Configuring the 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA

This chapter provides information about configuring the 1-Port Channelized OC-3/STM-1 SPA and the 1-Port Channelized OC-12/STM-4 SPA on the Cisco ASR 1000 Series Aggregation Services Routers. It includes the following sections:

For information about managing your system images and configuration files, refer to the *Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide* and *Cisco IOS XE Configuration Fundamentals Configuration Guide, Release 2*.

For more information about the commands used in this chapter, refer to the *Cisco IOS XE Software Command References* site on Cisco.com. For more information, see the "Related Documentation" section on page -xxxiii.

Restrictions for Configuring the 1-Port Channelized OC-12/STM-4 SPA

This chapter contains information for configuring two models of the channelized SPAs on the Cisco ASR 1000 Series Aggregation Services Routers, but some features are not yet supported on both models.

Consider the following restrictions when configuring the 1-Port Channelized OC-12/STM-4 SPA on the Cisco ASR 1000 Series Aggregation Services Routers in Cisco IOS XE Release 2.6:

- Multilink Frame Relay (MLFR) is not supported.
- A maximum of 2000 NxDS0 channels are supported.

Note Before Cisco IOS XE Release 3.1S, APS (Automatic Protection Switching) was not supported for POS SPAs. The Cisco IOS XE Release 3.1S implements 1+1 bidirectional SR APS feature support for POS SPAs. Hence, 1+1 bidirectional SR APS feature will be supported in Cisco IOS XE Release 3.1S and later releases for POS SPAs.

Configuration Tasks

This section describes how to configure the 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA on the Cisco ASR 1000 Series Router, including required and optional configurations. It includes information about configuring the SPAs in either synchronous optical network (SONET) or synchronous digital hierarchy (SDH) framing modes.

It includes the following topics:

Specifying the Physical Address for Controller and Interface Configuration

This section describes how to specify the physical location of the SIP, SPAs, and interfaces on the 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA.

To specify the physical address for controller or interface configuration, use the **interface** and **controller sonet** commands, where:

- *slot*—Specifies the chassis slot number in the Cisco ASR 1000 Series Aggregation Services Routers where the SIP is installed.
- *subslot*—Specifies the slot of the SIP where the SPA is installed.
- *port*—Specifies the SONET port number. There is only one port on a 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA, therefore the port number is always 0.

For example, if the 1-Port Channelized OC-3/STM-1 SPA or 1-Port Channelized OC-12/STM-4 SPA is installed in subslot 0 of a Cisco ASR 1000 SIP in slot 3 of the chassis, the controller configuration address is specified as **controller sonet 3/0/0**.

For channelized SPA configuration, the interface address format is: *slot***/***subslot***/***port***:***channel-group*, where:

- *channel-group*—Specifies the logical channel group assigned to the time slots within the T1 link.

For more information about identifying slots and subslots, see the "Identifying Slots and Subslots for the SIPs and SPAs" section on page 4-1.

Naming the Interface

Interface names are automatically generated, and the format will be dependent on the mode each particular linecard is operating on. The name formats of the serial interface created are listed below.

Channelized T3 mode

If framing is SONET or SDH with au-3:

interface serial [*slot***/***subslot***/***port*][*ds3*|*ds1*]**:**[*channel-group*]

SONET Mode

- If framing is SONET and mode is vt-15:

interface serial [*slot*/*subslot*/*port*].[*sts1*/*vtg*/*t1*]:[*channel-group*]

- If framing is SONET and mode is CT3

  interface serial [*slot*/*subslot*/*port*].[*ds3*/*t1*]:[*channel-group*]

- If framing is SONET and mode is T3:

  interface serial [*slot*/*subslot*/*port*].[*ds3*]

SDH Mode

If the aug mapping is au-4, the au-4 value is always 1; if the aug mapping is au-3, then the only supported mode is c-11 (carrying a T1).

- If SDH-AUG mapping is au-4 and if the tug-3 is mode t3/e3:

  interface serial [*slot*/*subslot*/*port*].[*au-4*/*tug-3*/*tug-2*/*e1*]:[*channel-group*]

- If SDH-AUG mapping is au-3:

  interface serial [*slot*/*subslot*/*port*/*au-3*/*tug-2*/*t1*]:[*channel-group*]

POS on the 1-Port Channelized OC-12/STM-4 SPA

If framing is SONET and *n* is from 1-12:

interface pos *slot*/*subslot*/*port*:*n***sts-1**

Required Configuration Tasks

This section lists the required configuration steps to configure the 1-Port Channelized OC-3/STM-1 SPA. Some of the required configuration commands implement default values that might be appropriate for your network.

This section includes the following topics:

Configuring the Controller for the SONET Mode and the SDH Mode

Controller configuration is required for both SONET and SDH framing modes. To configure the controller on the 1-Port Channelized OC-3/STM-1 SPA or 1-Port Channelized OC-12/STM-4 SPA, complete the following step:

Command	Purpose
Router(config)# **controller sonet** *slot/subslot/port*	Selects the controller to configure and enters controller configuration mode, where: • *slot/subslot/port*—Specifies the location of the interface. **Note** The port number is always zero on the 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA.

Configuring the SONET Mode

To configure the SONET mode, complete the following steps:

	Command	Purpose
Step 1	Router(config-controller)# **framing sonet**	Specifies SONET as the frame type. This is the default.
Step 2	Router(config-controller)# **clock source** {**internal** | **line**}	Sets the clock source, where: • **internal**—Specifies that the internal clock source is used. • **line**—Specifies that the network clock source is used. This is the default for T1 and E1.
Step 3	Router(config-controller)# **loopback** {**local** | **network**}	Enables or disables loopback mode on a SONET controller, where: • **local loopback**—Loops data from the transmit path to the receive path. • **network loopback**—Loops data received on the external port to the transmit path and back out the external port. The default is disabled loopback.
Step 4	Router(config-controller)# **sts-1 {1- 12 | 1 - 3 | 4 - 6 | 7 - 9 | 10 - 12} pos**	Configures the CHOC12 SONET controller for the OC12 POS mode and the OC3 POS mode by specifying that the STS-1s be bundled together for POS.
Step 5	Router(config-controller)# **sts-1** *sts1-#*	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS1 configuration mode, where: • *sts-1 #*—Number from 1 to 3 for the 1-Port Channelized OC-3/STM-1 SPA, and 1 to 12 for the 1-Port Channelized OC-12/STM-4 SPA.

