Configuring Serial Interfaces on Cisco IOS XR Software

This module describes the serial interfaces on routers supporting Cisco IOS XR software. Before you configure a serial interface, you must configure the clear channel T3/E3 controller or channelized T1/E1controller (DS0 channel) that is associated with that interface.

Feature History for Configuring Serial Controller Interfaces

Release	Modification
Release 3.3.0	This feature was introduced on the Cisco XR 12000 Series Router. Support was added on the Cisco XR 12000 Series Router for the following hardware: • Cisco XR 12000 SIP-401 • Cisco XR 12000 SIP-501 • Cisco XR 12000 SIP-601 Support was added on the Cisco XR 12000 Series Router for the following SPAs: • 2-Port and 4-Port Channelized T3 Serial SPA • 2-Port and 4-Port T3/E3 Serial SPA

Contents

Prerequisites for Configuring Serial Interfaces

Before configuring serial interfaces, be sure that the following tasks and conditions are met:

- You must be in a user group associated with a task group that includes the proper task IDs for serial Interface commands. Task IDs for commands are listed in *Cisco IOS XR Interface and Hardware Component Command Reference*.
- Your hardware must support T3/E3 controllers and serial interfaces. The following hardware supports T3/E3 controllers and serial interfaces in Cisco IOS XR Software Release 3.3:
  - 2-Port and 4-Port Clear Channel T3/E3 SPAs
  - 2-Port and 4-Port Channelized T3 SPAs

Note The 2-Port and 4-Port Channelized T3 SPAs support T1/E1 controllers and DS0 channels.

- You have already configured the clear channel T3/E3 controller or channelized T3-to-T1/E1controller that is associated with the serial interface you want to configure, as described in the Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software module earlier in this document.

Information About Serial Interfaces

Serial interfaces are supported on the following Cisco XR 12000 Series Router shared port adapter (SPA) cards:

- 2-Port and 4-Port Clear Channel T3/E3 SPAs
- 2-Port and 4-Port Channelized T3 SPAs

Note The 2-Port and 4-Port Channelized T3 SPAs can run in clear channel mode, or they can be channelized into 28 T1 or 21 E1 controllers.

T3/E3 serial interfaces are automatically created on clear channel T3/E3 controllers. On channelized T3-to-T1/E1 controllers, serial interfaces are automatically created when users configure individual DS0 channel groups the T1/E1 controllers.

To configure serial interfaces, you must understand the following concepts:

- High Level Over-View: Serial Interface Configuration on Clear-Channel SPAs, page HC-117
- High Level Over-View: Serial Interface Configuration on Channelized SPAs, page HC-118
- Default Settings for Serial Interface Configurations, page HC-119
- Serial Interface Naming Notation, page HC-119
- Cisco IOS XR PPP Encapsulation, page HC-120
- Cisco IOS XR HDLC Encapsulation, page HC-120
- Keepalive Timer, page HC-120

High Level Over-View: Serial Interface Configuration on Clear-Channel SPAs

Table 10 provides a high-level overview of the tasks required to configure a T3 serial interface on a 2-Port and 4-Port Clear Channel T3/E3 SPA.

Table 10 Overview: Configuring a T3 Serial Interface on a Clear Channel SPA

Step	Task	Module	Section
1.	Use the **hw-module subslot** command to set serial mode for the SPA to be T3, if necessary. **Note** By default, the 2-Port and 4-Port Clear Channel T3/E3 SPA is set to run in T3 mode.	"Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software"	"Setting the Card Type for the Clear Channel SPAs"
2.	Configure the T3 controller	"Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software"	"Setting the Card Type for the Clear Channel SPAs"
3.	Configure the serial interface that is associated with the T3 controller you configured in Step 2.	"Configuring Serial Interfaces on Cisco IOS XR Software"	"Configuring the Serial Interfaces"

Table 11 provides a high-level overview of the tasks required to configure an E3 serial interface on a 2-Port and 4-Port Clear Channel T3/E3 SPA.

Table 11 Overview: Configuring an E3 Serial Interface on a Clear Channel SPA

Step	Task	Module	Section
1.	Use the **hw-module subslot** command to set serial mode for the SPA to be E3.	*Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software*	*Setting the Card Type for the Clear Channel SPAs*
2.	Configure the E3 controller	*Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software*	*Setting the Card Type for the Clear Channel SPAs*
3.	Configure the serial interface that is associated with the E3 controller you configured in Step 2.	*Configuring Serial Interfaces on Cisco IOS XR Software*	*Configuring the Serial Interfaces*

High Level Over-View: Serial Interface Configuration on Channelized SPAs

Table 12 provides a high-level overview of the tasks required to configure a T1 serial interface on the 2-Port and 4-Port Channelized T3 SPA.

