the VT group. In SDH mode, *tributaryGroup* is the number of the TUG-2 group.
tributaryNumber	Number of the tributary within the group	In SONET mode, *tributaryNumber* is the number of the VT. In SDH mode, *tributaryNumber* is the number of the TUG-1 group or tributary unit.
channelGroup	A fraction of a T1 or an E1 line	A number in the range 1-24 for T1 or 1-31 for E1

T3 Controllers

You can configure the STS-1 frame to carry a single T3 signal through asynchronous mapping. As Figure 9 on page 107 shows, T3 on cOCx/STMx interfaces supports the following options:

- An unchannelized T3 controller
- A T3 controller channelized to DS0 (fractional T1). To configure fractional T1 over T3 on cOCx/STMx interfaces, you assign *timeslots* (also known as *subchannels*) to the T1 channel. Each T1 channel supports 24 T1 timeslots.

For any configuration, you must identify the path and each controller in the layers above the path layer. For example, for a T3 controller channelized to T1, you must identify the path channel, the T3 channel, and the T1 channel. Table 14 presents the identifiers for the T3 configurations.

Table 14: Identifiers for T3 Controllers

Configuration	identifier	Example
Unchannelized T3	*pathChannel/ds3-channel-number*	1/1
T3 channelized to DS0	*pathChannel/ds3Channel-number/ds1-channel-number/subchannelNumber*	1/1/10/15

HDLC

You must configure HDLC over the T3, unframed E1, or fractional T1/E1 line that you configure on an interface. As Figure 8 on page 105 shows, HDLC is at the top layer of the interface stack.

Numbering Scheme

A cOCx/STMx interface is identified by the *slot/port* format, where:

- *slot*—Number of the slot in which the line module resides in the chassis. In ERX-7xx models, line module slots are numbered 2-6 (slots 0 and 1 are reserved for SRP modules). In ERX-14xx models, line module slots are numbered 0–5 and 8–13 (slots 6 and 7 are reserved for SRP modules). In an ERX-310 router, line module slots are numbered 1–2 (slot 0 is reserved for the SRP module).

- *port*—Number of the port on the I/O module

  A cOC3/STM1 I/O module has four ports. Each port accepts one pair of SC-style fiber connectors.

  The cOC12/STM4 I/O module has one or two ports. On an I/O module that supports two ports, one port is active (primary) and the other is redundant. Cabling both ports provides a redundant path to the interface. If the active port fails, the redundant port automatically becomes active. You can configure only port 0 on a cOC12/STM4 I/O module. Port 0 accepts one pair of SC-style fiber connectors.

  On I/O modules that support APS/MSP, the port numbers for the working (primary) interfaces are assigned the lower half of the numbered interfaces, whereas the port numbers for the protect (redundant) interfaces are assigned the upper half of the numbered interfaces. For example, on an I/O module that provides one primary port and one redundant port, the working interface is port 0 and the protect interface is port 1.

- APS/MSP *channel number*—Identifier of the working or protect interface for configuration purposes

  The protect interface is always assigned channel number 0. The working interface is always assigned channel number 1.

For information about installing line modules and I/O modules in ERX routers, see *ERX Hardware Guide, Chapter 4, Installing Modules*.

References

For more information about MIB support for cOCx/STMx interfaces, consult the following resources:

- RFC 1661—The Point-to-Point Protocol (PPP) (July 1994)

- RFC 2495—Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types (January 1999)

- RFC 2496—Definitions of Managed Objects for the DS3/E3 Interface Types (January 1999)
- RFC 2558—Definitions of Managed Objects for the SONET/SDH Interface Type (March 1999)

For more information about APS/MSP, consult the following resources:

- Telcordia document GR-253—Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria, Revision 3 (September 2000)
- ITU-T G.783—Characteristics Of Synchronous Digital Hierarchy (SDH) Multiplexing Equipment Functional Blocks: Annex A – Multiplex Section Protection (MSP) Protocol, Commands And Operation (1990)
- Definitions of Managed Objects for SONET Linear APS Architectures—draft-ietf-atommib-sonetaps-mib-05.txt (November 2001 expiration)
- RFC 3498—Definitions of Managed Objects for Synchronous Optical Network (SONET) Linear Automatic Protection Switching (APS) Architectures (March 2003)

For more information about bit error rate test (BERT) patterns, consult the following resources:

- ITU O.151—Error performance measuring equipment operating at the primary rate and above (October 1992)
- ITU O.153—Basic parameters for the measurement of error performance at bit rates below the primary rate (October 1992)
- T1M1.3 Working Group—A Technical Report on Test Patterns for DS1 Circuits (November 1993)
- ANSI T1.404-1994 Standard for Telecommunications—Network-to-Customer – DS3 Metallic Interface Specification (1994)

For more information about MDL/FDL support on cOCx/STMx interfaces, consult the following resources:

- ANSI T1.107a-1990 Standard for Telecommunications—Digital Hierarchy – Supplement to Formats Specification (August 1990)
- ANSI T1.403-1989 Standard for Telecommunications—Network and Customer Installation Interfaces – DS1 Metallic Interface – Robbed-bit Signaling State Definitions (1989)
- AT&T Technical Reference 54016—Requirements for Interfacing Digital Terminal Equipment to Services Employing the Extended Superframe Format (September 1989)

Before You Configure an Interface

Before you configure a cOCx/STMx interface, verify the following:

- You have installed the line module and the I/O module correctly.
- Each configured line is able to transmit data to and receive data from your switch connections.

For more information about installing modules, see *ERX Hardware Guide, Chapter 4, Installing Modules*.

Make sure you also have the following information available:

- Framing type, clock source, and the cable length for each controller
- Framing type, line code, and clock source for each channel
- Timeslot mapping and line speed for each fractional channel
- HDLC channel information, such as data inversion information, CRC type, idle character, MTU, and MRU

Configuration Tasks

The following sections describe how to configure the layers on cOCx/STMx interfaces.

SONET/SDH Configuration Tasks

To configure SONET/SDH on a cOCx/STMx interface:

1. Select an interface.
2. Specify a clock source for the interface.
3. Specify that the mode be SDH, or accept the default mode, SONET.
4. (Optional) Assign a text description or an alias to the interface.
5. (Optional) Disable processing of SNMP link status information for the section and line layers of the interface.
6. Configure the path for the interface.
7. (Optional—not recommended) Overwrite the automatic setting for the path signal label (C2) byte.
8. (Optional) Enable processing of SNMP link status information for the path layer of the interface.
9. (Optional) Configure the router to use remote defect indications (RDIs) at the path layer to determine the operational status of a path.

10. (MPLS fast reroute over SONET/SDH interfaces) Specify the time duration after which the router sets an alarm when it records a defect at the path layer.

11. (MPLS fast reroute over SONET/SDH interfaces) Specify the time duration after which the router sets an alarm when it records a defect at the line or section layer.

12. Configure APS/MSP for the interface.

    For information about configuring APS/MSP, see *Configuring APS/MSP* in *Chapter 3, Configuring Unchannelized OCx/STMx Interfaces*.

You must now configure the next layer on the interface: E1, T1, or E3. See *T1/E1 Configuration Tasks* on page 116 or *T3 Configuration Tasks* on page 122.

clock source

- Use to configure the transmit clock source for the interface.
- For production networks, configure all STMx ports on the line module for internal chassis timing. You must also ensure that the chassis reference clock is of good quality — Stratum 3 or better, recovered either from a known good STM port or from one of the BITS inputs.
- Although the CLI enables you to specify the keywords **internal module** to use the line module's internal clock, in a production network we recommend that you do not do this. Instead, specify the keywords **internal chassis** to use the router's internal clock.
- For production networks, never specify the keyword **line** to use the line's receive clock as the transmit clock. Although the CLI enables this configuration, it is not supported because jitter transfer is not compliant for this timing and because pointer adjustments takes place on the outgoing link.
- In a nonproduction network, you can configure some ports with internal clock sources and others with line clock sources. However, all ports with internal clock sources must use either the router's clock or the module's clock. You cannot configure some ports on the I/O module to use the router's clock and others to use the module's clock.
- To change the clock source of the ports on a cOC3/STM1 I/O module from the router's clock to the module's clock or vice versa, first change the clock source of all ports to the line setting, and then to the new internal clock setting.
- Example

  host1(config-controll)#**clock source internal chassis**

- Use the **no** version to revert to the default, **line**.

controller sonet

- Use to select an interface on which you want to configure channelized SONET or SDH.
- Example

  host1(config)#**controller sonet 4/0**

- There is no **no** version.

description

- Use to assign a text description or an alias to a channelized SONET interface.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 64 characters.
- Use the **show controllers sonet** command to display the text description.
- Example

  host1(config-controll)#**description boston-sonet-interface**

- Use the **no** version to remove the text description or alias.

path

- Use to configure paths over channelized SONET and SDH interfaces.
- Specify the correct identifier for the type of interface. See *Interface Types and Specifiers* in *JUNOSe Command Reference Guide, About This Guide* for details of the syntax.
- Example for a cOC3/STM1 interface

  host1(config-controller)#**path 2 oc1**

- Example for a cOC12/STM4 interface in SONET mode

  host1(config-controller)#**path 2 oc1 1/2**

- Example for a cOC12/STM4 interface in SDH mode

  host1(config-controller)#**path 2 stm1 2**

- Use the **no** version to delete a SONET or SDH path.

path description

- Use to assign a text description or an alias to a channelized SONET path.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 64 characters.
- Example

  host1(config-controll)#**path 2 description westford**

- Use the **no** version to remove the description.

path overhead c2

- Use to overwrite the automatic setting for the path signal label (C2) byte.
- By default, the value of the C2 byte for the path is determined by the layers configured above the SONET/SDH interface and set automatically. The E-series router sets this default value in accordance with RFC 2558. (See *References* on page 109.)

CAUTION: Use this command only if you know that the automatic setting does not match the setting on the remote device. Otherwise, the remote device might send an unexpected value, and the router might lose data.

- Example

  host1(config-controll)#**path 2 overhead c2 20**

- Use the **no** version to restore the default setting, in which the value of the C2 byte is determined by the layers configured above the SONET/SDH interface.

path shutdown

- Use to disable a specified path.
- Paths are enabled by default.
- Example

  host1(config-controll)#**path 2 shutdown**

- Use the **no** version to restart a disabled path.

path snmp trap link-status

- Use to enable SNMP link status processing for the path layer of the interface.
- The default is disabled.
- Example

  host1(config-controll)#**path 2 snmp trap link-status**

- Use the **no** version to disable SNMP link status processing.

path trigger alarm prdi

- Use to configure the router to use remote defect indications (RDIs) at the path layer to determine the operational status of a path.
- Example

  host1(config-controll)#**path 2 trigger alarm prdi**

- Use the **no** version to restore the default setting, in which the software uses loss of pointer and AIS defects at the path layer to determine the operational status of a path.

path trigger delay

- Use to set the time duration after which the router sets an alarm when it records a defect at the path layer.
- Change this value from the default only when you are using MPLS fast reroute over a SONET/SDH interface.
  - Specify a value of 0 milliseconds if this interface does not use APS/MSP or if MPLS should have priority over APS/MSP.
  - Specify a value of at least 100 milliseconds if this interface uses APS/MSP and if APS/MSP should have priority over MPLS.
- Example

  host1(config-controll)#**path 2 trigger delay msec 1000**

- Use the **no** version to restore the default setting, 2500 milliseconds.

sdh

- Use to specify that the interface supports SDH.
- Example

  host1(config-controller)#**sdh**

- Use the **no** version to revert to SONET operation on this interface.

snmp trap link-status

- Use to enable SNMP link status processing for the section and line layers of the interface.
- The default is enabled.
- Example

  host1(config-controll)#**no snmp trap link-status**

- Use the **no** version to disable SNMP link status processing.

trigger delay

- Use to set the time duration after which the router sets an alarm when it records a defect at the line or section layer.
- Change this value from the default only when you are using MPLS fast reroute over a SONET/SDH interface.
  - Specify a value of 0 milliseconds if the interface does not use APS/MSP or if MPLS should have priority over APS/MSP.
  - Specify a value of at least 100 milliseconds if this interface uses APS/MSP and if APS/MSP should have priority over MPLS.
- Example

  host1(config-controll)#**trigger delay msec 1000**

- Use the **no** version to restore the default setting, 2500 milliseconds.

