Cisco IOS Software Configuration for the Cisco 12000 Series One-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card

Product Number: CHOC12/DS1-IR-SC

This software configuration note contains instructions for configuring the Cisco 12000 Series One-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card single-mode (SM), intermediate-reach (IR), Internet Services Engine (ISE) line card for the Cisco 12000 Series routers. Throughout this document, this line card is referred to as the 1-Port CHOC-12 ISE line card.

The Cisco 1-Port CHOC-12 ISE line card is built on the Cisco IP Services Engine (ISE) technology designed for telcos and Internet service providers (ISPs), the line card can channelize an STS-12 or STM-4 signal into a maximum of 70 channel groups per supported path (STS-1, TUG-3, or AU-3), with up to 840 channel groups of DS1, fractional DS1, or n x DS0 signals. (That is, 12 paths per line card with 70 channel groups maximum per path). The line card also supports up to 168 Multilink Frame Relay (MLFR) or Multilink Point-to-Point Protocol (MLPPP) T1 bundles, each of which supports up to 8 DS1 channel groups. The concatenated, or unchannelized SONET and SDH modes are not supported.

The Cisco 1-Port CHOC-12 ISE card supports four quality of service (QoS) queues per channel group or T1 bundle, with Weighted Random Early Detection (WRED) and Modified Deficit Round Robin (MDRR). For traffic with low-latency requirements such as voice over IP (VoIP), the line card supports link fragmentation and interleaving (LFI) and the FRF.12 standard protocol. The Cisco 1-Port CHOC-12 ISE Line Card can be used in any of the Cisco 12000 Series Routers and supports “hitless” online insertion and removal (OIR).

For descriptions and procedures that relate to the physic al installation of the line card see the document, *Cisco 12000 Series 1-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card Installation and Configuration* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/linecard/lc_chan/13921c12.htm

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Feature History

Release	Modification
12.0(27)S1	1-Port CHOC-12 ISE line card is introduced.[1]

1. No Cisco IOS commands were created or modified specifically for the linecard in this release.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Contents

Network Management Feature Descriptions

Administrative and management access to the 1-Port CHOC-12 ISE line card is provided through the standard console and Telnet CLI as well as through SNMP network management software such as CiscoWorks 2000. For MIB information, see the "MIBs" section on page 56.

Layer 1 Software Feature Descriptions

The following subsections sections identify the major software supported features provided by the 1-Port CHOC-12 ISE line card.

SONET and SDH

The following options are configured and monitored at the port level:

- SONET or SDH framing
- Internal and line clocking mode
- Local (diagnostic) and network (line) loopbacks
- Performance and error processing
- Receive and transmit alarms, performance and error processing
  - LOS, LOF, LAIS, PAIS, LOP, LRDI, PRDI, SF, SD, LREI (Line FEBE), PREI (Path FEBE)
  - Error counts for B1, B2, and B3
  - Threshold Crossing Alerts (TCA) for B1, B2, B3 with configurable threshold
- North American SONET Virtual Tributary 1.5 (VT 1.5) mapping:

  STS-1 to VTG to VT1.5 to DS1
- Plesiochronous Digital Hierarchy DS3 (PDH DS3) with M13 and C-bit mapping:

  STS-1 to DS3 to DS1
- European SDH Virtual Container 12 (VC-12) mapping:

  AU-4 to TUG-3 to TUG-2 to VC-12 to E1
- Japanese SDH VC-11 mapping:

  AU-3 to TUG-2 to VC-11 to DS1

DS1 Features

DS1s can be configured and monitored on a per-T1 channel basis. The 1-Port CHOC-12 ISE line card supports the following DS1 features:

- Framing control— Extended Superframe (ESF) and Super Frame (SF) support
- ESF statistics
- Internal and line clocking modes
- Local (diagnostic), network (line), and remote loopback (including SF inband)
- BER Test at DS1 level
- Receive and transmit alarm processing
- Performance and Error Counters

E1 Features

E1s can be configured and monitored at the individual E1 channel level. The 1-Port CHOC-12 ISE line card supports the following E1 features:

- Framing control—E1 and E1 -CRC, as well as Unframed
- Internal and line clocking mode
- Local (diagnostic) and network (line) loopback
- BER Test at E1 level
- Receive and transmit alarm processing
- Performance and error counters

Automatic Protection Switching

Automatic Protection Switching (APS) provides redundancy on SONET equipment to guard against line failures. The 1-Port CHOC-12 ISE line card supports the following APS features:

- SONET Linear APS 1+1 mode.
- Bi-directional and Uni-directional modes.
- Linear APS is defined to provide protection at the line layer. Therefore all of the STS SPEs carried in an OC-12 signal are protected together (That is, if a switch occurs, all of the STS SPEs are switched together).
- Working and Protect channel can be on the same router, or in different routers.

Online Insertion and Removal

The Online Insertion and Removal feature (OIR) permits the removal or insertion of a 1-Port CHOC-12 ISE line card without disrupting the packet forwarding or routing of other line cards operating in the same chassis. For additional information on OIR, see the document, *Cisco 12000 Series 1-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card Installation and Configuration* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/linecard/lc_chan/13921c12.htm

Layer 2 Software Feature Descriptions

The following subsections provide an overview of the wide area network protocols supported on the 1-Port CHOC-12 ISE line card:

Cisco High-level Data Link Control Protocol

The 1-Port CHOC-12 ISE line card supports standard Cisco HDLC encapsulation.

Frame Relay Protocol

The 1-Port CHOC-12 ISE line card supports the following frame relay features:

- ELMI address registration
- Cisco, ANSI and ITU LMI with autosensing
- 2-byte header
- Maximum of 1,024 data link connection identifiers (DLCIs) per interface, channel group or multilink bundle, with a total limit of 5,120 user defined DLCIs per line card.

Note The current Cisco IOS limitations are 2,048 IDBs per line card. Because each interface requires at least one hardware IDB and one software IDB, the limit of 1,024 DLCIs applies to each card.

- Link Fragmentation Reassembly (LFI) as specified by the Frame Relay Fragmentation Implementation Agreement (FRF.12). The available fragmentation sizes are 128, 256, and 512 bytes.

Note Forward explicit congestion notification (FECN) and backward explicit congestion notification (BECN) signaling are not supported at this release.

Multilink Point to Point Protocol

Compliant with the PPP Multilink Protocol (MP) RFC 1990, The 1-Port CHOC-12 ISE line card supports the following Multilink Point to Point Protocol(MLPPP) features:

- Up to 8 DS1s per multilink bundle
- Bundle members are limited to a single line card
- Links in the bundle must have equal DS1 bandwidth
- Up to 168 MLPP bundles.

Multilink Frame Relay

Compliant with the Multilink Frame Relay UNI/NNI Implementation Agreement (FRF. 16), the1-Port CHOC-12 ISE line card supports the following features:

- Up to 8 DS1s per multilink bundle
- Bundle members limited to a single line card
- Links in the bundle must have equal DS1 bandwidth
- Maximum of 4 DLCIs per multilink bundle
- Layer 2 Virtual Private Networks (VPNs) and Tunnel Services

Layer 3 Software Feature Descriptions

The 1-Port CHOC-12 ISE line card layer 3 software features are a subset of Cisco IOS 12.0(27)S1 and Cisco IOS 12.0(26)S. These features are described or referenced in the document, *Cross-Platform Release Notes for Cisco IOS Release 12.0 S, Part 2: New Features and Important Notes* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/relnote/xprn120s/120snewf.htm

How to Configure Layer 1 Features

The following sections provides the following configuration procedures for the 1-Port CHOC-12 ISE line card:

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Restrictions

The 1-Port CHOC-12 ISE line card can be installed only in the Cisco 12000 Series Router. The hardware and software configuration procedures and tasks are similar to all other Cisco 12000 Series Router line cards.

Each 1-Port CHOC-12 ISE line card requires 512 interface description blocks (IDBs) describing the DS1 channels (one per DS1 channel). We recommend that you install no more than two 1-Port CHOC-12 ISE line cards on a Cisco 12000 Series Router chassis.

Configuring the SONET Controller

Summary Steps

1. **enable**
2. **configure terminal**
3. **controller sonet** *slot/port*
4. **framing** {**sonet** | **sdh**}
5. **clock source** {**internal** | **line**}
6. **description** *string*
7. **report** {**all** | *event*}
8. **threshold** *type value*
9. **overhead s1s0** *number*
10. **overhead c2** *number*
11. **overhead j1 length [16 | 64]**
12. **overhead j1 message**

Table 1 lists the SONET controller default values.

Table 1 Controller Parameters and Default Configuration Values

Parameter	Configuration Command	Default Value
AIS shut—send LAIS when shut down	[**no**] **ais-shut**	on
APS—modify APS parameters	[**no**] **aps** ...	off
Clock source—specify the clock source for the SONET port	[**no**] **clock source** [**internal** | **line**]	line
Loopback—put the SONET port in loopback	[**no**] **loopback** [**internal** | **line**]	no loopback
Overhead—configure SONET overhead flags	[**no**] **overhead** [**j0** | **s1s0**]	j1=1; s1s0=00
Report—enable reporting of selected alarms	[**no**] **report** [**all** | **b1-tca** | **b2-tca** | **b3-tca** | **lais** | **lom** | **lrdi** | **pais** | **plop** | **prdi** | **puneq** | **sd-ber** | **sf-ber** | **slof** | **slos**]	sf-ber, slos, slof, b1-tca, lais, b2-tca,

Table 1 Controller Parameters and Default Configuration Values (continued) (continued)

Parameter	Configuration Command	Default Value
Shutdown—shut down channelized SONET controller	[**no**] **shutdown**	shutdown
Thresholds—set BER threshold values	[**no**] **threshold** [**b1-tca** | **b2-tca** | **b3-tca** | **sd-ber**] [*3..9*]	b1-tca=6 ($10e^{-6}$) b2-tca=6 ($10e^{-6}$) b3-tca=6 ($10e^{-6}$) sd-ber=6 ($10e^{-6}$) sf-ber=3 ($10e^{-3}$)

Detailed Steps:

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 1	**controller sonet** *slot/port* **Example:** `Router(config)# controller sonet 1/0`	Selects the physical port to configure, and enters controller configuration mode. The 1-Port CHOC-12 ISE line card only has port 0. To shut down the SONET controller, use the **shutdown** controller command. When shut down, the OC-12/STM-4 port transmits a Line AIS (MS-AIS) signal. The received signal is ignored. Bring the SONET controller back up with the **no shutdown** controller command.
Step 2	**framing** {**sonet** | **sdh**} **Example:** `Router(config-controller)# framing sdh`	Specifies SONET or SDH framing type. The default is SONET framing.

Command or Action	Purpose
Step 3 `clock source {internal | line}` **Example:** `Router(config-controller)# clock source line`	Sets the clock source for the 1-Port CHOC-12 ISE line card. Typically, an 1-Port CHOC-12 ISE line card is connected to a SONET or SDH add/drop multiplexer (ADM). In this application, Cisco recommends using the default setting of **clock source line**, because: • The clock source used by the SONET/SDH network is of higher accuracy than the internal clock source on the 1-Port CHOC-12 ISE line card. • The SONET/SDH network is designed for optimal operation in synchronous mode, where all clocks used in the network can be traced to a single high-accuracy clock source. Using the internal clock on the line card port introduces an independent clock source into the network, and may cause synchronization-related anomalies to be detected by the SONET/SDH network elements. When configured for line clocking, the 1-Port CHOC-12 ISE line card port will automatically default to internal clocking if the line clock source is considered unusable for any of the following reasons: • The port detects a Loss of Signal (SLOS) defect. • The port detects a Loss of Frame (LOF) defect. • The port detects a Section (RS) Loss of Frame (SLOF) defect. • The port detects a Line (MS) Alarm Indication Signal (LAIS) defect. • The port receives the “Do not use for synchronization” code in byte S1 of the Line (MS) overhead. • The port has been put into the local loopback mode through the use of the **loopback local** controller command. When the loopback is cleared, the port reverts to using the **line** clock source. **Note** The OC-12/STM-4 port always sends the “Do not use for synchronization” code in byte S1 of the Line (MS) overhead toward the directly connected ADM.

