



Configuring Channelized SONET/SDH on Cisco IOS XR Software

This module describes the configuration of Channelized SONET/SDH on the Cisco XR 12000 Series Router.

Feature History for Configuring Channelized SONET/SDH on Cisco IOS XR Software

Release	Modification
Release 3.5.0	This feature was introduced on the Cisco XR 12000 Series Router.
Release 3.7.0	Channelized ATM and clear channel ATM procedures and examples was added.
Release 3.9.0	Support for the following SPAs was introduced on the Cisco XR 12000 Series Router: <ul style="list-style-type: none">• Cisco 1-Port Channelized OC-12/DS0 SPA• Cisco 1-Port Channelized OC-48/STM-16 SPA

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Prerequisites for Configuring Channelized SONET/SDH

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Before configuring Channelized SONET/SDH, be sure that the following tasks and conditions are met:

- You have at least one of the following SPAs installed in your chassis:
 - Cisco 1-Port Channelized OC-3/STM-1 SPA

- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA
- Cisco 2-Port Channelized T3/E3 ATM and Circuit Emulation SPA
- You should know how to apply and specify the SONET controller name and *interface-path-id* with the generalized notation *rack/slot/module/port*. The SONET controller name and *interface-path-id* are required with the **controller sonet** command.

Information About Configuring Channelized SONET/SDH

To configure Channelized SONET/SDH, you must understand the following concepts:

- [Channelized SONET Overview, page 264](#)
- [Channelized SDH Overview, page 269](#)
- [Default Configuration Values for Channelized SONET/SDH, page 272](#)
- [How to Configure Channelized SONET/SDH, page 273](#)

Channelized SONET Overview

Synchronous Optical Network (SONET) is an American National Standards Institute (ANSI) specification format used in transporting digital telecommunications services over optical fiber.

Synchronous Digital Hierarchy (SDH) is the international equivalent of SONET.

Channelized SONET provides the ability to transport SONET frames across multiplexed T3/E3 and virtual tributary group (VTG) channels.

Channelized SONET is supported on the following SPAs:

- Cisco 1-Port Channelized OC-3/STM-1 SPA
- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA

Channelized SDH is supported on the following SPAs:

- Cisco 1-Port Channelized OC-3/STM-1 SPA
- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA

Channelized T3/E3 ATM is supported only on the following SPA:

- Cisco 2-Port Channelized T3/E3 ATM and Circuit Emulation SPA

SONET uses Synchronous Transport Signal (STS) framing. An STS is the electrical equivalent to an optical carrier 1 (OC-1).

SDH uses Synchronous Transport Mode (STM) framing. An STM-1 is the electrical equivalent to 3 optical carrier 1s (OC-1s).

A channelized SONET interface is a composite of STS streams, which are maintained as independent frames with unique payload pointers. The frames are multiplexed before transmission.

When a line is channelized, it is logically divided into smaller bandwidth channels called *paths*. These paths carry the SONET payload. The sum of the bandwidth on all paths cannot exceed the line bandwidth.

When a line is not channelized, it is called *clear channel*, and the full bandwidth of the line is dedicated to a single channel that carries broadband services.

An STS stream can be channelized into the following types of channels:

- T3/E3
- VT1.5 mapped T1
- Packet over SONET/SDH (POS) (OC12 and OC48 only)

The T3/E3 channels can be channelized further into T1s, and the T1s can be channelized into time slots (DS0s), except on the ATM Cisco 2-Port Channelized T3/E3 ATM and Circuit Emulation Shared Port Adapter, which does not support DS0s.

, except on the 1-Port Channelized OC-48/STM-16 SPA, which does not support T1 or DS0s. Channelizing a SONET line consists of two primary processes:

- Configuring the controller
- Configuring the interface into channelized paths

You configure the controller first by setting the mode of the STS path. The mode can be set to T3, or VT1.5-mapped T1, or POS, depending on your hardware support.

**Note**

POS is supported only on the STS-3c and STS-12c paths on the Cisco 1-Port Channelized OC-12/DS0 SPA and on the STS-3c, STS-12c, and STS-48c paths on the Cisco 1-Port Channelized OC-48/STM-16 SPA.

When the mode is specified, the respective controller is created, and the remainder of the configuration is applied on that controller. For example, mode T3 creates a T3 controller. The T3 controller can then be configured to a serial channel, or it can be further channelized to carry T1s, and those T1s can be configured to serial interfaces.

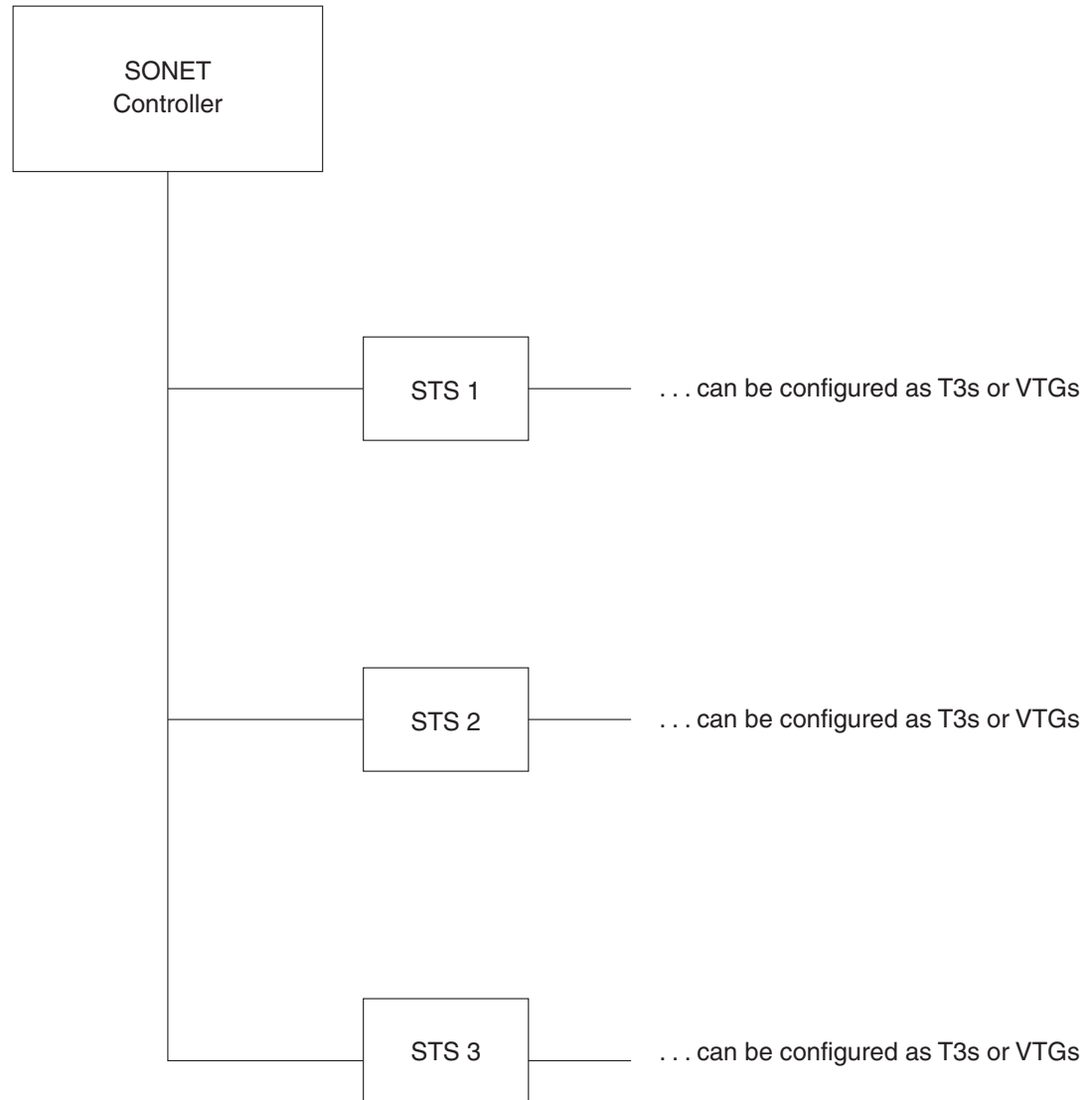
On a Cisco 1-Port Channelized OC-3/STM-1 SPA, the default configuration consists of the following paths that are already configured when the SONET card is installed.

- STS 1
- STS 2
- STS 3

Each STS path can be independently configured into T3s, E3s, or VTGs, and so on.

Figure 13 shows the SONET controller default configuration that is in place when the Cisco 1-Port Channelized OC-3/STM-1 SPA is installed.