	Command	Purpose
Step 6	Router(config-ctrlr-sts1)# **mode** {**ct3** | **ct3-e1** | **t3** | **vt-15**}	Specifies the mode of operation of an STS-1 path, where: • **ct3**—A STS-1 carrying a DS3 signal is divided into 28 T1s (Plesiochronous Digital Hierarchy [PDH]). • **ct3-e1**—The channelized T3 is carrying E1 circuits. • **t3**—STS-1 carries an unchannelized (clear channel) T3. • **vt-15**—A STS-1 is divided into seven Virtual Tributary Groups (VTG). Each VTG is then divided into four VT1.5's, each carrying a T1.
Step 7	Router(config-ctrlr-sts1)# **vtg** *vtg#*	Configures the T1 on the VTG, where: • *vtg#*—Specifies the VTG number. For SONET framing, values are 1 to 7.

Configuring the SDH Mode

Note The SDH mode is supported on 1-Port Channelized OC-12/STM-4 SPA from Cisco IOS XE Release 3.1.1S onwards.

To configure the SDH mode, complete the following steps:

	Command	Purpose
Step 1	Router(config-controller)# **framing sdh**	Specifies SDH as the frame type.
Step 2	Router(config-controller)# **aug mapping** {**au-3** | **au-4**}	Configures AUG mapping for SDH framing. If the AUG mapping is configured to be AU-4, then the following muxing, alignment, and mapping will be used: TUG-3 <--> VC-4 <--> AU-4 <--> AUG If the mapping is configured to be AU-3, then the following muxing, alignment, and mapping will be used: VC-3 <--> AU-3 <--> AUG Default is **au-4.**
Step 3	Router(config-controller)# **clock source** {**internal** | **line**}	Sets the clock source, where: • **internal**—Specifies that the internal clock source is used. • **line**—Specifies that the network clock source is used. This is the default for T1 and E1.

	Command	Purpose
Step 4	Router(config-controller)# **au-4** *au-4#* **tug-3** *tug-3#* or Router(config-controller)# **au-3** *au-3#*	Configures AU-3, AU-4, and tributary unit groups, type 3 (TUG-3) for AU-4 and enters specific configuration mode. Depending on the framing mode of SONET or SDH, each STS-1, AU-3, TUG-3, and AU-4 of a 1-Port Channelized OC-3/STM-1 SPA can be configured with one of these commands. Depending on currently configured AUG mapping setting, this command further specifies TUG-3, AU-3, AU-4 or STS-1 muxing. The CLI command parser enters into config-ctrlr-tug3 (SDH mode), config-ctrlr-au3 (SDH mode), or config-ctrlr-sts1 parser mode (SONET mode), which makes only relevant commands visible. • *au-4#*—Range is from 1 to 4. • *tug-3#*—Range is from 1 to 3. • *au-3#* —Range is from 1 to 12.
Step 5	In SDH framing in AU-4 mode: Router(config-ctrlr-tug3)# **mode** {**c-11** | **c-12** | **t3** | **e3**} In SDH framing AU-3 mode: Router(config-ctrlr-au3)# **mode** {**c-11** | **c-12** | **t3** | **e3** | **ct3** | **ct3-e1**}	Configures mode of operation for AU-3 or AU-4 mode, where: C-11 and C-12 are container level-n (SDH) channelized T3s. They are types of T3 channels that are subdivided into 28 T1 channels. • **c-11**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2s. Each TUG-2 is then divided into four TU11s, each carrying a C-11 T1. • **c-12**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2. Each TUG-2 is then divided into three TU12s, each carrying a C-12 E1. • **t3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) T3. • **e3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) E3. • **ct3**—Specifies an AU-3 carrying a DS3 signal divided into 28 T1s Plesiochronous Digital Hierarchy [PDH]). • **ct3–e1**—Specifies a channelized T3 carrying E1 circuits.

Configuring the Channelized DS3 Mode

To configure channelized DS3 mode, complete the following steps:

	Command	Purpose
Step 1	Router(config)# **controller sonet** *slot/subslot/port*	Selects the controller to configure and enters controller configuration mode, where: • *slot/subslot/port*—Specifies the location of the interface. See the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 2	Router(config-controller)# **sts-1** *sts1-#*	Selects STS mode and enters sts1 configuration mode. • *sts-1#*—A value from 1 to y, y being the SONET STS level.
Step 3	Router(config-ctrlr-sts1)# **t3 framing** {**c-bit** | **m23** | **auto-detect**}	Specifies the framing mode, where: • **c-bit**—Specifies C-bit parity framing. • **m23**—Specifies M23 framing. • **auto-detect**—Detects the framing type of the device at the end of the line and switches to that framing type. If both devices are set to auto-detect, c-bit framing is used. This is the default.
Step 4	Router(config-ctrlr-sts1)# **t3 clock source** {**internal** | **line**}	Sets the clock source, where: • **internal**—Specifies that the internal clock source is used. • **line**—Specifies that the network clock source is used. This is the default. **Note** The clock source is set to internal if the opposite end of the connection is set to line and the clock source is set to line if the opposite end of the connection is set to internal.
Step 5	Router(config-ctrlr-sts1)# **t3 loopback** {**local** | **network** [**line** | **payload**] | **remote** [**line** | **payload**]}	Enables or disables loopback mode on a SONET controller, where: • **local loopback**—Loops data from the transmit path to the receive path. • **network loopback—**Loops data received on the external port to the transmit path and back out the external port. • **remote loopback**—Applicable only to c-bit framing. The default is no loopback.

