5 Configuring Channelized OCx/STMx Interfaces

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

Overview

The cOCx/STMx 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 signalling.

Each connection is made through standard SC connectors.

ERX Models

Both the ERX-700 series and the ERX-1400 series support the cOCx/STMx line modules.

Features

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 5-1 shows the stack for cOCx/STMx interfaces.

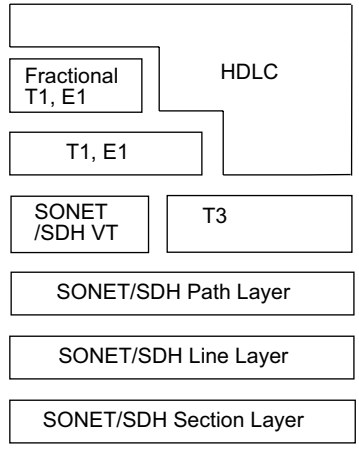

Figure 5-1 Stack for cOCx/STMx interfaces

Note: *For a detailed discussion of interface types and specifiers, see the ERX Command Reference Guide, About This Guide. For a discussion about interfaces, see ERX 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, it is important to 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.

Higher-Level Protocols

See the release notes for information about the higher-level protocols that cOCx/STMx interfaces support.

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 system 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 5-1 shows the VT types and TU names that the system supports.

Table 5-1 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 5-2 shows the structure for SONET, and Figure 5-3 shows the structure for SDH.

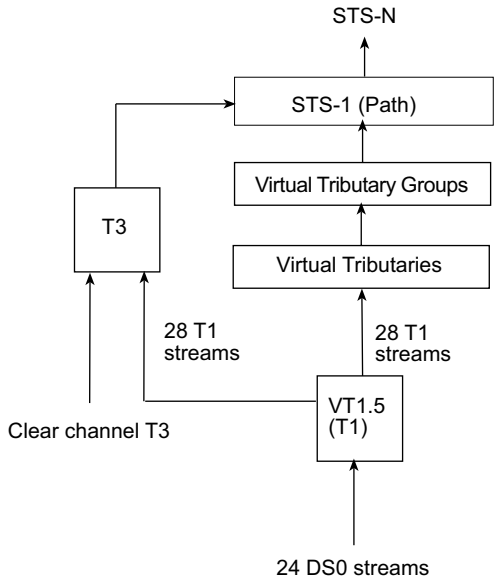

Figure 5-2 SONET multiplexing

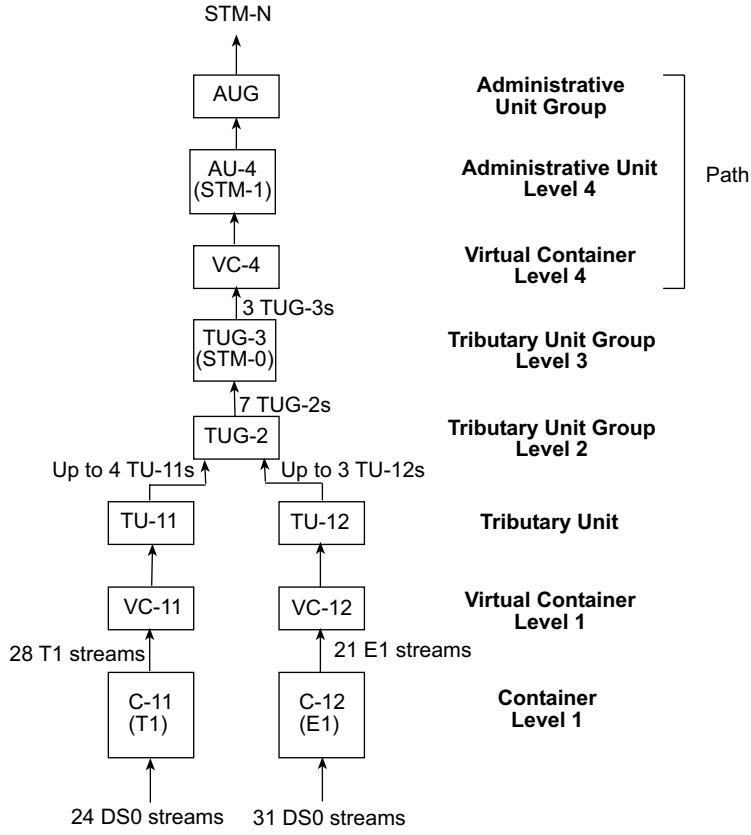

Figure 5-3 SDH multiplexing

For both SONET/SDH VT configurations, you must identify the path and controllers above the path layer. Table 5-2 shows the identifiers for these configurations, and Table 5-3 provides definitions for the identifiers.