	Command or Action	Purpose
Step 4	**description** *string* **Example:** `Router(config-controller)# description E1T1Card`	(Optional). You can add a description of up to 80 characters about a controller to help you remember what is attached to it. The description is intended solely as a comment about the use of the controller. The description will appear in the output of the following commands: • show configuration • show system running config • show controllers.
Step 5	**report** {**all** | *event*} **Example:** `Router(config-controller)# report {all | event}`	(Optional). Enable reporting of selected alarm and signal events. The following alarm and signal events are enabled and reported by default: • sf-ber • slos • slof • b1-tca • lais • b2-tca Enable reporting for the alarm and signal events individually, or use the **all** keyword to enable all of the available alarm and signal events.
Step 6	**threshold** *type value* **Example:** `Router(config-controller)# threshold all`	(Optional). Set threshold values for the BER Threshold Crossing Alarms. For further information, see the document *Bit Error Rate Testing on Channelized Line Cards in Cisco 12000 Series Internet Routers* at the following URL: http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s21/bert.htm
Step 7	**overhead s1s0** *number* **Example:** `Router(config-controller)# overhead s1s0 2`	(Optional). Sets S1 and S0 overhead bits. Legal values are 0 to 3. The default is 0 for SONET and 2 for SDH framing. The values for these bits are set automatically with frame type. Change the values only to ensure operability with older or nonstandard equipment, or to ensure operability if the bit values in the network are other than the defaults. For example, SDH equipment in Australia might use 1 as the SDH value. The S1 and S0 bits are located in the H1 Administrative Unit (AU) pointer byte, bit locations 5 and 6.
Step 8	**overhead j0** *number* **Example:** `Router(config-controller)# overhead j0 82`	(Optional). Sets identifier of transmitting equipment (0 to 255). Default is 1. Section trace is a maintenance feature of SONET. One byte (J0) of the Section overhead associated with each SONET frame is used to carry information identifying the transmitting equipment.

	Command or Action	Purpose

Step 9	**overhead c2** *number*
	
	Example:
	`Router(config-controller)# au-4 1 overhead c2`
	`or`
	`Router(config-controller)# au-3 3`
	`Router(config-ctrlr-au3)# overhead c2 98`
	`or`
	`Router(config-controller)# sts-1`
	`Router(config-ctrlr-sts1)# overhead c2 98`
		(Optional). Legal values are 0 to 255. Defaults are as follows:
		• 02 for vt15, c11, and c12
		• 04 for ct3
		The Signal Label field is configured at the path level configuration mode.
		The Path Signal Label field occupies one byte (C2) of the SONET STS Path overhead, and the SDH High Order Path overhead. This byte indicates the type of contents carried in the SONET Synchronous Payload Envelope (SPE), or SDH High Order Virtual Container (HOVC). Setting the Path Signal Label affects both the Transmitted (sent) value and the Expected value of the C2 overhead byte.

Step 10	**overhead j1 length [16 | 64]**
	overhead j1 message
	
	Example:J1 configuration for SDH AU-4 mode
	`Router(config-controller)# au-4 1 overhead j1 length 16`
	`Router(config-controller)# au-4 1 overhead j1 message metro_SF`
	
	Example:J1 configuration for SDH AU-3 mode
	`Router(config-controller)# au-3 3`
	`Router(config-ctrlr-au3)# overhead j1 length 16`
	`Router(config-ctrlr-au3)# overhead j1 message metro_LA`
	
	Example:J1 Configuration for SONET STS-1 mode
	`Router(config-ctrlr-sts1)# overhead j1 length 64`
	`Router(config-ctrlr-sts1)# overhead j1 message metro_washington gsr_0057/4/3`
		(Optional). The Path Trace identifier consists of two configuration settings, the message length and the message text.
		The default message length is 16 for SDH framing, and 64 for SONET framing.
		If you select a message length of 16, the actual message length can be up to 15 characters. An additional byte, prepended to the message, contains the result of a CRC7 calculated on the message. If the actual message text is fewer than 15 characters, the message text is padded to its full length with NULL characters.
		If you select a message length of 64 and the actual message text is fewer than 62 characters, the message text is padded with NULL characters. The last two byte positions, 63 and 64, are always CR/LF (0x0D/0x0A).
		The STS/High Order Path Trace Identifier (J1) is a maintenance feature of SONETand SDH.
		One byte (J1) of the Path overhead associated with each path in the SONET/SDH frame is used to carry information identifying the originating Path Terminating Equipment (PTE).
		In SDH with AU-4 mapping, the Path Trace identifier is configured at the controller level. In SDH with AU-3 mapping or in SONET framing, the Path Trace identifier is configured at the path level.

Configuring an STS-1 Mode of Operation with SONET Framing

Under SONET framing, each of the STS-1 paths can be configured to carry a set of T1s mapped into either a VT1.5 signal or a DS3 signal. The DS3 signal itself carries a set of T1s (thus becoming a channelized T3, or CT3).

Summary Steps

1. **controller sonet slot/port**
2. **framing sonet {sonet | sdh}**
3. **sts-1 number**
4. **mode** {**vt-15** | **ct3**}

Detailed Steps

	Command	Purpose
Step 1	**controller sonet slot/port** **Example:** `Router(config)# controller sonet 1/0`	Selects the physical port to configure. Enters controller configuration mode.
Step 2	**framing sonet {sonet | sdh}** **Example:** `Router(config-controller)# framing sonet`	Specifis framing type. Choose SONET for STS-1 configuration.
Step 3	**sts-1 number** **Example:** `Router(config-controller)# sts-1 3`	Legal sts-1 number values are 1 to 12. Enters STS-1 path configuration mode. From the STS-1 path configuration mode, you can configure the mode of operation to be vt-15 (Virtual Tributary Group structure VT1.5, which is used for DS1 transport) or ct3 (channelized T3).
Step 4	**mode** {**vt-15** | **ct3**} **Example:** `Router(config-ctrlr-sts1)# mode vt-15`	Selects the STS-1 mode of operation. Default is **ct3**. DS1 signals are multiplexed in one of two methods: Virtual Tributary Group (VTG) structure VT1.5 mapping, which is used for DS1 transport, or T1 PDH M13 mapping (channelized T3, or CT3), which multiplexes DS1 signals asynchronously to form a DS3 signal. When you select ct3, the specified STS-1 will carry a DS3 signal divided into 28 T-1s (multiplexed asynchronously). . When you select vt-15, the specified STS-1 is divided into seven virtual tributary groups (VTGs). Each of those VTGs is then divided into four VT1.5s, each carrying one T1. .

Configuring T3 Links with SONET Framing

You can configure T3 links from the STS-1 path configuration level when ct3 is the STS-1 mode of operation.

Summary Steps

1. **t3 framing** [**auto-detect** | **c-bit** | **m23**
2. **t3 clock source** [**internal** | **line**]
3. **t3 equipment {customer | network } loopback**

Detailed Steps

	Command	Purpose
Step 1	**t3 framing** [**auto-detect**	**c-bit**	**m23**] **Example:** `Router(config-crtlr-sts1)# t3 framing m23`	Specifies the framing type for the T3 link. Default is auto-detect. **Note** The M23 framing type might be referred to as M13 in other technical literature and on test equipment. Auto-detect identifies the framing type the line card is receiving from the far end and then transmits with that same framing type.
Step 2	**t3 clock source** [**internal**	**line**] **Example:** `Router(config-crtlr-sts1)# t3 clock source line`	Sets the clock source for the selected T3 link. The default is **internal**. **Note** On a T3 circuit, at least one end must provide the clock source (by using the internal clock source). The other end of the T3 circuit can use either line or internal as the clock source.
Step 3	**t3 equipment {customer	network } loopback** **Example:** `Router(config-ctrlr-sts1)# t3 equipment customer loopback`	The default is **t3 equipment customer loopback**. The **equipment customer loopback** command enables the line card to respond to remote T3 link loopback commands from the remote T3 equipment . The **equipment network loopback** command enables the line card to ignore remote T3 link loopback commands,

Configuring T1 Lines Under SONET Framing

With SONET framing, you can configure T1s in vt-15 or in ct3 mode.

Procedures and examples for configuring T1 channel-groups on the 1-Port CHOC-12 ISE line card are presented in the following sections:

Configuring a T1 in SONET Virtural Tributary Mode

Summary Steps:

1. **vtg** *vtg-number* **t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* [**speed** {**56** | **64**}]
2. **vtg** *vtg-number* **t1** *t1-line-number* **framing** {**esf** | **sf** [**hdlc-idle** {**0x7E** | **0xFF**}]}
3. **vtg** *vtg-number* **t1** *t1-line-number* **clock source** {**internal** | **line**}

Detailed Steps

	Command	Purpose
Step 1	**vtg** *vtg-number* **t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* [**speed** {**56**	**64**}] **Example**: `Router(config-crtlr-sts1)# vtg 1 t1 1 channel-group 15 timeslots 1-5, 20-23`	Creates a logical channel group for a T1 line from the STS-1 configuration level. In vt-15 mode, the range of the *t1-line-number* parameter is 1 to 5. The **channel-group** keyword defines a logical channel group to identify the set of timeslots allocated to this *n* x DS0 channel in the channelized T1 line (where *n* ranges from 1 to 24 DS0 timeslots). The **timeslots** keyword creates the combination of subranges . The default speed for DS0 timeslots is 64 Kbps. In this example, the first T1 line is assigned to logical channel group 15 with channelized timeslots 1 to 5, and 20 to 23. The DS0 speed per timeslot is 64 Kbps.

	Command	Purpose
Step 2	**vtg** *vtg-number* **t1** *t1-line-number* **framing** {**esf** | **sf** [**hdlc-idle** {**0x7E** | **0xFF**}]} **Example:** `Router(config-crtlr-sts1)# vtg 1 t1 1 framing esf`	Specifies the T1 framing format. The default framing format is Extended Super Frame (ESF). Super Frame (SF) format offers the hdlc-idle option, which can be set to use either 0x7E or 0xFF as the HDLC idle pattern. **Note** When you select SF framing, consider using the **no** *t1-line-number* **yellow detection** command to turn off yellow alarm detection, because the yellow alarm can be incorrectly detected with SF framing.
Step 3	**vtg** *vtg-number* **t1** *t1-line-number* **clock source** {**internal** | **line**} **Example:** `Router(config-crtlr-sts1)# vtg 1 t1 1 clock source line`	Sets the internal or line (network) clock source. The value of n depends on the mode of operation selected: In ct3 mode, n = 28; in vt-15 mode, n = 4. Defines the clock source for the T1 line. The default clock source is internal. Defines the clock source for the T1 line. The default clock source is internal.

Configuring a T1 in SONET CT3 Mode

The CT3 mode is the default mode for STS-1 with SONET framing

Summary Steps

1. **t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* **[speed {56 | 64}]**
2. **t1** *t1-line-number* **framing {esf | sf [hdlc-idle {0x7E | 0xFF}]}**
3. **t1** *t 1-line-number* **clock source {internal | line}**

Detailed Steps

	Command	Purpose
Step 1	**t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* [**speed** {**56** | **64**}] **Example:** `Router(config-ctrlr-sts1)# t1 1 channel-group 15 timeslots 1-5, 20-23`	Configured in STS-1 configuration mode, creates a logical channel group on a T1 line. Default speed is 64 kbps. • The example shows the configuring a logical channel group in ct3 mode. The first T1 line is assigned to logical channel group 15 with channelized timeslots 1 to 5, and 20 to 23.
Step 2	**t1** *t1-line-number* **framing** {**esf** | **sf** [**hdlc-idle** {**0x7E** | **0xFF**}]} **Example:** `Router(config-crtlr-sts1)# t1 1 framing sf`	Specifies the T1 framing format. Default is Extended Super Frame (ESF). Super Frame (SF) format offers the hdlc-idle option, which can be set to use either 0x7E or 0xFF as the HDLC idle pattern. **Note** When you select SF framing, consider using the **no** *t1-line-number* **yellow detection** command to turn off yellow alarm detection, because the yellow alarm can be incorrectly detected with SF framing.
Step 3	**t1** *t1-line-number* **clock source** {**internal** | **line**} **Example:** `Router(config-crtlr-sts1)# t1 1 clock source line`	Sets the internal or line (network) clock source. Default is internal.