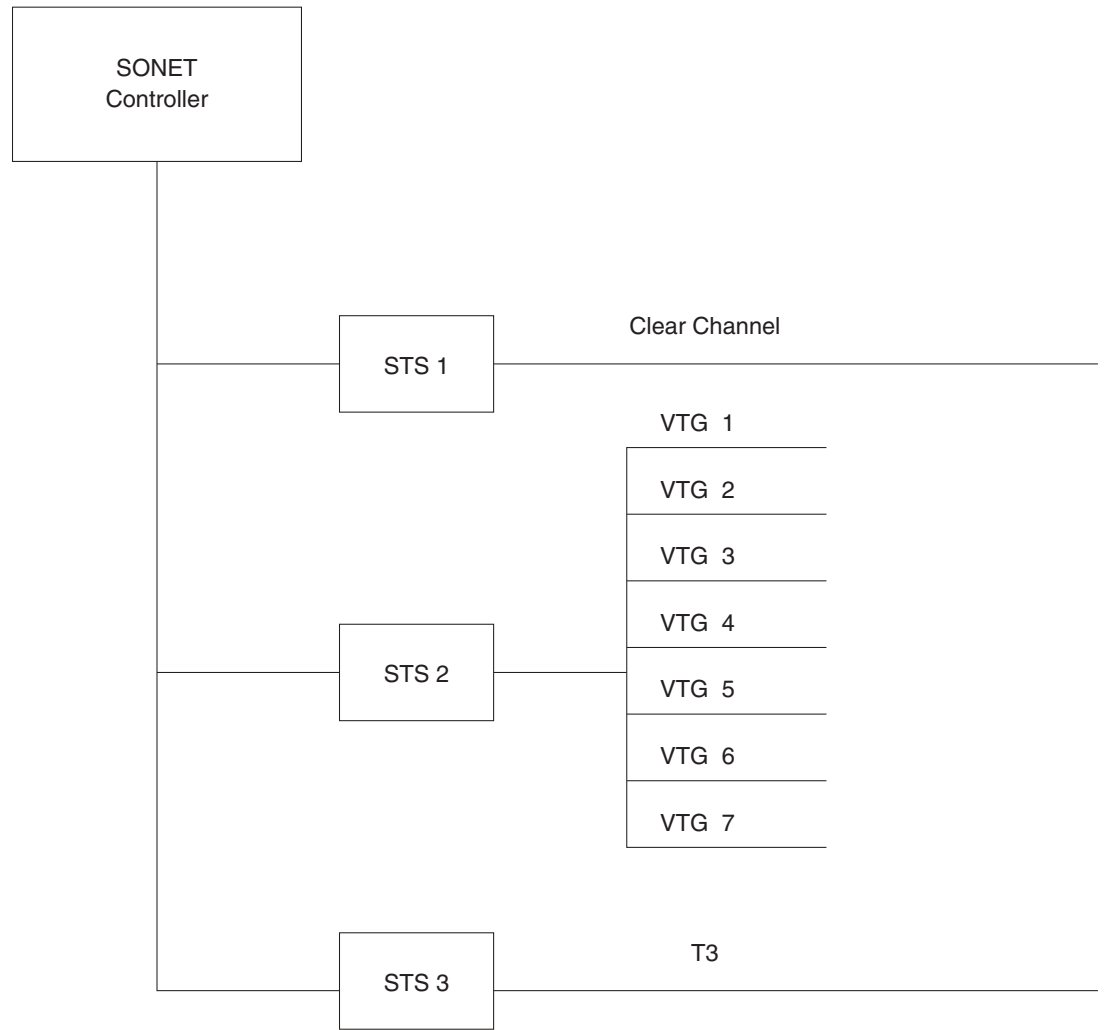
Figure 13 SONET Controller Default Configuration



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Figure 14 shows an example of some SONET controller configuration combinations.

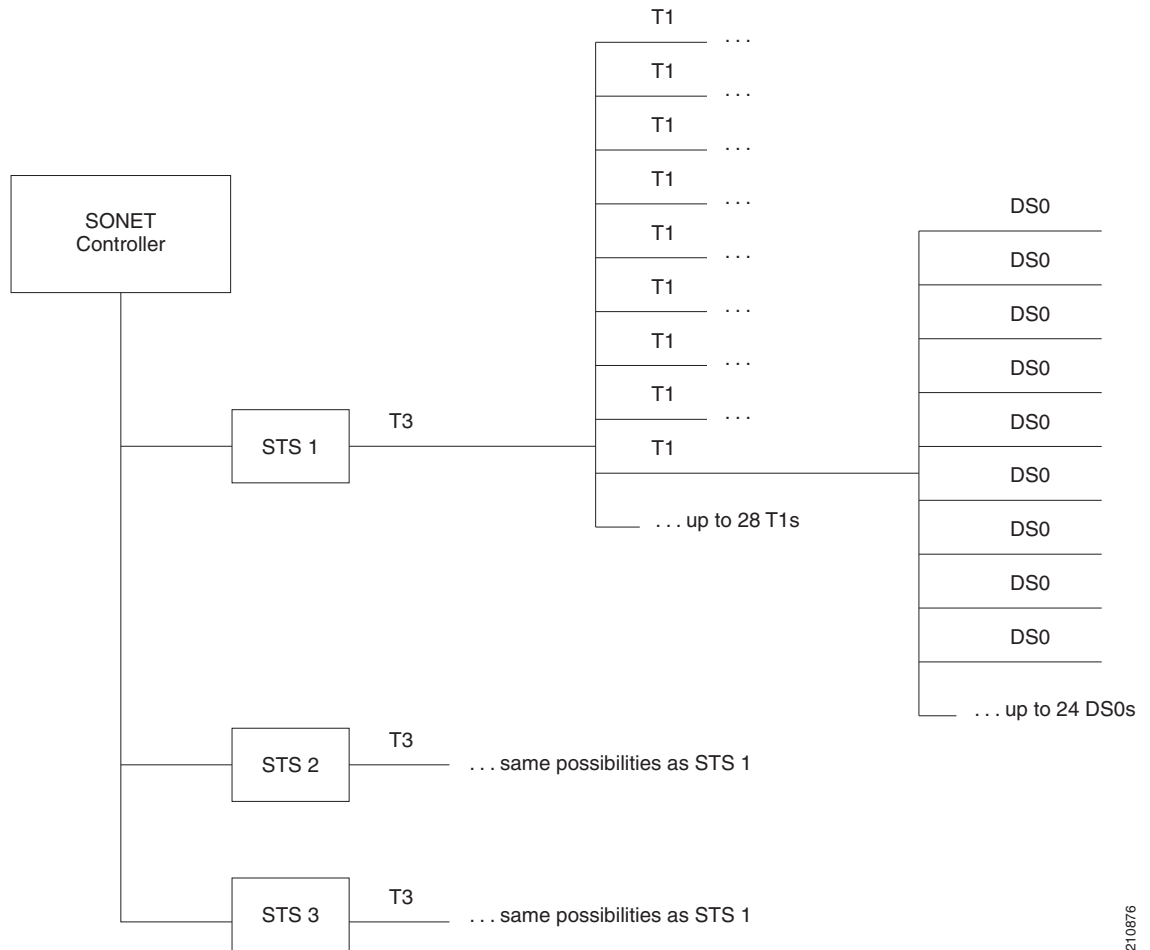
Figure 14 SONET Controller Configuration Combinations



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Figure 15 shows the T3 paths that can be configured.

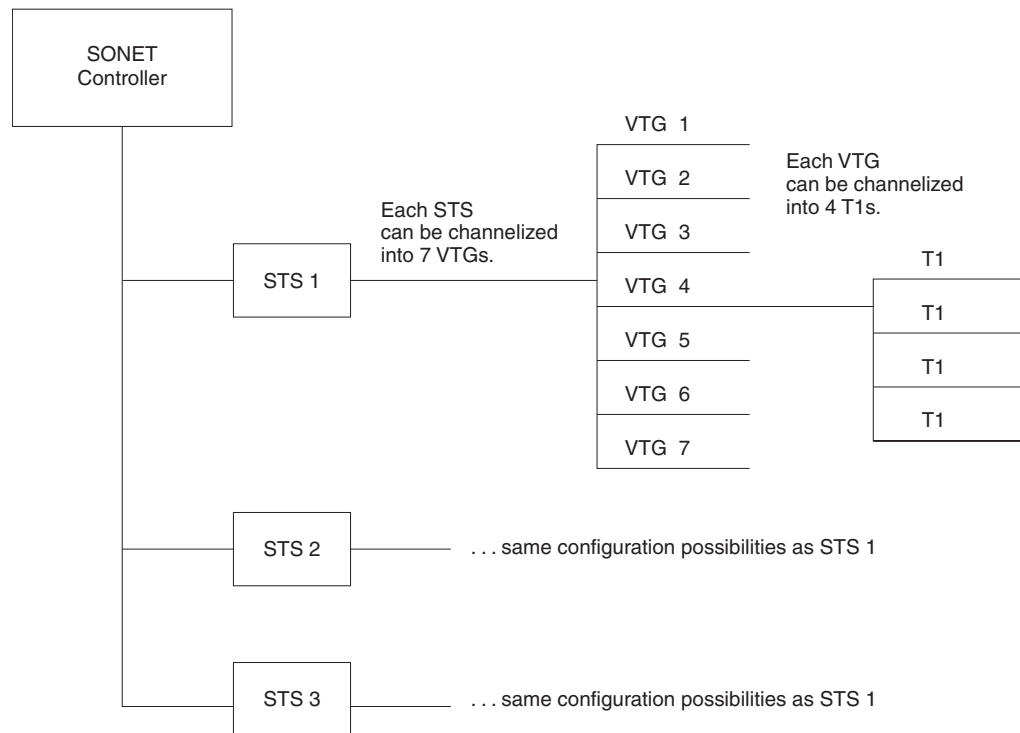
Figure 15 SONET T3 Channelized Paths



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Figure 16 shows the VTG paths that can be configured.

