Configuring Optical Interface Modules

This chapter describes the most common configurations for optical interface modules on the Cisco ASR 900 Series Routers.

Limitations and Restrictions

- The 4-port OC3/STM-1 (OC-3) or 1-port OC12/STM-4 (OC-12) interface module is *not* supported on the RSP3 module.

- SDH framing mode is supported; SONET framing is supported beginning in Cisco IOS XE Release 3.8.

- On the OC-3 controller, framing mode is applicable on the interface module and per port. When framing mode is set to SONET, all the 4 ports on the interface module are enabled for SONET mode. Similarly, when framing mode is set to SDH mode, all 4 ports on the interface module are enabled for SDH mode.

- The OC-3 controller supports Asynchronous mode at the V5 byte level for Plesiochronous Digital Hierarchy (PDH). This value cannot be modified. If a mismatch occurs between the V5 byte, and the peer (remote router), loss of frames may be observed at the PDH level.

- HDLC, PPP, and MLPPP encapsulation are supported. In POS mode, HDLC and PPP are supported.

- ATM Layer 2 AAL0 and AAL5 encapsulation types are supported.

- E1 unframed encapsulation is not supported except using SAToP pseudowire interfaces.

- Unframed T1 is supported only for SATOP. E1 unframed is supported.

- MPLS-TP is not supported over Packet Over Sonet (POS) interfaces.

- Multicast is not supported on OC-12 interfaces.

- QoS is supported using MLPPP interfaces and egress POS interfaces.

- MPLS is supported only on PoS interfaces; MPLS on T1/E1 MLP is supported starting with Cisco IOS XE Release 3.9. MPLS over MLP is also supported.

- Channelization is not supported for serial interfaces. However, Channelization is supported for CEM at the DS0 level.

- DS3 Clear channel is supported only on CEM.

- BERT is not supported on DS0 and DS1 CEM. It is supported only on DS3 CEM mode.

- Configurations on the interface module must be completely removed before moving the interface module to a different slot on the router.

- Mixed configurations of features are not supported on the same port. For example, one OC-3 port can have only CEM (CESoP or SAToP) or ATM or IMA or DS3 configurations, but not a combination of these features on a single port.

- CEM is not supported across OC12/ STM-4 interface module. CEM is supported on all four ports of OC-3/STM-1 interface module.

- If two CEM circuits are configured under the same OC-3 interface module, the circuits should not be confiugred with the same circuit-id. If two CEM cirsuits are configured on different OC-3 inteface modules, then both circuits can be configured with the same circuit-id.

- By default, AIS-SHUT is enabled on the OC-3 SONET/SDH controller and port level shut down of SONET/SDH controller results in AIS alarm on peer node. To enable the LOS alarm on controller shut down, you must configure "no ais-shut" at SONET/SDH controller level.

- Maximum channels per OC-3/ STM interface module for T1 interfaces is 336 for RSP1 and RSP2.

- Maximum channels per OC-3/STM interface module for E1 interfaces is 252 for RSP1 and RSP2.

Configuring the Controller

Starting with Cisco IOS XE Release 3.10, OC-3 and OC-12 is licensed. For information on licensing these interfaces, see Licensing the OC-3 and OC-12 Interface Modules .

Note   When the mode is changed, the interface module reloads.

Command	Purpose
platform enable controller controller-type *slot/subslot/port* `Router(config)# platform enable controller SONET 0/2/3`	Enables the ports on slot where the interface is present. **Note** The slot number for the controller **sonet** is always zero on the router. • controller—Configures a specific controller • controller-type—Type of controller.
controller sonet *slot/subslot/port* `Router(config)# controller sonet 0/2/3`	Selects the controller to configure and enters controller configuration mode, where: • *slot/subslot/port* —Specifies the location of the interface. **Note** The slot number is always zero on the Cisco ASR 900 Series Router.

Configuring SDH

The following sections describe how to configure SDH on the optical interface module:

Configuring SDH Mode

SDH T1 Mode

To configure SDH T1 mode, complete the following steps:

Procedure

	Command or Action	Purpose
Step 1	**framing sdh** **Example:** `Router(config-controller)# framing `**`sdh`**	Specifies SDH as the frame type.
Step 2	**aug mapping** {**au-4**} **Example:** `Router(config-controller)# `**`aug mapping au-4`**	Configures AUG mapping for SDH framing.
Step 3	**clock source** {**internal** | **line**} **Example:**	Sets the clock source, where: • internal—Specifies that the internal clock source is used.

	Command or Action	Purpose
	`Router(config-controller)# clock source line`	• line—Specifies that the network clock source is used. This is the default for T1 and E1.
Step 4	**au-4** *au-4#* **tug-3** *tug-3#* **Example:** `Router(config-controller)# `**`au-4`**` 1 `**`tug-3`**` 3`	Configures AU-4, and tributary unit groups, type 3 (TUG-3) for AU-4 and enters specific configuration mode. • *au-4#*—Range is from 1 to 4 for OC-12 mode and 1 for OC-3 mode • *tug-3#*—Range is from 1 to 3.
Step 5	In SDH framing in AU-4 mode: **Example:** **mode {c-11 | c-12 | t3 | e3}** **Example:** `Router(config-ctrlr-tug3)# `**`mode`**` {`**`c-11`**` | `**`c-12`**` | `**`t3`**` | `**`e3`**`}`	(Optional) Configures mode of operation for AU-3 or AU-4 mode, where: C-11 and C-12 are container level-n (SDH) channelized T3s. They are types of T3 channels that are subdivided into 28 T1 channels. • **c-11**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2s. Each TUG-2 is then divided into four TU11s, each carrying a C-11 T1. • **c-12**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2. Each TUG-2 is then divided into three TU12s, each carrying a C-12 E1. • **t3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) T3. • **e3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) E3. **Note** Only c-11 and c-12 are currently supported.
Step 6	**SAToP CEM Group** **Example:** **tug-2 1 e1 1 cem-group 1 unframed** **Example:** `Router(config-ctrlr-tug3)# `**`tug-2`**` 1 e1 1 cem-group 1 unframed` **Example:** **CESoPSN CEM Group**	Creates a CEM group, IMA group, or channel-group for the AU-3 or AU-4. Valid values are: • e1— 1–3 • **tug-3—1-3** • **tug-2**—1–7 • **unframed**—Specifies that a single CEM channel is being created including all time slots and the framing structure of the line.