Configuring Higher Layers

You must now configure the next layer on the interface: E1, T1, or T3. See *T1/E1 Configuration Tasks* on page 116 or *T3 Configuration Tasks* on page 122.

T1/E1 Configuration Tasks

Before you configure T1 or E1 on an interface, you must configure SONET or SDH. See *SONET/SDH Configuration Tasks* on page 111.

To configure a T1 or an E1 over SONET or SDH on a cOCx/STMx interface:

1. Configure a tributary for the path.
2. (Optional) Assign a text description or an alias to the interface.
3. Configure one of the following:
   - An unframed E1 line. (See *Configuring T1 and E1 Lines* on page 117.)
   - A T1 or an E1 line. (See *Configuring T1 and E1 Lines* on page 117.)

For detailed examples, see *Configuration Examples* on page 133.

path ds1|e1

- Use to create and configure SONET tributaries, SDH tributaries, and T1 or E1 on the path.
- Example

  host1(config-controller)#**path 2 ds1 1/7/4 vt15**

- Use the **no** version to delete SONET and SDH tributaries.

path ds1|e1 description

- Use to assign a text description or an alias to a T1/E1 over SONET/SDH VT layer on channelized SONET and SDH interfaces.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 80 characters.
- Use the **show controllers sonet ds1|e1** command to display the text description.
- Example

  host1(config-controller)#**path 2 ds1 1/7/4 description nyc01**

- Use the **no** version to remove the text description or alias.

Configuring an Unframed E1 Line

Use the following command to configure an unframed E1 line.

path e1 unframed

- Use to configure an unframed E1 on the path.
- You cannot configure a mixture of T1 and E1 lines on the same cOCx/STMx line module.
- When you issue this command, the router creates one channel for the unframed E1 line, and assigns the number one to that channel.
- Example

  host1(config-controller)#**path 1 e1 1/7/4**
  host1(config-controller)#**path 1 e1 1/7/4 unframed**

- Use the **no** version to delete an unframed E1 interface from the path.

Configuring T1 and E1 Lines

You can configure T1 and E1 interfaces on paths and tributaries. To do so, complete the following steps:

1. Configure the clock source. You must coordinate this setting with the other end of the line to establish which end is the transmit (internal) clock and which is the receive (line) clock.
2. (Optional) Configure the framing format.
3. (Optional) Enable processing of SNMP link status information about an interface and its associated tributary.
4. Configure the T1 or E1 line parameters.
5. (Optional) Enable processing of SNMP link status information about a channel group.
6. (Optional—T1 only) Configure FDL messages.
7. (Optional) Assign a text description or an alias to the interface.

path ds1|e1 channel-group description

- Use to assign a text description or an alias to a DS1 (T1) or an E1 channel group for channelized SONET and SDH interfaces.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 80 characters.
- Use the **show controllers sonet ds1|e1** command to display the text description.

- Example

  host1(config-controller)#**path 10 e1 1/5/1 channel-group 4 description westford e1 151.4**

- Use the **no** version to remove the text description or alias.

path ds1|e1 channel-group shutdown

- Use to disable a T1 or an E1 channel group.
- T1 and E1 channel groups are enabled by default.
- Example

  host1 (config-controll)#**path 12 e1 1/4/1 channel-group 2 shutdown**

- Use the **no** version to restart a disabled channel group.

path ds1|e1 channel-group snmp trap link-status

- Use to enable SNMP link status processing for a T1 or an E1 channel group.
- The default is disabled.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 channel-group 2 snmp trap link-status**

- Use the **no** version to disable SNMP link status processing for a T1 or an E1 channel group.

path ds1|e1 channel-group timeslots

- Use to configure T1 or E1 line parameters.
- You cannot configure a mixture of T1 and E1 lines on the same cOCx/STMx line module.
- Specify a T1 or E1 channel group number, and assign a range of timeslots.
- To configure a whole T1 or E1 line, assign all the timeslots to the channel group.
- You can specify a line speed that applies to all DS0 timeslots assigned to a channel group.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 channel-group 2 timeslots 5-6**

- Use the **no** version to remove the timeslots from the channel group.

path ds1|e1 clock source

- Use to configure the transmit clock source for the T1 or E1 interface.
- Select a clock as follows:
  - Specify the keyword **line** to use a transmit clock recovered from the line's receive data stream.
  - Specify the keywords **internal module** to use the line module's internal clock.

  - Specify the keywords **internal chassis** to use the router's clock.
- You can usually accept the default option, **line**, to use a transmit clock recovered from the line's receive data stream, except in rare cases such as back-to-back router tests. When performing back-to-back router tests, configure one end of the line as **internal** and the other end as **line**.
- On a cOC3/STM1 I/O module, you can configure some interfaces with internal clock sources and others with line clock sources. However, all interfaces with internal clock sources must use either the router's clock or the module's clock. You cannot configure some interfaces on the I/O module to use the router's clock and others to use the module's clock.
- To change the clock source of the interfaces on a cOC3/STM1 I/O module from the router's clock to the module's clock or vice versa, first change the clock source of all ports to the line setting, and then to the new internal clock setting.
- Example

  host1(config-controll)#**path 12 e1 1/4/1 clock source line**

- Use the **no** version to restore the default value, **line**.

path ds1|e1 framing

- Use to configure the framing format for a T1 or an E1 interface.
- For T1, specify **esf** (extended superframe) or **sf** (superframe). The default is **esf**.
- The HDLC idle character differs from non–E-series implementations. For T1 interfaces, if you configure SF, the router sets the HDLC idle character to 0xFF. If you configure ESF, the router sets the HDLC idle character to 0x7E.
- For E1, specify **crc4** or **no-crc4**. The default is **crc4**.
- Choose a framing format that is compatible with the framing format at the other end of the line.
- Example

  host1(config-controll)#**path 12 e1 1/4/1 framing no-crc4**

- Use the **no** version to restore the default value.

path ds1|e1 snmp trap link-status

- Use to enable SNMP link status processing for a T1 or an E1 interface and its associated tributary.
- The default is disabled.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 snmp trap link-status**

- Use the **no** version to disable SNMP link status processing.

Configuring T1 Interfaces to Send FDL Messages

You can configure a T1 interface to send FDL messages. To configure FDL:

1. Specify a SONET interface.

   host1(config)#**controller sonet 8/0**

2. Specify the standard for transmission of FDL messages on both ends of the T1 connection.

   host1(config-controll)#**path 2 ds1 1/1/1 fdl ansi**

3. (Optional) Configure the interface to operate in an FDL carrier environment.

   host1(config-controll)#**path 2 ds1 1/1/1 fdl carrier**

4. (Optional) Specify the FDL messages.

   host1(config-controll)#**path 2 ds1 1/1/1 fdl string eic "ERX-1410"**
   host1(config-controll)#**path 2 ds1 1/1/1 fdl string lic "Bldg 10"**
   host1(config-controll)#**path 2 ds1 1/1/1 fdl string fic "GY788"**
   host1(config-controll)#**path 2 ds1 1/1/1 fdl string unit 080001**

5. Enable transmission of FDL messages.

   host1(config-controll)#**path 2 ds1 1/1/1 fdl transmit idle-signal**

path ds1 fdl

- Use to specify the FDL standard for the interface.
- Specify the keyword **ansi** to support the ANSI FDL standard (see *References* on page 109).
- Specify the keyword **att** to support the AT&T FDL standard (see *References* on page 109).
- Specify the keyword **all** to support both the ANSI and AT&T standards.
- Specify the keyword **none** to remove the current FDL mode settings.
- You can configure a different standard on each T1 channel.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 fdl att**

- Use the **no** version to restore the default, none.

path ds1 fdl carrier

- Use to specify that an interface is used in the carrier environment.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 fdl carrier**

- Use the **no** version to restore the default situation, in which the T1 interface does not operate in the carrier environment.

path ds1 fdl string

- Use to configure an FDL message as defined in the ANSI T1.403 specification.

NOTE: The router sends these FDL messages only if you have issued the **path ds1 fdl** command with the **ansi** or **all** keyword and then issued the **path ds1 fdl transmit** command.

- Example

  host1(config-controll)#**path 2 ds1 1/1/1 fdl string eic "ERX-1440"**

- Use the **no** version to restore the default value to the specified FDL message or to all FDL messages.

path ds1 fdl transmit

- Use to configure the router to send the specified type of FDL message on the T1 channel.
- By default, the router sends no FDL messages.

NOTE: The router sends FDL messages specified with the **path ds1 fdl string** command only if you have issued the **path ds1 fdl** command with the **ansi** or **all** keyword. If you specified the **att** keyword with the **path ds1 fdl** command, the router sends only performance data.

- Specify the keyword **path-id** to transmit path identifications every second.
- Specify the keyword **idle-signal** to send idle signals every second.
- Specify the keyword **test-signal** to transmit test signals every second.
- Example

  host1(config-controll)#**path 2 ds1 1/1/1 fdl transmit path-id**

- Use the **no** version to disable transmission of the specified FDL message or all FDL messages.

Disabling Interfaces and Channel Groups

To disable interfaces and channel groups, use the following commands.

path ds1|e1 shutdown

- Use to disable a T1 or an E1 interface.
- T1 and E1 interfaces are enabled by default.
- Example

  host1 (config-controll)#**path 12 e1 1/4/1 shutdown**

- Use the **no** version to restart a disabled interface.

Configuring Higher Layers

You must configure HDLC over the top layer of the T1/E1 interface. See *HDLC Channel Configuration Tasks* on page 130.

T3 Configuration Tasks

Before you configure T3 on an interface, you must configure SONET or SDH on the interface. See *SONET/SDH Configuration Tasks* on page 111.

To configure T3 over SONET or SDH on a cOCx/STMx interface, complete the following actions:

1. Configure a T3 path over the SONET and SDH interfaces.
2. Configure T3 line parameters (for both clear channel T3 lines and multiplexed T3 lines composed of fractional T1 lines).
3. (Optional) Configure T1 or fractional T1 line parameters.

For detailed examples, see *Configuration Examples* on page 133.

path ds3

- Use to create and configure a T3 path over SONET and SDH interfaces.
- Example

  host1(config-controller)#**path 2 ds3 1 channelized**

- Use the **no** version to delete a path.

Configuring T3 Line Parameters

Complete the following steps to configure T3 line parameters. Configure these parameters for both clear channel and multiplexed T3 lines.