	Command	Purpose
Step 6	Router(config-ctrlr-sts1)# **t3 mdl string** {**eic** | **fic** | **generator** | **lic** | **pfi** | **port** | **unit**} *string*	Configures maintenance data link (MDL) support parameters, where: • **eic**—Specifies equipment ID code. • **fic**—Specifies frame ID code. • **generator**—Specifies the generator number in MDL test signal. • **lic**—Specifies location ID code. • **pfi**—Specifies the Path Facility Identification code in MDL the path message. • **port**— Specifies the port number in the MDL idle string message. • **unit**—Specifies unit identification code. • *string*—Specifies user identifier for the chosen support parameter. The default is **no mdl string**.
Step 7	Router(config-ctrlr-sts1)# **t3 mdl transmit** {**path** | **idle-signal** | **test-signal**}	Configures MDL transmit parameters, where: • **path**—Enables MDL path message transmission. • **idle-signal**—Enables MDL idle signal message transmission. • **test-signal**—Enables MDL test-signal message transmission. The default is **no mdl transmit**.
Step 8	Router(config-ctrlr-sts1)# **t3 equipment** {**customer** | **network**} **loopback**	Enables the port to honor remote loopback request. Equipment network loopback disables this functionality. **Note** Remote loopbacks are only available in c-bit framing mode.
Step 9	Router(config-ctrlr-sts1)# **t3 bert pattern** *pattern* **interval** *1-14400*	Enables Bit Error Rate Testing (BERT), where: • *pattern*—Specifies the length of the repeating BERT test pattern. Allowed values are 0s, 1s, 2^15, 2^20, 2^23, and alt-0-1. • **interval**—Specifies the duration of the BERT test, in minutes. The interval can be a value from 1 to 14400.

Configuring DS1 (Channelized T3 mode)

To configure DS1, complete the following steps:

	Command	Purpose
Step 1	Router(config)# **controller sonet** *slot/subslot/port*	Selects the controller to configure and enters controller configuration mode, where: • *slot/subslot/port*—Specifies the location of the interface. See the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 2	Router(config-controller)# **sts-1** *sts-1#*	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS configuration mode, where: • *sts-1#*—STS values are 1 to 3.
Step 3	Router(config-ctrlr-sts1)# **mode** {**ct3** | **vt-15**}	Specifies the mode of operation of an STS-1 path, where: • **ct3**—A STS-1 carrying a DS31 signal is divided into 28 T1s (Plesiochronous Digital Hierarchy [PDH]) • **vt-15**—A STS-1 is divided into seven Virtual Tributary Groups (VTG). Each VTG is then divided into four VT1.5's, each carrying a T1.
Step 4	Router(config-ctrlr-sts1)# **t1** *t1#* **clock source** {**internal** | **line**}	Configures the clocking source, where: • *t1#*—Number indicating the T1 channel. • **internal**—Specifies that the internal clock source is used. • **line**—Specifies that the network clock source is used. This is the default.
Step 5	Router(config-ctrlr-sts1)# **t1** *t1#* **fdl** *ansi*	Enables the one-second transmission of the remote performance reports using Facility Data Link (FDL), where: • *t1#*—Number indicating the T1 channel. • **fdl** *ansi*—Specifies FDL and ANSI T1.403 standard. Without this command, FDL runs in ATT, the default mode. ATT is the AT&T TR54016 standard.
Step 6	Router(config-ctrlr-sts1)# **t1** *t1#* **framing** {**sf** | **esf**}	Specifies the type of framing, where: • *t1#*—Number indicating the T1 channel. • **sf**— Specifies that Super Frame (SF) is used as the T1 framing type. • **esf**—Specifies that Extended Super Frame (ESF) is used as the T1 framing type.
Step 7	Router(config-ctrlr-sts1)# **t1** *t1#* **yellow** {**detection** | **generation**}	Enables detection and generation of DS1 yellow alarms, where: • **detection**—Detects yellow alarms. • **generation**—Generates yellow alarms.

	Command	Purpose
Step 8	Router(config-ctrlr-sts1)# **t1** *t1#* **channel-group** *channel-group#* **timeslots** *list-of-timeslots* **speed** [**56** | **64**]	Configures a T1 or E1 interface, where: • *t1#*—Number indicating the T1 channel. • *channel-group#*—Specifies the channel-group number, from 0 to 23. • *list-of-timeslots*—Specifies one or more time slots. • **speed** [**56** | **64**]—(Optional) Specifies the line speed in kilobits per second. Valid values are 56 and 64.
Step 9	Router(config-ctrlr-sts1)# **t1** *t1#* **loopback** [**local** | **network** {**line** | **payload**} | **remote** {**line** {**fdl** {**ansi** | **bellcore**} | **inband**} | **payload** [**fdl**] [**ansi**]}]	Enables specific t1 channels to loopback, where: • *t1#*—Number indicating the T1 channel. • **local loopback**—(Optional) Loops data from the transmit path to the receive path. • **network loopback**—(Optional) Loops data received on the external port to the transmit path and back out the external port. • **remote line fdl** {**ansi** | **bellcore**}—(Optional) Sends a repeating, 16-bit Extended Superframe (ESF) data link code word 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 channel. Specify the bellcore keyword to enable the remote SmartJack loopback on the T1 channel. • **remote line inband**— (Optional) Sends a repeating, 5-bit inband pattern (00001) to the remote end requesting that it enter into a network line loopback. • **remote payload** [**fdl**] [**ansi**]—(Optional) Sends a repeating, 16-bit ESF data link code word to the remote end requesting that it enter into a network payload loopback. Enables the remote payload FDL ANSI bit loopback on the T1 channel.
Step 10	Router(config-ctrlr-sts1)# **t1** *t1#* **shutdown**	Shuts down the specified T1 channel, where: • *t1#*—Number indicating the T1 channel.

Configuring E1 (Channelized T3/E3 mode)

Note From Cisco IOS XE Release 3.1.1S onwards, E1/E3 channelization modes are supported on the 1-Port Channelized OC-12/STM-4 SPA.