After a T1 channel group is configured, it appears to the Cisco IOS software as a serial interface; therefore, all the configuration commands for a serial interface are available, but not all commands are applicable to the T1 channel group.

All the encapsulation formats, such as PPP, HDLC, and Frame Relay are applicable to the configured T1 channel group. Be sure that you are in serial interface configuration mode when you set the encapsulation format.

All the switching types that are applicable to a serial interface are also applicable to the configured T1 channel group.

Note When a timeslot on a tributary is disabled, an idle pattern is transmitted on that slot. The **idle pattern *number*** STS-1 configuration command changes the idle pattern globally for all the serial interfaces on all 12 STS-1 paths. Under most operating circumstances there is no need to change the default values of the **idle pattern** STS-1 configuration command.

Removing a Logical Channel Group from a T1 Line

You can remove a logical channel group from a T1 line (or a T1 line) with the **no** form of the **t1** *t1-line-number* **channel-group** *channel-group-number* STS-1 path configuration command, using the extended command prefix that is appropriate to your channelized configuration.

To configure a T1 line, you must enter controller configuration mode and specify the line card slot and port. The following examples show a SONET controller in slot 6 and port 0.

- The following example shows the process of removing a logical channel group in vt15 mode:

```
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# no vtg 1 t1 1 channel-group 15 timeslots 1-5, 20-23
Router(config-ctrlr-sts1)#
```

- The following example shows the process of removing a logical channel group in ct3 mode, which means that no extended command prefix is required:

```
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# no t1 1 channel-group 15 timeslots 1-5, 20-23
Router(config-ctrlr-sts1)#
```

Using the ping Command to Verify Network Connectivity

Using the **ping** command, you can verify that an interface port is functioning properly. The **ping** command sends echo request packets out to a remote device at an IP address that you specify. After sending an echo request, the system waits a specified time for the remote device to reply. Each echo reply is displayed as an exclamation point (!) on the console terminal; each request that is not returned before the specified timeout is displayed as a period (.). A series of exclamation points (!!!!!) indicates a good connection; a series of periods (.....) or the messages [timed out] or [failed] indicate a bad connection.

Following is an example of a successful **ping** command to a remote server with the address 10.0.0.10:

```
Router# ping 10.0.0.10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 10.0.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/15/64 ms
Router#
```

If the connection fails, verify that you have the correct IP address for the destination and that the device is active (powered on), then repeat the **ping** command.

Proceed to the next section, "Using T1 Interface Loopback Modes," to finish checking network connectivity.

Using T1 Interface Loopback Modes

If you have difficulty with the 1-Port CHOC-12 ISE line card configuration or installation, you can troubleshoot the problem using the **t1** *t1-line-number* **loopback** [**local** | **network** {**line** | **payload**} | **remote** {**line fdl** {**ansi** | **bellcore**} | **payload** [**fdl**] [**ansi**]}] path configuration command, using the

extended command prefix that is appropriate to your channelized configuration. In vt-15 mode, *t1-line-number* is a number in the range from 1 to 4; in ct3 mode, *t1-line-number* is a number in the range from 1 to 28. Table 2 describes the supported loopback modes within the syntax of this command.

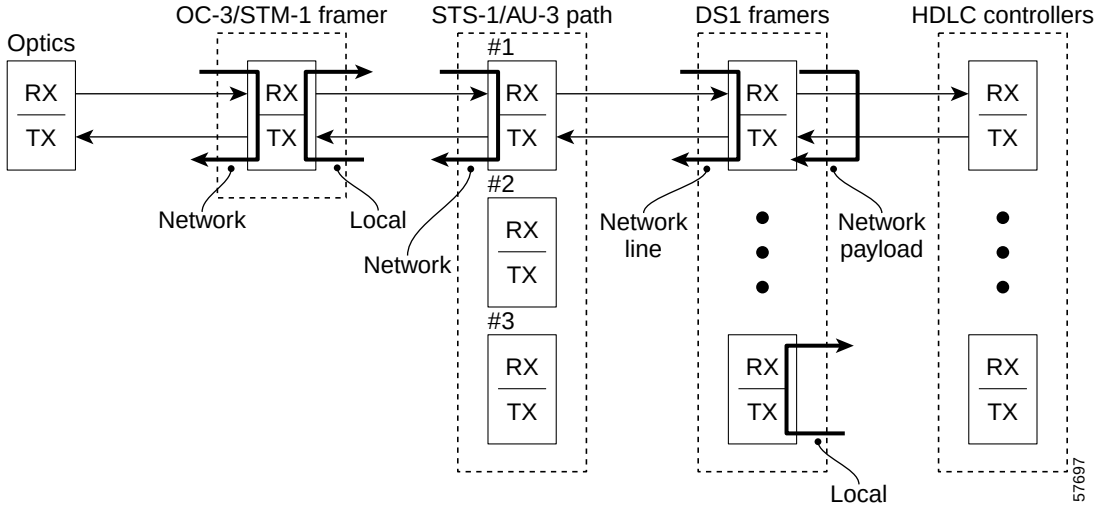
Note **fdl loopback** commands are available only for T1 links configured for ESF framing.

Table 2 provides explanations of specific T1 loopback modes.

Table 2 Supported T1 Interface Loopback Modes

local	Optional. Loops the router output data back toward the router at the T1 framer.
network {**line** | **payload**}	Optional. Selecting **network line** loops the data back toward the network before the T1 framer. Selecting **network payload** sets a loopback that works much like the **network line** loopback, except that the T1 framing bits are stripped at the receive side of the T1 framer and regenerated at the transmit side of the T1 framer (toward the network). If the T1 channel is configured for internal clocking and you attempt to set a **network payload** loopback, you will receive the following warning message: `This channel is configured for Internal clocking. Data integrity in network payload loopback is guaranteed only if the opposite end is configured for Line clocking, or vice versa.` Either the local port should be **internal**, and the remote port **line**, or the local port should be **line**, and the remote port **internal**.
remote line fdl {**ansi** | **bellcore**}	Optional. Sends a repeating, 16-bit ESF data link code word (00001110 11111111 for ANSI; 00010010 11111111 for Bellcore) 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, per the ANSI T1.403 specification. Specify the **bellcore** keyword to enable the remote SmartJack loopback on the T1 channel, per the TR-TSY-000312 specification.
remote payload [**fdl**] [**ansi**]	Optional. 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 Facility Data Link (FDL) ANSI bit loopback on the T1 channel. You can optionally specify **fdl** and **ansi**, but it is not necessary.

Figure 1 T1 Link Loopbacks under SONET Framing with VT1.5 Mode



The following examples show how to specify loopbacks for a T1 line in vt-15 mode:

- To set a T1 line into local loopback mode, use the **loopback local** path configuration command.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 loopback local
Router(config-ctrlr-sts1)#
```

- To set a T1 line into network line loopback mode, use the **loopback network line** path configuration command.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 loopback network line
Router(config-ctrlr-sts1)#
```

- To set a T1 line into network payload loopback mode, use the **loopback network payload** path configuration command.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 loopback network payload
Router(config-ctrlr-sts1)#
```

- To set a T1 line into **remote line fdl ansi** loopback, use the **loopback remote line fdl ansi** path configuration command.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 loopback remote line fdl ansi
Router(config-ctrlr-sts1)#
```

- To set the first T1 line into remote payload fdl ansi bit loopback, use the **loopback remote payload fdl ansi** path configuration command.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 loopback remote payload fdl ansi
Router(config-ctrlr-sts1)#
```

Enabling Remote Performance Reports

To enable and disable 1-second transmissions of performance reports through the Facility Data Link (FDL), use the **t1** *t1-line-number* **fdl ansi** configuration command, using the extended command prefix that is appropriate to your channelized configuration. The command must be used on both ends of the connection. In this command, *t1-line-number* is a number in the range from 1 to 4 in vt-15 mode, and 1 to 28 in ct3 mode.

The following example shows how to enable performance reports for a T1 line in vt-15 mode:

```
Router(config)# controller sonet 6/0
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 4 t1 1 fdl ansi
Router(config-ctrlr-sts1)#
```

Note You can use this command *only* when the T1 framing is ESF. Use the **no** form of the command to disable remote performance reports. The 1-Port CHOC-12 ISE line card supports the reporting of controlled slip seconds (CSS). Controlled slip seconds are reported from the far end only when a network payload loopback is set.

Note If you do not first enable remote performance data with the **t1** *t1-line-number* **fdl ansi** command, the following message is displayed:

```
T1 1 - Remote Performance Data (Not available)
```

Configuring a BER Test on a T1 Line

For explanations on how to send, display and terminate a BER test on a T1 line, see the document, *Bit Error Rate Testing on Channelized Line Cards in Cisco 12000 Series Internet Routers* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s21/bert.htm

Configuring Attributes Under SDH Framing

Procedures and examples for configuring attributes under SDH framing are presented in the following sections:

Configuring the Mapping of an Administrative Unit Group (AUG)

In SDH, there are two possible mapping/multiplexing schemes for most payload types: ANSI and ETSI.

In ANSI mapping, the Low Order payloads are aggregated into a VC-3 High Order Path. An AU pointer is added to the VC-3 to create an AU-3 (Administrative Unit type 3). Three such AU-3s are then synchronously multiplexed into an AUG (AU group). The multiplexing scheme is as follows:

…VC-3 to AU-3 (x3) to AUG to STM-1

SDH ANSI mapping is very similar to the SONET frame structure.

In ETSI mapping, the Low Order payloads are aggregated into a VC-4 High Order Path. An AU pointer is added to the VC-4 to create an AU-4 (Administrative Unit type 4). One AU-4 is "multiplexed" into an AUG (AU group), which is to say, the AUG is, in fact, equivalent to an AU-4. The multiplexing scheme is as follows:

…TUG-3 (x3) to VC-4 to AU-4 (x1) to STM-1

To specify the AUG mapping, use the controller command **aug mapping** {**au-3** | **au-4**}. The default is operation using AU-4 mapping.

Note This command is available only when SDH framing is configured.

The example that follows selects AU-3 mapping for port 1 of the 1-Port CHOC-12 ISE line card in slot 2 of a Cisco 12000 Series Router:

```
Router(config)# controller sonet 2/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-3
```

Configuring a TUG-3 or AU-3

Under SDH framing with AUG mapping set to AU-4, the VC-4 High Order Path comprises three TUG-3s. Each TUG-3 can be configured to carry up to 21 E1s, mapped into VC-12s. The mode of operation of a TUG-3 is not configurable, and defaults to **mode c-12**.

Under SDH framing with AUG mapping set to AU-3, each VC-3 High Order Path can be configured to carry up to 28 T-1s, mapped into VC-11s. The mode of operation of an AU-3 is not configurable, and defaults to **mode c-11**.

Note When configured for SDH framing, the 1-Port CHOC-12 ISE line card supports channelization to E1s when the AUG mapping is set to AU-4, and channelization to T-1s when the AUG mapping is set to AU-3. Different combinations of payload types and AUG mappings are not supported.

Entering TUG-3 Configuration Mode

To configure a TUG-3, use the **au-4** *au-4-number* **tug-3** *tug-3-number* controller configuration command to enter TUG-3 configuration mode, which is indicated by a change in the command prompt. Table 4 describes the syntax of this command.

Table 3 au-4 tug-3 Command Syntax

	Range	Description
aug-4-number	1 to N	A number in the range from 1 to N, where N is the STM level. (For the 1-Port CHOC-12 ISE line card, N is 12.)
tug-3-number	1 to 3	A number in the range from 1 to 3.

In the example that follows, the second TUG-3 of the AU-4 of the 1-Port CHOC-12 ISE line card in slot 4 of a Cisco 12000 Series Router is selected for configuration:

```
Router(config)# controller sonet 4/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)#
```

Entering AU-3 Configuration Mode

To configure an AU-3, use the **au-3** *au-3-number* controller configuration command to enter AU-3 configuration mode, which is indicated by a change in the command prompt. *au-3-number* is a number in the range from 1 to 3.

In the example that follows, the second AU-3 the 1-Port CHOC-12 ISE line card in slot 4 of a Cisco 12000 Series Router is selected for configuration:

```
Router(config)# controller sonet 4/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-3
Router(config-controller)# au-3 2
Router(config-ctrlr-au3)#
```

Configuring T1 Lines Under SDH Framing

Procedures and examples for configuring T1 channel-groups on the 1-Port CHOC-12 ISE line card are presented in the following sections:

Using Extended Configuration Commands for T1 Lines in AU-3 Configuration Mode

In AU-3 configuration mode, you must add the **tug-2** *tug-2-number* modal prefix to the commands used to configure T1 line attributes, where *tug-2-number* is a number in the range from 1 to 7. For example, the AU-3 configuration command to configure the T1 framing takes the form:

tug-2 *tug-2-number* **t1** *t1-line-number* **framing** {**esf** | **sf**}

Similarly, when you want to negate or reset the effects of a command by using the **no** form of the command, you must apply the **no** form of the extended command.

Creating a Logical Channel Group on a T1 Line

You can create a logical channel group on a T1 line using the **tug-2** *tug-2-number* **t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* [**speed** {**56** | **64**}] AU-3 configuration command. Table 4 describes the syntax of this command.

Table 4 T1 Line Channel Group Syntax

	Range	Description
tug-2 *tug-2-number*	1 to 7	When framing is SDH, AUG mapping is AU-3, and mode of operation is c-11, *tug-2-number* is a number in the range from 1 to 7.
t1 *t1-line-number*	1 to 4	In c-11 mode, a number in the range from 1 to 4.
channel-group *channel-group-number*	0 to 23	Defines a logical channel group, identifying the set of timeslots allocated to this *n* x DS0 channel in the channelized T1 line (where *n* ranges from 1 to 24 timeslots).

Table 4 T1 Line Channel Group Syntax (continued)

	Range	Description
timeslots *list-of-timeslots*	1 to 24	Combination of subranges within 1 to 24 (each subrange is a list of timeslots that makes up the T1 line).
speed {**56** | **64**}	56 or 64 kbps	Optional keyword and argument that sets the DS0 speed. The default speed is 64 kbps.

To configure a T1 line, you must enter SONET controller configuration mode and specify the line card slot and port, and then enter AU-3 configuration mode.

The following example shows the process of configuring a logical channel group in c-11 mode. The first T1 line in the fourth TUG-2 group is assigned to logical channel group 15 with channelized timeslots 1 to 5, and 20 to 23:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 channel-group 15 timeslots 1-5, 20-23
Router(config-ctrlr-au3)#
```

Note After a T1 channel group is configured, it appears to the Cisco IOS software as a serial interface; therefore, all the configuration commands for a serial interface are available, but not all commands are applicable to the T1 channel group.

All the encapsulation formats, such as PPP, HDLC, and Frame Relay are applicable to the configured T1 channel group. Be sure that you are in serial interface configuration mode when you set the encapsulation format.

All the switching types that are applicable to a serial interface are also applicable to the configured T1 channel group.

Removing a Logical Channel Group from a T1 Line

You can remove a logical channel group from a T1 line (or a T1 line) with the **no** form of the **tug-2** *tug-2-number* **t1** *t1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* [**speed** {**56** | **64**}] AU-3 configuration command.

The following example shows the process of removing a logical channel group in c-11 mode, and uses port 0 of the 1-Port CHOC-12 ISE line card in slot 6 of a Cisco 12000 Series Router. The first T1 line in the fourth TUG-2 group is being removed from logical channel group 15 with channelized timeslots 1 to 5, and 20 to 23:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# no tug-2 4 t1 1 channel-group 15 timeslots 1-5, 20-23
Router(config-ctrlr-au3)#
```

Setting the Framing Format on a T1 Line

You can specify the T1 framing format using the **tug-2** *tug-2-number* **t1** *t1-line-number* **framing** {**esf** | **sf**} AU-3 configuration command. Table 5 describes the syntax of this command.

Table 5 T1 Line Framing Command Syntax

	Range	Description
tug-2 *tug-2-number*	1 to 7	When framing is SDH, AUG mapping is AU-3, and mode of operation is c-11, *tug-2-number* is a number in the range from 1 to 7.
t1 *t1-line-number*	1 to 4	In c-11 mode, a number in the range from 1 to 4.
framing {**esf** | **sf** [**hdlc-idle** {**0x7E** | **0xFF**}]}	Extended Super Frame (ESF) or Super Frame (SF)	Defines the type of framing for the T1 line. The default framing format is Extended Super Frame (ESF). Super Frame format offers the **hdlc-idle** option, which can be set to use either 0x7E or 0xFF as the HDLC idle pattern.

To configure a T1 line, you must enter controller configuration mode and specify the line card slot and port. The following examples use port 0 of a SONET controller in slot 6.

- The following example selects ESF framing for the first T1 line in the fourth TUG-2:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 framing esf
Router(config-ctrlr-au3)#
```

- The following example selects SF framing with an HDLC idle pattern of 0x7E for the first T1 line in the fourth TUG-2:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 framing sf hdlc-idle 0x7e
Router(config-ctrlr-au3)#
```

Note When you select SF framing, consider using the **no** *t1-line-number* **yellow detection** command to turn off yellow alarm detection, because the yellow alarm can be incorrectly detected with SF framing. You can use the [**no**] **t1** *t1-line-number* **yellow** {**detection** | **generation**} command (where *t1-line-number* is 1 to 28) to turn the detection or generation of a yellow alarm on and off.

Setting the Clock Source on a T1 Line

You can set the internal or line (network) clock source for a T1 line with the **tug-2** *tug-2-number* **t1** *t1-line-number* **clock source** {**internal** | **line**} AU-3 configuration command. Table 6 describes the syntax of this command.

Table 6 T1 Line Clock Source Command Syntax

	Range	Description
tug-2 *tug-2-number*	1 to 7	When framing is SDH, AUG mapping is AU-3, and mode of operation is c-11, *tug-2-number* is a number in the range from 1 to 7.
t1 *t1-line-number*	1 to 4	In c-11 mode, a number in the range from 1 to 4.
clock source {**internal** | **line**}	internal or line	Defines the clock source for the T1 line. The default clock source is **internal**.

Note On a T1 circuit, one end *must* provide the clock source by using the internal clock source. The other end of the circuit can use either **line** or **internal** as the clock source.

- The following example selects internal clocking for the first T1 line in the fourth TUG-2:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 clock source internal
Router(config-ctrlr-au3)#
```

- The following example selects line clocking for the first T1 line in the fourth TUG-2:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 clock source line
Router(config-ctrlr-au3)#
```

Using the ping Command to Verify Network Connectivity

Following is an example of a successful **ping** command to a remote server with the address 10.0.0.10:

```
Router# ping 10.0.0.10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 10.0.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/15/64 ms
Router#
```

If the connection fails, verify that you have the correct IP address for the destination and that the device is active (powered on), then repeat the **ping** command.

Proceed to the next section, "Using T1 Interface Loopback Modes," to finish checking network connectivity.

Using T1 Interface Loopback Modes

If you have difficulty with the 1-Port CHOC-12 ISE line card configuration or installation, you can troubleshoot the problem using the **tug-2** *tug-2-number* **t1** *t1-line-number* **loopback** [**local** | **network** {**line** | **payload**} | **remote** {**line fdl** {**ansi** | **bellcore**} | **payload** [**fdl**] [**ansi**]}] AU-3 configuration command. In c-11 mode, *t1-line-number* is a number in the range from 1 to 4. Table 7 describes the supported loopback modes within the syntax of this command.

Note **fdl loopback** commands are available only for T1 links configured for ESF framing.

Table 7 provides explanations of specific T1 loopback modes.

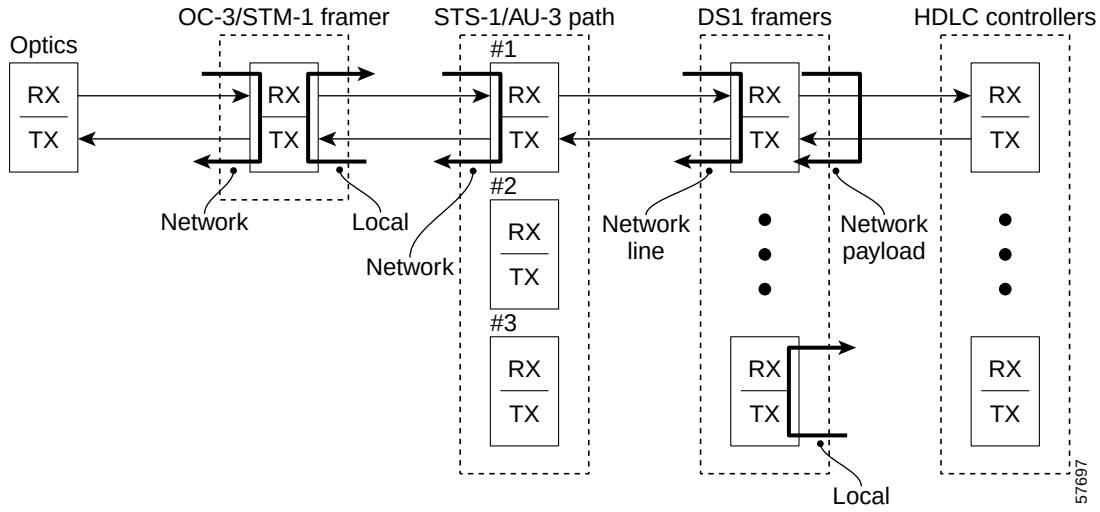
Table 7 T1 Interface Loopback Modes under SDH Framing with AU-3 AUG Mapping

local	Optional. Loops the router output data back toward the router at the T1 framer.
network {**line** | **payload**}	Optional. Selecting **network line** loops the data back toward the network before the T1 framer. Selecting **network payload** sets a loopback that works much like the **network line** loopback, except that the T1 framing bits are stripped at the receive side of the T1 framer and regenerated at the transmit side of the T1 framer (toward the network). If the T1 channel is configured for internal clocking and you attempt to set a **network payload** loopback, you will receive the following warning message: `This channel is configured for Internal clocking. Data integrity in network payload loopback is guaranteed only if the opposite end is configured for Line clocking, or vice versa.` Either the local port should be **internal**, and the remote port **line**, or the local port should be **line**, and the remote port **internal**.
remote line fdl {**ansi** | **bellcore**}	Optional. Sends a repeating, 16-bit ESF data link code word (00001110 11111111 for ANSI; 00010010 11111111 for Bellcore) 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, per the ANSI T1.403 specification. Specify the **bellcore** keyword to enable the remote SmartJack loopback on the T1 channel, per the TR-TSY-000312 specification.

Table 7 T1 Interface Loopback Modes under SDH Framing with AU-3 AUG Mapping (continued)

remote payload [**fdl**] [**ansi**]	Optional. 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 Facility Data Link (FDL) ANSI bit loopback on the T1 channel. You can optionally specify **fdl** and **ansi**, but it is not necessary.

Figure 2 T1 Link Loopbacks under SDH Framing with AU-3 AUG Mapping



The following examples set loopbacks for a T1 line in c-11 mode:

- To set a T1 line into local loopback mode, use the **loopback local** AU-3 configuration command.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 loopback local
Router(config-ctrlr-au3)#
```

- To set a T1 line into network line loopback mode, use the **loopback network line** AU-3 configuration command.

```
Router(config-ctrlr-au3)# tug-2 4 t1 1 loopback network line
Router(config-ctrlr-au3)#
```

- To set a T1 line into network payload loopback mode, use the **loopback network payload** AU-3 configuration command.

```
Router(config-ctrlr-au3)# tug-2 4 t1 1 loopback network payload
Router(config-ctrlr-au3)#
```

- To set a T1 line into **remote line fdl ansi** loopback, use the **loopback remote line fdl ansi** controller configuration command.

```
Router(config-ctrlr-au3)# tug-2 4 t1 1 loopback remote line fdl ansi
Router(config-ctrlr-au3)#
```

- To set the first T1 line into remote payload fdl ansi bit loopback, use the **loopback remote payload fdl ansi** controller configuration command.

```
Router(config-ctrlr-au3)# tug-2 4 t1 1 loopback remote payload fdl ansi
Router(config-ctrlr-au3)#
```

Enabling Remote Performance Reports

To enable and disable 1-second transmissions of performance reports through the Facility Data Link (FDL), use the **tug-2** *tug-2-number* **t1** *t1-line-number* **fdl ansi AU-3** configuration command. The command must be used on both ends of the connection. In this command, *t1-line-number* is a number in the range from 1 to 4 in c-11 mode.