1. Configure the clock source. You must coordinate this setting with the other end of the line to establish which end is the transmit (internal) clock and which is the receive (line) clock.
2. (Optional) Assign a text description or an alias to the interface.
3. (Optional) Configure the framing format.
4. (Optional) Enable processing of SNMP link status information about an interface.
5. (Optional) Configure MDL settings.
6. (Optional) Configure T1 channels.

path ds3 clock source

- Use to configure the transmit clock source for the T3 line.
- Select a clock as follows:
  - Specify the keyword **line** to use a transmit clock recovered from the line's receive data stream.
  - Specify the keywords **internal module** to use the line module's internal clock.
  - Specify the keywords **internal chassis** to use the router's clock.
- You can usually accept the default option, **line**, to use a transmit clock recovered from the line's receive data stream, except in rare cases such as back-to-back router tests. When performing back-to-back router tests, configure one end of the line as **internal** and the other end as **line**.
- On a cOC3/STM1 I/O module, you can configure some interfaces with internal clock sources and others with line clock sources. However, all interfaces with internal clock sources must use either the router's clock or the module's clock. You cannot configure some interfaces on the I/O module to use the router's clock and others to use the module's clock.
- To change the clock source of the interfaces on a cOC3/STM1 I/O module from the router's clock to the module's clock or vice versa, first change the clock source of all ports to the line setting, and then to the new internal clock setting.
- Example

  host1(config-controll)#**path 12 ds3 1 clock source line**

- Use the **no** version to restore the default value, **line**.

path ds3 description

- Use to assign a text description or an alias to a T3 (DS3) over channelized SONET/SDH interface.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 80 characters.
- Use the **show controllers sonet ds3** command to display the text description.
- Example

  host1(config-controller)#**path 12 ds3 1 description boston_t3**

- Use the **no** version to remove the text description or alias.

path ds3 framing

- Use to configure the framing format for a T3 interface.
- Specify **c-bit** parity framing or **m23** multiplexer framing.
- Example

  host1(config-controll)#**path 12 ds3 1 framing m23**

- Use the **no** version to restore the default value, **c-bit** parity framing.

path ds3 shutdown

- Use to disable a T3 interface.
- T3 interfaces are enabled by default.
- Example

  host1(config-controll)#**path 12 ds3 1 shutdown**

- Use the **no** version to restart a disabled interface.

path ds3 snmp trap link-status

- Use to enable SNMP link status processing for a T3 interface.
- The default disables SNMP link status processing.
- Example

  host1(config-controll)#**path 12 ds3 1 snmp trap link-status**

- Use the **no** version to disable SNMP link status processing.

Configuring T3 Interfaces to Send MDL Messages

You can configure a T3 interface to send MDL messages. MDL messages are supported only when the T3 framing is set for C-bit parity, the default setting.

To configure a T3 interface to send MDL messages:

1. Specify a SONET interface.

   host1(config)#**controller sonet 8/0**

2. (Optional) Configure the interface to operate in an MDL carrier environment.

   host1(config-controll)#**path 12 ds3 1 mdl carrier**

3. Specify the MDL messages.

```
host1(config-controll)#path 12 ds3 1 mdl string eic "ERX 1410"
host1(config-controll)#path 12 ds3 1 mdl string fic "FG786"
host1(config-controll)#path 12 ds3 1 mdl string lic "Bldg 2"
host1(config-controll)#path 12 ds3 1 mdl string pfi "Site 1"
host1(config-controll)#path 12 ds3 1 mdl string port 0800
host1(config-controll)#path 12 ds3 1 mdl string unit 080001
```

4. Enable transmissions of MDL messages.

```
host1(config-controll)#path 12 ds3 1 mdl transmit path-id
host1(config-controll)#path 12 ds3 1 mdl transmit idle-signal
host1(config-controll)#path 12 ds3 1 mdl transmit test-signal
```

path ds3 mdl carrier

- Use to specify that an interface is used in the carrier environment.
- Example

  ```
  host1(config-controll)#path 12 ds3 1 mdl carrier
  ```

- Use the **no** version to restore the default situation, in which the interface does not operate in the carrier environment.

path ds3 mdl string

- Use to specify an MDL message.
- Example

  ```
  host1(config-controll)#path 12 ds3 1 mdl string port 0800
  ```

- Use the **no** version to restore the default value to the specified MDL message or to all MDL messages.

path ds3 mdl transmit

- Use to enable transmission of MDL messages.
- Specify the keyword **path-id** to transmit path identifications every second.
- Specify the keyword **idle-signal** to send idle signals every second.
- Specify the keyword **test-signal** to transmit test signals every second.
- Example

  ```
  host1(config-controll)#path 12 ds3 1 mdl transmit test-signal
  ```

- Use the **no** version to disable transmission of the specified type of MDL messages or all MDL messages.

Configuring T1 Channels on T3 Interfaces

To configure T1 and fractional T1 channels over T3 interfaces:

1. Configure the T1 path.
2. Configure the clock source.

   You must coordinate this setting with the other end of the line to establish which end is the transmit (internal) clock and which is the receive (line) clock.
3. (Optional) Assign a text description or an alias to the interface.
4. (Optional) Configure the framing format.
5. (Optional) Enable processing of SNMP link status information about an interface.
6. Configure the T1 line parameters.

   You can specify parameters for a single channel, multiple individual channels, ranges of channels, or any combination of the three types of specifications. For example:

   host1(config-controll)#**path 12 ds3 1 t1 25-28**
7. (Optional) Enable processing of SNMP link status information about a channel group.

path ds3 t1

- Use to create and configure the T1 path over SONET and SDH interfaces.
- Example

  host1(config-controll)#**path 12 ds3 1 t1 25-28**
- Use the **no** version to delete a path.

path ds3 t1 clock source

- Use to configure the transmit clock source for the T3 line.
- Use a transmit clock recovered from the line's receive data stream, except in rare cases such as back-to-back router tests. When performing back-to-back router tests, configure one end of the line as **internal** and the other end as **line**.
- Specify the keyword **line** to use a transmit clock recovered from the line's receive data stream.
- Specify the keywords **internal module** to use the line module's internal clock.
- Specify the keywords **internal chassis** to use the router's clock.
- On a cOC3/STM1 I/O module, you can configure some ports with internal clock sources and others with line clock sources. However, all ports with internal clock sources must use either the router's clock or the module's clock. You cannot configure some ports on the I/O module to use the router's clock and others to use the module's clock.

- To change the clock source of the ports on a cOC3/STM1 I/O module from the router's clock to the module's clock or vice versa, change the clock source of all ports first to the line setting, and then to the new internal clock setting.
- Example

  host1(config-controll)#**path 12 ds3 1 t1 28 clock source internal chassis**

- Use the **no** version to restore the default value, **line** clocking.

path ds3 t1 description

- Use to assign a text description or an alias to a T1 or fractional T1 channel on a T3 (DS3) over channelized SONET/SDH interface.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 80 characters.
- Use the **show controllers sonet ds3** command to display the text description.
- Examples

  host1(config-controller)#**path 12 ds3 1 t1 28 description boston_t1_on_t3**
  host1(config-controller)#**path 12 ds3 1 t1 28/5**
  description washington_fractional_t1_on_t3

- Use the **no** version to remove the text description or alias.

path ds3 t1 framing

- Use to configure the T1 framing format for a T3 interface.
- You must specify either **esf** (extended superframe) or **sf** (superframe) framing.
- The framing format you choose must be compatible with the framing format at the other end of the line.
- Example

  host1(config-controll)#**path 12 ds3 1 t1 28 framing sf**

- Use the **no** version to restore the default value, **esf** framing.

path ds3 t1 shutdown

- Use to disable T1 channels or a subchannel.
- T1 channels and subchannels are enabled by default.
- Examples

  host1(config-controll)#**path 12 ds3 t1 5,9,14-17 shutdown**
  host1(config-controll)#**path 12 ds3 t1 28/5 shutdown**

- Use the **no** version to restart a disabled interface.

path ds3 t1 snmp trap link-status

- Use to enable SNMP link status processing for T1 channels or a subchannel.
- The default disables SNMP link status processing.
- Examples

  host1(config-controll)#**path 2 ds3 3 t1 28 snmp trap link-status**
  host1(config-controll)#**path 2 ds3 3 t1 28/5 snmp trap link-status**

- Use the **no** version to disable SNMP link status processing for a T1 channel.

path ds3 t1 timeslots

- Use to assign a range of DS0 timeslots to a subchannel as a single data stream.
- You can specify a line speed for all DS0 timeslots assigned to a subchannel.
- Examples

  host1(config-controll)#**path 2 ds3 1 t1 28 timeslots 1-10**
  host1(config-controll)#**path 2 ds3 1 t1 28/1 timeslots 1-10 speed 56**

- Use the **no** version to delete the fractional T1 circuit.

Configuring T1 Channels to Send FDL Messages

To configure T1 channels to send FDL messages:

1. Specify a SONET interface.

   host1(config)#**controller sonet 8/0**

2. Specify the standard for transmission of FDL messages on both ends of the T1 connection.

   host1(config-controll)#**path 2 ds3 1 t1 28 fdl ansi**

3. (Optional) Configure the interface to operate in an FDL carrier environment.

   host1(config-controll)#**path 2 ds3 1 t1 28 fdl carrier**

4. (ANSI signals) Specify the FDL messages.

   host1(config-controll)#**path 2 ds3 1 t1 28 fdl string eic "ERX-1410"**
   host1(config-controll)#**path 2 ds3 1 t1 28 fdl string lic "Bldg 10"**
   host1(config-controll)#**path 2 ds3 1 t1 28 fdl string fic "GY788"**
   host1(config-controll)#**path 2 ds3 1 t1 28 fdl string unit 080001**

5. Enable transmission of FDL messages.

   host1(config-controll)#**path 2 ds3 1 t1 28 fdl transmit idle-signal**

path ds3 t1 fdl

- Use to specify the FDL standard for the interface.
- Specify the T1 channels in the range 1 through 28.
- Specify the keyword **ansi** to support the ANSI FDL standard (see *References* on page 109).
- Specify the keyword **att** to support the AT&T FDL standard (see *References* on page 109).
- Specify the keyword **all** to support both the ANSI and AT&T standards
- Specify the keyword **none** to remove the current FDL mode settings
- You can configure a different standard on each T1 channel.
- Example

  host1(config-controll)#**path 2 ds3 1 t1 20-28 fdl att**

- Use the **no** version to restore the default, no specified FDL standard.

path ds3 t1 fdl carrier

- Use to specify that T1 channels are used in the carrier environment.
- Example

  host1(config-controll)#**path 2 ds3 1 t1 4,6,10-14 fdl carrier**

- Use the **no** version to restore the default situation, in which the T1 channel does not operate in the carrier environment.

path ds3 t1 fdl string

- Use to configure an FDL message as defined in the ANSI T1.403 specification.

NOTE: The router sends these FDL messages only if you have issued the **path ds3 t1 fdl** command with the **ansi** or **all** keyword and then issued the **path ds3 t1 fdl transmit** command.

- Example

  host1(config-controll)#**path 2 ds3 1 t1 28 fdl string eic "ERX-1440"**

- Use the **no** version to restore the default value to the specified FDL message or to all FDL messages.

path ds3 t1 fdl transmit

- Use to configure the router to send the specified type of FDL message.
- By default, the router sends only FDL performance data messages.

NOTE: The router sends FDL messages specified with the **path ds3 t1 fdl string** command only if you have issued the **path ds3 t1 fdl** command with the **ansi** or **all** keyword. If you specified the **att** keyword with the **path ds3 t1 fdl** command, the router sends only performance data.