	Command or Action	Purpose

	`tug-2 1 e1 1 cem-group 1 timeslots 1-31`
	
	Example:
	
	`Router(config-ctrlr-tug3)# tug-2 1 e1 1 cem-group 1 timeslots 1-31`
	
	Example:
	
	IMA Group
	
	`tug-2 1 e1 1 ima-group 1`
	
	Example:
	
	`Router(config-ctrlr-tug3)# tug-2 1 e1 1 ima-group 1`
	
	Example:
	
	Channel Group
	
	`tug-2 1 e1 1 [[channel-group` *channel-group-number]* `[timeslots` *list-of-timeslots]]*
	
	Example:
	
	`Router(config-ctrlr-tug3)# `**`tug-2`** *1* **`e1`** *1* **`channel-group`** `1` **`timeslots`** *1-31]*	

Step 7	exit **Example:** `Router(config-controller)# `**`exit`**	Exits controller configuration mode.
Step 8	**controller t1** *interface-path-id* **Example:** `Router(config-controller)# `**`controller t1 0/1/1/0/0/0`**	Enters controller configuration mode for an individual T1 or E1.
Step 9	Creates a CEM group, IMA group, or channel-group on the T1 or E1 controller.	**SAToP CEM Group** `Router(config-ctrlr)# `**`t1 cem-group`** `1` **`unframed`** **CESoPSN CEM Group** `Router(config-ctrlr)# `**`t1 cem-group`** `1` **`timeslots 1-24`** **Clear-Channel ATM**

	Command or Action	Purpose
	`Router(config-ctrlr-tug3)#` **e1** *1* **atm** **IMA Group** `Router(config-ctrlr-tug3)#` **e1** *1* **ima-group** *1* **Channel Group** `Router(config-ctrlr)#` **t1** 2 **channel-group** 4 *[[***channel-group** *channel-group-number] [***timeslots** *list-of-timeslots]]*	

What to do next

Example

The example configures SDH E1 mode:

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# clock source internal
Router(config-controller)# au-4 1 tug-3 2
Router(config-ctrlr-tug3)# tug-2 1 e1 1 channel-group 1 timeslots 1-31
```

SDH T1 Mode

To configure SDH T1 mode, complete the following steps:

Procedure

	Command or Action	Purpose
Step 1	**framing sdh** **Example:** `Router(config-controller)#` framing **sdh**	Specifies SDH as the frame type.
Step 2	**aug mapping {au-3}** **Example:** `Router(config-controller)#` **aug mapping au-3**	Configures AUG mapping for SDH framing. Supports au-3 and au-4 aug mapping. The default setting is **au-3.**
Step 3	**clock source {internal | line}** **Example:**	Sets the clock source, where: • internal—Specifies that the internal clock source is used.

	Command or Action	Purpose
	`Router(config-controller)# clock source line`	• line—Specifies that the network clock source is used. This is the default for T1 and E1.
Step 4	**au-3** *au-3#* **Example:** `Router(config-controller)# au-3 au-3#`	Configures AU-3, and enters specific configuration mode. • *au-3#* —Range is from 1 to 12 for OC-12 mode. For OC-3 mode, the value is 1–3.
Step 5	In SDH framing in AU-3 mode: **Example:** `mode {c-11	c-12	t3	e3}`  **Example:**  `Router(config-ctrlr-au3)# mode {c-11	c-12	t3	e3}`	(Optional) Configures mode of operation for AU-3 or AU-4 mode, where: C-11 and C-12 are container level-n (SDH) channelized T3s. They are types of T3 channels that are subdivided into 28 T1 channels. • **c-11**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2s. Each TUG-2 is then divided into four TU11s, each carrying a C-11 T1. • **c-12**—Specifies an AU-3/AU-4 TUG-3 divided into seven TUG-2. Each TUG-2 is then divided into three TU12s, each carrying a C-12 E1. • **t3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) T3. • **e3**—Specifies an AU-3/AU-4 TUG-3 carrying an unchannelized (clear channel) E3. **Note** Only c-11 and c-12 are currently supported.

Step 6	**SAToP CEM Group**
	
	Example:
	`tug-2 1 t1 1 cem-group 1 unframed`
	
	Example:
	
	`Router(config-ctrlr-au3)# tug-2 1 t1 1 cem-group 1 unframed`
	
	Example:
	CESoPSN CEM Group
	
	Example:
		Creates a CEM group, IMA group, or channel-group for the AU-3 or AU-4. Valid values are:
		
		• **t1**—Range is from 1 to 12 for OC-12 mode. For OC-3 mode, the value is 1–3.
		
		• **tug-2**—1–7
		
		• **unframed**—Specifies that a single CEM channel is being created including all time slots and the framing structure of the line.

Command or Action	Purpose

`tug-2 1 e1 1 cem-group 1 timeslots 1-31`
Example:
`Router(config-ctrlr-au3)# tug-2 1 t1 1 cem-group 1 timeslots 1-31`
Example:
IMA Group
`tug-2 1 t1 1 ima-group 1`
Example:
`Router(config-ctrlr-au3)# tug-2 1 t1 1 ima-group 1`
Example:
Channel Group
`tug-2 1 e1 1` [[`channel-group` *channel-group-number]* [`timeslots` *list-of-timeslots]]*
Example:
`Router(config-ctrlr-tug3)# tug-2 1 t1 1 channel-group 0 timeslots 1-31`	

Step 7	exit **Example:** `Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	**controller t1** *interface-path-id* **Example:** `Router(config-controller)# controller t1 0/1/1/0/0/0`	Enters controller configuration mode for an individual T1 or E1.

Step 9	Creates a CEM group, IMA group, or channel-group on the T1 or E1 controller.	**SAToP CEM Group**
		
		`Router(config-ctrlr)# t1 cem-group 1 unframed`
		
		CESoPSN CEM Group
		
		`Router(config-ctrlr)# t1 cem-group 1 timeslots 1-24`

	Command or Action	Purpose
	Clear-Channel ATM	
	Router(config-ctrlr-tug3)# **e1** *1* **atm**	
	IMA Group	
	Router(config-ctrlr-tug3)# **e1** *1* **ima-group** *1*	
	Channel Group	
	Router(config-ctrlr)# **t1** *2* **channel-group** *4* *[[***channel-group** *channel-group-number]* *[***timeslots** *list-of-timeslots]]*	

What to do next

The example configures SDH T1 mode:

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-3
Router(config-controller)# au-3 1
Router(config-ctrlr-au3)# tug-2 1 t1 1 channel-group 1 timeslots 1-31
```

For information about configuring optional features, see Optional Configurations, on page 21.