E1 configuration must be done in channelized DS3 mode. To configure E1, complete the following steps:

	Command	Purpose
Step 1	Router(config-controller)# **e1** *e1#* **channel-group** *channel-group#* **timeslots** *list-of-timeslots* **speed** [**56** | **64**]	Creates a logical channel group on an E1 line, where: • *e1#*—A number in the range of 1 to 3. • **channel-group**—Defines a logical channel group to be a channelized E1 line. • *channel-group#*—Specifies the channel group number. • *list-of-timeslots*—Specifies the number of timeslots that make up the E1 line. • **speed** [**56** | **64**]—Specifies the line speed in kilobits per second. Valid values are 56 and 64
Step 2	Router(config-controller)# **e1** *e1#* **unframed**	Creates an E1 unframed (clear channel) logical channel group on an E1 line, where: • *e1#*—A number in the range of 1 to 3.
Step 3	Router(config-controller)# **e1** *e1#* [**unframed** | **framing**] {**crc4** | **no-crc4**}	Sets the type of framing (including unframed) used by an E1 line, where: • *e1#*—A number in the range of 1 to 3. • **crc4**—Specifies 4-bit cyclic redundancy check (CRC) framing. • **no-crc4**—Specifies basic framing.
Step 4	Router(config-controller)# **e1** *e1#* **clock source** {**internal** | **line**}	Sets the clock source on an E1 line, where: • **internal**—Specifies that the internal clock source is used. • **line**—Specifies the E1 line as the clock source.
Step 5	Router(config-controller)# **e1** *e1#* **national bits** *pattern*	Sets the national reserved bits on an E1 line, where: • *e1#*—A number in the range of 1 to 3. • *pattern*—A hexadecimal value in the range 0x0 to 0x1F (hexadecimal) or 0 to 31 (decimal).

	Command	Purpose
Step 6	Router(config-controller)# **e1** *e1#* **loopback** [**local** | **network**]	Specifies a loopback on an E1 line, where: • *e1#*—A number in the range of 1 to 3. • **local loopback**—(Optional) Loops data from the transmit path to the receive path. • **network loopback**—(Optional) Loops data received on the external port to the transmit path and back out the external port.
Step 7	Router(config-controller)# **e1** *e1#* **shutdown**	Shuts down an individual E1 line, where: • *e1#*—A number in the range of 1 to 3.

Configuring the Unchannelized E3 Serial Interface

Note From Cisco IOS XE Release 3.1.1S onwards, E1/E3 channelization modes are supported on the 1-Port Channelized OC-12/STM-4 SPA.

To configure an unchannelized E3 serial interface, complete the following:

	Command	Purpose
Step 1	Router(config-controller)# **dsu mode** {**cisco** | **digital-link** | **kentrox**}	Specifies the interoperability mode used by a T3 or E3 controller, where: • **cisco**—Specifies cisco as the data service unit (DSU) mode. • **digital-link**—Specifies Digital link as the DSU mode. Range is from 300-34010. • **kentrox—**Specifies kentrox as the DSU mode. Range is 1000-24500, or 34010. The default is **cisco**.
Step 2	Router(config-controller)# **dsu bandwidth** *number*	Specifies the maximum allowed bandwidth in kbps, where: • *number*—Allowed values are 0 to 34368. The default is 34368.
Step 3	Router(config-controller)# **scramble**	Enables scrambling for the E3 physical layer interface. The default is no scramble.
Step 4	Router(config-controller)# **national bit** {**0** | **1**}	Sets the national reserved bits on an E3 line. The default is 0.
Step 5	Router(config-controller)# **framing** {**bypass** | **g751** | **g832**}	Sets the framing on the interface, where: • **bypass—**Configures framing bypass to use the full E3 bandwidth. • **g751**— Specifies g751 framing. This is the default for E3. • **g832**—Specifies g832 framing.

	Command	Purpose
Step 6	Router(config-controller)# **crc** {**16** | **32**}	Selects the CRC size in bits, where: • **16**—16-bit CRC. This is the default • **32**—32-bit CRC.
Step 7	Router(config-controller)# **loopback** {**network** | **local** | **remote**}	Specifies loopback is enabled for the unchannelized E3 serial interface, where: • **local loopback**—Loops data from the transmit path to the receive path. • **network loopback**—Loops data received on the external port to the transmit path and back out the external port. • **remote loopback**—Sends a far-end alarm control request to the remote end requesting that it enter into a network line loopback.
Step 8	Router(config-controller)# **shutdown**	Shuts down the E3 interface.
Step 9	Router(config-controller)# **bert pattern** *pattern* **interval** *1-14400*	Sends a BERT pattern on an E3 line, where: • *pattern*—Specifies the length of the repeating BERT test pattern. Allowed values are 2^15, 2^20, 2^23, 0s, 1s, and alt-0-1. • ***interval*** *time*—Specifies the duration of the BERT test, in minutes. The interval can be a value from 1 to 14400.

Verifying the Interface Configuration

Use the **show interface serial** command to verify the interface configuration:

```
Router# show interface serial 1/0/0.1/1:0
Serial1/0/0.1/1:0 is up, line protocol is up
  Hardware is SPA-1XCHSTM1/OC3
  Internet address is 10.1.1.1/16
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, crc 16, loopback not set
  Keepalive not set
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 output buffer failures, 0 output buffers swapped out
     1 carrier transitions no alarm present
  VC 0: timeslot(s): 1, Transmitter delay 0, non-inverted data
```

Optional Configurations

There are several standard, but optional, configurations that might be necessary to complete the configuration of your serial SPA.

- Configuring the Encapsulation Method, page 19-14
- Configuring the CRC Size for T1, page 19-15
- Configuring FDL, page 19-16
- Configuring FRF.12, page 19-17
- Configuring Multilink Point-to-Point Protocol (Hardware-Based on the QFP), page 19-17
- Configuring LFI, page 19-20
- Inverting Data on the T1/E1 Interface, page 19-20
- Inverting Data on the T1/E1 Interface, page 19-20
- Changing a Channel Group Configuration, page 19-21
- Configuring BERT, page 19-21
- Configuring QoS Features on Serial SPAs, page 19-23

Configuring the Encapsulation Method

When traffic crosses a WAN link, the connection needs a Layer 2 protocol to encapsulate traffic. To set the encapsulation method, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface serial** *slot***/***subslot***/***port***:***channel-group*	Selects the interface to configure and enters interface configuration mode. • *slot***/***subslot***/***port***:***channel-group*—Specifies the location of the interface. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2. and "Naming the Interface" section on page 19-2.