- Specify the keyword **path-id** to transmit path identifications every second.
- Specify the keyword **idle-signal** to send idle signals every second.
- Specify the keyword **test-signal** to transmit test signals every second.
- Example

  host1(config-controll)#**path 2 ds3 1 t1 28 fdl transmit path-id**

- Use the **no** version to disable transmission of the specified FDL message or all FDL messages.

Configuring Higher Layers

You must configure HDLC over the top layer of the T3 interface. See *HDLC Channel Configuration Tasks* on page 130.

HDLC Channel Configuration Tasks

You must configure HDLC over the T3, T1, unframed E1, or fractional T1/E1 line that you configure on an interface. As Figure 8 on page 105 shows, HDLC must be the top layer of the interface stack.

To configure an HDLC channel, specify a serial interface. For example:

host1(config)#**interface serial 4/0:1/1/1/1**

Optional Tasks

The following configuration tasks are optional when you configure an HDLC channel on a channelized T3 interface:

- Configure the CRC.
- Configure the HDLC idle character.
- Enable data inversion on the interface.
- Set the MRU.
- Set the MTU.
- Assign a text description or an alias to the serial interface.

crc

- Use to configure the size of the CRC.
- Specify the number of bits (16 or 32) that are used to calculate the frame check sequence (FCS). Both the sender and receiver must use the same setting.
- The CRC is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data.

- A 32-bit CRC should be used to protect longer streams at faster rates and, therefore, provide better ongoing error detection.
- Example

  host1(config-if)#**crc 32**

- Use the **no** version to restore the default, 16.

idle-character

- Use to configure the HDLC idle character.
- The idle character is sent between HDLC packets.
- Specify one of the following idle characters:
  - **flags**—Sets the idle character to 0x7E
  - **marks**—Sets the idle character to 0xFF
- Example

  host1(config-ifs)#**idle-character marks**

- Use the **no** version to restore the default value, 0x7E (flags).

interface serial

- Use to specify a serial interface.
- Example for unframed E1 interface

  host1(config)#**interface serial 4/0:1/1/1/1/1**

- Example for fractional T1/E1 interface

  host1(config)#**interface serial 4/0:1/1/1/1/1**

- Example for unchannelized T3 interface

  host1(config)#**interface serial 4/0:1/1**

- Example for T3 interface channelized to fractional T1

  host1(config)#**interface serial 4/0:1/1/10/22**

- Use the **no** version to remove the interface.

invert data

- Use to enable data stream inversion for the interface.
- Enable data stream inversion only if it is turned on at the other end of the line.
- Example

  host1(config-if)#**invert data**

- Use the **no** version to disable the feature.

mru

- Use to configure the MRU size for the interface.
- Specify a value in the range 4–9996 bytes.
- Coordinate this value with the network administrator on the other end of the line.
- If you set this value with a different value for another protocol, such as IP, the router uses the lower value. The lower MRU might cause unexpected results in the network.
- Example

  host1(config-if)#**mru 1500**

- Use the **no** version to restore the default, 1600 bytes.

mtu

- Use to configure the MTU size for the interface.
- Specify a value in the range 4–9996 bytes.
- You should coordinate this value with the network administrator on the other end of the line.
- You can set a different MTU value in higher-level protocols, such as IP. If you do, the router uses the lower value. The lower MTU might cause unexpected results in the network.
- Example

  host1(config-if)#**mtu 1500**

- Use the **no** version to restore the default, 1600 bytes.

serial description

- Use to assign a text description or an alias to a serial HDLC interface.
- You can use this command to help you identify the interface and keep track of interface connections.
- The description or alias can be a maximum of 80 characters.
- Use the **show interfaces serial** command to display the text description.
- Example

  host1(config-if)#**serial description ottawa012 hdlc channel**

- Use the **no** version to remove the text description or alias.

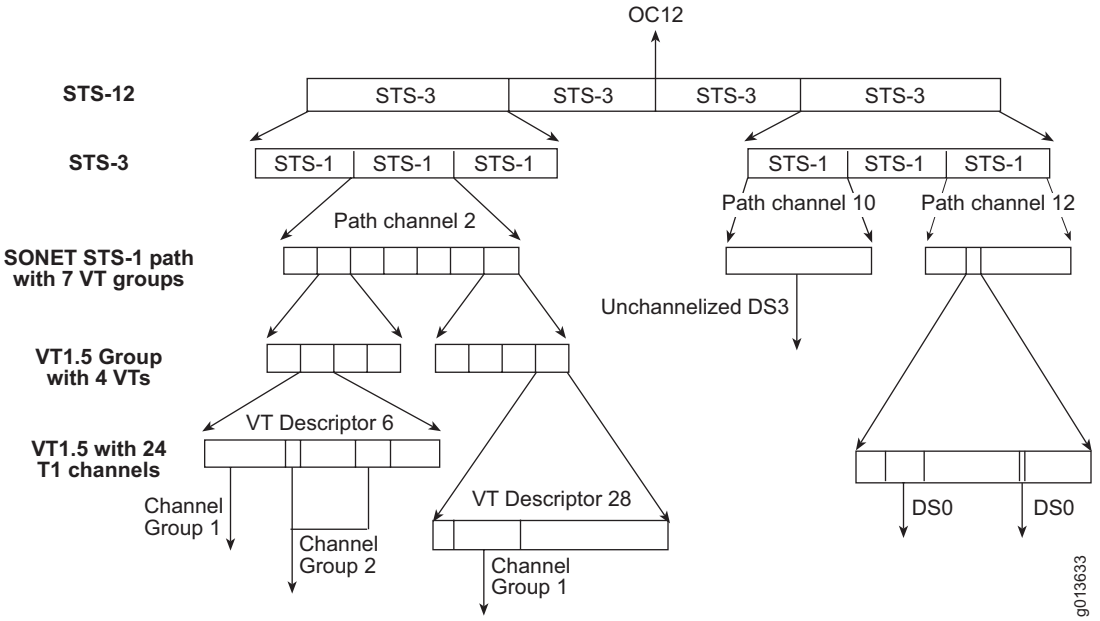
Configuration Examples

This section provides some configuration examples to illustrate how to use the CLI commands.

Example 1: Configuring Interfaces in SONET Mode

The following example illustrates how to configure T1 lines on channelized SONET interfaces, as shown in Figure 11.

Figure 11: Configuring Fractional T1 in SONET Mode



1. Select an OC-12 SONET controller.

   host1(config)#**controller sonet 4/0**

2. Configure two STS-1 paths.

   host1(config-controller)#**path 2 oc1 1/2**
   host1(config-controller)#**path 10 oc1 4/1**

3. Configure two VT1.5 tributaries on SONET path channel 2.

   host1(config-controller)#**path 2 ds1 1/2/2 vt15**
   host1(config-controller)#**path 2 ds1 1/7/4 vt15**

4. Configure two fractional T1 lines on VT 1/2/2 in path 2.

   host1(config-controller)#**path 2 ds1 1/2/2 channel-group 1 timeslots 1-10**
   host1(config-controller)#**path 2 ds1 1/2/2 channel-group 2 timeslots 11, 21-26**

5. Configure a fractional T1 line on VT 1/7/4 in path 2.

   host1(config-controller)#**path 2 ds1 1/7/4 channel-group 1 timeslots 2-7**
6. Configure an unchannelized T3 on SONET path channel 10.

   host1(config-controller)#**path 10 ds3 1 unchannelized**

7. Configure a channelized T3 on SONET path channel 12.

   host1(config-controller)#**path 12 ds3 1 channelized**

8. Configure a T1 channel on the channelized T3 on SONET path channel 12.

   host1(config-controller)#**path 12 ds3 1 t1 4**

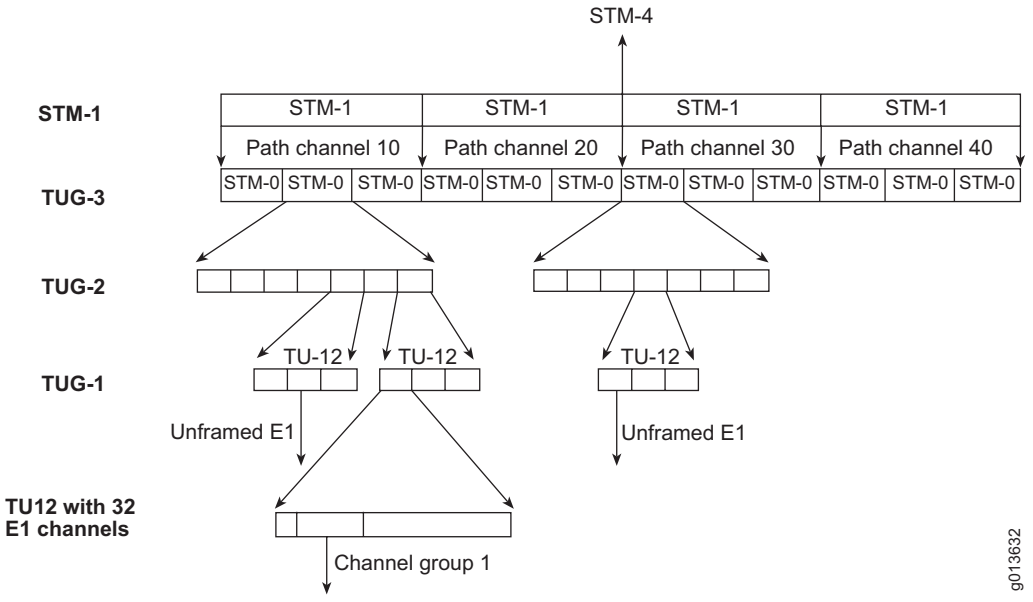
9. Configure two fractional T1 lines on the T3 in path channel 12.

   host1(config-controller)#**path 12 ds3 1 t1 4/1 timeslots 3-8**
   host1(config-controller)#**path 12 ds3 1 t1 4/2 timeslots 20**

Example 2: Configuring Interfaces in SDH Mode

The following example illustrates how to configure fractional E1 and unframed E1 lines in SDH mode, as shown in Figure 12.

Figure 12: Configuring Fractional E1 and Unframed E1 in SDH Mode



1. Select an OC-12 SONET controller.

   host1(config)#**controller sonet 4/0**

2. Switch to SDH mode.

   host1(config-controller)#**sdh**

3. Configure four STM-1 paths. An OC-12 interface has four STM-1 paths.

   host1(config-controller)#**path 10 stm1 1**
   host1(config-controller)#**path 20 stm1 2**
   host1(config-controller)#**path 30 stm1 3**
   host1(config-controller)#**path 40 stm1 4**

4. Configure a TU-12 on TUG-2 #7 on TUG-3 #2 of path 10.

   host1(config-controller)#**path 10 e1 2/7/1 tu12**

5. Configure a TU-12 on TUG-2 #5 on TUG-3 #2 of path 10.

   host1(config-controller)#**path 10 e1 2/5/2 tu12**

6. Configure a fractional E1 line on tributary 2/7/1 of path 10.

   host1(config-controller)#**path 10 e1 2/7/1 channel-group 1 timeslots 2-5**

7. Configure an unframed E1 line on tributary 2/5/2 of path 10.

   host1(config-controller)#**path 10 e1 2/5/2 unframed**

8. Configure a TU-12 on TUG-2 #4 on TUG-3 #1 of path 30.

   host1(config-controller)#**path 30 e1 1/4/1 tu12**

9. Configure an unframed E1 line on tributary 1/4/1 of path 30.

   host1(config-controller)#**path 30 e1 1/4/1 unframed**

Example 3: Configuring Frame Relay

The following example illustrates how to configure Frame Relay on VT 1/7/4 in path 2 of the configuration shown in Figure 11.