Configuring SDH in POS Mode

Follow these steps to configure SDH in POS mode on the optical interface module.

Procedure

	Command or Action	Purpose
Step 1	**controller sonet** *slot*/*subslot*/*port* **Example:** **Example:** Router(config)# **controller sonet** *0/1/0*	Selects the controller to be configured.
Step 2	**framing {sonet	sdh}** **Example:** Router(config)# **framing sdh**	Specifies SDH as the framing mode. **Note** The interface module reloads if the framing is changed.

	Command or Action	**Purpose**
Step 3	**aug mapping {au-3	au-4}** **Example:** Router(config-controller)# **aug mapping au-4**	Specifies AUG mapping. **Note** POS mode is only supported with AU-4 mode.
Step 4	**au-4** *au-4-number* **pos** **Example:** Router(config-controller)# **au-4 1 pos**	Selects the AU-4 to be configured in POS mode with SDH framing. The command creates a POS interface, such as POS0/0/1:1. In OC-3 mode, the value is 1; in OC-12 mode, valid values are 1-4.
Step 5	**end** **Example:** Router(config-controller)# **end**	Exits configuration mode.

Configuring SONET Mode

Example

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 pos
Router(config-controller)# end
```

For information about configuring optional features, see Optional Packet over SONET Configurations, on page 23

Configuring SONET Mode

The following sections describe how to configure SONET mode on the optical interface module:

Configuring SONET Mode

To configure an interface module to use SONET mode:

Procedure

	Command or Action	**Purpose**
Step 1	**controller sonet** *slot*/*subslot*/*port* **Example:**	Selects the controller to be configured.

	Command or Action	Purpose
	`Router(config)# controller sonet 0/1/0`	
Step 2	**framing {sonet	sdh}** **Example:** `Router(config-controller)# framing sonet`	Specifies SONET as the framing mode.
Step 3	**clock source {line	internal}** **Example:** `Router(config-if)# clock source line`	Specifies the clock source for the POS link, where: • **line**—The link uses the recovered clock from the line. This is the default setting. • **internal**—The link uses the internal clock source.
Step 4	**sts-1 {1 - 12	1 - 3	4 - 6	7 - 9	10 - 12}** **Example:** `Router(config-controller)# sts-1 1 - 3`	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS-1 configuration mode. The starting-number and ending-number arguments indicate the starting and ending STS value of the interface. For OC-3 interfaces, this value is 1. **Note** The **1-12** value is supported only in OC-12 mode.
Step 5	**vtg** *vtg-number* **t1** *t1-line-number* **channel-group** *channel-group-no* **timeslots** *list-of-timeslots* **Example:** `Router(config-if)# vtg 1 t1 1 channel-group 0 timesolts 1-24`	Configures the T1 on the VTG, where • *vtg-number*—Specifies the VTG number. The framing is1-7 • **t1** *t1-line-number*—1-4 • **channel-group** *channel-group-no*—0-24 • **timeslots** *list-of-timeslots*—1-24
Step 6	**end** **Example:** `Router(config-if)# end`	Exits configuration mode.

What to do next

The below example shows the configuration for the DS1 T1 serial interface:

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sonet
Router(config-controller)# clock source line
Router(config-controller)# sts-1 1 - 3
```

```
Router(config-ctrlr-sts1)# vtg 1 t1 1 channel-group 0 timeslot 1-24
Router(config-controller)# end
```

For information on optional SONET configurations, see Optional Configurations, on page 21. For information on optional ATM, IMA, POS and Serial interface configuration, see Optional Configurations, on page 21.

Configuring SONET POS Mode

To configure an interface module to use SONET in POS mode, perform the following procedure.

Procedure

	Command or Action	Purpose
Step 1	**controller sonet** *slot*/*subslot*/*port* **Example:** `Router(config)# `**`controller sonet`** **`0/1/0`**	Selects the controller to be configured.
Step 2	**framing {sonet	sdh}** **Example:** `Router(config-controller)# `**`framing`** **`sonet`**	Specifies SONET as the framing mode.

Step 3	**clock source** {**line**	**internal**}
		
		Example:
		
		`Router(config-controller)# clock source`
		` line`
			Specifies the clock source for the POS link, where:
			
			• **line**—The link uses the recovered clock from the line. This is the default setting.
			
			• **internal**—The link uses the internal clock source.

Step 4	**sts-1 {1- 12	1 - 3	4 - 6	7 - 9	10 - 12} pos** **Example:** `Router(config-controller)# `**`sts-1 1 -`** **`3 pos`**	Specifies POS mode; starting-number and ending-number arguments indicate the starting and ending STS value of the POS interface. For OC-3 interfaces, this value is 1. **Note** The **1-12** value is supported only in OC-12 mode.
Step 5	**exit** **Example:** `Router(config-controller# `**`exit`**	Exits controller configuration mode.
Step 6	Do one of the following: • **interface POS** *slot*/*subslot*/*port* •	Use any of the following commands to access the POS interface.

	Command or Action	Purpose
	• **interface POS** *slot/subslot/port.POS-interface* • • **interface POS** *slot/subslot/port:POS-interface* **Example:** `interface POS0/0/1` **Example:** `interface POS0/0/1.1` **Example:** `interface POS0/0/1:1`	
Step 7	**encapsulation** *encapsulation-type {***hdlc** / **ppp***}* **Example:** `Router(config-if)# encapsulation hdlc`	Configures encapsulation; you can configure the following options: • **hdlc**—Serial HDLC. This is the default for synchronous serial interfaces. • **ppp**—Point-to-Point Protocol (for serial interface).
Step 8	**end** **Example:** `Router(config-if)# end`	Exits configuration mode.