	Command	Purpose
Step 3	Router(config-if)# **encapsulation** *encapsulation-type* **{hdlc | ppp | frame-relay}**	Sets the encapsulation method on the interface, where: • **hdlc**—Sets the High-Level Data Link Control (HDLC) protocol for serial interface. This encapsulation method provides the synchronous framing and error detection functions of HDLC without windowing or retransmission. This is the default for synchronous serial interfaces. • **ppp**—Sets point-to-point protocol (PPP) for serial interface. • **frame-relay**—Sets Frame Relay (for serial interface).
Step 4	Router(config-if)# **crc** {**16** | **32**}	Selects the CRC size in bits, where: • **16**—16-bit CRC. This is the default • **32**—32-bit CRC.

Configuring the CRC Size for T1

CRC is an error-checking technique that uses a calculated numeric value to detect errors in transmitted data. The 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA uses a 16-bit cyclic redundancy check (CRC) by default, but also supports a 32-bit CRC. The designators 16 and 32 indicate the length (in bits) of the frame check sequence (FCS). A CRC of 32 bits provides more powerful error detection, but adds overhead. Both the sender and receiver must use the same setting.

To set the length of the cyclic redundancy check (CRC) on a T1 interface, use these commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface serial** *slot***/***subslot***/***port***:***channel-group*	Selects the interface to configure and enters interface configuration mode. • *slot***/***subslot***/***port***:***channel-group*—Specifies the location of the interface. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2 and "Naming the Interface" section on page 19-2.
Step 3	Router(config-if)# **crc** {**16** | **32**}	Selects the CRC size in bits, where: • **16**—16-bit CRC. This is the default. • **32**—32-bit CRC.

Configuring FDL

Facility Data Link (FDL) is a 4-kbps channel provided by the Extended Super Frame (ESF) T1 framing format. The FDL performs outside the payload capacity and allows you to check error statistics on terminating equipment without intrusion. To configure FDL, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **controller sonet** *slot/subslot/port*	Selects the controller to configure and enters controller configuration mode. • *slot/subslot/port*—Specifies the location of the controller. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 3	Router(config)# **sts-1** *sts-#*	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS1 configuration mode, where: *sts-1#*—STS values are 1 to 3.
Step 4	Router(config-ctrlr-sts1)# **mode** {**ct3** | **ct3-e1** | **t3** | **vt-15**}	Specifies the mode of operation of an STS-1 path, where: • **ct3**—A STS-1 carrying a DS3 signal is divided into 28 T1s (Plesiochronous Digital Hierarchy [PDH]). • **ct3-e1**—The channelized T3 is carrying E1 circuits. • **t3**—STS-1 carries an unchannelized (clear channel) T3. • **vt-15**—A STS-1 is divided into seven Virtual Tributary Groups (VTG). Each VTG is then divided into four VT1.5's, each carrying a T1.
Step 5	If **vt-15** mode was selected: Router(config-ctrlr-sts1)# **vtg** *vtg#*	Configures the T1 on the VTG, where: • *vtg#*—Specifies the VTG number. Values are 1 to 7.
Step 6	Router(config-ctrlr-sts1)# **t1** *t1#* **framing** {**sf** | **esf**}	Specifies the type of framing, where: • *t1#*—Number indicating the T1 channel. • **sf**— Specifies that Super Frame (SF) is used as the T1 framing type. • **esf**—Specifies that Extended Super Frame (ESF) is used as the T1 framing type. Select **esf** to configure FDL.
Step 7	Router(config-ctrlr-sts1)# **t1** *t1#* **fdl** *ansi*	Configures the format used for Facility Data Link (FDL) if the framing format was configured for **esf**, where: • *t1#*—Number indicating the T1 channel. • **fdl** *ansi*—Selects ANSI for FDL to use the ANSI T1.403 standard.

Verifying FDL

Use the **show controllers t1** command to verify the **fdl** setting:

```
Router# show controllers t1
T1 6/0/1 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  alarm-trigger is not set
  Framing is ESF, FDL is ansi, Line Code is B8ZS, Clock Source is Line.
  Data in current interval (742 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Total Data (last 73 15 minute intervals):
     1278491 Line Code Violations, 3 Path Code Violations,
     0 Slip Secs, 1 Fr Loss Secs, 177 Line Err Secs, 0 Degraded Mins,
     3 Errored Secs, 0 Bursty Err Secs, 1 Severely Err Secs, 227 Unavail Secs
```

Configuring FRF.12

The 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA support FRF.12 end-to-end fragmentation for Frame Relay. For information about how to configure Frame Relay fragmentation support, see the "Frame Relay Queueing and Fragmentation at the Interface" chapter of the *Cisco IOS XE Wide-Area Networking Configuration Guide*, Release 2 at:

http://www.cisco.com/en/US/docs/ios/ios_xe/wan/configuration/guide/wan_frque_frag_if_xe.html

Configuring Multilink Point-to-Point Protocol (Hardware-Based on the QFP)

Multilink Point-to-Point Protocol (MLPPP) allows you to combine interfaces which correspond to an entire T1 or E1 multilink bundle. You can choose the number of bundles and the number of T1 or E1 lines in each bundle in any combination of E1, T1, and NxDS0 member links interfaces.

On the Cisco ASR 1000 Series Router, MLPPP functionality is implemented on the Quantum Flow Processor (QFP)—not the SPA. On other platforms that implement SPA-based MLPPP, the MLPPP member links must reside on the same SPA—this is not a restriction on the Cisco ASR 1000 Series Aggregation Services Routers. QFP-based MLPPP supports member links in the MLPPP bundle across different SPAs and SIPs on the Cisco ASR 1000 Series Aggregation Services Routers.

For more information about configuring MLPPP in Cisco IOS XE software, see the "Configuring Media-Independent PPP and Multilink PPP" chapter of the *Cisco IOS XE Wide-Area Networking Configuration Guide, Release 2*.