1. Select the interface on which you want to configure Frame Relay.

   host1(config)#**interface serial 4/0:2/1/7/4/1**

2. Specify Frame Relay as the encapsulation method on the interface.

   host1(config-if)#**encapsulation frame-relay ietf**

3. Configure the interface as a DTE, DCE, or NNI.

   host1(config-if)#**frame-relay intf-type dce**

Example 4: Configuring PPP

The following example illustrates how to configure PPP on VT 1/2/2 in path 2 of the configuration shown in Figure 11.

1. Select the interface on which you want to configure PPP.

   host1(config)#**interface serial 4/0:2/1/2/2/1**

2. Specify PPP as the encapsulation method on the interface.

   host1(config-if)#**encapsulation ppp**

Testing Interfaces

Testing interfaces allows you to troubleshoot problems and to check the quality of links at various layers in the interface stack. The router supports the following test options:

- Transmission of BERT patterns to remote devices
- Receipt of BERT patterns from remote devices
- Local loopback—The ability to loop the data back toward the router; on supported line modules, also sends an alarm indication signal (AIS) out toward the network
- Network loopback—The ability to loop the data toward the network before the data reaches the frame
- Remote loopback, which provides:
  - The ability to request that remote devices enter into loopback
  - The ability to be placed in loopback by remote devices
- Connectivity tests to remote devices

Sending BERT Patterns

The router can send BERT patterns from different layers in the interface stack. For a list of the modules that support bit error rate tests (BERTs), see *ERX Module Guide, Appendix A, Module Protocol Support*.

To send BERT patterns:

1. Select a controller.
2. Configure a specific layer in the interface to generate BERT patterns.

   For information about BERT patterns, see *References* on page 109.

path ds1|e1 bert

- Use to enable bit error rate tests using the specified pattern at the T1/E1 over SONET/SDH VT layer.
- Unlike other configuration commands, **path ds1|e1 bert** is not stored in NVRAM.
- Specify one of the following options:
  - **2^11**—Pseudorandom test pattern, 2047 bits in length
  - **2^15**—Pseudorandom test pattern, 32,767 bits in length
  - **2^20-O153**—Pseudorandom test pattern, 1,048,575 bits in length
- Specify the duration of the test in the range 1–1440 minutes.
- Optionally, specify the **unframed** keyword to overwrite the framing bits.
- Example

  host1(config-controll)#**path 12 ds1 1/3/4 bert pattern 2^11 interval 10 unframed**

- Use the **no** version to stop the test that is running.

path ds3 bert

- Use to enable bit error rate tests using the specified pattern at the T3 layer.
- Unlike other configuration commands, **path ds3 bert** is not stored in NVRAM.
- Specify one of the following options:
  - **0s**—Repetitive test pattern of all zeros, 00000...
  - **1s**—Repetitive test pattern of all ones, 11111...
  - **2^9**—Pseudorandom test pattern, 511 bits in length
  - **2^11**—Pseudorandom test pattern, 2047 bits in length
  - **2^15**—Pseudorandom test pattern, 32,767 bits in length
  - **2^20**—Pseudorandom test pattern, 1,048,575 bits in length
  - **2^20-QRSS**—Pseudorandom QRSS test pattern, 1,048,575 bits in length
  - **2^23**—Pseudorandom test pattern, 8,388,607 bits in length
  - **alt-0-1**—Repetitive alternating test pattern of zeros and ones, 01010101...
- Specify the duration of the test in the range 1–1440 minutes.
- Example

  host1(config-controll)#**path 12 ds3 2 bert pattern 0s interval 10**

- Use the **no** version to stop the test that is running.

path ds3 t1 bert

- Use to enable bit error rate tests using the specified pattern at the T1 over T3 layer.
- Unlike other configuration commands, **path ds3 t1 bert** is not stored in NVRAM.
- Specify one of the following options:
  - **2^11**—Pseudorandom test pattern, 2047 bits in length
  - **2^15**—Pseudorandom test pattern, 32,767 bits in length
  - **2^20-O153**—Pseudorandom test pattern, 1,048,575 bits in length
- Specify the duration of the test in the range 1–1440 minutes.
- Optionally, specify the **unframed** keyword to overwrite the framing bits.
- Example

  host1(config-controll)#**path 12 ds3 2 t1 14 bert pattern 2^11 interval 10 unframed**

- Use the **no** version to stop the test that is running.

Receiving BERT Patterns

The router can receive BERT patterns from a remote device at the T1/E1 over SONET/SDH VT and T1/E1 over T3 layers. To receive BERT patterns, configure the interface on the router for network payload loopback and the remote interface to use the line clock. Inaccurate results might occur if you use other loopback modes or clock sources.

When the router is synchronized with and receiving BERT patterns from a remote device, the router records the number of bit errors and the number of bits received. To view these statistics, issue the **show controllers sonet** command.

Enabling Local or Network Loopback

You can enable loopback tests on the router at the following layers in the interface stack:

- SONET/SDH section layer
- T1/E1 over SONET/SDH VT layer
- T3 layer
- T1/E1 over T3 layer

See *Interface Stack* on page 105 for a description of the layers.

To enable local or network loopback:

1. Select a controller.
2. Configure local or network loopback at the desired layers in the interface.

loopback

- Use to configure the type of loopback at the SONET/SDH section layer.
- Specify one of the following options:
  - **local**—Loops the data back toward the router; on supported line modules, also sends an alarm indication signal (AIS) out toward the network.
  - **network**—Loops the data toward the network before the data reaches the frame.
- Example

  host1(config)#**controller sonet 4/0**
  host1(config-controller)#**loopback network**

- Use the **no** version to disable loopback.

path ds1|e1 loopback

- Use to configure a loopback at the T1/E1 over SONET/SDH VT layer.
- Specify one of the following options:
  - **local**—Loops the router output data back toward the router at the T1/E1 framer; on supported line modules, also sends an alarm indication signal (AIS) out toward the network.
  - **network { line | payload }**
    - Specify the **line** keyword to loop the data back toward the network before the T1/E1 framer and automatically set a local loopback at the HDLC controllers.
    - Specify the **payload** keyword to loop the payload data back toward the network at the T1/E1 framer and automatically set a local loopback at the HDLC controllers.
- Example

  host1(config-controll)#**path 12 ds1 1/3/4 loopback network line**

- Use the **no** version to clear the local loopback configuration.

path ds3 loopback

- Use to configure a loopback at the T3 layer.
- Specify one of the following options:
  - **local**—Loops the data back toward the router; on supported line modules, also sends an alarm indication signal (AIS) out toward the network.
  - **network { line | payload }**
    - Specify the **line** keyword to loop the data toward the network before the data reaches the framer.
    - Specify the **payload** keyword to loop the data toward the network after the framer has processed the data.

- Example

  host1(config-controll)#**controller sonet 5/0**
  host1(config-controll)#**path 12 ds3 1 loopback local**

- Use the **no** version to turn off the loopback.

path ds3 t1 loopback

- Use to configure a loopback at the T1 over T3 layer.
- Specify one of the following options:
  - **local**—Loops the router output data back toward the router at the T1 framer; on supported line modules, also sends an alarm indication signal (AIS) out toward the network.
  - **network { line | payload }**
    - Specify the **line** keyword to loop the data back toward the network before the T1 framer and automatically set a local loopback at the HDLC controllers.
    - Specify the **payload** keyword to loop the payload data back toward the network at the T1 framer and automatically set a local loopback at the HDLC controllers.
- Example

  host1(config-controll)#**path 12 ds3 2 t1 14 loopback network line**

- Use the **no** version to clear the local loopback configuration.

Enabling Remote Loopback Testing

You can configure the router to request that compatible devices connected at the following layers enter into a loopback:

- T1 over SONET/SDH VT layer
- T1 over T3 layer
- T3 layer

You can also configure the router to start loopback testing when it receives an appropriate signal from a devices connected at any of these layers.

For a list of the modules that support remote loopback, see *ERX Module Guide, Appendix A, Module Protocol Support*.

NOTE: There is no protocol that allows remote loopback on E1 links.

To enable remote loopback:

1. Select a controller.
2. Configure remote loopback at the desired layers in the interface.

path ds1|e1 loopback remote

- Use to place a remote device, connected at the T1 over SONET/SDH VT layer, in loopback.
- Specify one of the following options:
  - **line fdl ansi** (T1 only)—Sends a repeating 16-bit ESF data link code word (00001110 11111111) to the remote end requesting that it enter into a network line loopback. Specify the **ansi** keyword to enable the remote line facilities data link (FDL) ANSI bit loopback on the T1 line, according to the ANSI T1.403 specification.
  - **line fdl bellcore** (T1 only)—Sends a repeating 16-bit ESF data link code word (00010010 11111111) to the remote end requesting that it enter into a network line loopback. Specify the **bellcore** keyword to enable the remote line FDL Bellcore bit loopback on the T1 line, according to the Bellcore TR-TSY-000312 specification.
  - **payload** [**fdl**] [**ansi**] (T1 only)—Sends a repeating 16-bit ESF data link code word (00010100 11111111) to the remote end requesting that it enter into a network payload loopback. Enables the remote payload FDL ANSI bit loopback on the T1 line. You can optionally specify **fdl** and **ansi**.
- Example

  host1(config-controll)#**path 12 ds1 1/3/4 loopback remote line fdl ansi**

- Use the **no** version to send the 16-bit ESF data link code word to deactivate the loopback at the remote end, depending on the last activate request sent to the remote end.

path ds1 remote-loopback

- Use to enable the router to accept remote loopback requests from a remote device connected at the T1 over SONET/SDH VT layer.
- Example

  host1(config-controll)#**path 12 ds1 1/3/4 remote-loopback**

- Use the **no** version to restore the default, which is to reject remote loopback requests.

path ds3 equipment loopback

- Use to enable or disable the router's ability to enter into a loopback initiated by a remote device connected at the T3 layer.

NOTE: Remote loopback is available only on frame-based T3 interfaces configured to use C-bit framing.

- Specify one of the following loopback options:
  - **customer**—Enables the router to enter into loopback when it receives an appropriate signal from the remote interface
  - **network**—Disables the router's ability to enter into loopback when it receives an appropriate signal from the remote interface; this is the default behavior

- Examples

  host1(config-controll)#**path 12 ds3 2 equipment customer loopback**
  host1(config-controll)#**path 12 ds3 2 equipment network loopback**

- Use the **no** version to restore the default behavior, which disables the router's ability to be placed in loopback by a remote device. Using the **no** version has the same effect as issuing the command with the network keyword.

path ds3 loopback remote

- Use to place a remote device, connected at the T3 layer, in loopback.
- Specify the **remote** keyword to send a far end alarm code in the C-bit framing, as defined in ANSI T1.404, to notify the remote end to activate or (when you use the **no** version) deactivate the line loopback.

NOTE: Remote loopback is available only on frame-based T3 interfaces configured to use C-bit framing.