Table 5-2 Identifiers for SONET/SDH VT controllers

Configuration	Identifier	Example
Unframed E1	*pathChannel*/*pathPayload*/*tributaryGroup*/*tributaryNumber*/*channelNumber* [a]	10/1/2/2/1
Fractional T1 or E1	*pathChannel*/*pathPayload*/*tributaryGroup*/*tributaryNumber*/*channelGroup*	10/1/2/2/1

a. The system automatically assigns the channel number one to an unframed E1 line.

Table 5-3 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

Table 5-3 Definitions for identifiers for SONET/SDH VT controllers (continued)

Identifier	Definition	Value
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 via asynchronous mapping. As Figure 5-2 shows, T3 on cOCx/STMx interfaces support 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 5-4 shows the identifiers for the T3 configurations.

Table 5-4 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 5-1 shows, HDLC is at the top layer of the interface stack.

SONET APS and SDH MSP

The system supports APS and 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 the *Release Notes*. For an overview of APS/MSP, see *APS and MSP* in *Chapter 4, Configuring Unchannelized SONET/SDH Interfaces*.

MDL/FDL Support

Interfaces on cOCx/STMx line modules support maintenance data link (MDL) messages at the T3 level and facility data link (FDL) messages at the T1 level. For an overview of MDL/FDL support, see *MDL/FDL Support* in *Chapter 1, Configuring Channelized T3 Interfaces*.

References

A cOCx/STMx interface provides MIB support in accordance with the following specifications:

- 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, refer to the following documents:

- 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-09.txt (April 2003 expiration)

MDL/FDL support on cOCx/STMx interfaces complies with the following standards:

- 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)

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 the ERX-700 series, line module slots are numbered 2-6 (slots 0 and 1 are reserved for SRP modules). In the ERX-1400 series, line module slots are numbered 0–5 and 8–13 (slots 6 and 7 are reserved for SRP modules).
- *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.

There are one or two ports on the cOC12/STM4 I/O module. On an I/O module that supports two ports, one port is active 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.

Figure 5-5 shows the physical ports for a cOC3/STM1 I/O module in the ERX-700 series and the ERX-1400 series. Figure 5-6 shows the physical ports for a cOC12/STM4 I/O module in the ERX-700 series and the ERX-1400 series.