This section includes the following topics:

- MLPPP Configuration Guidelines, page 19-17
- Creating a Multilink Bundle, page 19-18 (required)
- Assigning an Interface to a Multilink Bundle, page 19-18 (required)
- Configuring Fragmentation Size and Delay on an MLPPP Bundle, page 19-19 (optional)
- Disabling Fragmentation on an MLPPP Bundle, page 19-19 (optional)

MLPPP Configuration Guidelines

When configuring MLPPP, consider the following guidelines:

- Only T1, E1, or NxDS0 links are supported in a bundle. The configuration will not prohibit higher bandwidth links from being added to the bundle, but they are not supported.
- Links of differing bandwidths are supported in the same bundle.
- PPP encapsulation must be enabled before configuring multilink-related commands.

Creating a Multilink Bundle

To create a multilink bundle, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface multilink** *group-number*	Creates a multilink interface and enters multilink interface mode, where: • *group-number*—The group number for the multilink bundle.
Step 3	Router(config-if)# **ip address** *address mask*	Sets the IP address for the multilink group, where: • *address*—The IP address. • *mask*—The IP netmask.

Assigning an Interface to a Multilink Bundle

To assign an interface to a multilink bundle, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface serial** *slot/subslot/port*	Selects the interface to configure and enters interface configuration mode, where: • *slot/subslot/port*—Specifies the location of the controller. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 3	Router(config-if)# **encapsulation ppp**	Enables PPP encapsulation.
Step 4	Router(config-if)# **ppp multilink group** *group-number*	Assigns the interface to a multilink bundle, where: • *group-number*—The multilink group number for the T1 or E1 bundle.
Step 5	Router(config-if)# **ppp multilink**	Enables multilink PPP on the interface.
Step 6	**Note** Repeat these commands for each interface you want to assign to the multilink bundle.	

Configuring Fragmentation Size and Delay on an MLPPP Bundle

To configure the fragmentation size on a multilink PPP bundle, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface multilink** *group-number*	Creates a multilink interface and enters multilink interface mode, where: • *group-number*—The group number for the multilink bundle. Range 1-2147483647
Step 3	Router(config-if)# **multilink fragment size** *fragment-size*	Sets the fragmentation size in bytes. Fragmentation is disabled by default.
Step 4	Router(config-if)# **ppp multilink fragment-delay** *delay*	Sets the configured delay on the multilink bundle that satisfies the fragmentation size, where: • *delay*—Delay in milliseconds.

The following example of the **show ppp multilink** command shows the MLPPP type and the fragmentation size:

```
Router# show ppp multilink
Multilink1, bundle name is test2
Bundle up for 00:00:13
Bundle is Distributed
0 lost fragments, 0 reordered, 0 unassigned
0 discarded, 0 lost received, 206/255 load
0x0 received sequence, 0x0 sent sequence
Member links: 2 active, 0 inactive (max not set, min not set)
Se4/2/0/1:0, since 00:00:13, no frags rcvd
Se4/2/0/2:0, since 00:00:10, no frags rcvd
Distributed fragmentation on. Fragment size 512. Multilink in Hardware..
```

Disabling Fragmentation on an MLPPP Bundle

By default, PPP multilink fragmentation is enabled. To disable fragmentation on a multilink bundle, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface multilink** *group-number*	Specifies the multilink interface and enters multilink interface mode, where: • *group-number*—The group number for the multilink bundle. Range 1-2147483647
Step 3	Router(config-if)# **ppp multilink fragment disable**	Disables PPP multilink fragmentation.

Configuring LFI

Link Fragmentation and Interleaving (LFI) is implemented on the QFP on the Cisco ASR 1000 Series Aggregation Services Routers. QFP-based LFI supports LFI on a bundle with any number of links—from one link, up to the maximum number supported by the router. When using LFI on MLPPP, the QFP load balances the priority packets across all links in the bundle to minimize the latency on the priority interleaved traffic.

LFI Configuration Guidelines

When you configure LFI, consider the following guidelines:

- Configure LFI using the **ppp multilink interleave** command. For MLPPP, this is on the multilink interface.
- Configure and apply an output QoS service-policy that classifies the priority and non-priority traffic. For MLPPP, you can apply the output policy on the multilink interface.

LFI Restrictions

When you configure LFI, note the following restrictions:

- Virtual-template interfaces are not supported.
- Packet ordering is not guaranteed for priority traffic sent interleaved on an MLPPP bundle with multiple links.
- IP header compression (such as, cRTP, cUDP, or cTCP) is not supported on packets classified by QoS as priority packets when using LFI on an MLPPP bundle with multiple links. IP header compression requires packet ordering. LFI sends all priority packets using PPP encapsulation, which does not preserve packet order when there are multiple links in the bundle. If you must support IP header compression, then you should not configure LFI or you should not make the LFI traffic priority. MLP encapsulation on non-priority QoS classes does preserve packet ordering.

To configure LFI on a multilink interface, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface multilink** *group-number*	Creates or specifies a multilink interface and enters multilink interface mode, where: • *group-number*—The group number for the multilink bundle. Range 1-2147483647
Step 3	Router(config-if) **ppp multilink**	Enables Multilink PPP.
Step 4	Router(config-if)# **ppp multilink interleave**	Enables interleaving of packets among the fragments of larger packets on an MLP bundle.

Inverting Data on the T1/E1 Interface

If the interface on the channelized SPA is used to drive a dedicated T1 line that does not have B8ZS encoding, you must invert the data stream on the connecting CSU/DSU or on the interface. Be careful not to invert data on both the CSU/DSU and the interface, as two data inversions will cancel each other out.

To invert data on a T1/E1 interface, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface serial** *slot/subslot/port*	Selects the serial interface and enters interface configuration mode, where: • *slot/subslot/port*—Specifies the location of the controller. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 3	Router(config-if)# **invert data**	Inverts the data stream.