What to do next

Example

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sonet
Router(config-controller)# clock source line
Router(config-controller)# sts-1 1 - 3 pos
Router(config-controller)# exit
Router(config)# interface POS0/0/1
Router(config-if)# encapsulation hdlc
Router(config-if)# end
```

For information on optional SONET configurations, see .

Configuring a CEM group

Configuring CEM Group in SONET Mode

To configure a T1 CEM group in SONET mode:

Procedure

	Command or Action	Purpose
Step 1	**enable** 	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal**	Enters global configuration mode.
Step 3	**controller sonet** *slot/bay/port* **Example:** Router(config)# controller sonet 0/4/1	Selects the controller to configure and enters controller configuration mode, where: • *slot/bay/port*—Specifies the location of the interface. **Note** The slot number is always 1 and the bay number is always 0.
Step 4	**framing {sonet	sdh}** **Example:** Router(config)# framing sonet	Specifies SONET as the framing mode.
Step 5	**sts-1 {1 - 12	1 - 3	4 - 6	7 - 9	10 - 12}** **Example:** Router(config-controller)# **sts-1 1 - 3**	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS-1 configuration mode. The starting-number and ending-number arguments indicate the starting and ending STS value of the interface. For OC-3 interfaces, this value is 1. **Note** The **1-12** value is supported only in OC-12 mode.
Step 6	**mode {t3	vt-15}** **Example:** Router(config-ctrlr-sts1-3)# mode t3	Specifies the mode of operation of an STS-1 path, where: **Note** Note VT-15 is the only supported mode. • **t3**—DS3 clear channel mode. STS-1carries an unchannelized (clear channel) T3. • **vt-15**—A STS-1 is divided into seven Virtual Tributary Groups (VTG). Each

	Command or Action	Purpose
		VTG is then divided into four VT1.5's, each carrying a T1.
Step 7	**SATOP CEM** **Example:** **cem-group** *channel-number* unframed **Example:** Router(config-ctrlr-sts1-3)# cem-group 0 unframed **Example:** **CeSOP CEM** vtg *vtg_number* **t1** *t1_line_number* **cem-group** *channel-number* **timeslots** *list-of-timesolts* **Example:** Router(config-ctrlr-sts1-3)# vtg 1 t1 1 cem-group 1 timeslots 1-10	Configures the T1 on the VTG, where: • *vtg_number*—Specifies the VTG number. For SONET framing, values are 1 to 7. • *t1_line_number*—Specifies the T1 line number. Valid range is 1 to 4. • *channel-number*—Specifies the channel number. Valid range is 0 to 2015. • *list-of-timeslots*—Specifies the list of timeslots. Valid range is from 1 to 24.
Step 8	**end**	Exits controller configuration mode and returns to privileged EXEC mode.

What to do next

Example

The example shows a CEM interface configuration:

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sonet
Router(config-controller)# sts-1 1
Router(config-ctrlr-sts1)# vtg 1 t1 1 cem-group 1 timeslots 1-10
Router(config-ctrlr-sts1)# exit
```

Configuring CEM Group in SDH Mode

To configure CEM group in SDH mode:

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	**Purpose**
Step 2	**configure terminal**	Enters global configuration mode.
Step 3	**controller sonet** *slot/bay/port* **Example:** Router(config)# controller sonet 0/1/0	Selects the controller to configure and enters controller configuration mode, where: • *slot/bay/port*—Specifies the location of the interface. **Note** The slot number is always 1 and the bay number is always 0.
Step 4	**framing {sonet | sdh}** **Example:** Router(config-controller)# framing sdh	Specifies SDH as the framing mode.
Step 5	**au-4** *au-4#* **tug-3** *tug-3#* **Example:** Router(config-controller)# au-4 1 tug-3 1	Configures AU-4, and tributary unit groups, type 3 (TUG-3) for AU-4 and enters specific configuration mode. In SDH framing mode, each TUG-3, and AU-4 can be configured with one of these commands. Depending on currently configured AUG mapping setting, this command further specifies TUG-3, or AU-4 muxing. The CLI command parser enters into config-ctrlr-tug3 (SDH mode) or config-ctrlr-au3 (SDH mode), which makes only relevant commands visible. • au-4#—Range is from 1 to 4. For OC-3 mode, the value is 1. **Note** DS3 configuration is supported only on AuU-4. • tug-3#—Range is from 1 to 3. **Note** T1 can only be configured in au-3 mode, E1 can only be configured in the au-4 mode.
Step 6	**mode {t3 | e3}** **Example:** Router(config-ctrlr-tug3)# mode e3	Specifies the mode of operation. • **t3**—Specifies an unchannelized (clear channel) T3. • **e3**—Specifies a AU-3 or C3 that carries a unchannelized (DS3 clear channel) E3. **Note** Only e3 mode is supported for SDH framing.
Step 7	**cem-group** *group-number* {**unframed**} **Example:**	Creates a CEM group.

	Command or Action	Purpose
	`Router(config-ctrlr-tug3)# cem-group 4 unframed`	• **unframed**—Specifies that a single CEM channel is being created including all time slots and the framing structure of the line.
Step 8	**end** **Example:** `Router(config-ctrlr-tug3)# end`	Exits controller configuration mode and returns to privileged EXEC mode.