Table 12 Overview: Configuring a Serial Interface on a T1 DS0 Channel

Step	Task	Module	Section
1.	Configure the T3 controller parameters and set the SPA mode to be T3. 28 T1 controllers are automatically created.	"Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software"	"Configuring a Channelized T3-to-T1 Controller"
2.	Create and configure DS0 channel groups on the T1 controllers you created in Step 1.	"Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software"	"Configuring a Channelized T3-to-T1 Controller"
3.	Configure the Serial interfaces that are associated channel groups you created in Step 2.	"Configuring Serial Interfaces on Cisco IOS XR Software"	"Configuring the Serial Interfaces"

Table 13 provides a high-level overview of the tasks required to configure an E1 serial interface on the 2-Port and 4-Port Channelized T3 SPA.

Table 13 Overview: Configuring a Serial Interface on an E1 DS0 Channel

Step	Task	Module	Section
1.	Configure the T3 controller parameters and set the SPA mode to be E3. 21 E1 controllers are automatically created.	Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software	Configuring a Channelized T3-to-T1 Controller
2.	Create and configure DS0 channel groups on the E1 controllers you created in Step 1.	Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software	Configuring a Channelized T3-to-E1 Controller
3.	Configure the Serial interfaces that are associated channel groups you created in Step 2.	Configuring Serial Interfaces on Cisco IOS XR Software	Configuring the Serial Interfaces

Default Settings for Serial Interface Configurations

When an interface is enabled on a T3/E3 SPA, and no additional configuration commands are applied, the default interface settings shown in Table 14 are present. These default settings can be changed by configuration. Default settings do not appear in the output of the **show running-config** command.

Table 14 Serial Interface Default Settings

Parameter	Configuration File Entry	Default Settings
Keepalive	**keepalive** [**disable**] **no keepalive**	keepalive 10 seconds
Encapsulation	**encapsulation** [**hdlc** | **ppp**]	hdlc
Maximum transmission unit (MTU)	**mtu** *bytes*	4474 bytes
Cyclic redundancy check (CRC)	**crc** [**16** | **32]**	32
Data stream inversion on a serial interface	**invert**	Data stream is not inverted
Payload scrambling (encryption)	**scramble**	Scrambling is disabled.
Number of High-Level Data Link Control (HDLC) flag sequences to be inserted between the packets	**transmit-delay**	Default is 0 (disabled).

Serial Interface Naming Notation

The naming notation for serial interfaces on a clear channel SPA is *rack*/*slot*/*module*/*port*, as shown in the following example:

```
interface serial 0/0/1/2
```

The naming notation for T1, E1, and DS0 interfaces on a channelized SPA is *rack*/*slot*/*module*/*port*/*t1-num*:*channel-group-number*, as shown in the following example:

```
interface serial 0/0/1/2/4:3.
```

Note A slash between values is required as part of the notation.

The naming notation syntax for serial interfaces is as follows:

- *rack*: Chassis number of the rack.
- *slot*: Physical slot number of the modular services card or line card.
- *module*: Module number. Shared port adapters (SPAs) are referenced by their subslot number.
- *port*: Physical port number of the T3 controller.

- *t1-num*: T1 or E1 channel number. T1 channels range from 0 to 23; E1 channels range from 0 to 30.
- *channel-group-number*: Time slot number. T1 time slots range from 1 to 24; E1 time slots range from 1 to 31. The *channel-group-number* is preceded by a colon and not a slash.

Use the question mark (**?**) online help function following the **serial** keyword to view a list of all valid interface choices.

Cisco IOS XR PPP Encapsulation

PPP is a standard protocol used to send data over synchronous serial links. PPP also provides a link control protocol (LCP) for negotiating properties of the link. LCP uses echo requests and responses to monitor the continuing availability of the link.

PPP provides Network Control Protocols (NCPs) for negotiating properties of data protocols that will run on the link:

- IP Control Protocol (IPCP) to negotiate IP properties
- Multiprotocol Label Switching control processor (MPLSCP) to negotiate MPLS properties
- Cisco Discovery Protocol control processor (CDPCP) to negotiate CDP properties
- IPv6CP to negotiate IP Version 6 (IPv6) properties
- Open Systems Interconnection control processor (OSICP) to negotiate OSI properties

Note The default encapsulation type for the serial line card configurations is Cisco HDLC. To change the encapsulation type to be PPP, you must use the **encapsulation ppp** command in interface configuration mode for the serial interface.