Use the **show running configuration** command to verify that invert data has been set:

```
router# show running configuration
interface Serial6/0/0:0
 no ip address
 encapsulation ppp
 logging event link-status
 load-interval 30
 invert data
 no cdp enable
 ppp chap hostname group1
 ppp multilink
 ppp multilink group 1
```

Changing a Channel Group Configuration

To alter the configuration of an existing channel group, the channel group needs to be removed first using the **no** form of the **channel-group** command. To remove an existing channel group, use the following commands:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface serial** *slot/subslot/port*	Select the controller to configure and enters controller configuration mode, where: • *slot/subslot/port*—Specifies the location of the controller. For addressing information, refer to the "Specifying the Physical Address for Controller and Interface Configuration" section on page 19-2.
Step 3	Router(config-controller)# **no channel-group t1** *t1-number*	Selects the channel group you want to remove, where: • *t1-number*—Channel-group number.

Configuring BERT

BERT (Bit-Error Rate Testing) is used for analyzing quality and for problem resolution of digital transmission equipments. BERT tests the quality of an interface by directly comparing a pseudorandom or repetitive test pattern with an identical locally generated test pattern.

The BERT operation is data-intensive. Regular data cannot flow on the path while the test is in progress. The path is reported to be in alarm state when BERT is in progress and restored to a normal state after BERT has been terminated.

BERT Test Configuration Guidelines

When configuring BERT on the 1-Port Channelized OC-3/STM-1 SPA or 1-Port Channelized OC-12/STM-4 SPA, consider the following guidelines:

- Only DS1/T1 and DS3/T3 paths are supported on the 1-Port Channelized OC-12/STM-4 SPA.
- A maximum of 27 concurrent tests across all paths on the SPA is supported.

BERT Pattern Descriptions

Table 19-1 and Table 19-2 describe the supported BERT patterns on the 1-Port Channelized OC-3/STM-1 SPA and 1-Port Channelized OC-12/STM-4 SPA.

Table 19-1 DS1/T1/E1 BERT Patterns

Pattern	Description
0s	All 0's in the test pattern (...000...).
1-in-8	8-bit test pattern where 1 out of 8 bits is set to 1.
1s	All 1's in the test pattern (...111...).
2^11	Pseudorandom 1 test pattern that is 2,048 bits in length.
2^15	Pseudorandom 1 O.151 test pattern that is 32,768 bits in length.
2^15-inverted	Pseudorandom 1 inverted O.151 test pattern that is 32,768 bits in length.
2^20-O153	Pseudorandom 1 O.153 test pattern that is 1,048,575 bits in length.
2^20-QRSS	Pseudorandom 1 quasi-random signal sequence (QRSS) 0.153 test pattern that is 1,048,575 bits in length.
2^23	Pseudorandom 1 O.151 test pattern that is 8,388,607 bits in length.
2^23-inverted	Pseudorandom 1 inverted O.151 test pattern that is 8,388,607 bits in length.
2^9	Pseudorandom 1 O.150 test pattern that is 511 bits in length.
3-in-24	24-bit test pattern where 3 out of 24 bits is set to 1.
alt-0-1	Repeating test pattern of alternating 0's and 1's (...01010...).

Table 19-2 DS3/T3/E3 BERT Patterns

Pattern	Description
0s	All 0's in the test pattern (...000...).
1s	All 1's in the test pattern (...111...).
2^15	Pseudorandom 1 O.151 test pattern that is 32,768 bits in length.
2^20	Pseudorandom 1 O.153 test pattern that is 1,048,575 bits in length.
2^23	Pseudorandom 1 O.151 test pattern that is 8,388,607 bits in length.
alt-0-1	Repeating test pattern of alternating 0's and 1's (...01010...).

To configure a BERT pattern for DS1/T1/E1, use one of the following commands:

Command	Purpose
Router(config-controller)# **t1** *channel-number* **bert pattern** *pattern* **interval** *time* or Router(config-ctrlr-sts1)# **e1** *e1-number* **bert pattern** *pattern* **interval** *time*	Sends a BERT pattern on a line, where: • *channel-number*—Number identifying the specific T1 channel where you want to run BERT. • *e1-number* —Number identifying the specific E1 channel where you want to run BERT. • *pattern*—Specifies the type of repeating BERT test pattern. Supported values are 0s, 1s, 1-in-8, 2^11, 2^15, 2^15-inverted, 2^20-O.153, 2^20-QRSS, 2^23, 2^23-inverted, 2^9, 3-in-24, and alt-0-1. • **interval** *time*—Specifies the duration of the BERT test, in minutes. The range is 1 to 14400.

To configure a BERT pattern for DS3/T3/E3, use the following command in controller configuration mode:

Command	Purpose
Router(config-controller)# **bert pattern** {**0s** | **1s** | **2^15** | **2^20** | **2^23** | **alt-0-1**} **interval** *time* or Router(config-ctrlr-sts1)# **bert pattern** {**0s** | **1s** | **2^15** | **2^20** | **2^23** | **alt-0-1**} **interval** *time*	Sends a BERT pattern on the DS3 channel, where: • **interval** *time*—Specifies the duration of the BERT test, in minutes. The range is 1 to 14400. **Note** See Table 19-2 for pattern descriptions.

Configuring QoS Features on Serial SPAs

The SIPs and SPAs support many QoS features using modular QoS CLI (MQC) configuration. Since there are no serial SPA-specific QoS features, refer to your network processor documentation for QoS configuration information.

Saving the Configuration

To save your running configuration to nonvolatile random-access memory (NVRAM), use the following command in privileged EXEC configuration mode:

Command	Purpose
Router# **copy running-config startup-config**	Writes the new configuration to NVRAM.

For more information about managing configuration files, refer to the *Cisco IOS XE Configuration Fundamentals Configuration Guide, Release 2* and *Cisco IOS Configuration Fundamentals Command Reference* publications.

Verifying Interface Configuration

Besides using the **show running-configuration** command to display your Cisco ASR 1000 Series Router configuration settings, you can use the **show interface serial** and the **show controllers sonet** commands to get detailed information on a per-port basis for your channelized SPA.

Verifying Per-Port Interface Status

To find detailed interface information on a per-port basis for the channelized SPAs, use the **show interface serial** and **show controllers sonet** commands.