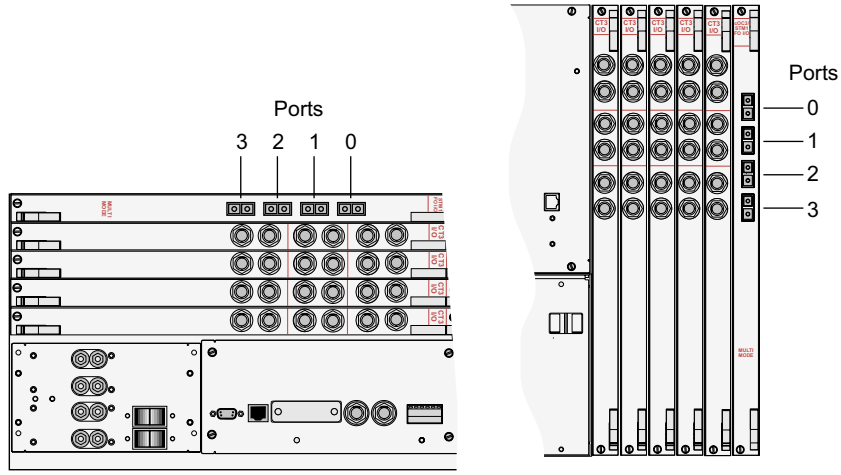

Figure 5-4 cOC3 STM1 FO I/O modules in the ERX-700 series and ERX-1400 series

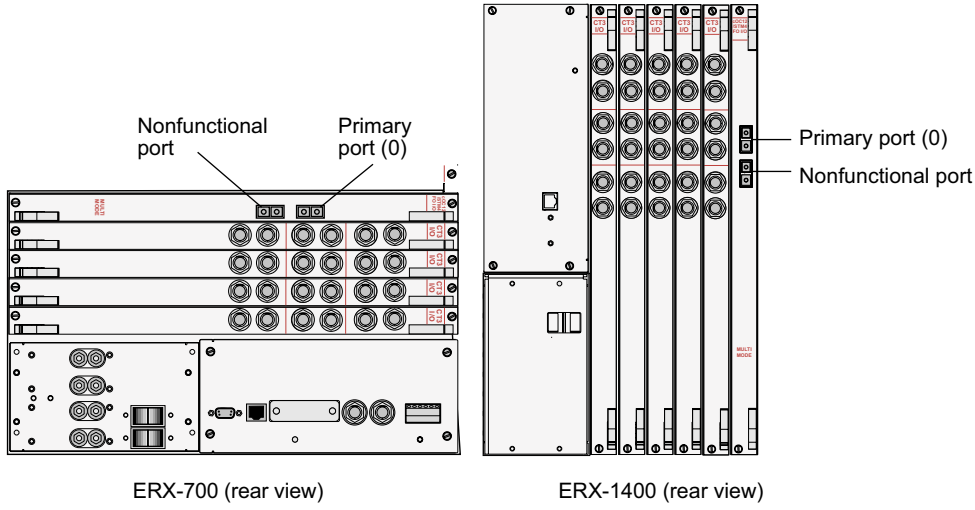

Figure 5-5 cOC12 STM4 FO I/O modules in the ERX-700 series and ERX-1400 series

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

  The channel numbers of the working and protect interfaces are related to the number of the corresponding primary port. The channel number of the working interface is equal to the number of the corresponding primary port. The channel number of the protect interface is equal to the number of the corresponding primary port plus *n*, the number of active ports on the I/O module.

For example, on an I/O module that provides one active port and one redundant port, if the primary port is labeled 0, the working interface has the channel number 0 and the protect interface has the channel number 1.

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 on installing modules, see the *ERX Installation and User Guide*.

You should 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, 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 will be SDH, or accept the default mode, SONET.

4 (Optional) Disable processing of SNMP link status information for the section and line layers of the interface.

5 Configure the path for the interface.

6 (Optional) Enable processing of SNMP link status information for the path layer of the interface.

7 Configure APS/MSP for the interface.

For information on configuring APS/MSP, see *Configuring APS/MSP* in *Chapter 4, Configuring Unchannelized SONET/SDH Interfaces*.

You must now configure the next layer on the interface: E1, T1, or E3. See *T1/E1 Configuration Tasks* or *T3 Configuration Tasks*, later in this chapter.

clock source

- Use to configure the transmit clock source for the interface.
- In most cases, accept the default option, **line**. This setting allows the interface to derive the transmit clock from the received clock. In certain circumstances, it may be appropriate to generate a clock from one of the internal sources (options **module** or **chassis**).
- Specify the keyword **line** to use a transmit clock on 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 system'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 system's clock or the module's clock. You cannot configure some ports on the I/O module to use the system'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 system's clock to the module's clock or vice versa, change the clock source of all ports firstly to the line setting, and then to the new internal clock setting.
- Example

```
host1(config-controll)#clock source internal module
```

- 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.

path

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

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

- Example for cOC12/STM4 interface in SONET mode:

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

- Example for 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 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.

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.

Configuring Higher Layers

You must now configure the next layer on the interface: E1, T1, or T3. See *T1/E1 Configuration Tasks* or *T3 Configuration Tasks*, later in this chapter.

T1/E1 Configuration Tasks

Before you configure T1 or E1 on an interface, you must configure SONET or SDH. See *SONET/SDH Configuration Tasks*, earlier in this chapter.

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

1. Configure a tributary for the path.
2. Configure one of the following:
   - An unframed E1 line (See *Configuring T1 and E1 Lines*).
   - A T1 or an E1 line (See *Configuring T1 and E1 Lines*).

For detailed examples, refer to *Configuration Examples* later in this chapter.

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.

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 system 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 on an interface and its associated tributary.
4. Configure the T1 or E1 line parameters.
5. (Optional) Enable processing of SNMP link status information on a channel group.
6. (Optional–T1 only) Configure FDL messages.