- Example

  host1(config)#**controller sonet 5/0**
  host1(config-controll)#**path 12 ds3 1 loopback remote**

- Use the **no** version to turn off the loopback.

path ds3 t1 loopback remote

- Use to place a remote device, connected at the T1 over T3 layer, in loopback.
- Specify one of the following options:
  - **line fdl ansi**—Sends a repeating 16-bit ESF data link code word (00001110 11111111) to the remote end requesting that it enter into a network line loopback. Specify the **ansi** keyword to enable the remote line FDL ANSI bit loopback on the T1 line, according to the ANSI T1.403 specification.
  - **line fdl bellcore**—Sends a repeating 16-bit ESF data link code word (00010010 11111111) to the remote end requesting that it enter into a network line loopback. Specify the **bellcore** keyword to enable the remote line FDL Bellcore bit loopback on the T1 line, according to the Bellcore TR-TSY-000312 specification.
  - **payload** [**fdl**] [**ansi**]—Sends a repeating 16-bit ESF data link code word (00010100 11111111) to the remote end requesting that it enter into a network payload loopback. Enables the remote payload FDL ANSI bit loopback on the T1 line. You can specify **fdl** or **ansi**.
- Example

  host1(config-controll)#**path 12 ds3 2 t1 14 loopback remote payload**

- Use the **no** version to send the 16-bit ESF data link code word to deactivate the loopback at the remote end, depending on the last activate request sent to the remote end.

path ds3 t1 remote-loopback

- Use to enable the router to accept remote loopback requests from a remote device connected at the T1 over T3 layer.
- Example

  host1(config-controll)#**path 12 ds3 2 t1 14 remote-loopback**

- Use the **no** version to restore the default, which is to reject remote loopback requests.

Testing Connectivity

Use the **path overhead j1** command to check for connectivity between the router and a SONET/SDH device at the other end of the line. This command defines:

- A message that the router sends from the specified interface to the SONET/SDH device at the other end of the line.
- A message that the router expects to receive on the specified interface from the SONET/SDH device at the other end of the line.

When you define a message that the interface sends, you must monitor receipt of that message at the remote end.

When you define a message that the interface expects to receive, you should configure the remote device to transmit the same message to the interface. You can then use the **show controllers sonet** command to compare the expected and received messages.

path overhead j1

- Use to define messages that the router sends to or expects to receive from a SONET/SDH device connected to a cOCx/STMx interface.
- Specify a path identifier between 1 and 2,147,483,648 for a cOCx/STMx interface.
- Specify the keyword **msg** for a message that the router transmits for this path.
- Specify the keyword **exp-msg** to define a message that the router expects to receive on this path.
- Define a message of up to 62 characters for SONET or up to 15 characters for SDH.
- Configure the remote device to send the same message that the router expects to receive on this path. You can then compare the expected and received messages in the display of the **show controllers sonet** command.
- Example for cOCx/STMx interface:

  host1(config-controller)#**path 2 overhead j1 exp-msg goodbye**

- Use the **no** version to restore the default situation, in which all the characters in the transmitted or expected message are zeros.

Monitoring Interfaces

To display statistics for channelized SONET and SDH interfaces, use the **show controllers sonet** command. The following section describes some of the options for the command and shows some sample displays.

From User Exec mode, use the following **show** commands to monitor and display the T3, T1/E1, and HDLC serial data channel information:

- Display E1 or T1 statistics for E1 or T1 over a VT.

  host1#**show controllers sonet 2/0 e1**

- Display T3 statistics.

  host1#**show controllers sonet 2/1 ds3**

- Display statistics for the section, line, path, and tributary layers.

  host1#**show controllers sonet 2/1 section**

- Display the configuration for channelized SONET and SDH interfaces.

  host1#**show controllers sonet 2/0 configuration**

- Display statistics for serial interfaces.

  host1#**show interfaces serial 2/0:1/1/1/1/1**

Setting a Baseline

You can set statistics baselines for serial interfaces, subinterfaces, and circuits using the **baseline interface serial** command. You can also set statistics baselines for the section, line, and path layers using the **baseline interface sonet** command. Use the **delta** options with the **show** commands to display statistics with the baseline subtracted.

Output Filtering

You can use the output filtering feature of the **show** command to include or exclude lines of output based on a text string you specify. See *JUNOSe System Basics Configuration Guide, Chapter 2, Command-Line Interface*, for details.

baseline interface serial

- Use to set a statistics baseline for serial interfaces.
- The router implements the baseline by reading and storing the statistics at the time the baseline is set and then subtracting this baseline whenever baseline-relative statistics are retrieved.
- Use the **delta** keyword with the **show interfaces serial** command to view the baseline statistics.

- Example

  host1#**baseline interface serial 2/0:1/1**

- There is no **no** version.

baseline line interface sonet

- Use to set a statistics baseline for the SONET/SDH line layer.
- The router implements the baseline by reading and storing the MIB statistics at the time the baseline is set and then subtracting this baseline whenever baseline-relative statistics are retrieved.
- Use the **total** [**delta**] keywords with the **show controllers sonet line** command to view the baseline statistics.
- Example

  host1#**baseline line interface sonet 2/0**

- There is no **no** version.

baseline path interface sonet

- Use to set a statistics baseline for the SONET/SDH path layer.
- The router implements the baseline by reading and storing the MIB statistics at the time the baseline is set and then subtracting this baseline whenever baseline-relative statistics are retrieved.
- Use the **total** [**delta**] keywords with the **show controllers sonet path** command to view the baseline statistics.
- Example

  host1#**baseline path interface sonet 2/0:1**

- There is no **no** version.

baseline section interface sonet

- Use to set a statistics baseline for the SONET/SDH section layer.
- The router implements the baseline by reading and storing the MIB statistics at the time the baseline is set and then subtracting this baseline whenever baseline-relative statistics are retrieved.
- Use the **total** [**delta**] keywords with the **show controllers sonet section** command to view the baseline statistics.
- Example

  host1#**baseline section interface sonet 2/0**

- There is no **no** version.

show controllers sonet configuration

- Use to display the configuration for channelized SONET and SDH interfaces.
- Specify an interface in *slot*/*port* format.
- To view information for a controller and all layers above that controller, specify a controller. For example, to view all controllers on interface 3/0, use **show controllers sonet 3/0 configuration**. To view information for path 1 only, use **show controllers sonet 3/0:1 configuration**.
- Field descriptions
  - Interface specifier in slot/port format
  - channelized—Number of channels and speed for the interface
  - ifAdminStatus—Configured status of the interface: up or down
  - description—Configured description of the controller
  - snmp trap link-status—State of SNMP link status processing for the section and line layers of the interface: enabled or disabled
  - alarms used for operational status calculation—Types of defects that the router uses to determine the operational status of the interface at the section and line layers
  - defect trigger soaking delay—Time that the router waits to set an alarm when the router records a defect at the section or line layer
  - Operational Status—Physical state of the interface:
    - up—Interface is operational
    - down, failure alarm—Interface is not operational; type of defect that caused failure is specified
    - time since last status change—Time since the line module was rebooted
  - Loopback State—Type of loopback configured at this layer in the interface, or none
  - Last Remote Loopback Request Sent
  - BERT test—Number of current test and total number of tests
    - Test interval—Length of the BERT test
    - status—Sync (controller is synchronized with remote device) or NoSync (controller is not synchronized with remote device
    - Sync count—Number of times the pattern detector synchronized with the incoming data pattern
    - Received bit count—Number of bits received
    - Error bit count—Number of bits with errors
  - Mode—Type of interface: SONET or SDH
  - Timing source—Type of clock source configured for the channel:
    - internal module—Internal clock is from the line module itself
    - chassis—Internal clock is from the configured router clock

- Current section alarms—Number of suspect bit patterns found in several consecutive frames in section layer, or none
- Current line alarms—Number of suspect bit patterns found in several consecutive frames in line layer
- Channel configuration—Parameters for specific controllers; the actual parameters depend on the controller.
- ifAdminStatus—State of the controller in the software configuration: up or down
- ifOperStatus—Physical state of the controller: up or down
- Time since last status change—Time the controller has been up or down
- Alarms—Number of suspect bit patterns found in several consecutive frames
- snmp trap link-status—State of SNMP link status processing for the controller: enabled or disabled
- alarms used for operational status calculation—Types of defects that the router uses to determine the operational status of the interface at the path layer
- defect trigger soaking delay—Time that the router waits to set an alarm when the router records a defect at the path layer
- c2 byte—Setting of path signal byte: set by upper interface type (automatic setting) or configured value
- Operational Status—Physical state of this layer: up, down, or lowerLayerDown
  - time since last status change—Time since the line module was rebooted
- Framing—Type of framing configured for the controller:
  - c-bit parity framing (for T3 interfaces)
  - M23 multiplexer framing (for T3 interfaces)
  - crc4—Cyclic redundancy check (for E1 interfaces)
  - no-crc4—No cyclic redundancy check (for E1 interfaces)
  - esf—Extended superframe (for T1 interfaces)
  - sf—Superframe (for T1 interfaces)
- Line Code—Type of line coding the router assigned to the controller: B8ZS or AMI
- Clock source—Type of clock source configured for the channel:
  - module—Internal clock is from the line module itself
  - chassis—Internal clock is from the configured router clock
- J1 transmit trace message—Trace message sent to the remote device
- J1 expected trace message—Trace message expected from the remote device
- J1 received trace message—Trace message received from the remote device

- Example 1

```
host1#show controllers sonet 3/0 configuration
oc12 3/0
non channelized
ifAdminStatus: up
description: link1
snmp trap link-status: enabled
alarms used for operational status calculation: LOS LOF AIS RDI
defect trigger soaking delay: 2500 milliseconds
Operational Status: up
      time since last status change: 00:03:30
Loopback State: none
Mode: sonet
Timing source: internal module
Receive FIFO Overruns: 0, Reconfigurations: 0
Current section defects: none
Current line    defects: none

Channel configuration:
channel = 0, path = oc12, hierarchy = 1/1/0/0, current path defects: none
 ifAdminStatus: up
 snmp trap link-status: disabled
 alarms used for operational status calculation: LOP AIS
 defect trigger soaking delay: 2500 milliseconds
 c2 byte override 20
 Operational Status: up
       time since last status change: 00:03:30
 J1 transmit trace message: sonet3/0
 J1 expected trace message: sonet4/0
 J1 received trace message: sonet4/0
```

- Example 2—If you do not specify the layer in the interface, the router shows the configuration for all layers, whether or not you specify the keyword **configuration**.

```
host1#show controllers sonet 2/1
oc3 2/1
channelized (3 channels, oc1 minimum speed)
ifAdminStatus: up
description: link1
snmp trap link-status: enabled
alarms used for operational status calculation: LOS LOF AIS RDI
defect trigger soaking delay: 2500 milliseconds
Operational Status: up
      time since last status change: 00:03:30
Operational Status: up
      time since last status change: 00:06:49
Loopback State: none
Mode: sonet
Timing source: internal module
Current section alarms: none
Current line alarms   : none

Channel configuration:
channel = 1, path = oc1, hierarchy = 1/1/1/1, current path alarms: none
 ifAdminStatus: up
 snmp trap link-status: disabled
 alarms used for operational status calculation: LOP AIS
 defect trigger soaking delay: 2500 milliseconds
 c2 byte override 20
```

```
Operational Status: up
       time since last status change: 00:06:49
Ds3 1, unchannelized
 ifOperStatus =  ifOperUp
 snmp trap link-status = disabled
 Framing is C-BIT, Line Code is B3ZS, Clock Source is Internal - Module
```