Cisco IOS XR HDLC Encapsulation

Cisco High-Level Data Link Controller (HDLC) is Cisco's proprietary protocol for sending data over synchronous serial links using HDLC. Cisco HDLC also provides a simple control protocol called Serial Line Address Resolution Protocol (SLARP) to maintain serial link keepalives. HDLC is the default encapsulation for serial interfaces under Cisco IOS XR software.

Keepalive Timer

The HDLC usage of the keepalive timer also applies to PPP encapsulation to control how often ECHOREQ (echo request) packets are sent out.

Use the **keepalive** command in interface configuration mode to set how frequently LCP should send out ECHOREQ packets to its peer. To restore the system to the default keepalive interval of 10 seconds, use the **keepalive** command with no argument. To disable keepalives, use the **no keepalive** or **keepalive disable** command. For both PPP and Cisco HDLC, a keepalive of 0 disables keepalives and is reported in the **show running-config** command output as **keepalive disable**.

When LCP is running on the peer and receives an ECHOREQ packet, it should respond with an echo reply (ECHOREP) packet, regardless of whether keepalives are enabled on the peer.

Keepalives are independent between the two peers. One peer end can have keepalives enabled; the other end can have them disabled. Even if keepalives are disabled locally, LCP still responds with ECHOREP packets to the ECHOREQ packets it receives. Similarly, LCP also works if the period of keepalives at each end is different.

When the interface has PPP encapsulation, if LCP sends three ECHOREQ packets without an ECHOREP being received then it declares the link down and initiates full LCP negotiation again. If the interface has HDLC encapsulation, the number of resends is only three before the link is taken down. Only when LCP negotiation is complete (for example, when LCP is Open) are ECHOREQ packets sent out.

How to Configure Serial Interfaces

After you have configured a channelized or clear channel T3/E3 controller, as described in the *Configuring Clear Channel T3/E3 Controllers and Channelized T3 Controllers on Cisco IOS XR Software* module earlier in this document, you can configure the Serial interfaces associated with that controller. The following task describes how to configure a serial interface.

- Configuring the Serial Interfaces, page HC-121

Configuring the Serial Interfaces

Before you can use a serial interface, you must configure the IP address and bring the interface to the up state, as described in the steps that follow.

Note All global commands are supported on serial interfaces. Only commands specific to serial interfaces are described in this section. For more information about global interface commands, refer to the *Global Interface Commands on Cisco IOS XR Software module* in *Cisco IOS XR Interface and Hardware Component Command Reference*.

SUMMARY STEPS

1. **configure**
2. **interface serial** *instance*
3. **ipv4 address** *ip-address*
4. **encapsulation** [**hdlc** | **ppp**]
5. **keepalive** {*seconds* | **disable**}
6. **serial**
7. **crc** *length*
8. **invert**
9. **scramble**
10. **transmit-delay** *hdlc-flags*
11. **exit**
12. **no shutdown**

13. **end**
    or
    commit
14. **show interfaces serial** *instance*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**interface serial** *instance* **Example:** `RP/0/0/CPU0:router(config)# interface serial 0/1/0/0/10:15`	Specifies the serial interface name and enters interface configuration mode. Naming notation for T3/E3 interfaces is *rack*/*slot*/*module*/*port* and for T1/E1/DS0 interfaces is *rack*/*slot*/*module*/*port*/*t1-num:channel-group-number.*
Step 3	**ipv4 address** *ip-address* **Example:** `RP/0/0/CPU0:router(config-if)# ipv4 address 10.1.2.1 255.255.255.224`	Assigns an IP address and subnet mask to the interface.
Step 4	**encapsulation** [**hdlc** | **ppp**] **Example:** `RP/0/0/CPU0:router(config-if)# encapsulation hdlc`	(Optional) Configures the interface encapsulation parameters and details such as HDLC or PPP. **Note** The default encapsulation is **hdlc**.
Step 5	**keepalive** {*seconds* | **disable**} **Example:** `RP/0/R0/CPU0:router(config-if)# keepalive 10`	(Optional) Configures the HDLC keepalive value. **Note** The default value for the keepalive timer is **10** seconds.