What to do next

Example

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# au-4 1 tug-3 1
Router(config-ctrlr-tug3)# mode e3
Router(config-ctrlr-tug3)# cem-group 4 unframed
Router(config-ctrlr-tug3)# end
```

Configuring DS3 Clear Channel on OC-3 and OC-12 Interface Module

Note DS3 clear channel is supported only on CEM.

Configuring DS3 Clear Channel in SONET Mode

To configure DS3 clear channel in SONET mode:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `enable`	Enables privileged EXEC mode. • Enter your password if prompted
Step 2	**configure terminal** **Example:** `Router(config)# configure terminal`	Enters global configuration mode.

	Command or Action	**Purpose**
Step 3	**controller sonet** *slot/bay/port* **Example:** `Router(config)# controller sonet 0/4/1`	Selects the controller to configure and enters controller configuration mode, where: • *slot/bay/port*—Specifies the location of the interface. **Note** The slot number is always 1 and the bay number is always 0.
Step 4	**framing {sonet	sdh}** **Example:** `Router(config)# framing sonet`	Specifies SONET as the framing mode.

Step 5	**clock source** {**line**	**internal**}
		
		Example:
		
		`Router(config-if)# `**`clock source`**
		`internal`
			Specifies the clock source for the POS link, where:
			
			  • **line**—The link uses the recovered clock from the line. This is the default setting.
			
			  • **internal**—The link uses the internal clock source.

Step 6	**sts-1 {1 - 12	1 - 3	4 - 6	7 - 9	10 - 12}** **Example:** `Router(config-controller)# sts-1 1`	Specifies the SONET Synchronous Transport Signal (STS) level and enters STS-1 configuration mode. The starting-number and ending-number arguments indicate the starting and ending STS value of the interface. For OC-3 interfaces, this value is 1. The 1-12 value is supported only in OC-12 mode.

Step 7	**mode {t3	vt-15}**
		
		Example:
		
		`Router(config-ctrlr-sts1)# mode t3`
			Specifies the mode of operation of an STS-1 path, where:
			
			  • **t3**—DS3 clear channel mode. STS-1 carries an unchannelized (clear channel) T3.
			
			  • **vt-15**—A STS-1 is divided into seven Virtual Tributary Groups (VTG). Each VTG is then divided into four VT1.5's, each carrying a T1.

Step 8	cem-group *channel-number* {unframed}
	
	Example:
	
	`Router(config-ctrlr-sts1)# cem-group 4`
	`unframed`
		Creates a CEM group.
		
		  • **unframed**—Specifies that a single CEM channel is being created including all time slots and the framing structure of the line.

	Command or Action	Purpose
Step 9	end	Exits controller configuration mode and returns to privileged EXEC mode.

What to do next

Example

The below example shows the configuration for a DS3 interface:

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sonet
Router(config-controller)# clock source line
Router(config-controller)# sts-1 1 - 3
Router(config-ctrlr-sts1)# mode t3
Router(config-ctrlr-sts1)# cem-group 0 unframed
Router(config-controller)# end
```

Configuration Example

```
controller SONET 1/0/0
framing sonet
clock source internal
!
sts-1 1
mode t3
cem-group 0 unframed
!
sts-1 2
mode t3
cem-group 1 unframed
!
sts-1 3
mode t3
cem-group 2 unframed
interface CEM1/0/0
no ip address
cem 0
xconnect 2.2.2.2 501 encapsulation mpls
!
cem 1
xconnect 2.2.2.2 502 encapsulation mpls
!
cem 2
xconnect 2.2.2.2 503 encapsulation mpls
!
```

Configuring DS3 Clear Channel in SDH Mode

To configure DS3 clear channel in SDH mode:

Procedure

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.

	Command or Action	Purpose
		• Enter your password if prompted.
Step 2	**configure terminal**	Enters global configuration mode.
Step 3	**controller sonet** *slot/bay/port* **Example:** Router(config)# controller sdh 0/1/0	Selects the controller to configure and enters controller configuration mode, where: • *slot/bay/port*—Specifies the location of the interface. **Note** The slot number is always 1 and the bay number is always 0.
Step 4	**framing {sonet	sdh}** **Example:** Router(config-controller)# framing sdh	Specifies SDH as the framing mode.
Step 5	**clock source** {**line**	**internal**} **Example:** Router(config-controller)# **clock source line**	Specifies the clock source for the POS link, where: • **line**—The link uses the recovered clock from the line. This is the default setting. • **internal**—The link uses the internal clock source.
Step 6	**aug mapping au-4** **Example:** Router(config-controller)# aug mapping au-4	Configures AUG mapping for SDH framing. If the AUG mapping is configured to be AU-4, then the following muxing, alignment, and mapping will be used: TUG-3 <--> VC-4 <--> AU-4 <--> AUG.
Step 7	**au-4** *au-4#* **tug-3** *tug-3#* **Example:** Router(config-controller)# au-4 1 tug-3 1	Configures AU-4, and tributary unit groups, type 3 (TUG-3) for AU-4 and enters specific configuration mode. In SDH framing mode TUG-3, and AU-4 can be configured with one of these commands. Depending on currently configured AUG mapping setting, this command further specifies TUG-3, or AU-4 muxing. The CLI command parser enters into config-ctrlr-tug3 (SDH mode) or config-ctrlr-au3 (SDH mode), which makes only relevant commands visible. • au-4#—Range is from 1 to 4. For OC-3 mode, the value is 1. • tug-3#—Range is from 1 to 3. **Note** E1 can only be configured in the AU-4 mode.

	Command or Action	Purpose
Step 8	**mode e3** **Example:** `Router(config-ctrlr-au4)# mode e3`	Specifies the mode of operation. • **e3**—Specifies a C3 that carries a unchannelized (DS3 clear channel) E3.
Step 9	**cem-group** *channel-number* {**unframed**} **Example:** `Router(config-ctrlr-au4)# cem-group 4 unframed`	Creates a CEM group. • **unframed**—Specifies that a single CEM channel is being created including all time slots and the framing structure of the line.
Step 10	**end**	Exits controller configuration mode and returns to privileged EXEC mode.

What to do next

Example

```
Router# configure terminal
Router(config)# controller sonet 0/1/0
Router(config-controller)# framing sdh
Router(config-controller)# clock source line
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 tug-3 1
Router(config-ctrlr-au4)# mode e3
Router(config-ctrlr-au4)# cem-group 4 unframed
Router(config-ctrlr-au4)# end
```

Optional Configurations

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

Configuring the National Bit

When G.751 framing is used, bit 11 of the G.751 frame is reserved for national use and is set to 1 by default.

✎

Note Configure national bit 1 only when required for interoperability with your telephone company.

To set the national bit in the G.751 frame, use the following commands:

Command	Purpose
Router# **configure terminal**	Enters global configuration mode.

Command	Purpose
Router(config)# **controller {t1 | e1}** *slot/subslot/port*	Selects the controller to configure. • t1—Specifies the T1 controller. • e1—Specifies the E1 controller. • slot/subslot/port—Specifies the location of the controller.
Router(config-controller)# *national reserve {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1} {0 | 1}*	Sets the national bit (the first bit): • 0—Sets the international bit in the G.704 frame to 0. This is the default. • 1—Sets the international bit in the G.704 frame to 1. **Note** When CRC4 framing is configured, the first bit is the national bit. When no-CRC4 framing is configured, the first bit becomes the international bit and should be set to 1 if crossing international borders and 0 if not crossing international borders. Sets the five national bits: • 0—Set to 0 when not crossing international borders. • 1—Set to 1 when crossing international bordrs.