See the "Verifying the Interface Configuration" section on page 13 for an example of the **show interface serial** command.

The following example provides sample output for interface port 0 on the SPA located in subslot 0 of the Cisco ASR 1000 SIP installed in slot 1of a Cisco ASR 1000 Series Router:

```
Router# show controllers sonet 1/0/0

SONET 1/0/0 is up.
  Hardware is SPA-1XCHSTM1/OC3
  IO FPGA version: 1.7, HDLC Framer version: 0
  T3/T1 Framer(1) version: 1
  Sonet/SDH Framer version: 0
  SUBRATE FPGA version: 1.4
  HDLC controller available FIFO buffers 3760
 Applique type is Channelized Sonet/SDH

 Clock Source is Line
Medium info:
  Type: Sonet, Line Coding: NRZ,
 SECTION:
  LOS = 0          LOF = 0                          BIP(B1) = 85

SONET/SDH Section Tables
  INTERVAL       CV     ES    SES   SEFS
  23:15-23:20     0      0     0      0
  23:00-23:15     0      0     0      0
  22:45-23:00    85      1     1      0
Total of Data in Current and Previous Intervals
  22:45-23:20    85      1     1      0

LINE:
  AIS = 0          RDI = 1          REI = 65         BIP(B2) = 207
Active Defects: None
Active Alarms: None
Alarm reporting enabled for: SF SLOS SLOF B1-TCA B2-TCA
BER thresholds:  SF = 10e-3  SD = 10e-6
TCA thresholds:  B1 = 10e-6  B2 = 10e-6

SONET/SDH Line Tables
  INTERVAL       CV     ES    SES    UAS
  23:15-23:20     0      0     0      0
  23:00-23:15     0      0     0      0
  22:45-23:00   272      1     0      5
Total of Data in Current and Previous Intervals
  22:45-23:20   272      1     0      5
.
.
.
```

```
SONET/SDH Path Tables
  INTERVAL       CV    ES   SES   UAS
  23:15-23:20     0     0     0     0
  23:00-23:15     0     0     0     0
  22:45-23:00 187382     2     0     0
Total of Data in Current and Previous Intervals
  22:45-23:20 187382     2     0     0
.
.
.
T3 1/0/0 Path 1 is up.
  Hardware is SPA-1XCHSTM1/OC3
  IO FPGA version: 1.7, HDLC Framer version: 0
  T3/T1 Framer(1) version: 1
  Sonet/SDH Framer version: 0
  SUBRATE FPGA version: 1.4
  HDLC controller available FIFO buffers 3760
  Applique type is T3
  No alarms detected.
  MDL transmission is enabled

  FEAC code received: No code is being received
  Framing is C-BIT Parity, Cablelength is 224
  Clock Source is Line
  Equipment customer loopback
  Data in current interval (346 seconds elapsed):
     0 Line Code Violations, 0 P-bit Coding Violation
     0 C-bit Coding Violation, 0 P-bit Err Secs
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
     0 Unavailable Secs, 0 Line Errored Secs
     0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
     0 Severely Errored Line Secs
     0 Far-End Errored Secs, 0 Far-End Severely Errored Secs
     0 CP-bit Far-end Unavailable Secs
     0 Near-end path failures, 0 Far-end path failures
     0 Far-end code violations, 0 FERF Defect Secs
     0 AIS Defect Secs, 0 LOS Defect Secs
.
.
.
CT3 1/0/0.2 is up.
  Hardware is SPA-1XCHSTM1/OC3
  IO FPGA version: 1.7, HDLC Framer version: 0
  T3/T1 Framer(1) version: 1
  Sonet/SDH Framer version: 0
  SUBRATE FPGA version: 1.4
  HDLC controller available FIFO buffers 3760
  Applique type is Channelized T3 to T1
  No alarms detected.
  Framing is M23, Cablelength is 224
  Clock Source is Internal
  Equipment customer loopback
  Data in current interval (356 seconds elapsed):
     0 Line Code Violations, 0 P-bit Coding Violation
     0 C-bit Coding Violation, 0 P-bit Err Secs
     0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
     0 Unavailable Secs, 0 Line Errored Secs
     0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
     0 Severely Errored Line Secs
     0 Far-End Errored Secs, 0 Far-End Severely Errored Secs
     0 CP-bit Far-end Unavailable Secs
```

```
     0 Near-end path failures, 0 Far-end path failures
     0 Far-end code violations, 0 FERF Defect Secs
     0 AIS Defect Secs, 0 LOS Defect Secs

(Remaining output omitted)
```

Configuration Examples

This section includes the following configuration examples:

- Example of T3 Framing Configuration, page 19-26
- Example of Cyclic Redundancy Check Configuration, page 19-26
- Example of Facility Data Link Configuration, page 19-26
- Example of Invert Data on T1/E1 Interface, page 19-27

Example of T3 Framing Configuration

The following example configures framing on a T3 interface:

```
! Specify the interface to configure and enter interface configuration mode.
!
Router(config)# controller sonet 3/0/0
!
! Select the STS mode.
!
Router(config-controller)# sts-1 2
!
!Select the framing mode.
!
Router(config-controller)# t3 framing m23
```

Example of Cyclic Redundancy Check Configuration

The following example configures CRC on a T1 interface:

```
! Specify the interface to configure and enter interface configuration mode.
!
Router(config)# interface serial 2/0/0.1
!
! Specify the CRC type.
!
Router(config-if)# crc 32
```

Example of Facility Data Link Configuration

The following example configures FDL on a T1 interface:

```
! Specify the interface to configure and enter interface configuration mode.
!
Router(config)# interface serial 1/0/0.2
!
! Specify the T1 number and select fdl.
!
```

```
Router(config-controller)#t1 2 fdl ansi
```

Example of Invert Data on T1/E1 Interface

The following example inverts the data on the serial interface:

```
! Specify the interface to configure and enter interface configuration mode.
!
Router(config)# interface serial 3/0/0.1/2/1:0
!
! Configure invert data.
!
Router(config-if)# invert data
```