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 an 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.
- 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 system'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 system's clock or the module's clock. You cannot configure some ports on the I/O module to use the system'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 system's clock to the module's clock or vice versa, change the clock source of all ports firstly 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 code differs from non-ERX implementations. For T1 interfaces, if you configure SF, the system sets the HDLC idle code to OxFF. If you configure ESF, the system sets the HDLC idle code to Ox7E.
- 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 (ANSI signals) Specify the FDL messages.

```
host1(config-controll)#path 2 ds1 1/1/1 fdl string eic
  "ERX-1400"
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* earlier in this chapter).
- Specify the keyword **att** to support the AT&T FDL standard (see *References* earlier in this chapter).
- 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 system 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
    "RX-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 system to send the specified type of FDL message on the T1 channel.
- By default, the system sends no FDL messages.

Note: *The system 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 system 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 10 seconds.
- Specify the keyword **test-signal** to transmit test signals every 10 seconds.
- 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*, later in this chapter.

T3 Configuration Tasks

Before you configure T3 on an interface, you must configure SONET or SDH on the interface. See *SONET/SDH Configuration Tasks*, earlier in this chapter.

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, refer to *Configuration Examples* later in this chapter.

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) Configure the framing format.

3 (Optional) Enable processing of SNMP link status information on an interface.

4 (Optional) Configure MDL settings.

5 (Optional) Configure T1 channels.

path ds3 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 system'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 system's clock or the module's clock. You cannot configure some ports on the I/O module to use the system'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 system's clock to the module's clock or vice versa, change the clock source of all ports firstly 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 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"
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 10 seconds.
- Specify the keyword **test-signal** to transmit test signals every 10 seconds.
- 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) Configure the framing format.
4. (Optional) Enable processing of SNMP link status information on an interface.
5. Configure the T1 line parameters.
6. (Optional) Enable processing of SNMP link status information on 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 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 system'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 system's clock or the module's clock. You cannot configure some ports on the I/O module to use the system'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 system's clock to the module's clock or vice versa, change the clock source of all ports firstly 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 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 a T1 channel or subchannel.
- T1 channels and subchannels are enabled by default.
- Examples

```
host1(config-controll)#path 12 ds3 t1 28 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 a T1 channel or 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.
- Example

```
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 a T1 channel 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-1400"
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 channel with a number from 1 through 28.
- Specify the keyword **ansi** to support the ANSI FDL standard (see *References* earlier in this chapter).
- Specify the keyword **att** to support the AT&T FDL standard (see *References* earlier in this chapter).
- 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 28 fdl att
  ```