Verifying the National Bit

Use the show controllers command to verify the national bits:

```
router# show controllers E1
E1 6/0/0 is up.
Applique type is Channelized E1 - balanced
No alarms detected.
alarm-trigger is not set
Framing is CRC4, Line Code is HDB3, Clock Source is Line.
International Bit: 1, National Bits: 11111
Data in current interval (234 seconds elapsed):
0 Line Code Violations, 0 Path Code Violations
0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
Total Data (last 5 15 minute intervals):
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
```

Configuring the CRC Size for T1

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

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

Procedure

	Command or Action	**Purpose**
Step 1	**interface serial** *slot*/*subslot*/*port***:***channel-group* **Example:** `Router(config)# ` **`interface serial`** `0/0/1.1/1/1/1:0`	Selects the interface to configure and enters interface configuration mode. • *slot*/*subslot*/*port***:***channel-group* —Specifies the location of the interface.
Step 2	**crc {16	32}** **Example:** `Router(config-if)# ` **`crc 16`**	Selects the CRC size in bits, where: • 16—16-bit CRC. This is the default. • 32—32-bit CRC.

Optional Packet over SONET Configurations

The following sections describe how to configure optional settings on a packet over SONET (POS) interface.

Encapsulation

encapsulation *encapsulation-type* `Router(config-if)# ` **`encapsulation hdlc`**	Configures encapsulation; you can configure the following options: • HDLC • PPP

MTU Value

mtu bytes `Router(config-if)# ` **`mtu 4000`**	Configures the maximum packet size for an interface in bytes. The default packet size is 4470 bytes.

CRC Value

crc *size-in-bits* **`Router(config-if)# crc 32`**	CRC size in bits. Valid values are 16 and 32. The default is 16.

Keepalive Value

keepalive [*period* [*retries*]] Router(config-if)# **keepalive 9 4**	Specifies the frequency at which the Cisco IOS software sends messages to the other end of the line to ensure that a network interface is alive, where: • *period*—Specifies the time interval in seconds for sending keepalive packets. The default is 10 seconds. • *retries*—Specifies the number of times that the device continues to send keepalive packets without response before bringing the interface down. The default is 3 retries.

Bandwidth

Use the following command to configure the bandwidth of a POS interface.

bandwidth {*kbps*	**inherit** [*kbps*]}	To set and communicate the current bandwidth value for an interface to higher-level protocols, use the **bandwidth** command in interface configuration mode.Valid values are from 1 to 10000000. You can apply the following keywords: • **inherit** —Specifies how a subinterface inherits the bandwidth of its main interface. • **receive**—Specifies the receive-side bandwidth.

Scrambling

Use the following command to enable scrambling on a POS interface.

pos scramble-atm	Enables scrambling on the interface.

C2 Flag

Use the following command to configure the C2 flag on a POS interface.

pos flag c2 *value*	Specifies the C2 byte field for the interface as defined in RFC 2615. Valid values are 0-255.

J1 Flag

Use the following command to configure the J1 flag on a POS interface.

pos flag j1 message *word*	Specifies the value of the J1 byte in the SONET Path OverHead (POH) column.

You can use the following commands to verify your configuration:

• **show interfaces pos**

Managing Interface Naming

The following sections describe how to manage interface naming on the Cisco ASR 900 Series Routers.

Identifying Slots and Subslot

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

- slot—Specifies the chassis slot number where the interface module is installed; the slot number is always 0 for interface modules on the .Cisco ASR 900 Series Router.

- subslot—Specifies the subslot where the interface module is installed.

- port—Specifies the SONET port number.

For example, if the optical interface module is installed in slot 0 of the chassis, the controller configuration address is specified as **controller sonet 0/0/0**.

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

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

Configuring Multilink Point-to-Point Protocol

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

This section describes how to configure MLPPP on the optical interface module and includes the following topics:

MLPPP Configuration Guidelines

When configuring MLPPP, consider the following guidelines:

- Only T1 and E1 links are supported in a bundle.

- Enable PPP encapsulation before configuring multilink-related commands.

- Interfaces can be grouped into the MLPPP bundle if they belong to same interface module.

- A group can have a maximum of 16 interfaces.

- Maximum MTU for MLPP is 9216. For serial links that are not part of MLPPP configuration, maximum MTU varies for OC-3 and T1/E1 interfaces. The MTU range is as follows:

    - OC-3: 64 to 7673

    - T1/E1: 64 to 9216

Creating a Multilink Bundle

To create a multilink bundle, use the following commands:

Procedure

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 2	**interface multilink** *group-number* **Example:** Router(config)# **interface multilink 1**	Creates a multilink interface and enters multilink interface mode, where: • group-number—The group number for the multilink bundle.
Step 3	**ip address** *address mask* **Example:** Router(config-if)# **ip address** 192.168.1.1 255.255.255.0	Sets the IP address for the multilink group, where: • address—The IP address. • mask—The subnet mask.

Assigning an Interface to a Multilink Bundle

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

Procedure

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 2	**interface serial** *slot/subslot/port* **Example:** Router(config)# **interface serial** 0/0/1.1/1/1/1:0	Selects the interface to configure and enters interface configuration mode, where: • *slot/subslot/port* —Specifies the location of the controller.
Step 3	*encapsulation ppp* **Example:** Router(config-if)# *encapsulation ppp*	Enables PPP encapsulation.

	Command or Action	Purpose
Step 4	**ppp multilink** *group group-number* **Example:** Router(config-if)# **ppp multilink** *group* 1	Assigns the interface to a multilink bundle, where: • group-number—The multilink group number for the T1 or E1 bundle.
Step 5	**end**	

What to do next

Note Repeat these commands for each interface you want to assign to the multilink bundle

```
Router# configure terminal
Router(config)# controller SONET 0/0/0
Router(config-controller)# framing sdh
Router(config-controller)# aug mapping au-4
Router(config-controller)# au-4 1 tug-3 1
Router(config-controller)# tug-2 1 e1 1 channel-group 0 timeslots 1-31
Router# configure terminal
Router(config)# interface multilink 1
Router(config-if)# ip address 192.168.1.1 255.255.255.0
Router(config-if)# ppp multilink endpoint string string1
Router(config)# interface serial 0/0/1.1/1/1/1:0
Router(config-if)# encapsulation ppp
Router(config-if)# ppp multilink group 1
```

Configuring Fragmentation Size and Delay on an MLPPP Bundle

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

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 2	**interface multilink** *group-number* **Example:** Router(config)# **interface multilink** 1	Creates a multilink interface and enters multilink interface mode, where: • *group-number* —The group number for the multilink bundle. Range 1-2147483647

	Command or Action	Purpose
Step 3	**ppp multilink fragment size** *fragment-size* **Example:** Router(config-if)# **ppp multilink fragment size** 512	Sets the fragmentation size in bytes. Fragmentation is disabled by default. Valid values are 42 to 65535 bytes.
Step 4	**ppp multilink fragment-delay** *delay* **Example:** Router(config-if)# **ppp multilink fragment-delay** 20	Sets the configured delay on the multilink bundle that satisfies the fragmentation size, where: • *delay* —Delay in milliseconds.