The following example shows how to enable performance reports for a T1 line in c-11 mode:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 4 t1 1 fdl ansi
Router(config-ctrlr-au3)#
```

You can use this command *only* when the T1 framing is ESF. Use the **no** form of the command to disable remote performance reports. The 1-Port CHOC-12 ISE line card supports the reporting of controlled slip seconds (CSS). Controlled slip seconds are reported from the far end only when a network payload loopback is set.

Note If you do not first enable remote performance data with the **t1** *t1-line-number* **fdl ansi** command, the following message is displayed:

```
T1 1 - Remote Performance Data (Not available)
```

Configuring a BER Test on a T1 Line under SDH Framing with AU-3 AUG Mapping

For explanations on how to send, display and terminate a BER test on a T1 line, see the document, *Bit Error Rate Testing on Channelized Line Cards in Cisco 12000 Series Internet Routers* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s21/bert.htm

Configuring E1 Lines under SDH Framing with AU-4 AUG Mapping

Procedures and examples for configuring E1 channel-groups on the 1-Port CHOC-12 ISE line card are presented in the following sections:

Creating a Logical Channel Group on a E1 Line under SDH Framing with AU-4 AUG Mapping

E1 channels are supported under SDH framing, with AUG mapping set to AU-4. Configuration of the 63 E1s is done per TUG-3 (see the "Entering TUG-3 Configuration Mode" section on page 23). Each TUG-3 comprises 7 TUG-2s. Each TUG-2 can be configured to carry up to 3 E1s mapped into TU-12s.

To configure a logical channel group on an E1 line, use the **tug-2** *tug-2-number* **e1** *e1-line-number* **channel-group** *channel-group-number* **timeslots** *list-of-timeslots* TUG-3 configuration command. Table 8 describes the syntax of this channel group command:

Table 8 E1 Line Channel Group Syntax

	Range	Description
tug-2 *tug-2-number*	1to 7	Specifies the TUG-2 number in the selected TUG-3.
e1 *e1-line-number*	1 to 3	A TUG-2 can carry three TU-12s, each of which can carry a channelized E1 frame.
channel-group *channel-group-number*	0 to 30	Defines a logical channel group, identifying the set of timeslots allocated to this *n* x E0 channel in the channelized E1 line, where *n* is a timeslot number in the range from 1 to 31.
timeslots *list-of-timeslots*	1 to 31	Combination of subranges within 1 to 31 (each subrange is a list of timeslots that makes up the E1 line).

To configure an E1 line, you must enter SONET controller configuration mode and specify the line card slot and port, and then enter the command mode appropriate to the selected framing type and mode of operation for the for the TUG-3 of an AU-4. The following example shows the first E1 line in the fourth TUG-2 group being assigned to logical channel group 15 with channelized timeslots 1 to 5, and 20 to 23:

```
Router(config)# controller sonet 6/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# mode c-12
Router(config-ctrlr-tug3)# tug-2 4 e1 1 channel-group 15 timeslots 1-5, 20-23
Router(config-ctrlr-tug3)#
```

Note After an E1 channel group is configured, it appears to the Cisco IOS software as a serial interface; therefore, all the configuration commands for a serial interface are available, but not all commands are applicable to the E1 channel group.

All the encapsulation formats, such as PPP, HDLC, and Frame Relay are applicable to the configured E1 channel group. Be sure that you are in serial interface configuration mode when you set the encapsulation format.

All the switching types that are applicable to a serial interface are also applicable to the configured E1 channel group.

Removing a Logical Channel Group from an E1 Line under SDH Framing with AU-4 AUG Mapping

You can remove a logical channel group from an E1 line with the **no tug-2** *tug-2-number* **e1** *e1-line-number* **channel-group** *channel-group-number* TUG-3 configuration command, where:

- *tug-2-number* is 1 to 7.
- *e1-line-number* is 1 to 3.
- *channel-group-number* is 0 to 30.

To configure an E1 line, you must enter SONET controller configuration mode and specify the line card slot and port, and then enter the command mode appropriate to the selected framing type and mode of operation for the for the TUG-3 of an AU-4. The following example shows a SONET controller in slot 6 and port 0.

The following example removes logical channel group 10 from channelized E1 line 1 of TUG-2 number 4 in TUG-3 number 2.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 tug-3 2
Router(config-ctrlr-tug3)# no tug-2 4 e1 1 channel-group 10
Router(config-ctrlr-tug3)#
```

Creating an Unframed Logical Channel Group on an E1 Line

You can configure any of the E1 lines as unframed E1 data lines. An unframed E1 line contains no framing byte in timeslot 0. Unframed E1s are not divided into timeslots, thus allowing the full 2048 kbps bandwidth to be allocated to user data. Having no framing byte nor CRC-4 error detection, unframed E1s offer fewer performance monitoring and alarm detection capabilities than framed E1s.

To configure an unframed E1 line, use the **tug-2** *tug-2-number* **e1** *e1-line-number* **unframed** TUG-3 configuration command, where:

- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.

To configure an E1 line, you must enter SONET controller configuration mode and specify the line card slot and port, and then enter the command mode appropriate to the selected framing type and mode of operation for the for the TUG-3 of an AU-4. The following example shows the first E1 line in the fourth TUG-2 group being configured as an unframed E1:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 unframed
Router(config-ctrlr-tug3)#
```

Note After an unframed E1 logical channel group is configured, it appears to the Cisco IOS software as a serial interface with channel group number zero. The configuration commands in the previous example will create a serial interface with the following address: interface serial 6/0.1/2/4/1:0 (see Table 10 for interface naming details).

Setting the Framing Format on an E1 Line

You can specify the E1 framing format using the **tug-2** *tug-2-number* **e1** *e1-line-number* **framing** {**crc4** | **no-crc4**} TUG-3 configuration command, where:

- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.
- *e1-line-number* is a number in the range from 1 to 3.
- **crc4** sets the framing format to E1 with a 4-bit cyclic redundancy check (PCM31 CRC4). The default framing format is **crc4**.
- **no-crc4** sets the framing format to E1 without a 4-bit cyclic redundancy check (PCM31).

To configure an E1 line, you must enter SONET controller configuration mode and specify the line card slot and port, and then enter the command mode appropriate to the selected framing type and mode of operation for the for the TUG-3 of an AU-4. The following examples use port 0 of a SONET controller in slot 6.

- The following example shows how to set crc4 framing format for E1 line 1:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 framing crc4
Router(config-ctrlr-tug3)#
```

- The following example shows how to set **no-crc4** framing format for E1 line 1:

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 framing no-crc4
Router(config-ctrlr-tug3)#
```

Setting the Clock Source on an E1 Line

To specify where the clock source is obtained for an E1 line, use the **tug-2** *tug-2-number* **e1** *e1-line-number* **clock source** {**internal** | **line**} TUG-3 configuration command, where:

- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.
- **internal** specifies that the internal clock source is used. The default clock source is **internal**.
- **line** specifies that the network clock source, recovered from the received signal, is used.

Note On an E1 circuit, one end *must* provide the clock source by using the internal clock source. The other end of the circuit can use either **line** or **internal** as the clock source.

- The following example shows how to instruct E1 line 1 to use an internal clock source.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 clock source internal
Router(config-ctrlr-tug3)#
```

- The following example shows how to instruct E1 line 3 to use a line clock source.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 3 clock source line
Router(config-ctrlr-tug3)#
```

Setting the National Bits on an E1 Line

To configure the national reserve bit pattern for an E1 line, use the **tug-2** *tug-2-number* **e1** *e1-line-number* **national bits** *pattern* TUG-3 configuration command, where:

- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.
- *pattern* is a value in the range from 0x0 to 0x1F (hexadecimal) or 0 to 31 (decimal). The default value is 0x1F (or 31).

The following example sets the national bit pattern to 0x0 on the first E1 line in the fourth TUG-2.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 national bits 0x0
Router(config-ctrlr-tug3)#
```

Using the ping Command to Verify Network Connectivity

Following is an example of a successful **ping** command to a remote server with the address 10.0.0.10:

```
Router# ping 10.0.0.10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 10.0.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/15/64 ms
Router#
```

If the connection fails, verify that you have the correct IP address for the destination and that the device is active (powered on), then repeat the **ping** command.

Proceed to the next section, "Using E1 Interface Loopback Modes," to finish checking network connectivity.

Using E1 Interface Loopback Modes

If you have difficulty with the 1-Port CHOC-12 ISE line card configuration or installation, you can troubleshoot the problem using the supported E1 interface loopback modes:

- Diagnostic, or local loopback, mode
- Network loopback mode:
  - Line loopback
  - Payload loopback

To set one of these loopback modes, use the **tug-2** *tug-2-number* **e1** *e1-line-number* **loopback** {**local** | **network** {**line** | **payload**}} TUG-3 configuration command, where:

- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.

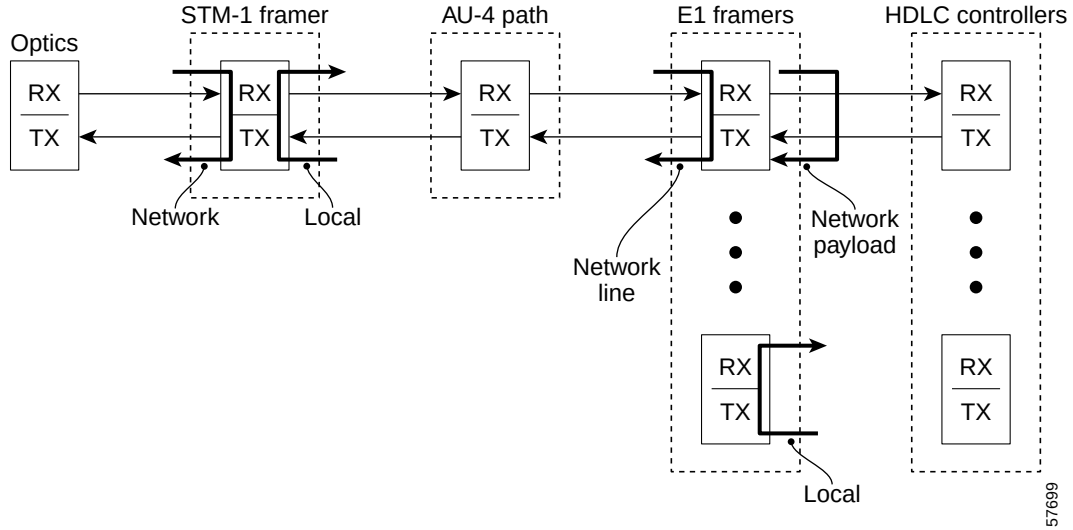
To disable one of these loopback modes, use the **no tug-2** *tug-2-number* **e1** *e1-line-number* **loopback** {**local** | **network** {**line** | **payload**}} TUG-3 configuration command.

Table 9 describes the supported E1 interface loopback modes.

Table 9 1-port ChOC-12/STM-4 to DS1/E1 ISE Line Card E1 Loopback Modes

local	Loops the router output data back toward the router at the E1 framer.
network {**line** | **payload**}	Selecting **network line** loops the data back toward the network before the E1 framer. Selecting **network payload** sets a loopback that works much like the **network line** loopback, except that the E1 framing bits are stripped at the receive side of the E1 framer and regenerated at the transmit side of the E1 framer (toward the network). If the E1 channel is configured for internal clocking and you attempt to set a **network payload** loopback, you will receive the following warning message: `This channel is configured for Internal clocking. Data integrity in network payload loopback is guaranteed only if the opposite end is configured for Line clocking, or vice versa.` Either the local port should be **internal**, and the remote port **line**, or the local port should be **line**, and the remote port **internal**.