- Example 3—This example displays the configuration for T3 1/1 on slot 2, port 1.

```
host1#show controllers sonet 2/1:1/1
oc3 2/1
channelized (3 channels, oc1 minimum speed)
ifAdminStatus: up
description: link1
snmp trap link-status: enabled
alarms used for operational status calculation: LOS LOF AIS RDI
defect trigger soaking delay: 2500 milliseconds
Operational Status: up
      time since last status change: 00:03:30
Loopback State: none
Mode: sonet
Timing source: internal module
Current section alarms: none
Current line alarms   : none

Channel configuration:
channel = 1, path = oc1, hierarchy = 1/1/1/1, current path alarms: none
 ifAdminStatus: up
 snmp trap link-status: disabled
 alarms used for operational status calculation: LOP AIS
 defect trigger soaking delay: 2500 milliseconds
 c2 byte override 20
Operational Status: up
       time since last status change: 00:05:37
Ds3 1, unchannelized
 ifOperStatus =  ifOperUp
 snmp trap link-status = disabled
 Framing is C-BIT, Line Code is B3ZS, Clock Source is Internal - Module
```

show controllers sonet ds1|e1

- Use to display E1 or T1 (DS1) statistics for the different layers in channelized SONET and SDH interfaces. Figure 8 on page 105 shows the layers in the interface.
- For definitions of the MIB statistics, see RFC 2495—Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types (January 1999).
- Specify an interface in *slot*/*port* format.
- To view information for a specific controller in a layer, enter the specifier for the controller and the type for the controller. For example, to view the E1 controller 1/1/1 on path 1 on the interface 4/0, enter **show controllers sonet 4/0:1/1/1/1 e1**.
- To view information for all controllers above a particular layer, enter the specifier for the layer and the type for the controller. For example, to view all E1 controllers on the interface 4/0 path 1, enter **show controllers sonet 4/0:1 e1**.
- To view E1 or T1 statistics for a layer, specify the controller type, **e1** or **ds1**.

- To view the configuration for a controller or all controllers in a layer, omit the controller type.
- Field descriptions
  - Description—Text description or alias if configured for the interface
  - BERT test—Number of current test and total number of tests
    - Test interval—Length of the BERT test
    - status—Sync (controller is synchronized with remote device) or NoSync (controller is not synchronized with remote device
    - Sync count—Number of times the pattern detector synchronized with the incoming data pattern
    - Received bit count—Number of bits received
    - Error bit count—Number of bits with errors
  - Number of valid intervals—Number of 15-minute intervals since the line module was last powered on or reset
  - Time elapsed in current interval—Reported in 15-minute intervals
  - Errored seconds—Number of errored seconds encountered by a T1 or an E1 in the current interval
  - Severely errored seconds—Number of severely errored seconds encountered by a T1 or an E1 in the current interval
  - Severely errored frame seconds—Number of severely errored framing seconds encountered by a T1 or an E1 in the current interval
  - Unavailable seconds—Number of unavailable seconds encountered by a T1 or an E1 in the current interval
  - Clock slip seconds—Number of clock slips encountered by a T1 or an E1 in the current interval
  - Path code violations—Number of coding violations encountered by a T1 or an E1 in the current interval
  - Line errored seconds—Number of line errored seconds encountered by a T1 or an E1 in the current interval
  - Bursty errored seconds—Number of bursty errored seconds encountered by a T1 or an E1 in the current interval
  - Degraded minutes—Number of minutes that a T1 or an E1 line is degraded
  - Line code violations—Number of line code violations encountered by a T1 or an E1 in the current interval
- Example—This example displays statistics for all the E1 lines on the interface 2/0.

```
host1#show controllers sonet 2/0 e1
E1 1/1/1

Description: boston111 e1
BERT test - 2 in 11
Test Interval 1 minute(s), Running - Status is Sync
0 minute(s), 33 second(s) left in test interval
Sync count         = 1
```

```
Received bit count = 41472000
Error bit count    = 0

 Number of valid interval - 0
 Time elapse in current interval - 0

Current Interval Counters
Errored seconds                  = 0
Severely errored second          = 0
Severely errored frame seconds   = 0
Unavailable seconds              = 0
Clock slip seconds               = 0
Path code violations             = 0
Line errored seconds             = 0
Bursty errored seconds           = 0
Degraded minutes                 = 0
Line code violations             = 0

24 Hour Total Counters
Errored seconds                  = 0
Severely errored second          = 0
Severely errored frame seconds   = 0
Unavailable seconds              = 0
Clock slip seconds               = 0
Path code violations             = 0
Line errored seconds             = 0
Bursty errored seconds           = 0
Degraded minutes                 = 0
Line code violations             = 0
```

show controllers sonet ds3

- Use to display T3 statistics for the different layers in channelized SONET and SDH interfaces. Figure 8 on page 105 shows the layers in the interface.
- For definitions of the MIB statistics, see RFC 2496—Definitions of Managed Objects for the DS3/E3 Interface Types (January 1999).
- Specify an interface in *slot*/*port* format.
- To view information for a specific controller in a layer, enter the specifier for the controller and the type for the controller. For example, to view T3 controller 1 on path 1 on the interface 4/0, enter **show controllers sonet 4/0:1/1 ds3**.
- To view information for all controllers above a particular layer, enter the specifier for the layer and the type for the controller. For example, to view all DS3 controllers on the interface 4/0, enter **show controllers sonet 4/0 ds3**.
- To view T3 statistics for a layer, specify the controller type, **ds3**.
- To view the configuration for a controller or all controllers in a layer, omit the controller type.
- Field descriptions
  - Description—Text description or alias if configured for the interface
  - BERT test—Number of current test and total number of tests
    - Test interval—Length of the BERT test
    - status—Sync (controller is synchronized with remote device) or NoSync (controller is not synchronized with remote device

  - Sync count—Number of times the pattern detector synchronized with the incoming data pattern
  - Received bit count—Number of bits received
  - Error bit count—Number of bits with errors
- Number of valid intervals—Number of 15-minute intervals since the line module was last powered on or reset
- Time elapse in current interval—Time (seconds) passed in current interval
- Current Interval Counters—Statistics for the current 15-minute interval
- P-bit errored seconds—Number of errored seconds encountered by a T3
- P-bit severely errored seconds—Number of severely errored seconds encountered by a T3
- Severely errored frame seconds—Number of severely errored framing seconds encountered by a T3
- Unavailable seconds—Number of unavailable seconds encountered by a T3
- Line code violations—Number of line code violations encountered by a T3
- P-bit coding violations—Number of coding violations encountered by a T3
- Line errored seconds—Number of line errored seconds encountered by a T3
- C-bit coding violations—Number of C-bit coding violations encountered by a T3
- C-bit errored seconds—Number of C-bit errored seconds encountered by a T3
- C-bit severely errored seconds—Number of C-bit severely errored seconds encountered by a T3
- 24 Hour Total counters—Statistics for last 24 hours

- Example 1—This example shows all T3 controllers on the interface 2/1.

```
host1#show controllers sonet 2/1 ds3
Ds3 1
Description: ottawa211 ds3
 Number of valid interval - 0
 Time elapse in current interval - 696

Current Interval Counters
P-bit errored seconds          = 0
P-bit severely errored seconds = 0
Severely errored frame seconds = 0
Unavailable seconds            = 541
Line code violations           = 0
P-bit coding violations        = 0
Line errored seconds           = 0
C-bit coding violations        = 0
C-bit errored seconds          = 0
C-bit severely errored seconds = 0

24 Hour Total Counters
P-bit errored seconds          = 0
P-bit severely errored seconds = 0
Severely errored frame seconds = 0
Unavailable seconds            = 0
```

```
Line code violations           = 0
P-bit coding violations        = 0
Line errored seconds           = 0
C-bit coding violations        = 0
C-bit errored seconds          = 0
C-bit severely errored seconds = 0
```

- Example 2—This example shows statistics for the T3 controller 1/1 on interface 2/0.

```
host1#show controllers sonet 2/0:1/1 ds3
Ds3 1
Description: ottawa2011 ds3
Number of valid interval - 0
 Time elapse in current interval - 534

Current Interval Counters
P-bit errored seconds          = 0
P-bit severely errored seconds = 0
Severely errored frame seconds = 0
Unavailable seconds            = 117
Line code violations           = 0
P-bit coding violations        = 0
Line errored seconds           = 0
C-bit coding violations        = 0
C-bit errored seconds          = 0
C-bit severely errored seconds = 0

24 Hour Total Counters
P-bit errored seconds          = 0
P-bit severely errored seconds = 0
Severely errored frame seconds = 0
Unavailable seconds            = 0
Line code violations           = 0
P-bit coding violations        = 0
Line errored seconds           = 0
C-bit coding violations        = 0
C-bit errored seconds          = 0
C-bit severely errored seconds = 0
```

show controllers sonet line | path | section | tributary

- Use to display statistics for the different layers in channelized SONET and SDH interfaces. Figure 8 on page 105 shows the layers in the interface.
- For definitions of the MIB statistics, see RFC 2558—Definitions of Managed Objects for the SONET/SDH Interface Type (March 1999).
- Specify an interface in *slot*/*port* format.
- To view information for a specific controller in a layer, enter the specifier for the controller and the type for the controller. For example, to view tributary 1/1/1 on path 1 of interface 4/0, enter **show controllers sonet 4/0:1/1/1/1 tributary**.
- To view information for all controllers above a particular layer, enter the specifier for the layer and the type for the controller. For example, to view all tributaries on path 1 of interface 4/0, enter **show controllers sonet 4/0:1 tributary**.
- To view statistics for a layer, specify the type of layer.

- To view the configuration for a controller or all controllers in a layer, omit the controller type.
- To view all statistics for all sessions, specify the **total** keyword.
- To view baselined statistics for all intervals, specify the **delta total** keywords.
- Field descriptions
  - Current Interval Counters—Statistics for the current 15-minute interval
    - Errored seconds—Number of errored seconds encountered by a T1 or an E1 in an interval
    - Severly errored seconds—Number of severely errored seconds encountered in an interval
    - Severly errored framing seconds—Number of severely errored framing seconds encountered in an interval
    - Coding violations—Number of coding violations encountered in an interval
    - Unavailable seconds—Number of unavailable seconds encountered in an interval
  - Last Interval Counters—Statistics for the previous 15-minute interval
  - Current Far End Interval Counters—Statistics for the remote connection associated with the SONET/SDH path in the current 15-minute interval
  - Last Far End Interval Counters—Statistics for the remote connection associated with the SONET/SDH path in the previous 15-minute interval
  - Total interval counters—Shows the statistics for all intervals or baselined statistics
- Example 1—This example shows the MIB statistics for the section layer on interface 2/1.

```
host1#show controllers sonet 2/1 section
Current Section Interval Counters
Current status                   = No Defect
Errored seconds                  = 0
Severly errored seconds          = 0
Severely errored framing seconds = 0
Coding violations                = 0

Last Section Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Severely errored framing seconds = 0
Coding violations                = 0
```