Figure 16 SONET VTG Channelized Paths



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Channelized SDH Overview

Synchronous Digital Hierarchy (SDH) is the international equivalent of SONET.

Channelized SDH is supported on the following SPAs:

- Cisco 1-Port Channelized OC-3/STM-1 SPA
- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA

A Synchronous Transport Module (STM) signal is the Synchronous Digital Hierarchy (SDH) equivalent of the SONET STS, but the numbers are different for each bandwidth. In this guide, the STM term refers to both path widths and optical line rates. The paths within an STM signals are called administrative units (AUs).

A summary of the basic terminology differences between SONET and SDH is as follows:

- SONET STS is equivalent to SDH administrative unit (AU)
- SONET VT is equivalent to SDH tributary unit (TU)
- SDH basic building blocks are STM-1 (equivalent to STS-3) and STM-0 (equivalent to STS-1)

An administrative unit (AU) is the information structure that provides adaptation between the higher-order path layer and the multiplex section layer. It consists of an information payload (the higher-order virtual container) and an administrative unit pointer, which indicates the offset of the payload frame start relative to the multiplex section frame start.

An AU can be channelized into tributary units (TUs) and tributary unit groups (TUGs).

An administrative unit 4 (AU-4) consists of three STM-1s or an STM-3.

An administrative unit 3 (AU-3) consists of one STM-1.

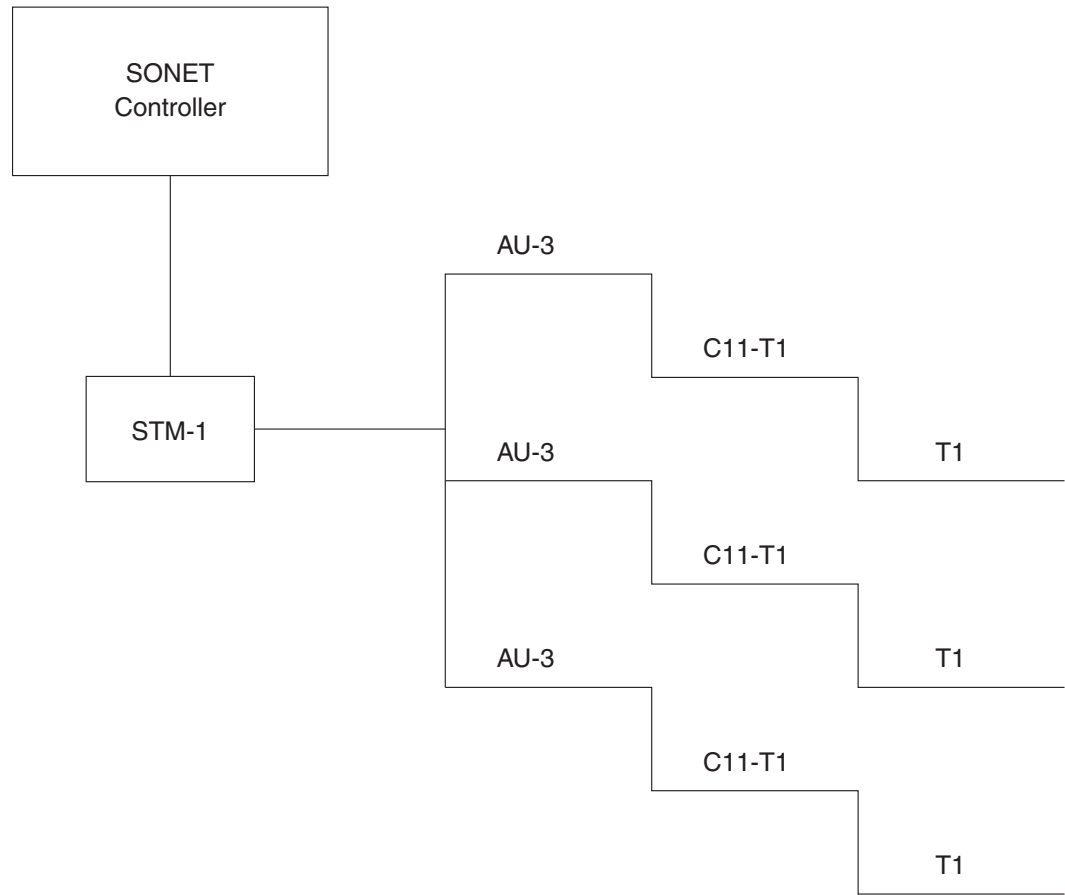
An administrative unit group (AUG) consists of one or more administrative units occupying fixed, defined positions in an STM payload.

Table 5 *SONET and SDH Terminology Equivalencies*

SONET Term	SDH Term
SONET	SDH
STS-3c	AU-4
STS-1	AU-3
VT	TU
SPE	VC
Section	Regenerator Section
Line	Multiplex Section
Path	Path

Figure 17 shows an example of SDH AU-3 paths that can be configured on certain supported SPAs.

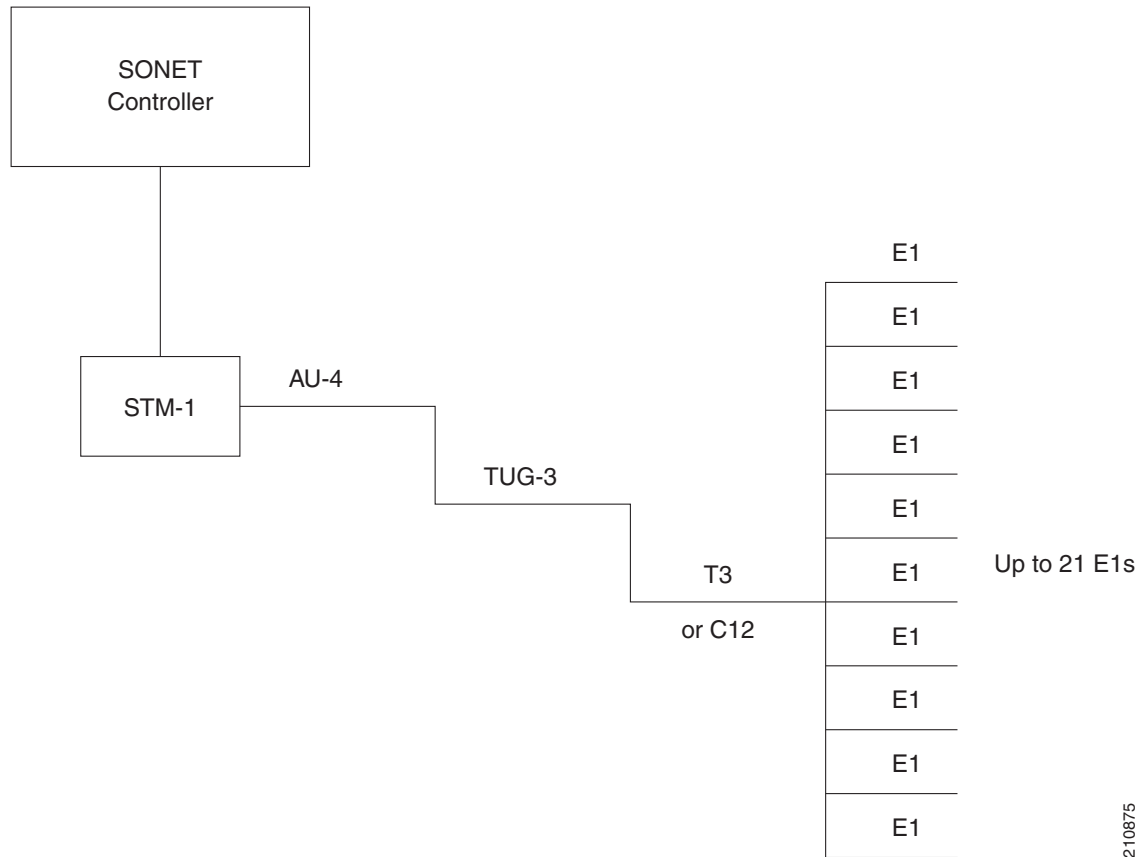
Figure 17 SDH AU3 Paths



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Figure 18 shows the SDH AU4 paths that can be configured on supported SPAs.

Figure 18 SDH AU4 Paths



Default Configuration Values for Channelized SONET/SDH

Table 6 describes the default configuration parameters that are present on the Channelized SONET/SDH.

Table 6 SONET/SDH Controller Default Configuration Values

Parameter	Default Value	Configuration File Entry
Clock source	line	clock source {internal line}
SONET framing	sonet	framing {sdh sonet}

How to Configure Channelized SONET/SDH

This section contains the following procedures:

- [Configuring SONET T3 and VT1.5-Mapped T1 Channels, page 273](#)
- [Configuring Packet over SONET Channels, page 278](#)
- [Configuring a Clear Channel SONET Controller for T3, page 281](#)
- [Configuring Channelized SONET APS, page 284](#)
- [Configuring SDH AU-3, page 287](#)
- [Configuring SDH AU-4, page 294](#)

Configuring SONET T3 and VT1.5-Mapped T1 Channels

This task explains how to configure a SONET line into T3 and VT-mapped T1 Channels.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.
- STS paths can be channelized into T3s on the following SPAs:
 - Cisco 1-Port Channelized OC-3/STM-1 SPA
 - Cisco 1-Port Channelized OC-12/DS0 SPA
 - Cisco 1-Port Channelized OC-48/STM-16 SPA
- STS paths can be channelized into VTG mapped T1s on the following SPAs:
 - Cisco 1-Port Channelized OC-3/STM-1 SPA
 - Cisco 1-Port Channelized OC-12/DS0 SPA
- T3 paths can be channelized into T1s or E1s on the following SPAs:
 - Cisco 1-Port Channelized OC-3/STM-1 SPA
 - Cisco 1-Port Channelized OC-12/DS0 SPA (No E1 support in this release)

Restrictions

T1s and E1s are not supported on the Cisco 1-Port Channelized OC-48/STM-16 SPA.