Figure 3 E1 Link Loopbacks under SDH Framing with AU-4 AUG Mapping



To set a local loopback on an E1 line, use the **loopback local** TUG-3 configuration command.

```
Router(config)# controller sonet 6/0
Router(config-controller)# au-4 tug-3 2
Router(config-ctrlr-tug3)# tug-2 4 e1 1 loopback local
Router(config-ctrlr-tug3)#
```

To set a network line loopback on an E1 line, use the **loopback network line** TUG-3 configuration command.

```
Router(config-ctrlr-tug3)# tug-2 4 e1 1 loopback network line
Router(config-ctrlr-tug3)#
```

To set a network payload loopback on an E1 line, use the **loopback network payload** TUG-3 configuration command.

```
Router(config-ctrlr-tug3)# tug-2 4 e1 1 loopback network payload
Router(config-ctrlr-tug3)#
```

Configuring a BER Test on an E1 Line

For explanations on how to send, display and terminate a BER test on a E-1 line, see the document, Bit *Error Rate Testing on Channelized Line Cards in Cisco 12000 Series Internet Routers* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s21/bert.htm

Configuring the Serial Interfaces

The following sections describe how to enable an interface and specify IP routing. You may also need to enter other configuration commands, depending on your system configuration requirements. For descriptions of configuration commands and the configuration options available, refer to the appropriate software publications listed in the "Related Documents" section on page 54.

A serial interface is automatically created for each T-1and E1 configured. Table 10 lists the command syntax for the selected framing.

Table 10 Serial Interface Command Format

Framing Configuration	Command Syntax
SDH; AU-4 AUG mapping	**interface serial** *slot/port.au-4-number/tug-3-number/tug-2-number/e1-number*:*channel-group-number*
SDH; AU-3 AUG mapping	**interface serial** *slot/port.au-3-number/tug-2-number/t1-number*: *channel-group-number*
SONET; CT3 mode	**interface serial** *slot/port.sts1-number/t1-number*: *channel-group-number*
SONET; VT1.5 mode	**interface serial** *slot/port.sts1-number/vtg-number/t1-number*: *channel-group-number*

Follow these steps to configure the 1-Port CHOC-12 ISE line card interface, beginning in privileged EXEC mode:

Step 1 Enter the **configure terminal** EXEC command to enter global configuration mode as follows:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

Step 2 Specify the 1-Port CHOC-12 ISE line card interface by entering the **interface serial** global configuration command in the appropriate format (see Table 10).

```
Router(config)# interface serial 2/0.1/2/4/1:15     (for SDH with au-4 AUG mapping)
Router(config-if)#
```

or

```
Router(config)# interface serial 3/0.3/4/1:15     (for SDH with au-3 AUG mapping)
Router(config-if)#
```

or

```
Router(config)# interface serial 4/0.3/5/1:15     (for SONET and vt-15 mode)
Router(config-if)#
```

or

```
Router(config)# interface serial 4/0.3/26:15     (for SONET and ct3 mode)
Router(config-if)#
```

The prompt changes to interface configuration mode.

Step 3 Use the **ip address** interface configuration command to specify an interface by an IP address and subnet mask:

```
Router(config-if)# ip address 10.0.0.1 255.255.255.0
Router(config-if)#
```

Step 4 Add any additional configuration commands required to enable routing protocols and set the interface characteristics.

Step 5 To change the shutdown state to up and enable the interface, use the **no shutdown** interface command:

```
Router(config-if)# no shutdown
Router(config-if)#
```

Step 6 Repeat Step 2 through Step 5 to configure additional interfaces, as required.

Step 7 Enter **exit** to exit configuration mode:

```
Router(config-if)# exit
Router#
```

Step 8 Write the new configuration to nonvolatile random access memory (NVRAM) by using the **copy running-config startup-config** command:

```
Router# copy running-config startup-config
[OK]
Router#
```

Using clear Commands on Serial Interfaces

To reset the hardware logic for a serial interface, use the **clear interface serial** *slot*/*port*.*path*:*channel-group-number* EXEC command, where:

- *path* depends on the interface configuration (SDH framing with AU-4 or AU-3 AUG mapping, or SONET framing in ct3 or vt-15 mode; see Table 10).
- *channel-group-number* is 0 to 30 for an E1 line, or 0 to 23 for a T1 line.

The following example clears serial interface 3/0.1/1/1:1, which is configured in the context of SONET framing in vt-15 mode. The number sequence .1/1/1/:1 corresponds to the *sts-1-number*/*vtg-number*/*t1-line-number*:*channel-group number* sequence.

```
Router# clear interface serial 3/0.1/1/1:1
Router#
```

Note As long as the serial interface is available, you can enter this command immediately after using the **enable** command to enter privileged EXEC mode.

To initialize the counters for a serial interface, use the **clear counters serial** *slot*/*port*.*path*:*channel-group-number* EXEC command, where:

- *path* depends on the interface configuration (SDH framing with AU-4 or AU-3 AUG mapping, or SONET framing in ct3 or vt-15 mode; see Table 10).
- *channel-group-number* is 0 to 30 for an E1 line, or 0 to 23 for a T1 line.

The following example clears the counters for serial interface 3/0.1/1/1:1, which is configured in the context of SONET framing in vt-15 mode. The number sequence .1/1/1:1 corresponds to the *sts-1-number*/*vtg-number*/*t1-line-number*:*channel-group-number* sequence.

```
Router# clear counters serial 3/0.1/1/1:1
Clear “show interface” counters on this interface [confirm]
Router#
```

Note As long as the serial interface is available, you can enter this command immediately after using the **enable** command to enter privileged EXEC mode.

Configuring Automatic Protection Switch

On the 1-Port CHOC-12 ISE line card, you configure APS at the SONET controller level, and not at the interface level as in Packet-Over-Sonet.

The minimum configuration tasks to complete for configuring APS are as follows:

- Configure APS working and protect interfaces

  Use the **aps working** and the **aps protect** controller configuration commands to specify the working and protect channels.

- Configure other APS features (Optional)

  Other APS features include the following:

  - group
  - lockout
  - manual
  - reflector
  - revert
  - signalling
  - timers
  - unidirectional

- Monitor and maintain APS (Optional)

  Use the **show aps**, **show controllers sone**t, and **show interfaces** EXEC commands to monitor APS configurations.

- Configure SONET Alarm Reporting (Optional)

For procedures on how to configure automatic protection switching on the 1-Port CHOC-12 ISE line card, see the document, *Automatic Protection Switching of Packet-over-SONET Circuits*, at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios112/ios112p/gsr/posapsgs.htm

Two SONET connections are required to utilize APS and, in a Telco environment, the SONET circuits must be provisioned for APS. At the time of provisioning, the operation (ie. 1+1), mode (ie. bidirectional) and revert operation (that is, no revert) need to be specified. If the SONET connections are homed on two separate routers (the normal configuration), then a communications channel between the two routers (NOT utilizing the working and protect SONET circuits) needs to be set up for APS communication.

In enabling APS operation, it is recommended to configure the working channel first. Normal operation with 1+1 operation is to configure it as working channel 1.

Configuration on the router hosting the working channel:

```
Router# configure terminal
Router(config)# interface ethernet 0/0
Router(config-if)# ip address 7.7.7.7 255.255.255.0
Router(config-if)# exit
Router(config)# controller sonet  4/0
Router(config-controller)# aps working 1
```

Configuration on the router hosting the protect channel:

```
Router# configure terminal
```

```
Router(config)# interface ethernet 0/0
Router(config-if)# ip address 7.7.7.6 255.255.255.0
Router(config-if)# exit
Router(config)# controller sonet 4/0/0
Router(config-controller)# aps protect 1 7.7.7.7
```

How to Configure Layer 2 Features

This section contains the following procedures:

Configuring Distributed Multilink Point-to-Point Protocol, page 40

Configuring Multilink Frame-Relay, page 42

Configuring Distributed Multilink Point-to-Point Protocol

Configuring Distributed Multilink Point-to-Point Protocol (MLPPP) is presented in the following sections:

- Create a Multilink Bundle, page 40
- Assign a Serial Interface to a Multilink Bundle, page 41
- Disable PPP Multilink Fragmentation, page 42

MLPPP allows you to increase the bandwidth of your network links beyond that of a single T1/E1 line without having to purchase a T-3/E3 line. You can combine T1/E1 lines in a 1-Port CHOC-12 ISE line card on a Cisco 12000 Series Router into a bundle that has the combined bandwidth of multiple T1/E1 lines. This is done by using an MLPPP link. You choose the number of bundles and the number of T1/E1 lines in each bundle.

An individual MLPPP bundle can span across multiple T1/E1s on the same line card, but bundles cannot span across multiple line cards.

Note Distributed Multilink PPP is not supported across multiple Cisco 12000 series line cards.

A bundle can be composed of the following:

- 1 to 8 T1/E1 lines
- Individual T1/E1 line that can span across both ports
- Each T1/E1 component must be of equal bandwidth

For additional information, refer to the document, *Configuring Media-Independent PPP and Multilink PPP* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_c/dcppp.htm.

Create a Multilink Bundle

A multilink bundle consists of a maximum of 8 T1/E1s. To create a multilink bundle, use the following commands beginning in global configuration mode:

Step 1 Enter multilink interface configuration mode:

```
Router# configure terminal
Router(config)# interface multilink group-number
```

Step 2 Assign an IP address to the multilink interface:

```
Router(config-if)# ip address address mask
Router(config-if)#
```

Step 3 Enable PPP encapsulation:

```
Router(config-if)# encapsulation ppp
Router(config-if)#
```

Step 4 Enable Multilink PPP:

```
Router(config-if)# ppp multilink
Router(config-if)#
```

Step 5 Assign the multilink interface to a multilink bundle:

```
Router(config-if)# multilink-group group-number
Router(config-if)#
```

Step 6 Optional. Enable Challenge Handshake Authentication Protocol (CHAP) authentication:

```
Router(config-if)# ppp chap hostname group group-number
Router(config-if)#
```

Note If more than one bundle is configured on the Cisco 12000 series Internet Router, you must add the **ppp chap hostname group** command to both the bundle and link configurations.

Assign a Serial Interface to a Multilink Bundle

To assign a serial interface to a multilink bundle, use the following commands in interface configuration mode:

Step 1 Select the serial interface using the form of the **interface serial** command that is appropriate to your configuration context (see Table 10):

```
Router(config)# interface serial slot/port.number
```

Step 2 Remove any specified IP address.

```
Router(config-if)# no ip address
Router(config-if)#
```

Step 3 Set the frequency of keepalive packets.

```
Router(config-if)# keepalive
Router(config-if)#
```

Step 4 Enable PPP encapsulation.

```
Router(config-if)# encapsulation ppp
Router(config-if)#
```

Step 5 Enable Multilink PPP.

```
Router(config-if)# ppp multilink
Router(config-if)#
```

Step 6 Disable CDP on the serial link.

```
Router(config-if)# no cdp enable
Router(config-if)#
```

Note CDP should be disabled on serial links belonging to an MLPPP bundle because CDP packets cannot be encapsulated on these links. CDP can be enabled on the MLPPP bundle, but not on individual serial links.

Step 7 Assign the interface to a multilink bundle.

```
Router(config-if)# multilink-group group-number
Router(config-if)#
```

Step 8 Optional. Enable Challenge Handshake Authentication Protocol (CHAP) authentication.

```
Router(config-if)# ppp chap hostname group group-number
Router(config-if)#
```

Note If more than one bundle is configured on the Cisco 12000 series Internet Router, you must add the **ppp chap hostname group** command to both the bundle and link configurations.

Disable PPP Multilink Fragmentation

By default, PPP multilink fragmentation is enabled. To disable PPP multilink fragmentation, use the following command in interface configuration mode:

- Disable PPP multilink fragmentation.

```
Router(config-if)# no ppp multilink fragmentation
Router(config-if)# exit
Router#
```

Note Enabling fragmentation reduces the delay latency among bundle links, but adds some load to the CPU. Disabling fragmentation can result in better throughput. If your data traffic is consistently of a similar size, Cisco recommends that you disable fragmentation. In this case, the benefits of fragmentation might be outweighed by the added load on the CPU.