- Example 2—This example illustrates the behavior of the **baseline section interface sonet** command. The examples show the MIB statistics of the section layer before and after the command is issued.

```
host1#show controllers sonet 2/0 section total
Number of valid intervals - 0
 Time elapsed in current interval - 192

Current Section Interval Counters
Current status                   = No Defect
Errored seconds                  = 68
Severly errored seconds          = 68
```

```
Severely errored framing seconds = 2
Coding violations                = 4018

Total Section Counters
Errored seconds                  = 68
Severly errored seconds          = 68
Severely errored framing seconds = 2
Coding violations                = 4018

host1#baseline section interface sonet 2/0

host1#show controllers sonet 2/0 section total delta
Number of valid intervals - 0
 Time elapsed in current interval - 209
Current Section Interval Counters
Current status                   = No Defect
Errored seconds                  = 68
Severly errored seconds          = 68
Severely errored framing seconds = 2
Coding violations                = 4018

Total Section Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Severely errored framing seconds = 0
Coding violations                = 0
```

- Example 3—This example shows the MIB statistics for the line layer on interface 2/1.

```
host1#show controllers sonet 2/1 line
Current Line Interval Counters
Current status                   = No Defect
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 190
Last Line Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 900

Current Far End Line Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0

Far End Last Line Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
```

- Example 4—This example shows the MIB statistics for the path layer on interface 2/1.

```
host1#show controllers sonet 2/1 path
Channel number 1
Current Path Interval Counters
Current status                   = No Defect
Errored seconds                  = 0
```

```
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 248

Last Path Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Current Far End Path Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 248

Far End Last Path Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
```

- Example 5—This example displays the tributary statistics for all tributaries on interface 4/0, path 1.

```
host1#show controllers sonet 4/0:1 tributary
Tributary 1/1/1
Current Tributary Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Last Tributary Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Current Far End Path Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Far End Last Tributary Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
```

- Example 6—This example displays the tributary statistics for the tributary 1/1/1 on path 1 on slot 4, port 0.

```
host1#show controllers sonet 4/0:1/1/1/1 tributary
Tributary 1/1/1
Current Tributary Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Last Tributary Interval Counters
Errored seconds                  = 0
Severly errored seconds          = 0
Coding violations                = 0
Unavailable seconds              = 0
Current Far End Path Interval Counters
```

```
Errored seconds                 = 0
Severly errored seconds         = 0
Coding violations               = 0
Unavailable seconds             = 0
Far End Last Tributary Interval Counters
Errored seconds                 = 0
Severly errored seconds         = 0
Coding violations               = 0
Unavailable seconds             = 0
```

show controllers sonet remote

- Use to display MIB statistics for the remote end of a channelized T3 interface configured for MDL or for the remote end of a T1 channel configured for FDL.
- Specify the **all** option to display detailed information for all 15-minute intervals.
- For definitions of the MIB statistics for a T3 connections, see RFC 2496—Definitions of Managed Objects for the DS3/E3 Interface Types (January 1999).
- For definitions of the MIB statistics for a T1 connections, see RFC 2495—Definitions of Managed Objects for the DS1, E1, DS2 and E2 Interface Types (January 1999).
- Field descriptions for a T3 interface
  - Far End MDL Carrier bit—Status of MDL configuration on remote device connected to T3 interface
    - set—MDL is configured for carrier mode
    - not set—MDL is not configured for carrier mode
  - Far End Equipment Identification Code—eic string sent by remote device for MDL
  - Far End Line Identification Code—lic string sent by remote device for MDL
  - Far End Frame Identification Code—fic string sent by remote device for MDL
  - Far End Unit Identification Code—unit string sent by remote device for MDL
  - Far End Facility Identification Code—pfi string sent by remote device for MDL
  - Far End Generator Number—generator string sent by remote device for MDL
  - Far End Port Number—port string sent by remote device for MDL
  - Number of valid intervals—Number of 15-minute intervals since the line module was last powered on or reset
  - Time elapse in current interval—Number of seconds that have passed in the 15-minute (900-second) interval
  - C-bit errored seconds—Number of C-bit errored seconds encountered by a T3 in the current interval
  - C-bit severely errored seconds—Number of C-bit severely errored seconds encountered by a T3 in the current interval

- C-bit coding violations—Number of C-bit coding violations encountered by a T3 in the current interval
- Unavailable seconds—Number of unavailable seconds encountered by a T3 in the current interval
- Invalid seconds—Number of seconds when statistics were not collected

- Field descriptions for a T1 channel
  - DS1—Identifier of T1 channel
  - Number of valid intervals—Number of 15-minute intervals since the line module was last powered on or reset
  - Time elapse in current interval—Number of seconds that have passed in the 15-minute (900-second) interval
  - Far End FDL Carrier bit—Status of FDL configuration on remote device connected to T1 channel
    - set—FDL is configured for carrier mode
    - not set—FDL is not configured for carrier mode
  - Far End Equipment Identification Code—eic string sent by remote device for FDL
  - Far End Line Identification Code—lic string sent by remote device for FDL
  - Far End Frame Identification Code—fic string sent by remote device for FDL
  - Far End Unit Identification Code—unit string sent by remote device for FDL
  - Far End Facility Identification Code—pfi string sent by remote device for FDL
  - Far End Generator Number—generator string sent by remote device for FDL
  - Far End Port Number—port string sent by remote device for FDL
  - Errored seconds—Number of errored seconds encountered by a T1 in the current interval
  - Severely errored seconds—Number of severely errored seconds encountered by a T1 in the current interval
  - Severely errored frame seconds—Number of severely errored framing seconds encountered by a T1 in the current interval
  - Unavailable seconds—Number of unavailable seconds encountered by a T1 in the current interval
  - Clock slip seconds—Number of clock slips encountered by a T1 in the current interval
  - Path code violations—Number of coding violations encountered by a T1 in the current interval
  - number of coding violations encountered by a T1 in the current interval
  - Line errored seconds—Number of line errored seconds encountered by a T1 in the current interval

- Bursty errored seconds—Number of bursty errored seconds encountered by a T1 in the current interval
- Degraded minutes—Number of minutes that a T1 line is degraded

- Example 1—In this example, a T3 interface is specified.

```
host1#show controllers sonet 5/0:1/1 remote
Far End MDL Carrier bit is not set
Far End Equipment Identification Code is the null string
Far End Line Identification Code is the null string
Far End Frame Identification Code is the null string
Far End Unit Identification Code is the null string
Far End Facility Identification Code is the null string
Far End Generator Number is the null string
Far End Port Number is the null string

Number of valid interval - 3
Time elapse in current interval - 756

Ds3 Current Interval Counters
C-bit errored seconds          = 0
C-bit severely errored seconds = 0
C-bit coding violations        = 0
Unavailable seconds            = 0
Invalid seconds                = 0

Ds3 Last Interval Counters
C-bit errored seconds          = 0
C-bit severely errored seconds = 0
C-bit coding violations        = 0
Unavailable seconds            = 0
Invalid seconds                = 0
Ds3 24 Hour Total Counters
C-bit errored seconds          = 1
C-bit severely errored seconds = 1
C-bit coding violations        = 330
Unavailable seconds            = 0
Invalid seconds                = 0
```

- Example 2—In this example, a T1 channel on a T3 over channelized SONET interface is specified.

```
host1#show controllers sonet 5/0:1/1/1 remote
DS1 10/1:1
Number of valid interval - 0
Time elapse in current interval - 0

Far End FDL Carrier bit is not set
Far End Equipment Identification Code is the null string
Far End Line Identification Code is the null string
Far End Frame Identification Code is the null string
Far End Unit Identification Code is the null string
Far End Facility Identification Code is the null string
Far End Port Number is the null string
Far End Generator Number is the null string

DS1 Current Interval Counters
Errored seconds                = 0
Severely errored second        = 0
Severely errored frame seconds = 0
Unavailable seconds            = 0
Clock slip seconds             = 0
Path code violations           = 0
Line errored seconds           = 0
Bursty errored seconds         = 0
Degraded minutes               = 0
```

```
DS1 24 Hour Total Counters
Errored seconds                 = 0
Severely errored second         = 0
Severely errored frame seconds = 0
Unavailable seconds             = 0
Clock slip seconds              = 0
Path code violations            = 0
Line errored seconds            = 0
Bursty errored seconds          = 0
Degraded minutes                = 0
```

- Example 3—In this example, a T1 over channelized SONET interface is specified.

```
host1#show controllers sonet 5/0:1/1/1/2/2 remote
DS1 10/1:1
Number of valid interval - 0
Time elapse in current interval - 0

Far End FDL Carrier bit is not set
Far End Equipment Identification Code is the null string
Far End Line Identification Code is the null string
Far End Frame Identification Code is the null string
Far End Unit Identification Code is the null string
Far End Facility Identification Code is the null string
Far End Port Number is the null string
Far End Generator Number is the null string

DS1 Current Interval Counters
Errored seconds                 = 0
Severely errored second         = 0
Severely errored frame seconds = 0
Unavailable seconds             = 0
Clock slip seconds              = 0
Path code violations            = 0
Line errored seconds            = 0
Bursty errored seconds          = 0
Degraded minutes                = 0

DS1 24 Hour Total Counters
Errored seconds                 = 0
Severely errored second         = 0
Severely errored frame seconds = 0
Unavailable seconds             = 0
Clock slip seconds              = 0
Path code violations            = 0
Line errored seconds            = 0
Bursty errored seconds          = 0
Degraded minutes                = 0
```

show interfaces serial

- Use to display information about the serial interfaces you specify.
- Field descriptions
  - Serial Interface—Location of the interface
  - Description—Text description or alias if configured for the interface

- ifOperStatus—Physical state of the interface
  - ifOperDown—Interface is not functioning
  - ifOperLowerLayerDown—Lower layer in the interface stack is not functioning
  - ifOperNotPresent—Module has been removed from the chassis
  - ifOperTesting—Interface is being tested
  - ifOperUp—Interface is functioning
- snmp trap link-status—Enabled or disabled
- Encapsulation—Layer 2 encapsulation display; options: ppp, frame-relay ietf, mlppp, mlframe-relay ietf, hdlc
- Crc type checking—Size of the CRC
- Hdlc mru—Current size of the MRU
- Hdlc mtu—Current size of the MTU
- Hdlc interface speed—Current line speed of the interface
- Hdlc idle-character—Current idle character
- Invert data disabled—Status of the data inversion feature
- Ds0 mode—Nx56 or Nx64
- 5 minute input rate—Data rates based on the traffic received in the last five minutes
- 5 minute output rate—Data rates based on the traffic sent in the last five minutes
- Interface Statistics
  - Packets received—Number of packets received on the interface
  - Bytes received—Number of bytes received on the interface
  - Errored packets received—Number of packets with errors received on the interface
  - Packets sent—Number of packets sent on the interface
  - Bytes sent—Number of bytes sent on the interface
  - Errored packets sent—Number of packets with errors sent from the interface

- Example

```
host1#show interfaces serial 2/0:1/1/1/1/1
Serial Interface at 2/0:1/1/1/1/1
Description: toronto20 hdlc channel
ifOperStatus = ifOperUp
snmp trap link-status = disabled
Encapsulation hdlc
Crc type checking - CRC16
Hdlc mru = 1600
Hdlc mtu = 1600
Hdlc interface speed = 1536000
Hdlc idle-character marks
Invert data disabled, Ds0 time slot map = 0xffffff
Ds0 mode = Nx64
```

```
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
Interface statistics
Packets received              100
Bytes received                1300
Errored packets received      1
Packets sent                  100
Bytes send                    1436
Errored packets sent          0
```

Monitoring APS/MSP

For information about monitoring APS/MSP, see *Monitoring APS/MSP* in ***Chapter 3, Configuring Unchannelized OCx/STMx Interfaces***.