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

path ds3 t1 fdl carrier

- Use to specify that a T1 channel is used in the carrier environment.
- Example

```
host1(config-controll)path 2 ds3 1 t1 28 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 system 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
  "RX-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 system to send the specified type of FDL message.
- By default, the system sends only FDL performance data messages.

Note: *The system 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 system 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 10 seconds.
- Specify the keyword **test-signal** to transmit test signals every 10 seconds.
- 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*.

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 5-1 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 CT3 interface:

- Configure the CRC.
- Enable data inversion on the interface.
- Set the MRU.
- Set the MTU.

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, provides better ongoing error detection.
- Example

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

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

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.

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.

mru

- Use to configure the MRU size for the interface.
- 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 system uses the lower value. The lower MRU may 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.
- 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 system uses the lower value. The lower MTU may cause unexpected results in the network.
- Example

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

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

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.

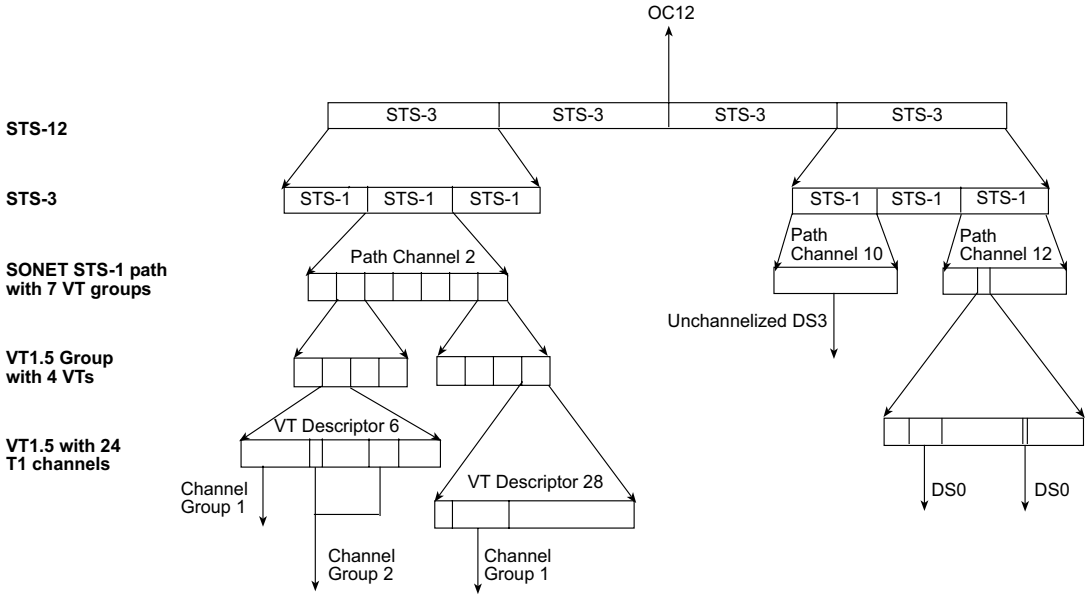

Figure 5-6 Configuring fractional T1 in SONET mode

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.

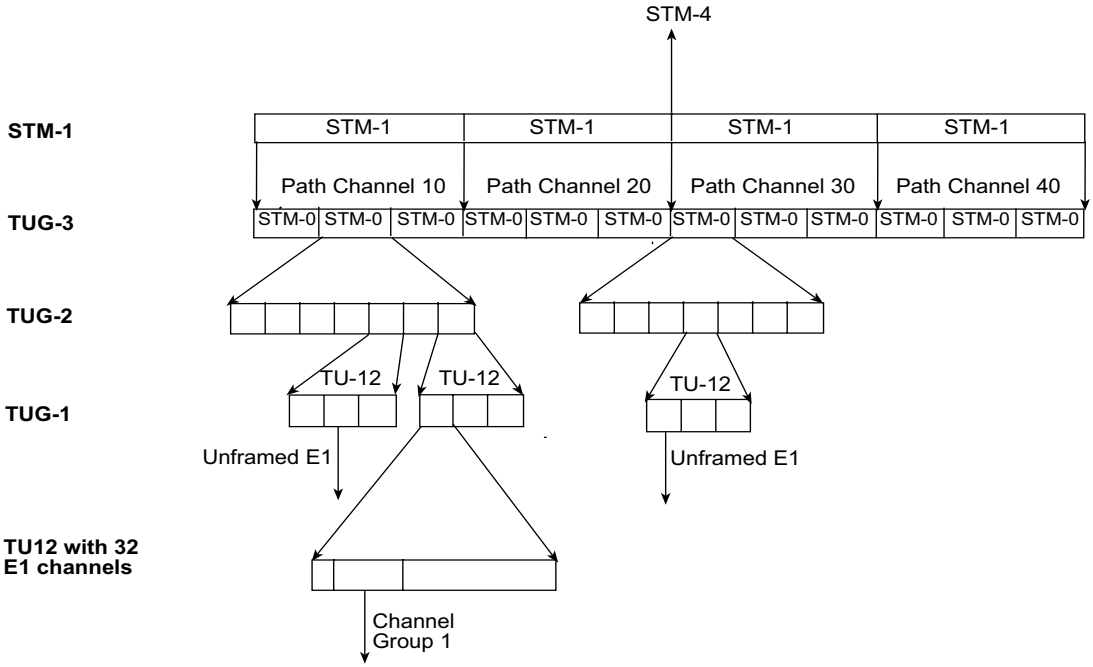

Figure 5-7 Configuring fractional E1 and unframed E1 in SDH mode

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 5-6.

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 5-6.

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 system supports the following test options:

- Transmission of bit error test (BERT) patterns to remote devices
- Receipt of BERT patterns from remote devices
- Local loopback – the ability to loop the data back toward the router and 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
  - > 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 system can send BERT patterns from the T1/E1 over SONET/SDH VT and T1/E1 over T3 layers. To send BERT patterns:

1 Select a controller.

2 Configure the controller to generate BERT patterns.

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, 2048 bits in length
  - › **2^15** – pseudorandom 0.151 test pattern, 32768 bits in length
  - › **2^20-O153** – pseudorandom 0.153 test pattern, 1048575 bits in length
- Specify the time interval between the tests in the range 1–14,400 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
  time 10 unframed
```

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

path ds3 t1 bert

- Use to enable BERTs 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, 2048 bits in length
  - **2^15** – pseudorandom 0.151 test pattern, 32768 bits in length
  - **2^20-O153** – pseudorandom 0.153 test pattern, 1048575 bits in length
- Specify the time interval between the tests in the range 1–14,400 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
  time 10 unframed
```

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

Receiving BERT Patterns

The system 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 system for network payload loopback and the remote interface to use the line clock. Inaccurate results may occur if you use other loopback modes or clock sources.

When the system is synchronized with and receiving BERT patterns from a remote device, the system records the number of bit errors an 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 system 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*, earlier in this chapter, 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 layer.
- Specify one of the following options:
  - **local** – loops the data back toward the router and 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 and sends an alarm indication signal (AIS) signal 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 and sends an alarm indication signal (AIS) out toward the network.
  - **network** – loops the data toward the network before the data reaches the framer.
  - **payload** – loops the data toward the network after the framer has processed the data.
- Example