SUMMARY STEPS

1. **configure**
2. **controller sonet** *interface-path-id*
3. **clock source** {**internal** | **line**}
4. **framing sonet**
5. **sts** *number*

6. **mode** *mode*
7. **width** *number*
8. **root**
9. **controller** *controllerName instance*
10. **mode** *mode*
11. **root**
12. **controller t1** *interface-path-id*
13. **channel-group** *number*
14. **timeslots** *num1:num2:num3:num4*
or
timeslots *range1-range2*
15. **show configuration**
16. **root**
17. **interface serial** *interface-path-id*
18. **encapsulation** { **frame-relay** | **hdlc** | **ppp** }
19. **ipv4** *ip-address mask*
20. **no shutdown**
21. **end**
or
commit
22. **show**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port</i> notation.

	Command or Action	Purpose
Step 3	<p>clock source {internal line}</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# clock source internal</p>	<p>Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line.</p> <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. <p>Note Internal clocking is required for SRP interfaces.</p>
Step 4	<p>framing sonet</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# framing sonet</p>	<p>Configures the controller for SONET framing.</p> <p>SONET framing (sonet) is the default.</p>
Step 5	<p>sts number</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# sts 1</p>	<p>Configures the STS stream specified by <i>number</i>. The ranges are:</p> <ul style="list-style-type: none"> 1 to 3—1-Port Channelized OC-3/STM-1 SPA 1 to 12—1 Port Channelized OC-12/DS0 SPA 1 to 48—1 Port Channelized OC-48/STM-16 SPA
Step 6	<p>mode mode</p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# mode t3</p>	<p>Sets the mode of interface at the STS level. The possible modes are:</p> <ul style="list-style-type: none"> t3—SONET path carrying T3 vt15-t1—SONET path carrying virtual tributary 1.5 T1s (VT15 T1) pos—Packet over SONET (OC12 and OC48 only)
Step 7	<p>width number</p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# width 3</p>	<p>Configures the number of the STS streams that are concatenated. The possible values for <i>number</i> are:</p> <ul style="list-style-type: none"> 1—Indicating one STS stream 3—Indicating three STS streams (STS-3c) 12—Indicating concatenation of 12 STS streams (STS-12c) 48—Indicating concatenation of 48 STS streams (STS-48c). This is the default on the 1-Port Channelized OC-48/STM-16 SPA. <p>Widths 3, and 12, and 48 are configured on STS paths at natural boundaries, which coincide with the following path numbers:</p> <ul style="list-style-type: none"> 1, 4, 7, 10, and so on, for STS-3c 1, 13, 25, and 37 for STS-12c 1 for STS-48c
Step 8	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# root</p>	<p>Exits to global configuration mode.</p>

	Command or Action	Purpose
Step 9	<p>controller <i>controllerName instance</i></p> <p>Example: RP/0/0/CPU0:router(config)# controller t3 0/1/1/0/0</p>	<p>Enters controller configuration submode and specifies the controller name and instance identifier with the <i>rack/slot/module/port/controllerName</i> notation. The controller names are:</p> <ul style="list-style-type: none"> t3—SONET path carrying T3 vt15-t1—SONET path carrying virtual tributary 1.5 T1s (VT15 T1)
Step 10	<p>mode <i>mode</i></p> <p>Example: RP/0/0/CPU0:router(config-t3)# mode t1</p>	<p>Sets the mode of interface at this level. The possible modes are:</p> <ul style="list-style-type: none"> t1—Channelized into 28 T1s e1—Channelized into 21 E1s serial—Clear channel carrying an HDLC-like payload
Step 11	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-t3)# root</p>	<p>Exits to global configuration mode.</p>
Step 12	<p>controller t1 <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router(config)# controller t1 0/1/1/0/0/0</p>	<p>Enters T1 controller configuration submode and specifies the T1 controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port/T3Num/T1num</i> notation.</p>
Step 13	<p>channel-group <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config-t1)# channel-group 1</p>	<p>Sets the channel group number to which time slots are assigned. The range is from 1 to 24.</p>
Step 14	<p>timeslots <i>num1:num2:num3:num4</i> or timeslots <i>range1-range2</i></p> <p>Example: RP/0/0/CPU0:router(config-t1-channel_group)# timeslots 1:3:7:9 RP/0/0/CPU0:router(config-t1-channel_group)# timeslots 1-24</p>	<p>Specifies the time slots for the interface by number with the <i>num1:num2:num3:num4</i> notation, or by range with the <i>range1-range2</i> notation.</p>
Step 15	<p>show configuration</p> <p>Example: RP/0/0/CPU0:router(config-t1-channel_group)# show configuration</p>	<p>Displays the contents of uncommitted configuration.</p>
Step 16	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-t3)# root</p>	<p>Exits to global configuration mode.</p>

	Command or Action	Purpose
Step 17	<p>interface serial <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router(config)# interface serial 0/1/1/0/0/0:0</p>	Specifies the complete interface number with the <i>rack/slot/module/port/T3Num/T1num:instance</i> notation.
Step 18	<p>encapsulation {frame-relay hdlc ppp}</p> <p>Example: RP/0/0/CPU0:router(config-if)# encapsulation ppp</p>	<p>Specifies the encapsulation type with the one of the following keywords:</p> <ul style="list-style-type: none"> • frame-relay—Frame Relay network protocol • hdlc—High-level Data Link Control (HDLC) synchronous protocol • ppp—Point-to-Point Protocol
Step 19	<p>ipv4 <i>ip-address mask</i></p> <p>Example: RP/0/0/CPU0:router(config-if)# ip address 10.10.10.10 255.255.255.255</p>	Assigns an IP address and subnet mask to the interface.
Step 20	<p>no shutdown</p> <p>Example: RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>Removes the shutdown configuration.</p> <p>Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).</p>
Step 21	<p>end or commit</p> <p>Example: RP/0/00/CPU0:router(config-sonet)# end or RP/0/0/CPU0:router(config-sonet)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> • When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> – Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 22	<p>show controllers sonet <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router# show controllers sonet 0/1/1/0</p>	Verifies the SONET controller configuration.

Configuring Packet over SONET Channels

This task explains how to configure Packet over SONET (POS) channels on SPAs supporting channelized SONET.

Prerequisites

You have one of the following SPAs installed:

- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA

SUMMARY STEPS

1. **configure**
2. **controller sonet** *interface-path-id*
3. **clock source** { **internal** | **line** }
4. **framing** { **sdh** | **sonet** }
5. **sts number**
6. **width number**
7. **mode mode scramble**
8. **root**
9. **interface pos** *interface-path-id*
10. **encapsulation** [**hdlc** | **ppp** | **frame-relay** [**IETF**]]
11. **pos crc** { **16** | **32** }
12. **mtu value**
13. **no shutdown**
14. **end**
or
commit
15. **show interfaces pos** *interface-path-id*

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port</i> notation.

	Command or Action	Purpose
Step 3	<p>clock source {internal line}</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# clock source internal</p>	<p>Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line.</p> <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. <p>Note Internal clocking is required for SRP interfaces.</p>
Step 4	<p>framing {sdh sonet}</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# framing sonet</p>	<p>(Optional) Configures the controller framing with either the sdh keyword for Synchronous Digital Hierarchy (SDH) framing or the sonet keyword for SONET framing.</p> <p>SONET framing (sonet) is the default.</p>
Step 5	<p>sts <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config-sonet)# sts 1</p>	<p>Configures the STS stream specified by <i>number</i>. The ranges are:</p> <ul style="list-style-type: none"> 1 to 12 on the 1-Port Channelized OC12/DS0 SPA 1 to 48 on the 1 Port Channelized OC48/DS3 SPA
Step 6	<p>width <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# width 3</p>	<p>Configures the number of the STS streams that are concatenated. The possible values for <i>number</i> are:</p> <ul style="list-style-type: none"> 3—Indicating three STS streams (STS-3c) 12—Indicating concatenation of 12 STS streams (STS-12c) 48—Indicating concatenation of 48 STS streams (STS-48c) <p>Widths 3, 12, and 48 are configured on STS paths at natural boundaries, which coincide with the following path numbers:</p> <ul style="list-style-type: none"> 1, 4, 7, 10, and so on, for STS-3c 1, 13, 25, and 37 for STS-12c 1 for STS-48c <p>Note POS interfaces are not supported when width is 1.</p>
Step 7	<p>mode <i>mode</i> scramble</p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# mode pos scramble</p>	<p>Sets the mode of interface at the STS level. Set the mode to pos to create POS interface (OC12 and OC48 only).</p>
Step 8	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-stsPath)# root</p>	<p>Exits to global configuration mode.</p>
Step 9	<p>interface pos <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router(config)# interface POS 0/1/1/0</p>	<p>Specifies the POS interface name and notation <i>rack/slot/module/port</i>, and enters interface configuration mode.</p>