What to do next

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

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

Changing the Default Endpoint Discriminator

To override or change the default endpoint discriminator, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **ppp multilink endpoint** {**hostname** | **ip** *IP-address* | **mac** *LAN-interface* | **none** | **phone** *telephone-number* | **string** *char-string* }	Overrides or changes the default endpoint discriminator the system uses when negotiating the use of MLP with the peer.

Disabling Fragmentation on an MLPPP Bundle

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

Procedure

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

Configuring BERT

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

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

The supported BERT patterns are 2^15, 2^23, all 0s and all 1s.

Configuring Automatic Protection Switching

For information on how to configure Automatic Protection Switching (APS) on the optical interface module, see the Time Division Multiplexing Configuration Guide.

TU-AIS Alarms

Tributary Unit-Alarm Indication Signal (TU-AIS) alarms are higher order alarms compared to the AIS alarms. Prior to Cisco IOS-XE Everest 16.6.1, the PDH AIS alarms were generated when the TDM circuits went down. But, the SDH devices are unable to detect the PDH AIS alarms. This feature enables the SDH device to detect the PDH AIS alarm. Effective Cisco IOS-XE Everest 16.6.1, TU-AIS alarms are generated and detected when the TDM circuits go down on the access layer of the network topology or a failure occurs in MPLS domain due to which SAToP connectivity goes down. TU-AIS alarms are supported on the OC3 IM in Cisco ASR 903 RSP1 and RSP2 modules according to TU-12 section as defined in ITU-G. 707 (8.3.2). TU-AIS means that all TU-12 (i.e. all 144B) carries all "1" according to ITU-T G.707 (6.2.4.1.3).

The following are some expected behaviour after configuring TU-AIS alarms:

- CE tug shut first displays AIS alarm and then TU-AIS alarms.

- After TU-AIS alarm gets cleared the RDI alarm is displayed for 11-12 seconds and gets cleared.

- If there is a change in dejitter on the CEM circuit and TU-AIS is not configured, it displays AIS alarms for 200-300 miliseconds. If TU-AIS is configured, it displays AIS alarms for 20-30 miliseconds.

- On cable pull in PE2 LOS is displayed and after connecting back it displays RDI and then clears.

Restrictions for TU-AIS Alarms

- TU-AIS is not supported on the CEMoUDP.

- The interface modules reset after you enable or disable the TU-AIS alarms under OC3 Controller.

- TU-AIS configuration takes effect on all 4 ports of A900-IMA4OS IM.

- TU_AIS alarm verification can be done by only using ANT-20 analyzer. ASR903 cannot display this alarm.

Configuring TU-AIS Alarms

Use the following commands to configure TU-AIS alarms:

```
enable
configure terminal
controller sonet 0/1/2
tu-ais
end
```

Verification of TU-AIS Alarm Configuration

Use the **show run | se** command to verify the configuration of TU-AIS alarm:

```
PE#show run | se SONET 0/1/2
platform enable controller SONET 0/1/2
controller SONET 0/1/2
 no ais-shut
 TU-AIS
 framing sdh
```

```
clock source internal
aug mapping au-4
!
au-4 1 tug-3 1
 mode c-12
 tug-2 1 e1 1 cem-group 555 unframed
 tug-2 1 e1 1 framing unframed
!
au-4 1 tug-3 2
 mode c-12
!
au-4 1 tug-3 3
 mode c-12
site1-PE#
```

Core Failure Event Detection

Effective Cisco IOS XE Everest 16.6.1, TU-AIS configuration can be used to detect core defects. This feature is applicable only on Cisco ASR 900 RSP2 Module. The core failure is detected in the following events:

- Shut on PE controller/tug level

- Unconfiguration of Xconnect

- Removal of GigE configuration, CEM configuration, controller configuration, or OSPF configuration

- Shut on OSPF, CEM group, Xconnect, or GigE interface

Verifying Interface Configuration

Besides using the **show running-configuration** command to display your Cisco ASR 900 Series Router configuration settings, you can use the **show interface serial** and the **show controllers sonet** commands to get detailed information on a per-port basis.

Verifying Per-Port Interface Status

To find detailed interface information on a per-port basis on an optical interface module, use the **show interface serial** and **show controllers sonet** commands.

For examples of the show commands here, see the *Cisco IOS Interface and Hardware Component Command Reference* .

Troubleshooting

You can use the following commands to verify your configuration:

- **show cem circuit**—shows information about the circuit state, administrative state, the CEM ID of the circuit, and the interface on which it is configured. If **xconnect** is configured under the circuit, the command output also includes information about the attached circuit.

- **show cem circuit** *0-504*—Displays the detailed information about that particular circuit.

- **show cem circuit summary**—Displays the number of circuits which are up or down per interface basis.

- **show controller sonet x/y/z—Displays the alarm information.**

- **show hw-module subslot transceiver**—Displays information about the optical transceiver.

- **show mpls l2transport vc**—Displays the state of local and peer access circuits.

- **show running configuration**—Shows detail on each CEM group.

- **show xconnect all**—Displays the state of the pseudowire and local and peer access circuits.

- **show interfaces pos—Displays all the current interface processors and their interfaces.**

The **show controllers** command output reports the following alarms:

- SLOS

- SLOF

- B1-TCA

- B2-TCA

When SLOS is reported, all the other alarms are masked.

```
Router(config-controller)# show controller sonet 0/5/2
SONET 0/5/2 is down.
  Hardware is A900-IMA4OS

Applique type is Channelized Sonet/SDH
Clock Source is Line, AUG mapping is AU4.
.
.
.
Multiplex Section:
  AIS = 6          RDI = 0          REI = 0          BIP(B2) = 0
Active Defects: None
Detected Alarms: SLOS SLOF LAIS B1-TCA B2-TCA ......<shows all alarms reported>
Asserted/Active Alarms: SLOS B1-TCA B2-TCA..........<shows hierarchy>
Alarm reporting enabled for: SLOS SLOF SF B1-TCA B2-TCA
BER thresholds:  SF = 10e-3  SD = 10e-6
TCA thresholds:  B1 = 10e-6  B2 = 10e-6
```

To provide information about system processes, the Cisco IOS software includes an extensive list of EXEC commands that begin with the word show, which, when executed, display detailed tables of system information. Following is a list of some of the common show commands for the APS feature.