Configuring Multilink Frame-Relay

For additional configuration information on Multilink Frame-Relay and the Cisco 12000 Series Router, see the document, *Multilink Frame Relay (FRF.16)* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s17/17s_mfr.htm

Create an MFR Bundle

A multilink bundle consists of a maximum of 8 T-1s or E1s. To create a multilink bundle, complete the following steps:

Step 1 Enter MFR interface configuration mode:

```
Router# configure terminal
Router(config)# interface MFR 1
```

Step 2 Assign an IP address to the MFR interface:

```
Router(config-if)# ip address address mask
Router(config-if)#
```

Step 3 Assign a bundle ID

```
Router(config-if)# frame-relay multilink bid BUNDLE1
```

Step 4 Remaining frame-relay configuration is the same as for non-multilink interfaces

Assign an Interface to an MFR Bundle

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

Step 1 Select the serial interface using the form of the interface serial command that is appropriate to your configuration context:

```
Router(config)# interface serial slot/port.number
```

Step 2 Associate a serial interface with the MFR bundle:

```
Router(config)# encapsulation frame-relay MFR1
Router(config)#
```

Link Fragmentation Reassembly Configuration

Link Fragmentation Reassembly (LFI) allows the router to send large, low priority packets and small, high priority packets on the same DLCI while minimizing the latency of high priority packets. The low priority packets are fragmented and high-priority packets are inserted between the fragments of the low priority packets. The configuration must include the following steps:

Step 1 Identify high priority traffic:

```
Router(config)# class-map match-all voice-ip
Router(config-cmap)# match ip dscp 63
Router(config-cmap)# match ip precedence 7
```

Step 2 Mark high priority traffic

```
Router(config)# policy-map LFI-policy
Router(config-pmap)# class voice-ip
Router(config-pmap-c)# priority
```

Step 3 Specify the fragmentation and policy:

```
Router(config)# map-class frame-relay LFI
Router(config-map-class)# service policy output LFI-policy
Router(config-map-class)# frame-relay fragment 128
```

Step 4 Create frame-relay interface/sub-interface:

```
Router(config)# interface serial2/0.1/1:0
Router(config-if)# no ip address
Router(config-if)# encapsulation frame-relay
Router(config-if)# exit
Router(config)# interface Serial2/0.1/1:0.1 point-to-point
Router(config-subif)# ip address 2.1.1.1 255.255.255.0
Router(config-subif)# frame-relay interface-dlci 16
Router(config-fr-dlci)# class LFI
```

How to Configure Layer 3 Features

The 1-Port CHOC-12 ISE line card supports all Cisco 12000 Series Router Internet Service Engine 3 (ISE 3) software features. Additional information can be found in the following documents:

Cross-Platform Release Notes for Cisco IOS Release 12.0 S, Part 2: New Features and Important Notes
http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/relnote/xprn120s/120snewf.htm#32390

Cisco IOS Release 12.0S Features for Cisco 12000 Series Internet Router
http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/12_0s/index.htm

Verifying and Monitoring Configurations with Show Commands

After installing the 1-Port CHOC-12 ISE line card, use **show** commands to display the status of the SONET controller, T1 channel-groups, and the 1-Port CHOC-12 ISE line card serial interfaces. Following are descriptions and examples of the **show** commands you can use to check the configuration. Descriptions are limited to fields that are relevant for verifying the configuration of the 1-Port CHOC-12 ISE line card.

Discovering the Slot Number of the Line Cards—show gsr

To ascertain the correct slot number with which to configure the SONET controller, use the **show gsr** EXEC command. The following example indicates that the 1-Port CHOC-12 ISE line card is in slot 2:

```
Router# show GSR
Slot 0  type  = Route Processor
        state = ACTV RP   IOS Running  ACTIVE
Slot 1  type  = 2 Ports OC3 Channelized to DS1/E1
        state = RTRYWAIT  Waiting to retry download after persistent failures
Slot 2  type  = 1 Port ISE OC12 Channelized to DS1/E1
        state = IOS RUN   Line Card Enabled
Slot 3  type  = 1 port SONET OC12 channelized to DS3
        state = ADMNDOWN  Administratively Down, Powered
Slot 16 type  = Clock Scheduler Card(8)
        state = Card Powered
Slot 17 type  = Clock Scheduler Card(8)
        state = Card Powered  PRIMARY CLOCK
Slot 18 type  = Switch Fabric Card(8)
        state = Card Powered
Slot 19 type  = Switch Fabric Card(8)
        state = Card Powered
Slot 20 type  = Switch Fabric Card(8)
        state = Card Powered
Slot 26 type  = AC Power Supply(8)
        state = Card Powered
```

Discovering the Version of the Current Software and Hardware—show version

The **show version** command displays the configuration of the system hardware (the channel of each line card installed), the software release currently operating, the names and sources of configuration files, and the boot images. The following example lists the 1-Port CHOC-12 ISE line card interface as an active line card.

```
Router# show version

Cisco Internetwork Operating System Software
IOS (tm) GS Software (GSR-P-M), Version 12.0(27)S1, SOFTWARE
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2003 by cisco Systems, Inc.
Compiled Tue 14-Feb-04 16:58 by nmasa
Image text-base: 0x50010C60, data-base: 0x5314A000

ROM: System Bootstrap, Version 11.2(20030116:225008) [rarcher-pre_lci_throttle 184],
DEVELOPMENT SOFTWARE
BOOTLDR: GS Software (GSR-BOOT-M), Version 12.0(8)S, EARLY DEPLOYMENT RELEASE SOFTWARE
(fc1)

lab1 uptime is 1 week, 3 days, 23 minutes
System returned to ROM by reload
System image file is "tftp://225.255.255.254//tftpboot/gsr-p-mz.120-26.3.S"

cisco 12008/GRP (R5000) processor (revision 0x05) with 262144K bytes of memory.
R5000 CPU at 200Mhz, Implementation 35, Rev 2.1, 512KB L2 Cache
Last reset from power-on

1 Route Processor Card
2 Clock Scheduler Cards
3 Switch Fabric Cards
1 One-port Channelized OC-12 controller (1 OC12s)

1 card shutdown

1 Ethernet/IEEE 802.3 interface(s)
10 Serial network interface(s)
507K bytes of non-volatile configuration memory.

20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x0

Router#
```

Discovering Current Status of the SONET Controller—show controllers sonet

To display information about the SONET port, including information on all of the configured channels, use the following form of the **show controllers sonet** command:

show controllers sonet *slot*/*port* [**brief** | **tabular**]

When framing is SDH and AUG mapping is AU-4, the form of the **show controllers** command is as follows:

show controllers sonet *slot*/*port*.*au-4-number*/*tug-3-number*/*tug-2-number*/*e1-line-number* [**brief** | **tabular**]

When framing is SDH and AUG mapping is au-3, the form of the **show controllers** command is as follows:

show controllers sonet *slot*/*port*.*au-3-number*/*tug-2-number*/*t1-number* [**brief** | **tabular**]

When framing is SONET and the mode is ct3, the form of the **show controllers** command is as follows:

show controllers sonet *slot*/*port*.*sts1-number*/*t1-number* [**brief** | **tabular**]

When framing is SONET and the mode is vt-15, the form of the **show controllers** command is as follows:

show controllers sonet *slot*/*port*.*sts1-number*/*vtg-number*/*t1-number* [**brief** | **tabular**]

where:

- *slot* refers to the chassis slot where the 1-Port CHOC-12 ISE line card is installed.
- *port* refers to the physical port on the 1-Port CHOC-12 ISE line card and is always 0.
- *au-4-number* is always 1 for this line card.
- *tug-3-number* is a number in the range from 1 to 3.
- *au-3-number* is a number in the range from 1 to 12.
- *tug-2-number* is a number in the range from 1 to 7.
- *e1-line-number* is a number in the range from 1 to 3.
- *t1-number* is a number in the range from 1 to 4 (in ct3 mode, where a channelized T-3 is mapped into the STS-1, *t1-number* is a number in the range from 1 to 28).
- *sts1-number* is a number in the range from 1 to 3.
- *vtg-number* is a number in the range from 1 to 7.

```
Router# show controllers sonet 2/0

SONET 2/0 is up. (Configured for Locally Looped) Hardware is GSR 1 port ISE OC12
(channelized)
STM1/OC3 (channelized)
  Applique type is Channelized OCx interface
  Clock Source is Line
Medium info:
  Type: Sonet, Line Coding: NRZ, Line Type: IR SM
SECTION:
  LOF = 9          LOS = 9                           BIP(B1) = 79233
LINE:
  AIS = 13         RDI = 6          REI = 711        BIP(B2) = 3921
Active Defects: SLOF SLOS LAIS
Active Alarms: SLOS
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  B3 = 10e-6
```

```
APS:
  COAPS = 24         PSBF = 0
  State: PSBF_state = FALSE
  ais_shut = TRUE
  Rx(K1/K2): 00/06
High Order Path:
Alarm reporting enabled for: LOP LOM B3-TCA

PATH 1:
  AIS = 90         RDI = 93         REI = 415790     BIP(B3) = 1477868
  LOP = 12         PSE = 0          NSE = 0          NEWPTR = 10
  LOM = 79         PLM = 253888     UNEQ = 44
Active Defects: AIS RDI PLM
Active Alarms: None

S1S0 = 03, C2 = FF

PATH TRACE BUFFER : STABLE

  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................

PATH 2:
  AIS = 92         RDI = 94         REI = 141        BIP(B3) = 343
  LOP = 12         PSE = 0          NSE = 0          NEWPTR = 87
  LOM = 80         PLM = 258542     UNEQ = 44
Active Defects: AIS RDI PLM
Active Alarms: None

S1S0 = 03, C2 = FF

PATH TRACE BUFFER : STABLE

  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................

PATH 3:
  AIS = 92         RDI = 94         REI = 98         BIP(B3) = 235
  LOP = 12         PSE = 4          NSE = 0          NEWPTR = 12
  LOM = 80         PLM = 258542     UNEQ = 44
Active Defects: AIS RDI PLM
Active Alarms: None

S1S0 = 03, C2 = FF

PATH TRACE BUFFER : STABLE

  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................
  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF    ................

OC12.CT3 2/0.1 is down.  Hardware is GSR 1 port ISE OC12 (channelized)
  Applique type is Channelized T3 in STS-1
  Transmitter is sending RAI.
  Receiver has loss of frame.
  Framing is M23, Clock Source is Internal
  Equipment customer loopback
  Data in current interval (687 seconds elapsed):
     0 Line Code Violations, 122142 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
    687 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
 Data in Interval 1:
    0 Line Code Violations, 159915 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
    900 Unavailable Secs, 0 Line Errored Secs
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
 Total Data (last 1 15 minute intervals):
    0 Line Code Violations, 159915 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,
    900 Unavailable Secs, 0 Line Errored Secs,
    0 C-bit Errored Secs, 0 C-bit Severely Errored Secs

STS-1 1, T1 1 (CT3 1/1) is down
 timeslots: 1-24
 FDL per AT&T 54016 spec.
 Receiver has loss of signal.
 Framing is ESF, Clock Source is Internal
 Data in current interval (0 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, 0 Stuffed Secs

STS-1 1, T1 2 (CT3 1/2) is down
 timeslots: 2-22
 FDL per AT&T 54016 spec.
 Receiver has loss of signal.
 Framing is ESF, Clock Source is Internal
 Data in current interval (0 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, 0 Stuffed Secs

STS-1 1, T1 3 (CT3 1/3) is down
 timeslots: 1-3
 FDL per AT&T 54016 spec.
 Receiver has loss of signal.
 Framing is ESF, Clock Source is Internal
 Data in current interval (0 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, 0 Stuffed Secs

STS-1 1, T1 4 (CT3 1/4)
   Not configured.

STS-1 1, T1 5 (CT3 1/5)
   Not configured.

STS-1 1, T1 6 (CT3 1/6)
   Not configured.

STS-1 1, T1 7 (CT3 1/7)
   Not configured.

STS-1 1, T1 8 (CT3 1/8)
   Not configured.
```

```
STS-1 1, T1 9 (CT3 1/9)
   Not configured.

STS-1 1, T1 10 (CT3 1/10)
   Not configured.

STS-1 1, T1 11 (CT3 1/11)
   Not configured.

STS-1 1, T1 12 (CT3 1/12)
   Not configured.

STS-1 1, T1 13 (CT3 1/13)
   Not configured.

STS-1 1, T1 14 (CT3 1/14)
   Not configured.

STS-1 1, T1 15 (CT3 1/15)
   Not configured.

STS-1 1, T1 16 (CT3 1/16)
   Not configured.

STS-1 1, T1 17 (CT3 1/17)
   Not configured.

STS-1 1, T1 18 (CT3 1/18)
   Not configured.

STS-1 1, T1 19 (CT3 1/19)
   Not configured.

STS-1 1, T1 20 (CT3 1/20)
   Not configured.

STS-1 1, T1 21 (CT3 1/21)
   Not configured.

STS-1 1, T1 22 (CT3 1/22)
   Not configured.

STS-1 1, T1 23 (CT3 1/23)
   Not configured.

STS-1 1, T1 24 (CT3 1/24)
   Not configured.

STS-1 1, T1 25 (CT3 1/25)
   Not configured.

STS-1 1, T1 26 (CT3 1/26)
   Not configured.

STS-1 1, T1 27 (CT3 1/27)
   Not configured.

STS-1 1, T1 28 (CT3 1/28)
   Not configured.
```

(Additional display text is not shown.)