	Command or Action	Purpose
Step 10	<p><code>encapsulation [hdlc ppp frame-relay [IETF]]</code></p> <p>Example: RP/0/0/CPU0:router(config-if)# encapsulation hdlc</p>	(Optional) Configures the interface encapsulation parameters and details such as HDLC or PPP. The default is HDLC.
Step 11	<p><code>pos crc {16 32}</code></p> <p>Example: RP/0/0/CPU0:router(config-if)# pos crc 32</p>	(Optional) Configures the CRC value for the interface. Enter the 16 keyword to specify 16-bit CRC mode, or enter the 32 keyword to specify 32-bit CRC mode. The default CRC is 32 .
Step 12	<p><code>mtu value</code></p> <p>Example: RP/0/0/CPU0:router(config-if)# mtu 4474</p>	(Optional) Configures the POS MTU value. The range is 64–65535.
Step 13	<p><code>no shutdown</code></p> <p>Example: RP/0/0/CPU0:router (config-if)# no shutdown</p>	Removes the shutdown configuration. Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).
Step 14	<p><code>end</code> OR <code>commit</code></p> <p>Example: RP/0/0/CPU0:router(config-sonet)# end OR RP/0/0/CPU0:router(config-sonet)# commit</p>	Saves configuration changes. <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]: <ul style="list-style-type: none"> Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 15	<p><code>show interfaces pos interface-path-id</code></p> <p>Example: RP/0/0/CPU0:router# show interfaces pos 0/1/1/0</p>	(Optional) Displays the interface configuration.

Configuring a Clear Channel SONET Controller for T3

This task explains how to configure a SONET line into a single T3 serial channel called *clear channel*. Clear channel is established by setting the T3 controller mode to serial.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.

Restrictions

On the Cisco 1-Port Channelized OC-3/STM-1 SPA, clear channel is supported only on STS-1 and STS-2.

SUMMARY STEPS

- configure**
- controller sonet** *interface-path-id*
- clock source** {**internal** | **line**}
- framing sonet**
- sts** *number*
- mode t3**
- root**
- controller t3** *interface-path-id*
- mode serial**
- root**
- interface serial** *interface-path-id*
- encapsulation** {**frame-relay** | **hdlc** | **ppp**}
- ipv4** *ip-address mask*
- no shutdown**
- end**
or
commit
- show controllers sonet** *interface-path-id*

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port</i> notation.
Step 3	clock source { internal line } Example: RP/0/0/CPU0:router(config-sonet)# clock source internal	Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line. <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. Note Internal clocking is required for SRP interfaces.
Step 4	framing sonet Example: RP/0/0/CPU0:router(config-sonet)# framing sonet	Configures the controller for SONET framing. SONET framing (sonet) is the default.
Step 5	sts <i>number</i> Example: RP/0/0/CPU0:router(config-sonet)# sts 1	Configures the STS stream specified by <i>number</i> . The ranges are: <ul style="list-style-type: none"> 1 to 3—1-Port Channelized OC-3/STM-1 SPA 1 to 12—1-Port Channelized OC-12/DS0 SPA 1 to 48—1-Port Channelized OC-48/DS3 SPA
Step 6	mode t3 Example: RP/0/0/CPU0:router(config-stsPath)# mode t3	Sets the mode of the interface at the STS level for T3.
Step 7	root Example: RP/0/0/CPU0:router(config-stsPath)# root	Exits to global configuration mode.
Step 8	controller t3 <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller t3 0/1/1/0/0	Enters T3 controller configuration submode and specifies the T3 controller name and interface-path-id identifier with the <i>rack/slot/module/port/T3Num</i> notation.

	Command or Action	Purpose
Step 9	mode serial Example: RP/0/0/CPU0:router(config-t3)# mode serial	Sets the mode of the interface to serial to establish a clear channel.
Step 10	root Example: RP/0/0/CPU0:router(config-t3)# root	Exits to global configuration mode.
Step 11	interface serial interface-path-id Example: RP/0/0/CPU0:router(config)# interface serial 0/1/1/0/0/0:0	Specifies the complete interface number with the <i>rack/slot/module/port/T3Num/T1num:instance</i> notation.
Step 12	encapsulation {frame-relay hdlc ppp} Example: RP/0/0/CPU0:router(config-if)# encapsulation ppp	Specifies the encapsulation type with the one of the following keywords: <ul style="list-style-type: none"> • frame-relay—Frame Relay network protocol • hdlc—High-level Data Link Control (HDLC) synchronous protocol • ppp—Point-to-Point Protocol
Step 13	ipv4 ip-address mask Example: RP/0/0/CPU0:router(config-if)# ip address 10.10.10.10 255.255.255.255	Assigns an IP address and subnet mask to the interface.
Step 14	no shutdown Example: RP/0/0/CPU0:router(config-if)# no shutdown	Removes the shutdown configuration. <p>Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).</p>

	Command or Action	Purpose
Step 15	<pre>end or commit</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router(config-sonet)# end or RP/0/0/CPU0:router(config-sonet)# commit</pre>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 16	<pre>show controllers sonet interface-path-id</pre> <p>Example:</p> <pre>RP/0//0/CPU0:router# show controllers sonet 0/1/1/0</pre>	<p>Verifies the SONET controller configuration.</p>

Configuring Channelized SONET APS

This task explains how to configure APS for channelized SONET lines. The Cisco XR 12000 Series Router supports both single router and multirouter APS.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.
- You should know how to configure the SONET APS as specified in the “[Configuring SONET APS](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.

SUMMARY STEPS

- aps group** *number*
- channel 0 local sonet** *interface*
or
channel 0 remote *ip-address*

3. **channel 1 local sonet** *interface*
or
channel 1 remote *ip-address*
4. **signalling** {*sonet | sdh*}
5. **end**
or
commit
6. **show aps**
7. **show aps group** [*number*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>aps group <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config)# aps group 1</p>	<p>Adds an APS group with a specified number and enters APS group configuration mode.</p> <ul style="list-style-type: none"> • Use the aps group command in global configuration mode. • To remove a group, use the no form of this command, as in: no aps group number, where the value range is from 1 to 255. <p>Note To use the aps group command, you must be a member of a user group associated with the proper task IDs for APS commands.</p> <p>Note The aps group command is used even when a single protect group is configured.</p>
Step 2	<p>channel 0 local sonet <i>interface</i> or channel 0 remote <i>ip-address</i></p> <p>Example: RP/0/0/CPU0:router(config-aps)# channel 0 local SONET 0/0/0/1 or RP/0/0/CPU0:router(config-aps)# channel 0 remote 172.18.69.123</p>	<p>Creates a protect channel for the APS group, where 0 designates a protect channel.</p> <p>Note The protect channel must be assigned before the active channel can be assigned.</p> <p>Note To configure APS where both channels are on one router, use the channel local command for both the protect and active channels. To configure APS using two different routers where the active channel is on one router and the protect channel is on another router, use the channel local command for either the protect or the active channel, but use the channel remote command for the other channel.</p>

	Command or Action	Purpose
Step 3	<pre>channel 1 local sonet interface or channel 1 remote ip-address</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router(config-aps)# channel 1 local SONET 0/0/0/2 or RP/0/0/CPU0:router(config-aps)# channel 1 remote 172.18.69.123</pre>	<p>Creates an active channel for the APS group, where 1 designates an active channel.</p> <p>Note The active channel must be assigned after the protect channel is assigned.</p> <p>Note To configure APS where both channels are on one router, use the channel local command for both the protect and active channels. To configure APS using two different routers where the active channel is on one router and the protect channel is on another router, use the channel local command for either the protect or the active channel, but use the channel remote command for the other channel.</p>
Step 4	<pre>signalling {sonet sdh}</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router(config-aps)# signalling sonet</pre>	<p>Configures the K1K2 overhead byte used for automatic protection switching (APS). The keyword options are:</p> <ul style="list-style-type: none"> • sonet—Sets signaling to SONET. • sdh—Sets signaling to Synchronous Digital Hierarchy (SDH).
Step 5	<pre>end or commit</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router(config-sonet)# end or RP/0/0/CPU0:router(config-sonet)# commit</pre>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> • When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> – Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. – Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. – Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 6	<pre>show aps</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router# show aps</pre>	<p>(Optional) Displays the operational status for all configured SONET APS groups.</p>
Step 7	<pre>show aps group [number]</pre> <p>Example:</p> <pre>RP/0/0/CPU0:router# show aps group 3</pre>	<p>(Optional) Displays the operational status for configured SONET APS groups.</p> <p>Note The show aps group command is more useful than the show aps command when multiple groups are defined.</p>

Configuring SDH AU-3

This section includes the following tasks:

- [Configuring SDH AU-3 Mapped to C11-T1 or C12-E1, page 287](#)
- [Configuring SDH AU-3 Mapped to T3 or E3, page 290](#)

Configuring SDH AU-3 Mapped to C11-T1 or C12-E1

This task explains how to configure SDH AU-3 with c11-t1 or c12-e1 mapping.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.