To display the information described, use these commands in privileged EXEC mode.

Command or Action	Purpose
Router# **show aps**	Displays information about the automatic protection switching feature.
Router# **show controller sonet** *slot/ port-adapter/ port*	Displays information about the hardware.
Router# **show interfaces**	Displays information about the interface.

For examples of the show commands here, see the *Cisco IOS Interface and Hardware Component Command Reference*.

Framing and Encapsulation Configuration Example

The following example sets the framing and encapsulation for the controller and interface:

```
! Specify the controller and enter controller configuration mode
!
Router(config)# controller sonet 6/0/0
!
! Specify the framing method
!
Router(config-controller)# framing esf
!
! Exit controller configuration mode and return to global configuration mode
!
Router(config-controller)# exit
!
! Specify the interface and enter interface configuration mode
!
Router(config)# interface serial 6/0/0:0
!
! Specify the encapsulation protocol
!
Router(config-if)# encapsulation ppp
!
! Exit interface configuratin mode
!
Router(config-if)# exit
!
! Exit global configuration mode
!
Router(config)# exit
Router#
```

National Bit Configuration Example

The following example sets the Natijonal Bits for the controller:

```
! Specify the controller and enter controller configuration mode
!
Router(config)# controller t1 6/0/0
!
! Set the national bits
!
Router(config-controller)#
national reserve 0 1 1 1 1 1
!
! Exit controller configuration mode and return to global configuration mode
!
Router(config-controller)# exit
!
! Exit global configuration mode
!
Router(config)# exit
Router#
```

CRC Configuration Example

The following example sets the CRC size for the interface:

```
! Specify the interface and enter interface configuration mode
!
Router(config)# interface serial 6/0/0:0
!
! Specify the CRC size
!
Router(config-if)# crc 32
!
! Exit interface configuration mode and return to global configuration mode
!
Router(config-if)# exit
!
! Exit global configuration mode
!
Router(config)# exit
Router#
```

Facility Data Link Configuration Example

The following example configures Facility Data Link:

```
! Specify the controller and enter controller configuration mode
!
Router(config)# controller sonet 6/0/0
!
! Specify the FDL specification
!
Router(config-controller)#
fdl ansi
!
! Exit controller configuration mode and return to global configuration mode
!
Router(config-controller)# exit
!
! Exit global configuration mode
!
Router(config)# exit
Router#
```

MLPPP Configuration Example

The following example creates a PPP Multilink bundle:

```
! Enter global configuration mode
!
Router# configure terminal
!
! Create a multilink bundle and assign a group number to the bundle
!
Router(config)# interface multilink 1
!
! Specify an IP address for the multilink group
!
Router(config-if)# ip address 123.456.789.111 255.255.255.0
```

```
!
! Enable Multilink PPP
!
Router(config-if)# ppp multilink
!
! Leave interface multilink configuration mode
!
Router(config-if)# exit
!
! Specify the interface to assign to the multilink bundle
!
Router(config)# interface serial 3/1//0:1
!
! Enable PPP encapsulation on the interface
!
Router(config-if)# encapsulation PPP
!
! Assign the interface to a multilink bundle
!
Router(config-if)# multilink-group 1
!
! Enable Multilink PPP
!
Router(config-if)# ppp multilink
!
! Exit interface configuration mode
!
Router(config-if)# exit
!
! Exit global configuration mode
!
Router(config)# exit
Router#
```

MFR Configuration Example

The following example configures Multilink Frame Relay (MFR):

```
! Create a MFR interface and enter interface configuration mode
!
Router(config)# interface mfr 49
!
! Assign the bundle identification (BID) name 'test' to a multilink bundle.
!
Router(config-if)# frame-relay multilink bid test
!
! Exit interface configuration mode and return to global configuration mode
!
Router(config-if)# exit
!
! Specify the serial interface to assign to a multilink bundle
!
Router(config)# interface serial 5/1/3:0
!
! Creates a multilink Frame Relay bundle link and associates the link with a multilink
bundle
!
Router(config-if)#
encapsulation frame-relay mfr 49
!
! Assigns a bundle link identification (LID) name with a multilink bundle link
!
```

```
Router(config-if)#
frame-relay multilink lid test
!
! Configures the interval at which the interface will send out hello messages
!
Router(config-if)# frame-relay multilink hello 15
!
! Configures the number of seconds the interface will wait for a hello message acknowledgement
 before resending the hello message
!
Router(config-if)# frame-relay multilink ack 6
!
! Configures the maximum number of times the interface will resend a hello message while
waiting for an acknowledgement
!
Router(config-if)# frame-relay multilink retry 5
!
! Exit interface configuration mode and return to global configuration mode
!
Router(config-if)# exit
!
! Exit global configuration mode
!
```

Router(config)# exit

Configuration Examples

This section includes the following configuration examples:

Example of Cyclic Redundancy Check Configuration

The following example configures CRC on a T1 interface:

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

Example of Facility Data Link Configuration

The following example configures FDL on a T1 interface:

```
! Specify the interface to configure and enter interface configuration mode.
!
Router(config)# interface serial 1/0/0.2
!
! Specify the T1 number and select fdl.
!
Router(config-controller)#t1 2 fdl ansi
```

Example of Invert Data on T1/E1 Interface

The following example inverts the data on the serial interface:

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

Additional Resources

For more information about configuring ATM, see

- Asynchronous Transfer Mode Configuration Guide, Cisco IOS XE Release 3S(ASR 900 Series)

For additional information on configuring optical interfaces, see

- Cisco IOS Asynchronous Transfer Mode Command Reference
- Interface and Hardware Component Configuration Guide, Cisco IOS XE Release 3S
- Wide-Area Networking Configuration Guide Library, Cisco IOS XE Release 3S