```
host1(config)#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 and sends an alarm indication signal (AIS) out toward the network.
  - **network line** – loops the data back toward the network before the T1 framer and automatically sets a local loopback at the HDLC controllers.
  - **network payload** – loops the payload data back toward the network at the T1 framer and automatically sets 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 system to request that compatible devices connected at the T1 over SONET/SDH VT or the T1 over T3 layers enter into a loopback. You can also configure the system to start loopback testing when it receives an appropriate signal from a devices connected at either of these layers.

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

To enable local or network 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 facility 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 acceptance of remote loopback requests 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 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 acceptance of remote loopback requests 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 system and a SONET/SDH device at the other end of the line. This command defines:

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

path overhead j1

- Use to define messages that the system sends to or expects to receive from a SONET/SDH device connected to a cOCx/STMx interface.
- Specify a path identifier between 1 and 2147483648 for a cOCx/STMx interface.
- Specify the keyword **msg** for a message that the system transmits for this path.
- Specify the keyword **exp-msg** to define a message that the system 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 system 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** commands. 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. Refer to *ERX System Basics Configuration Guide, Chapter 2, Command Line Interface*, for details.

baseline interface serial

- Use to set a statistics baseline for serial interfaces.
- The system 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** commands 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 system 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 system 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 system 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** commands 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, enter **show controllers sonet 3/0 configuration**. To view information for path 1 only, enter **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
  - snmp trap link-status – state of SNMP link status processing for the interface: enabled or disabled
  - Operational Status – physical state of the interface: up or down
  - Time since last status change – time since the line module was rebooted
  - Loopback State – type of loopback configured on the interface
  - 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:
    - module – internal clock is from the line module itself
    - chassis – internal clock is from the configured system clock
  - Current section alarms – number of suspect bit patterns found in several consecutive frames in section layer
  - 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
  - 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 system 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 system 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 2/0 configuration

stm1 2/0
channelized (3 channels, stm0 minimum speed)
ifAdminStatus: up
snmp trap link-status: enabled
Operational Status: up
      time since last status change: 3 days, 18 hours
Loopback State: none
Mode: sdh
Timing source: internal module
Current section alarms: none
Current line alarms   : none

Channel configuration:
channel = 1, path = stm1, hierarchy = 1/1/1/0, current path
  alarms: none
 tributary 1/1/1, VC12
  ifAdminStatus: Upl
  snmp trap link-status: enabled
  Operational Status: Up
      time since last status change: 3 days, 18 hours
  current tributary alarms: none
   E1 interface
    ifOperStatus: ifOperUp
         time since last status change: 3 days, 18 hours
    Alarms detected
    snmp trap link-status: disabled
```

```
    Unframed, Clock Source: internal Module
    Fractional interface 1
     ifOperStatus: ifOperUp
     snmp trap link-status disabled
     Unframed
J1 transmit trace message: hello
J1 expected trace message: goodbye
J1 received trace message: goodbye
```

- Example 2 – If you do not specify the type of controller, the system shows the configuration for the interface, 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
snmp trap link-status: enabled
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
 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
snmp trap link-status: enabled
Operational Status: up
```

```
      time since last status change: 00:05:37
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
 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 5-1 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
  - 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

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 5-1 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
  - 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
 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
 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 5-1 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
host16#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 t3 remote

- Use to display MIB statistics for the remote end of a CT3 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
- Example: 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
```

- 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
- 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 T1 channel on a T3 over channelized SONET interface is specified.

```
host1#show controller 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 2: In this example, a T1 over channelized SONET interface is specified.

```
host1#show controller 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
  - 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
  - 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
ifOperStatus = ifOperUp
snmp trap link-status = disabled
Encapsulation hdlc
Crc type checking - CRC16
Hdlc mru = 1600
Hdlc mtu = 1600
Hdlc interface speed = 1536000
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 on monitoring APS/MSP, see *Monitoring APS/MSP* in *Chapter 4, Configuring Unchannelized SONET/SDH Interfaces*.