Restrictions

Channelized SDH AU-3 with c11-t1 or c12-e1 mapping is supported on the following SPAs:

- Cisco 1-Port Channelized OC-3/STM-1 SPA
- Cisco 1-Port Channelized OC-12/DS0 SPA

SUMMARY STEPS

1. **configure**
2. **controller sonet** *interface-path-id*
3. **clock source** {**internal** | **line**}
4. **framing sdh**
5. **au** *number*
6. **mode** *mode*
7. **root**
8. **controller t1** *interface-path-id*
9. **channel-group** *number*
10. **timeslots** *num1:num2:num3:num4*
or
timeslots *range1-range2*
11. **show configuration**
12. **root**
13. **interface serial** *interface-path-id*
14. **encapsulation** {**frame-relay** | **hdlc** | **ppp**}
15. **ipv4** *ip-address mask*
16. **no shutdown**

17. **end**
or
commit
18. **show controllers sonet interface-path-id**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet interface-path-id Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and interface-path-id identifier with the <i>rack/slot/module/port</i> notation.
Step 3	clock source {internal line} Example: RP/0/0/CPU0:router(config-sonet)# clock source internal	Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line. <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. Note Internal clocking is required for SRP interfaces.
Step 4	framing sdh Example: RP/0/0/CPU0:router(config-sonet)# framing sdh	Configures the controller framing for Synchronous Digital Hierarchy (SDH) framing. SONET framing (sonet) is the default.
Step 5	au number Example: RP/0/0/CPU0:router(config-sonet)# au 1	Specifies the administrative unit (AU) group and enters AU path configuration mode. For AU-3, the valid range is: <ul style="list-style-type: none"> 1 to 3—1-Port Channelized OC-3/STM-1 SPA 1 to 12—1-Port Channelized OC-12/DS0 SPA Note The au command does not specify the AU type. It specifies the number of the AU group for the AU type that you want to configure. The range for the AU command varies based on whether you are configuring AU-3 or AU-4.
Step 6	mode mode Example: RP/0/0/CPU0:router(config-auPath)# mode c11-t1	Sets the mode of interface at the AU level. AU-3 paths can be mapped to c11-t1 or c12-e1 on supported SPAs.

	Command or Action	Purpose
Step 7	root Example: RP/0/0/CPU0:router(config-auPath)# root	Exits to global configuration mode.
Step 8	controller t1 interface-path-id Example: RP/0/0/CPU0:router(config)# controller T1 0/1/1/0/0/0/0	Enters T1 controller configuration submode and specifies the T1 controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port/auNum/t1Num</i> notation.
Step 9	channel-group number Example: RP/0/0/CPU0:router(config-t1)# channel-group 0	Sets the channel-group number to which time slots are assigned. The range is from 1 to 28.
Step 10	timeslots num1:num2:num3:num4 or timeslots range1-range2 Example: RP/0/0/CPU0:router(config-t1-channel_group)# timeslots 1:3:7:9 RP/0/0/CPU0:router(config-t1-channel_group)# timeslots 1-12	Specifies time slots for the interface by number with the <i>num1:num2:num3:num4</i> notation, or by range with the <i>range1-range2</i> notation.
Step 11	show configuration Example: RP/0/0/CPU0:router(config-t1-channel_group)# show configuration	Displays the contents of uncommitted configuration.
Step 12	root Example: RP/0/0/CPU0:router(config-t3)# root	Exits to global configuration mode.
Step 13	interface serial interface-path-id Example: RP/0/0/CPU0:router(config)# interface serial 0/1/1/0/0/0:0	Specifies the complete interface number with the <i>rack/slot/module/port/T3Num/T1Num:instance</i> notation.
Step 14	encapsulation {frame-relay hdlc ppp} Example: RP/0/0/CPU0:router(config-if)# encapsulation frame-relay	Specifies the encapsulation type with the one of the following keywords: <ul style="list-style-type: none"> • frame-relay—Frame Relay network protocol • hdlc—High-level Data Link Control (HDLC) synchronous protocol • ppp—Point-to-Point Protocol

	Command or Action	Purpose
Step 15	<p>ipv4 <i>ip-address mask</i></p> <p>Example: RP/0/0/CPU0:router(config-if)# ip address 10.10.10.10 255.255.255.255</p>	Assigns an IP address and subnet mask to the interface.
Step 16	<p>no shutdown</p> <p>Example: RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>Removes the shutdown configuration.</p> <p>Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).</p>
Step 17	<p>end or commit</p> <p>Example: RP/0/0/CPU0:router(config-sonet)# end or RP/0/0/CPU0:router(config-sonet)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]: Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 18	<p>show controllers sonet <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router# show controllers sonet 0/1/1/0</p>	Verifies the SONET controller configuration.

Configuring SDH AU-3 Mapped to T3 or E3

This task explains how to configure SDH AU-3 mapped to T3 or E3.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.

Restrictions

Channelized SDH AU-3 with T3 or E3 mapping is supported on the following SPAs:

- Cisco 1-Port Channelized OC-3/STM-1 SPA
- Cisco 1-Port Channelized OC-12/DS0 SPA
- Cisco 1-Port Channelized OC-48/STM-16 SPA

SUMMARY STEPS

1. **configure**
2. **controller sonet** *interface-path-id*
3. **clock source** {**internal** | **line**}
4. **framing sdh**
5. **au** *number*
6. **mode t3**
or
mode e3
7. **root**
8. **controller** {**t3** | **e3**} *interface-path-id*
9. **mode serial**
10. **show configuration**
11. **root**
12. **interface serial** *interface-path-id*
13. **encapsulation** {**frame-relay** | **hdlc** | **ppp**}
14. **ipv4** *ip-address mask*
15. **no shutdown**
16. **end**
or
commit
17. **show controllers sonet** *interface-path-id*

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and interface-path-id identifier with the <i>rack/slot/module/port</i> notation.

	Command or Action	Purpose
Step 3	<p><code>clock source {internal line}</code></p> <p>Example: RP/0/0/CPU0:router(config-sonet)# clock source internal</p>	<p>Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line.</p> <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. <p>Note Internal clocking is required for SRP interfaces.</p>
Step 4	<p><code>framing sdh</code></p> <p>Example: RP/0/0/CPU0:router(config-sonet)# framing sdh</p>	<p>Configures the controller framing for Synchronous Digital Hierarchy (SDH) framing.</p> <p>SONET framing (sonet) is the default.</p>
Step 5	<p><code>au number</code></p> <p>Example: RP/0/0/CPU0:router(config-sonet)# au 1</p>	<p>Specifies the administrative unit (AU) group and enters AU path configuration mode. For AU-3, the valid range is:</p> <ul style="list-style-type: none"> 1 to 3—1-Port Channelized OC-3/STM-1 SPA 1 to 12—1-Port Channelized OC-12/DS0 SPA 1 to 48—1-Port Channelized OC-48/DS3 SPA <p>Note The au command does not specify the AU type. It specifies the number of the AU group for the AU type that you want to configure. The range for the AU command varies based on whether you are configuring AU-3 or AU-4.</p>
Step 6	<p><code>mode t3</code> or <code>mode e3</code></p> <p>Example: RP/0/0/CPU0:router(config-auPath)# mode t3</p>	<p>Sets the mode of interface at the AU level to T3 or E3.</p>
Step 7	<p><code>root</code></p> <p>Example: RP/0/0/CPU0:router(config-auPath)# root</p>	<p>Exits to global configuration mode.</p>
Step 8	<p><code>controller {t3 e3} interface-path-id</code></p> <p>Example: RP/0/0/CPU0:router(config)# controller T3 0/1/1/0/0</p>	<p>Enters T3 or E3 controller configuration submode and specifies the T3 or E3 controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port/auNum</i> notation.</p>
Step 9	<p><code>mode serial</code></p> <p>Example: RP/0/0/CPU0:router(config-t3)# mode serial</p>	<p>Configures the mode of the port to be clear channel serial.</p>

	Command or Action	Purpose
Step 10	<p>show configuration</p> <p>Example: RP/0/0/CPU0:router(config-t3)# show configuration</p>	Displays the contents of uncommitted configuration.
Step 11	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-t3)# root</p>	Exits to global configuration mode.
Step 12	<p>interface serial interface-path-id</p> <p>Example: RP/0/0/CPU0:router(config)# interface serial 0/1/1/0/0/0:0</p>	Specifies the complete interface number with the <i>rack/slot/module/port/T3Num/T1num:instance</i> notation.
Step 13	<p>encapsulation frame-relay hdlc ppp</p> <p>Example: RP/0/0/CPU0:router(config-if)# encapsulation frame-relay hdlc ppp</p>	<p>Specifies the encapsulation type with the one of the following keywords:</p> <ul style="list-style-type: none"> • frame-relay—Frame Relay network protocol • hdlc—High-level Data Link Control (HDLC) synchronous protocol • ppp—Point-to-Point Protocol
Step 14	<p>ipv4 ip-address mask</p> <p>Example: RP/0/0/CPU0:router(config-if)# ip address 10.10.10.10 255.255.255.255</p>	Assigns an IP address and subnet mask to the interface.
Step 15	<p>no shutdown</p> <p>Example: RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>Removes the shutdown configuration.</p> <p>Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).</p>

	Command or Action	Purpose
Step 16	<pre>end or commit</pre> <p>Example: RP/0/0/CPU0:router(config-sonet)# end OR RP/0/0/CPU0:router(config-sonet)# commit </p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 17	<pre>show controllers sonet interface-path-id</pre> <p>Example: RP/0/0/CPU0:router# show controllers sonet 0/1/1/0 </p>	<p>Verifies the SONET controller configuration.</p>

Configuring SDH AU-4

This task explains how to configure an SDH AU-4 stream into a TUG-3 channel mapped to E3s.

Prerequisites

- You should know how to configure the SONET controller as specified in the “[How to Configure Clear Channel SONET Controllers](#)” section of the *Configuring Clear Channel SONET Controllers on Cisco IOS XR Software* module.

Restrictions

- Channelized SDH is supported on the following SPAs:
 - Cisco 1-Port Channelized OC-3/STM-1 SPA
 - Cisco 1-Port Channelized OC-12/DS0 SPA
 - Cisco 1-Port Channelized OC-48/STM-16 SPA
- In this release, AU-4 paths can only be channelized into TUG-3s.
- The 1-Port Channelized OC-48/STM-16 SPA does not support T1 or E1 channelization.

SUMMARY STEPS

1. **configure**
2. **controller sonet** *interface-path-id*
3. **clock source** {**internal** | **line**}
4. **framing sdh**
5. **au** *number*
6. **mode tug3**
7. **width** *number*
8. **tug3** *number*
9. **mode** *mode*
10. **root**
11. **controller** *name interface-path-id*
12. **mode** *mode*
13. **root**
14. **controller** *name instance*
15. **channel-group** *number*
16. **timeslots** *num1:num2:num3:num4*
or
timeslots *range1-range2*
17. **show configuration**
18. **root**
19. **interface serial** *interface-path-id*
20. **encapsulation** {**frame-relay** | **hdlc** | **ppp**}
21. **ipv4** *ip-address mask*
22. **no shutdown**
23. **end**
or
commit
24. **show controllers sonet** *interface-path-id*

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	controller sonet <i>interface-path-id</i> Example: RP/0/0/CPU0:router(config)# controller sonet 0/1/1/0	Enters SONET controller configuration submode and specifies the SONET controller name and <i>interface-path-id</i> with the <i>rack/slot/module/port</i> notation.
Step 3	clock source { internal line } Example: RP/0/0/CPU0:router(config-sonet)# clock source internal	Configures the SONET port transmit clock source, where the internal keyword sets the internal clock and the line keyword sets the clock recovered from the line. <ul style="list-style-type: none"> Use the line keyword whenever clocking is derived from the network. Use the internal keyword when two routers are connected back to back or over fiber for which no clocking is available. line is the default keyword. Note Internal clocking is required for SRP interfaces.
Step 4	framing sdh Example: RP/0/0/CPU0:router(config-sonet)# framing sdh	Configures the controller for Synchronous Digital Hierarchy (SDH) framing. SONET framing (sonet) is the default.
Step 5	au number Example: RP/0/0/CPU0:router(config-sonet)# au 1	Specifies the administrative unit (AU) group and enters AU path configuration mode. For AU-4, the valid range is: <ul style="list-style-type: none"> 1 to 3—1-Port Channelized OC-3/STM-1 SPA 1 to 4—1-Port Channelized OC-12/DS0 SPA 1 to 16—1-Port Channelized OC-48/DS3 SPA Note The au command does not specify the AU type. It specifies the number of the AU group for the AU type that you want to configure. The range for the AU command varies based on whether you are configuring AU-3 or AU-4.
Step 6	mode tug3 Example: RP/0/0/CPU0:router(config-auPath)# mode tug3	Sets the mode of interface at the AU level. Currently only TUG3 is supported.
Step 7	width number Example: RP/0/0/CPU0:router(config-auPath)# width 3	Configures the number of the AU streams.

	Command or Action	Purpose
Step 8	<p>tug3 <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config-auPath)#tug3 1</p>	Specifies the Tributary Unit Group (TUG) <i>number</i> and enters the config-tug3Path mode. The range is 1 to 3.
Step 9	<p>mode <i>mode</i></p> <p>Example: RP/0/0/CPU0:router(config-tug3Path)# mode e3</p>	<p>Sets the mode of interface at the tug3 level. The modes are:</p> <ul style="list-style-type: none"> • c11—TUG-3 path carrying TU-11 • c11-t1—TUG-3 path carrying TU-11 to T1 • c12—TUG-3 path carrying TU-12 • c12-e1—TUG-3 path carrying TU-12 to E1 • e3—TUG-3 path carrying E3 • t3—TUG-3 path carrying T3 <p>Note The 1-Port Channelized OC-48/STM-16 SPA only supports the e3 and t3 options.</p>
Step 10	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-tug3Path)# root</p>	Exits to global configuration mode.
Step 11	<p>controller <i>name instance</i></p> <p>Example: RP/0/0/CPU0:router(config)# controller e3 0/1/1/0/0/0</p>	<p>Enters controller configuration submode and specifies the controller name and instance identifier with the <i>rack/slot/module/port/name/instance</i> notation. The controller names are:</p> <ul style="list-style-type: none"> • e3—TUG3 path carrying E3 • t3—TUG3 path carrying T3 • e1—channelized E1 port <p>Note In this step, you can create an E3 or T3 controller and add T1 channels under the T3 controller as shown in Step 14, or you can create a channelized E1 port at this point.</p> <p>Note E1 is not supported on the 1-Port Channelized OC-48/STM-16 SPA.</p>
Step 12	<p>mode <i>mode</i></p> <p>Example: RP/0/0/CPU0:router(config-e3)#mode e1</p>	<p>Sets the mode of interface. The modes are:</p> <ul style="list-style-type: none"> • e1—Channelized into 21 E1s • serial—Clear Channel carrying HDLC-like payload • t1—Channelized into 28 T1s <p>Note T1 and E1 are not supported on the 1-Port Channelized OC-48/STM-16 SPA.</p>
Step 13	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-e3)# root</p>	Exits to global configuration mode.

	Command or Action	Purpose
Step 14	<p>controller <i>name instance</i></p> <p>Example: RP/0/0/CPU0:router(config)# controller E1 0/1/1/0/0/0/0/0</p>	<p>Enters controller configuration submode and specifies the controller name and instance identifier with the <i>rack/slot/module/port/name/instance1/instance2</i> notation. The controller names are:</p> <ul style="list-style-type: none"> serial—Clear Channel carrying HDLC-like payload. t1—Channelized into 24 T1s.
Step 15	<p>channel-group <i>number</i></p> <p>Example: RP/0/0/CPU0:router(config-e1)# channel-group 0</p>	<p>Sets the channel-group number to which time slots are assigned.</p> <ul style="list-style-type: none"> For t1, the range is from 1 to 24. For e1, the range is from 1 to 32.
Step 16	<p>timeslots <i>num1:num2:num3:num4</i> or timeslots <i>range1-range2</i></p> <p>Example: RP/0/0/CPU0:router(config-e1-channel_group)# timeslots 1:3:7:9 RP/0/0/CPU0:router(config-e1-channel_group)# timeslots 1-12</p>	<p>Specifies time slots for the interface by number with the <i>num1:num2:num3:num4</i> notation, or by range with the <i>range1-range2</i> notation.</p>
Step 17	<p>show configuration</p> <p>Example: RP/0/0/CPU0:router(config-e1-channel_group)# show configuration</p>	<p>Displays the contents of uncommitted configuration.</p>
Step 18	<p>root</p> <p>Example: RP/0/0/CPU0:router(config-e1-channel_group)# root</p>	<p>Exits to global configuration mode.</p>
Step 19	<p>interface serial <i>interface-path-id</i></p> <p>Example: RP/0/0/CPU0:router(config)# interface serial 0/1/1/0/0/0:0</p>	<p>Specifies the complete interface number with the <i>rack/slot/module/port/T3Num/T1num:instance</i> notation.</p>
Step 20	<p>encapsulation {<i>frame-relay</i> <i>hdlc</i> <i>ppp</i>}</p> <p>Example: Router(config-if)# encapsulation frame-relay hdlc ppp</p>	<p>Specifies the encapsulation type with the one of the following keywords:</p> <ul style="list-style-type: none"> frame-relay—Frame Relay network protocol hdlc—High-level Data Link Control (HDLC) synchronous protocol ppp—Point-to-Point Protocol
Step 21	<p>ipv4 <i>ip-address mask</i></p> <p>Example: Router(config-if)# ip address 10.10.10.10 255.255.255.255</p>	<p>Assigns an IP address and subnet mask to the interface.</p>

	Command or Action	Purpose
Step 22	<pre>no shutdown</pre> <p>Example: RP/0/0/CPU0:router (config-if)# no shutdown </p>	<p>Removes the shutdown configuration.</p> <p>Note Removal of the shutdown configuration eliminates the forced administrative down on the interface, enabling it to move to an up or down state (assuming that the parent SONET layer is not configured administratively down).</p>
Step 23	<pre>end or commit</pre> <p>Example: RP/0/0/CPU0:router(config-sonet)# end or RP/0/0/CPU0:router(config-sonet)# commit </p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes. Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes. Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 24	<pre>show controllers sonet interface-path-id</pre> <p>Example: RP/0/0/CPU0:router# show controllers sonet 0/1/1/0 </p>	<p>Verifies the SONET controller configuration.</p>

Configuration Examples for Channelized SONET

This section contains the following examples:

- [Channelized SONET Examples, page 299](#)
- [Channelized SDH Examples, page 302](#)

Channelized SONET Examples

- [Channelized SONET T3 to T1 Configuration: Example, page 300](#)
- [Channelized Packet over SONET Configuration: Example, page 300](#)
- [SONET Clear Channel T3 Configuration: Example, page 301](#)
- [Channelized SONET APS Single Router Configuration: Example, page 301](#)
- [Channelized SONET APS Multirouter Configuration: Example, page 301](#)

Channelized SONET T3 to T1 Configuration: Example

The following example shows SONET T3 to T1 configuration.

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sonet
  sts 1
  mode t3
  width 3
  root
controller t3 0/1/1/0/0
  mode t1
  framing auto-detect
  root
controller t1 0/1/1/0/0/0
  framing esf
  channel-group 0
  timeslots 1:3:7:9
  show configuration
  root
interface serial 0/1/1/0/0/0:0
  encapsulation hdlc
  ip address 10.10.10.10 255.255.255.255
  no shutdown
  commit
show controllers sonet 0/1/1/0
```

Channelized SONET in VT1.5 Mode and T1 Channelization to NxDS0



Note

This example is not supported on the 1-Port Channelized OC-48/STM-16 SPA.

The following example shows how to configure SONET channelized to NxDS0s through SONET VT1.5 mode:

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sonet
  sts 1
  mode vt15-t1
  root
controller t1 0/1/1/0/0/0
  channel-group 0 timeslots 1
  channel-group 1 timeslots 2-3
  commit
```

Channelized Packet over SONET Configuration: Example

The following example shows Channelized Packet over SONET configuration.

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sonet
  sts 1
  mode pos scramble
  width 3
```

```
root
interface POS 0/1/1/0
  encapsulation hdlc
  pos crc 32
  mtu 4474
  no shutdown
  commit
show interfaces pos 0/1/1/0
```

SONET Clear Channel T3 Configuration: Example

The following example shows SONET clear channel configuration for T3:

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sonet
  sts 1
  mode t3
  root
controller t3 0/1/1/0/0
  mode serial
  root
interface serial 0/1/1/0/0/0:0
  encapsulation ppp
  ip address 10.10.10.10 255.255.255.255
  no shutdown
  commit
show controllers sonet 0/1/1/0
```

Channelized SONET APS Single Router Configuration: Example

The following example shows SONET APS configuration for a single router.

```
aps group 1
  channel 0 local SONET 0/0/0/1
  channel 1 local SONET 0/0/0/2
  signalling sonet
  commit
show aps
show aps group 3
```

Channelized SONET APS Multirouter Configuration: Example

The following example shows SONET APS multirouter configuration.

```
aps group 1
  channel 0 local SONET 0/0/0/1
  channel 1 remote 172.18.69.123
  signalling sonet
  commit
show aps
show aps group 3
```

Channelized SDH Examples

- [Channelized SDH AU-3 Configuration: Examples, page 302](#)
- [Channelized SDH AU-4 Configuration: Examples, page 303](#)

Channelized SDH AU-3 Configuration: Examples

This section includes the following configuration examples:

- [Channelized SDH AU-3 to VC-3 and Clear Channel T3/E3: Examples, page 302](#)
- [Channelized SDH AU-3 to TUG-2, VC-11, T1 and NxDS0s: Example, page 302](#)
- [Channelized SDH AU-3 to TUG-2, VC-12, E1 and NxDS0s: Example, page 303](#)

Channelized SDH AU-3 to VC-3 and Clear Channel T3/E3: Examples

The following example shows how to configure SDH AU-3 to VC-3 and clear channel T3:

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sdh
  au 1
  width 1
  mode t3
  root
controller t3 0/1/1/0/1
  mode serial
commit
```

The following example shows how to configure SDH AU-3 to VC-3 and clear channel E3:

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sdh
  au 1
  width 1
  mode e3
  root
controller e3 0/1/1/0/1
  mode serial
commit
```

Channelized SDH AU-3 to TUG-2, VC-11, T1 and NxDS0s: Example



Note

This example is not supported on the 1-Port Channelized OC-48/STM-16 SPA.

The following example shows how to configure SDH AU-3 to TUG-2, VC-11 and channelized T1 to NxDS0s:

```
configure
controller sonet 0/1/1/0
  clock source internal
  framing sdh
  au 1
```



```

mode c11-t1
width 1
root
controller T1 0/1/1/0/0/1/1
channel-group 0
timeslots 1-12
show configuration
root
interface serial 0/1/1/0/1/1:0
encapsulation ppp
ip address 10.10.10.10 255.255.255.255
no shutdown
commit
show controllers sonet 0/1/1/0

```

Channelized SDH AU-3 to TUG-2, VC-12, E1 and NxDS0s: Example



Note

This example is not supported on the 1-Port Channelized OC-48/STM-16 SPA.

The following example shows how to configure SDH AU-3 to TUG-2, VC-12 and channelized E1 to NxDS0s:

```

configure
controller sonet 0/1/1/0
clock source internal
framing sdh
au 1
mode c12-e1
width 1
root
controller e1 0/1/1/0/0/1/1
channel-group 0
timeslots 1-12
show configuration
root
interface serial 0/1/1/0/1/1:0
encapsulation ppp
ip address 10.10.10.10 255.255.255.255
no shutdown
commit
show controllers sonet 0/1/1/0

```

Channelized SDH AU-4 Configuration: Examples

This section includes the following configuration examples:

- [Channelized SDH AU-4 to TUG-3 and Clear Channel T3/E3: Examples, page 303](#)
- [Channelized SDH AU-4 to TUG-3, TUG-2, and T1/E1 and NxDS0: Examples, page 304](#)

Channelized SDH AU-4 to TUG-3 and Clear Channel T3/E3: Examples

The following example shows SDH AU-4 channelization to TUG-3 and clear channel T3:

```

configure
controller sonet 0/4/0/0
framing sdh
au 1
width 3

```

```

mode tug3
tug3 1
  mode t3
  root
controller t3 0/4/0/0/1/1
mode serial
commit

```

The following example shows SDH AU-4 channelization to TUG-3 and clear channel E3:

```

configure
controller sonet 0/4/0/0
  framing sdh
  au 1
  width 3
  mode tug3
  tug3 1
  mode e3
  root
controller e3 0/4/0/0/1/1
mode serial
commit

```

Channelized SDH AU-4 to TUG-3, TUG-2, and T1/E1 and NxDS0: Examples



Note

Channelization to T1/E1 and NxDS0s is not supported on the 1-Port Channelized OC-48/STM-16 SPA.

The following example shows SDH AU-4 configuration with unframed E1 controllers and serial interfaces:

```

configure
controller sonet 0/1/2/0
  framing sdh
  au 1
  width 3
  mode tug3
  tug3 1
  mode c12-e1
!
  tug3 2
  mode c12-e1
!
  tug3 3
  mode c12-e1
!
controller E1 0/1/2/0/1/1/1/1
framing unframed
!
controller E1 0/1/2/0/1/1/1/2
framing unframed
!
controller E1 0/1/2/0/1/1/1/3
framing unframed
!
interface Serial0/1/2/0/1/1/1/1:0
encapsulation ppp
multilink
  group 1
!
interface Serial0/1/2/0/1/1/1/2:0
encapsulation ppp

```

```

multilink
  group 1
!
!
interface Serial0/1/2/0/1/1/1/3:0
encapsulation ppp
multilink
  group 1
!

```

This example shows SDH AU-4 configuration with E1 controller channel groups and serial interfaces:

```

configure
  controller SONET0/3/2/0
    framing sdh
    au 1
    width 3
    mode tug3
    tug3 1
    mode c12-e1
  !
    tug3 2
    mode c12-e1
  !
    tug3 3
    mode c12-e1
  !
  controller E1 0/3/2/0/1/1/1/1
    framing crc4
    channel-group 0
    timeslots 1-4
  !
  controller E1 0/3/2/0/1/1/3/1
    framing crc4
    channel-group 0
    timeslots 1-31
  !
  controller E1 0/3/2/0/1/1/1/2
    framing crc4
    channel-group 0
    timeslots 1-31
  !
  controller E1 0/3/2/0/1/2/7/3
    framing crc4
    channel-group 0
    timeslots 1-5
  !
    channel-group 1
    timeslots 6-31
  !
  interface Serial0/3/2/0/1/1/1/1:0
    encapsulation frame-relay IETF
    frame-relay lmi-type ansi
    frame-relay intf-type dce
  !
  interface Serial0/3/2/0/1/1/1/1:0.1 point-to-point
    ipv4 address 192.168.200.2 255.255.255.252
    ipv4 verify unicast source reachable-via rx
    pvc 100
    encaps ietf
  !
  interface Serial0/3/2/0/1/1/3/1:0
    encapsulation ppp
    multilink
    group 1

```

```

!
interface Serial0/3/2/0/1/1/1/2:0
 encapsulation ppp
 multilink
  group 1

```

Additional References

These sections provide references related to channelized SONET configuration.

Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	<i>Cisco IOS XR Master Commands List</i>
Cisco IOS XR interface configuration commands	<i>Cisco IOS XR Interface and Hardware Component Command Reference</i>
Initial system bootup and configuration information for a router using the Cisco IOS XR software	<i>Cisco IOS XR Getting Started Guide</i>
Information about user groups and task IDs	<i>Configuring AAA Services on Cisco IOS XR Software module of Cisco IOS XR System Security Configuration Guide</i>

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
There are no applicable MIBs for this module.	To locate and download MIBs for selected platforms using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of 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/support