Step 6	**serial**
	
	Example:
	`RP/0/0/CPU0:router(config-if)# serial`
	`RP/0/0/CPU0:ios(config-if-serial)#`
		(Optional) Enters serial submode to configure the serial parameters.

Step 7	**crc** *length* **Example:** `RP/0/0/CPU0:ios(config-if-serial)# crc 32`	(Optional) Specifies the length of the cyclic redundancy check (CRC) on the interface. **Note** The default is CRC length is 16.
Step 8	**invert** **Example:** `RP/0/0/CPU0:ios(config-if-serial)# inverts`	(Optional) Inverts the data stream.

	Command or Action	Purpose
Step 9	**scramble** **Example:** `RP/0/0/CPU0:ios(config-if-serial)# scramble`	(Optional) Enables payload scrambling on the interface. **Note** Payload scrambling is disabled on the interface.
Step 10	**transmit-delay** *hdlc-flags* **Example:** `RP/0/0/CPU0:ios(config-if-serial)# transmit-delay 10`	(Optional) Specifies a transmit delay on the interface. Values can be from 0 to 128. **Note** Transmit delay is disabled by default (the transmit delay is set to **0**).

Step 11	**exit**
	
	Example:
	`RP/0/0/CPU0:router(config-if-serial)# exit`
	`RP/0/0/CPU0:router(config-if)#`
		Exits serial configuration mode.

Step 12	**no shutdown** **Example:** `RP/0/0/CPU0:router(config-if)# no shutdown`	(Optional) Enables the serial interface. Use this command if the interface was shut down. **Note** Serial interfaces are enabled by default. However, if the card or router is reset and the serial interface is not configured, then it comes up in the shutdown state.

Step 13	**end**
	or
	commit
	
	Example:
	`RP/0/0/CPU0:router(config)# end`
	or
	`RP/0/0/CPU0:router(config)# commit`
		Saves configuration changes.
		• 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 14	**show interfaces serial** *instance* **Example:** `RP/0/0/CPU0:router# show interfaces serial 0/0/3/0/5:20`	Displays information about the interface.

Configuration Examples for Serial Interfaces

The following example shows how to configure a basic serial interface:

```
RP/0/0/CPU0:Router#config
RP/0/0/CPU0:Router(config)# interface Serial0/3/0/0/0:0
RP/0/0/CPU0:Router(config-if)# ipv4 address 192.0.2.2 255.255.255.252
RP/0/0/CPU0:Router(config-if)# serial
RP/0/0/CPU0:Router(config-if-serial)# crc 16
RP/0/0/CPU0:Router(config-if-serial)# invert
RP/0/0/CPU0:Router(config-if-serial)# scramble
RP/0/0/CPU0:Router(config-if-serial)# transmit-delay 3
RP/0/0/CPU0:Router(config-if-serial)# commit
```

Following is sample output from the **show interfaces serial** command:

```
RP/0/0/CPU0:Router# show interfaces serial 0/0/3/0/5:23
Serial0/0/3/0/5:23 is down, line protocol is down
  Hardware is Serial network interface(s)
  Internet address is Unknown
  MTU 1504 bytes, BW 64 Kbit
     reliability 143/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, crc 16,  loopback not set, keepalive set (10 sec)
  Last clearing of "show interface" counters 18:11:15
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     2764 packets input, 2816 bytes, 3046 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 0 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     3046 input errors, 1 CRC, 0 frame, 0 overrun, 2764 ignored, 281 abort
     2764 packets output, 60804 bytes, 0 total output drops
     Output 0 broadcast packets, 0 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Additional References

The following sections provide references related to T3/E3 and T1/E1 controllers and serial interfaces.

Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	*Cisco IOS XR Master Commands List*, Release 3.2
Cisco IOS XR interface configuration commands	*Cisco IOS XR Interface and Hardware Component Command Reference*
Initial system bootup and configuration information for a router using Cisco IOS XR software	*Cisco IOS XR Getting Started Guide*

Related Topic	Document Title
Cisco IOS XR AAA services configuration information	*Cisco IOS XR System Security Configuration Guide* and *Cisco IOS XR System Security Command Reference*
Information about configuring interfaces and other components on the Cisco CRS-1 from a remote Craft Works Interface (CWI) client management application	*Cisco CRS-1 Series Carrier Routing System Craft Works Interface Configuration Guide*

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
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature	To locate and download MIBs for selected platforms using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

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/techsupport