The **show controllers sonet** *slot/port* **brief** command shows limited information for a SONET port.

```
Router# show controllers sonet 2/0 brief

SONET 2/0 is up. (Configured for Locally Looped) Hardware is GSR 1 port ISE OC12
(channelized)
  Applique type is Channelized OCx interface
  Clock Source is Line, AUG mapping is AU4.
Medium info:
  Type: SDH, Line Coding: NRZ, Line Type: Short SM
Regenerator Section:
  LOF = 0          LOS = 0                           BIP(B1) = 0
Multiplex Section:
  AIS = 0          RDI = 0          REI = 0          BIP(B2) = 0
Active Defects: None
Active Alarms: None
Alarm reporting enabled for: SF SLOS SLOF B1-TCA B2-TCA B3-TCA
BER thresholds:  SF = 10e-3  SD = 10e-6
TCA thresholds:  B1 = 10e-6  B2 = 10e-6  B3 = 10e-6
High Order Path:

PATH 1:
  AIS = 0          RDI = 0          REI = 15         BIP(B3) = 11
  LOP = 0          PSE = 4          NSE = 0          NEWPTR = 1
  LOM = 0          PLM = 0          UNEQ = 0
Active Defects: None

S1S0 = 02, C2 = 02

PATH TRACE BUFFER : STABLE
CRC-7: 0xF2 OK
  52 6F 75 74 65 72 33 2F  30 2F 31 00 00 00 00       Router3/0/1....

 STM1.AU4 3/0.1 is up. Hardware is GSR 1 port ISE OC12 (channelized)
  Applique type is C12 in TUG-3 in AU-4

 AU-4 1, TUG-3 1, TUG-2 1, E1 1 (C-12 1/1/1/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
  BERT test result (running)
     Test Pattern : 2^15, Status : Sync, Sync Detected : 1
     Interval : 5 minute(s), Time Remain : 2 minute(s)
     Bit Errors (since BERT started): 0 bits,
     Bits Received (since BERT started): 311 Mbits
     Bit Errors (since last sync): 0 bits
     Bits Received (since last sync): 311 Mbits

 AU-4 1, TUG-3 1, TUG-2 1, E1 2 (C-12 1/1/1/2) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 1, TUG-2 1, E1 3 (C-12 1/1/1/3) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 1, TUG-2 2, E1 1 (C-12 1/1/2/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
```

```
 AU-4 1, TUG-3 1, TUG-2 2, E1 2 (C-12 1/1/2/2) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 1, TUG-2 2, E1 3 (C-12 1/1/2/3) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
.
.
.
AU-4 1, TUG-3 2, TUG-2 7, E1 1 (C-12 1/2/7/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 2, TUG-2 7, E1 2 (C-12 1/2/7/2) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 2, TUG-2 7, E1 3 (C-12 1/2/7/3) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 3, TUG-2 1, E1 1 (C-12 1/3/1/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 3, TUG-2 1, E1 2 (C-12 1/3/1/2) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 3, TUG-2 1, E1 3 (C-12 1/3/1/3) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
.
.
.
AU-4 1, TUG-3 3, TUG-2 7, E1 1 (C-12 1/3/7/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 3, TUG-2 7, E1 2 (C-12 1/3/7/2) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal

 AU-4 1, TUG-3 3, TUG-2 7, E1 3 (C-12 1/3/7/3) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
```

(Additional display text is not shown.)

By adding specific T1 or E1 line information to the preceding **show controllers sonet** *slot/port* **brief** command, you can show limited output for the specific line that you specify.

```
Router# show controllers sonet 2/0.1/1/1/1 brief

SONET 2/0 is up.
 Path mode C12

 AU-4 1, TUG-3 1, TUG-2 1, E1 1 (C-12 1/1/1/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
Router#
```

By adding specific T1 or E1 line information to the **show controllers sonet** *slot/port* **tabular** command, you can show output for the specific line that you specify in tabular format.

```
Router# show controllers sonet 2/0.1/1/1/1 tabular

SONET 2/0 is up.
 Path mode C12

 AU-4 1, TUG-3 1, TUG-2 1, E1 1 (C-12 1/1/1/1) is up
  timeslots: 1-31
  No alarms detected.
  Framing is crc4, Clock Source is Internal
  INTERVAL      LCV   PCV   CSS  SELS   LES    DM    ES   BES   SES   UAS    SS
  01:01-01:03     0     0     0     0     0     0     0     0     0     0     0
  00:46-01:01     0     0     0     0     0     0     0     0     0     0     0
  00:31-00:46     0     0     0     0     0     0     0     0     0     0     0
  00:16-00:31     0     0     0     0     0     0     0     0     0     0     0
  00:01-00:16     0     0     0     0     0     0     0     0     0     0     0
  Total           0     0     0     0     0     0     0     0     0     0     0
Router#
```

Discovering the Operational Status of Line Protocols on All Interfaces—show protocols

The **show protocols** EXEC command displays the protocols configured for the entire system and specific interfaces. If necessary, return to configuration mode to add or remove protocol routing on the system or specific interfaces.

```
Router# show protocols

Global values:
  Internet Protocol routing is enabled
Serial2/0.1/1/1/1:0 is up, line protocol is up
Serial2/0.1/1/2/1:0 is up, line protocol is up
Serial2/0.1/1/3/1:0 is up, line protocol is up
.
.
.
Serial2/0.1/3/7/1:0 is up, line protocol is up
Serial2/0.1/3/1/2:0 is up, line protocol is up
Serial2/0.1/3/7/3:0 is up, line protocol is up
POS5/0 is up, line protocol is down
  Internet address is 12.3.2.2/24
Multilink1 is up, line protocol is up
  Internet address is 12.1.1.2/24
Multilink2 is up, line protocol is up
  Internet address is 12.1.2.2/24
Multilink3 is up, line protocol is up
  Internet address is 12.1.3.2/24
.
.
.
Multilink7 is up, line protocol is up
  Internet address is 12.1.7.2/24
Ethernet0 is up, line protocol is up
  Internet address is 1.2.14.2/16
Router#
```

Discovering Multilink Bundle and Group Status—show ppp multilink

Use the **show ppp multilink** command to display information about the newly created multilink bundle:

```
Router# show ppp multilink

Multilink37, bundle name is group37
  Bundle is Distributed
  0 lost fragments, 0 reordered, 0 unassigned
  0 discarded, 0 lost received
  0x0 received sequence, 0x0 sent sequence
  Member links: 2 active, 0 inactive (max not set, min not set)
    Serial2/0.1/3/6/3:0
    Serial2/0.1/3/7/3:0

Multilink31, bundle name is group31
  Bundle is Distributed
  0 lost fragments, 0 reordered, 0 unassigned
  0 discarded, 0 lost received
  0x0 received sequence, 0x0 sent sequence
  Member links: 2 active, 0 inactive (max not set, min not set)
    Serial2/1.1/3/6/2:0
    Serial2/1.1/3/7/2:0

Multilink34, bundle name is group34
  Bundle is Distributed
```

```
  0 lost fragments, 0 reordered, 0 unassigned
  0 discarded, 0 lost received
  0x0 received sequence, 0x0 sent sequence
  Member links: 2 active, 0 inactive (max not set, min not set)
    Serial2/1.1/3/5/3:0
    Serial2/1.1/3/6/3:0
.
.
.
Multilink22, bundle name is group22
  Bundle is Distributed
  0 lost fragments, 0 reordered, 0 unassigned
  0 discarded, 0 lost received
  0x0 received sequence, 0x0 sent sequence
  Member links: 2 active, 0 inactive (max not set, min not set)
    Serial2/1.1/2/3/2:0
    Serial2/1.1/2/2/2:0
Router#
```

Additional References

The following sections provide references related to the features of the 1-Port CHOC-12 ISE line card.

Related Documents

Related Topic	Document Title
Cumulative list of Cisco IOS features pertaining specifically to the Cisco 12000 Series Router	*Cisco IOS Release 12.0S Features for Cisco 12000 Series Internet Router* http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/12_0s/index.htm
Cumulative list of features added to Cisco IOS 12.0 (S) release	*Cross-Platform Release Notes for Cisco IOS Release 12.0 S, Part 2: New Features and Important Notes* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/relnote/xprn120s/120snewf.htm
Physical installation and diagnostic procedures for the 1-Port CHOC-12 ISE line card.	*Cisco 12000 Series 1-Port Channelized OC-12/STM-4 (DS1/E1) ISE Line Card Installation and Configuration* at the following URL: http://www.cisco.com/univercd/cc/td/doc/product/core/cis12000/linecard/lc_chan/13921c12.htm
ACLs, EACLs and Turbo ACLs	*Implementing Access Lists on Cisco 12000 Series Internet Routers* http://www.cisco.com/en/US/products/hw/routers/ps167/products_tech_note09186a008015a057.shtml *Access List Performance Improvements for Cisco 12000 Gigabit Switch Routers* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s10/hw_acl.htm *Turbo Access Control Lists* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s6/turboacl.htm

Related Topic (continued)	Document Title (continued)
APS and SONET commands: complete command syntax, command mode, defaults, usage guidelines, and examples	*Cisco IOS Interface Command Reference, Release 12.0*
APS and SONET configuration	*Cisco IOS Interface Configuration Guide, Release 12.0*
APS on the Cisco 7500 and Cisco 12000 series routers	*Automatic Protection Switching of Packet-over-SONET Circuits feature document, Release 11.2 P* http://www.cisco.com/univercd/cc/td/doc/product/software/ios112/ios112p/gsr/posapsgs.htm
Configuring Multilink PPP	*Configuring Media-Independent PPP and Multilink PPP* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_c/dcppp.htm
Committed Access Rate (CAR)	*Committed Access Rate* http://www.cisco.com/univercd/cc/td/doc/product/software/ios111/cc111/car.htm
Modular Quality of Service (MQC)	*Modular Quality of Service Command-Line Interface* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120xe/120xe5/mqc/mcli.htm
MPLS Quality of Service feature module	*MPLS Quality of Service (QoS)* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s22/fs22cos.htm
MPLS Traffic Engineering feature module	*MPLS Traffic Engineering (TE)—Link and Node Protection, with RSVP Hellos Support Feature Overview* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s23/fs_frrnd.htm
Sampled Netflow feature module	*Sampled NetFlow* http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120limit/120s/120s11/12s_sanf.htm
Weighted Random Early Detection (WRED)	*Weighted Random Early Detection on the Cisco 12000 Series Router* http://www.cisco.com/univercd/cc/td/doc/product/software/ios112/ios112p/gsr/wred_gs.htm

Standards

Standards	Title
GR-253-CORE	*SONET Transport Systems:Common Generic Criteria*
ITU-T G.783 and Annex B of ITU-T G.783	*Characteristics of SDH equipment functional blocks*
FRF.12	*Frame Relay Fragmentation Implementation Agreement*
FRF.16	*Multilink Frame Relay UNI/NNI Implementation Agreement*

MIBs

MIBs	MIBs Link
• All MIBs support both the European SDH and the USA SONET standards – SONET (RFC 2558) – DS1 (RFC 1406) – DS3 (RFC 1407) • MIB II, including interface extensions • BGP-4 MIB • CAR MIB • Cisco CAR MIB • Cisco CDP MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 1990	The PPP Multilink Protocol (MP)
RFC 1661	The Point-to-Point Protocol (PPP)
RFC 1662	PPP in HDLC-like Framing
RFC 1406	Definitions of Managed Objects for the DS1 and E1 Interface Types
RFC 1407	Definitions of Managed Objects for the DS3/E3 Interface Type
RFC 2558	Definitions of Managed Objects for the SONET/SDH Interface Type

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml