



Preparing Synchronous Serial Ports

This chapter presents information and configuration tasks required to prepare a serial interface for such uses as ISDN PRI signalling, for example, or to configure dial-on-demand routing (DDR). It includes the following main sections:

- Synchronous Serial Interface Overview
- Synchronous Serial Interface Configuration Task List
- Synchronous Serial Interface Configuration Examples

For a complete description of the synchronous interface commands in this chapter, see the *Cisco IOS Dial Services Command Reference* publication. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Synchronous Serial Interface Overview

Synchronous serial ports can be used for leased-line or dialup communications. In addition, high-speed lines (E1 or T1) can be configured to support multiple serial interfaces that can themselves be configured as if they were attached to dialup lines. Dialers can be configured on synchronous serial lines to support DDR.

See the section “Relationship Between Lines and Interfaces” in the chapter “Interfaces, Controllers, and Lines Used for Dial Access Overview” for more information about Cisco serial interfaces.

See the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” for information about configuring ISDN PRI lines.

For information about dialup uses of the serial interfaces, see the chapters in the “Dial-on-Demand Routing” part of this manual. For protocol-specific routing configuration tasks, see the relevant routing protocol chapters in other volumes of the Cisco IOS software configuration guides.

Synchronous Serial Interface Configuration Task List

Synchronous serial ports are available on many serial network interface processors and cards. Refer to the *Cisco Product Catalog* for information about available router and interface options.



Note

As of Cisco IOS Release 11.3, all commands supported on the Cisco 7500 series are also supported on the Cisco 7000 series.

To configure a synchronous serial interface, perform the tasks in the following sections. The first task is required; the remaining tasks are optional.

- Specifying a Synchronous Serial Interface (Required)
- Specifying Synchronous Serial Encapsulation (Optional)
- Configuring PPP (Optional)
- Configuring Compression of HDLC Data (Optional)
- Configuring the CRC (Optional)
- Using the Line-Coding Format (Optional)
- Enabling the Internal Clock (Optional)
- Inverting the Transmit Clock Signal (Optional)
- Setting Transmit Delay (Optional)
- Configuring DTR Signal Pulsing (Optional)
- Ignoring DCD and Monitoring DSR as Line Up/Down Indicator (Optional)
- Configuring the Clock Rate for a DCE Mode Interface (Optional)
- Specifying the Timing Signal Configuration (Optional)
- Specifying G.703 Interface Options (Optional)

For examples of synchronous serial interface configuration, see the section “Synchronous Serial Interface Configuration Examples” at the end of this chapter.

Specifying a Synchronous Serial Interface

To specify a synchronous serial interface and enter interface configuration mode, use one of the following commands in global configuration mode:

Command	Purpose
<pre>interface serial <i>number</i> or interface serial <i>slot/port</i> (Cisco 7500 series or Cisco 7200 series) or interface serial <i>slot/port-adapter/port</i> (Cisco 7200 series) or interface serial <i>slot/port:channel-group</i> (channelized T1 or E1 interface on the Cisco 7500 series) or interface serial <i>number:channel-group</i> (channelized T1 or E1 interface on the Cisco 4000 series)</pre>	Specifies an interface and enter interface configuration mode.

See the section “Basic Serial Interface Configuration” later in this chapter for a configuration example.

Specifying Synchronous Serial Encapsulation

Encapsulation methods are set according to the type of protocol or application you configure in the Cisco IOS software. By default, synchronous serial lines use the High-Level Data Link Control (HDLC) serial encapsulation method, which provides the synchronous framing and error detection functions of HDLC without windowing or retransmission. Synchronous serial interfaces support the following serial encapsulation methods for dial solutions:

- HDLC
- PPP

In addition, synchronous serial interfaces support the following encapsulation methods that are discussed in other books in the Cisco IOS software documentation set:

- ATM-Data Exchange Interface
- Frame Relay
- Synchronous Data Link Control (SDLC)
- Switched Multimegabit Data Service (SMDS)
- Cisco Serial Tunnel (STUN)
- X.25-based encapsulations

These encapsulation methods are defined in their respective books and chapters describing the protocols or applications. Serial encapsulation methods are also discussed in the *Cisco IOS Configuration Interface Command Reference* publication under the **encapsulation** command.

To define the encapsulation method for dial solutions, use the following command in interface configuration mode:

Command	Purpose
<code>encapsulation {hdlc ppp}</code>	Configures synchronous serial encapsulation for dial solutions.

The default synchronous serial encapsulation is HDLC.

Configuring PPP

To configure PPP (including PPP compression), see the chapters in the “PPP Configuration” part of this publication.

Configuring Compression of HDLC Data

You can configure point-to-point software compression on serial interfaces that use HDLC encapsulation. Compression reduces the size of an HDLC frame via lossless data compression. The compression algorithm used is a Stacker (LZS) algorithm.

Compression is performed in software and might significantly affect system performance. We recommend that you disable compression if central processor unit (CPU) load exceeds 65 percent. To display the CPU load, use the **show process cpu EXEC** command.

If the majority of traffic is already compressed files, do not use compression.

To configure compression over HDLC, use the following commands in interface configuration mode:

	Command	Purpose
Step 1	<code>encapsulation hdlc</code>	Enables encapsulation of a single protocol on the serial line.
Step 2	<code>compress stac</code>	Enables compression.

Configuring the CRC

The cyclic redundancy check (CRC) on a serial interface defaults to a length of 16 bits. To change the length of the CRC to 32 bits on a Fast Serial Interface processor (FSIP) or HSSI Interface Processor (HIP) of the Cisco 7000 series router with RSP7000 only, use the following command in interface configuration mode:

Command	Purpose
<code>crc size</code>	Sets the length of the CRC.

Using the Line-Coding Format

All FSIP interface types on the Cisco 7000 series with RSP7000 support nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) format. This is a line-coding format that is required for serial connections in some environments. NRZ encoding is most common. NRZI encoding is used primarily with EIA/TIA-232 connections in IBM environments.

The default configuration for all serial interfaces is NRZ format. The default is **no nrzi-encoding**. To enable NRZI format, use the following command in interface configuration mode:

Command	Purpose
<code>nrzi-encoding</code>	Enables NRZI encoding format.

Enabling the Internal Clock

To enable the internally generated clock on a serial interface when a DTE device does not return a transmit clock, use the following interface configuration command on the Cisco 7000 series with RSP7000:

Command	Purpose
<code>transmit-clock-internal</code>	Enables the internally generated clock on a serial interface.

Inverting the Transmit Clock Signal

Delays between the serial clock transmit external (SCTE) clock and data transmission indicate that the transmit clock signal might not be appropriate for the interface rate and length of cable being used. Different ends of the wire may have variances that differ slightly. To invert the clock signal to compensate for these factors, use the following command in interface configuration mode on a Cisco 7000 series router with RSP7000, and Cisco 7200 and Cisco 7500 series routers:

Command	Purpose
<code>invert-txclock</code>	Inverts the clock signal on an interface.

Setting Transmit Delay

It is possible to send back-to-back data packets over serial interfaces faster than some hosts can receive them. You can specify a minimum dead time after sending a packet to alleviate this condition. This setting is available for serial interfaces on the MCI and SCI interface cards and for the High-Speed Serial Interface (HSSI) or MultiChannel Interface Processor (MIP). Use one of the following interface configuration commands, as appropriate, for your system to set the transmit delay:

Command	Purpose
<code>transmitter-delay <i>microseconds</i></code>	Sets the transmit delay on the MCI and SCI synchronous serial interfaces.
<code>transmitter-delay <i>hdlc-flags</i></code>	Sets the transmit delay on the HSSI or MIP.

Configuring DTR Signal Pulsing

You can configure pulsing data terminal ready (DTR) signals on all serial interfaces. When the serial line protocol goes down (for example, because of loss of synchronization) the interface hardware is reset and the DTR signal is held inactive for at least the specified interval. This function is useful for handling encryption or other devices that use the toggling of the DTR signal to resynchronize. To configure DTR signal pulsing, use the following command in interface configuration mode:

Command	Purpose
<code>pulse-time <i>seconds</i></code>	Configures DTR signal pulsing.

Ignoring DCD and Monitoring DSR as Line Up/Down Indicator

This task applies to Quad Serial network interface modules on the Cisco 4000 series routers and Hitachi-based serial interfaces on the Cisco 2500 series and Cisco 3000 series routers.

By default, when the serial interface is operating in DTE mode, it monitors the Data Carrier Detect (DCD) signal as the line up/down indicator. By default, the attached DCE device sends the DCD signal. When the DTE interface detects the DCD signal, it changes the state of the interface to up.

In some configurations, such as an SDLC multidrop environment, the DCE device sends the data set ready (DSR) signal instead of the DCD signal, which prevents the interface from coming up. To tell the interface to monitor the DSR signal instead of the DCD signal as the line up/down indicator, use the following command in interface configuration mode:

Command	Purpose
<code>ignore-dcd</code>	Configures the serial interface to monitor the DSR signal as the line up/down indicator.

Configuring the Clock Rate for a DCE Mode Interface

To configure the clock rate for the connector hardware of the serial interface to an acceptable bit rate, use the following command in interface configuration mode:

Command	Purpose
<code>clock rate <i>bps</i></code>	Configures the clock rate on serial interfaces.

See the section “Serial Interface in DCE Mode” for an example of how to configure DCE mode.

Specifying the Timing Signal Configuration

On Cisco 4000 series routers, you can specify the serial NPM timing signal configuration. When the board is operating as a DCE and the DTE provides terminal timing (SCTE or TT), you can configure the DCE to use SCTE from the DTE. When running the line at high speeds and long distances, this strategy prevents phase shifting of the data with respect to the clock.

To configure the DCE to use SCTE from the DTE, use the following command in interface configuration mode:

Command	Purpose
<code>dce-terminal-timing enable</code>	Configures the DCE to use SCTE from the DTE.

When the board is operating as a DTE device, you can invert the transmit clock (TXC) signal that it receives from the DCE, which the DTE uses to send data. Invert the clock signal if the DCE cannot receive SCTE from the DTE, the data is running at high speeds, and the transmission line is long. Again, this prevents phase shifting of the data with respect to the clock.

To configure the interface so that the router inverts the TXC clock signal, use the following command in interface configuration mode:

Command	Purpose
<code>dte-invert-txc</code>	Specifies timing configuration to invert TXC clock signal.

Specifying G.703 Interface Options

This section describes the optional tasks for configuring a G.703 serial interface:

- Enabling Framed Mode
- Enabling CRC4 Generation
- Using Time Slot 16 for Data
- Specifying a Clock

Interfaces that meet the G.703 electrical and mechanical specifications operate at E1 data rates (2.048 Mbps).

See the section “G.703 Serial Interface Configuration” for a configuration example.

Enabling Framed Mode

G.703 interfaces have two modes of operation: framed and unframed. By default, serial interfaces on a G.703 port adapter are configured for unframed mode. To enable framed mode, use the following command in interface configuration mode:

Command	Purpose
<code>timeslot start-slot - stop-slot</code>	Enables framed mode, and sets the range of time slot start and stop times.

To restore the default, use the **no** form of this command or set the starting time slot to 0.

Enabling CRC4 Generation

By default, the G.703 CRC4 (cyclic redundancy check) is not generated. To enable generation of the G.703 CRC4, which is useful for checking data integrity while operating in framed mode, use the following command in interface configuration mode:

Command	Purpose
<code>crc4</code>	Enables CRC4 generation.

Using Time Slot 16 for Data

By default, time slot 16 is used for signalling. It can also be used for data. To control the use of time slot 16 for data, use the following command in interface configuration mode:

Command	Purpose
<code>ts16</code>	Specifies that time slot 16 is used for data.

Specifying a Clock

A G.703 interface can clock its sent data from either its internal clock or from a clock recovered from the receive data stream of the line. By default, the clock source is the receive data stream of the line. To control which clock is used, use the following command in interface configuration mode:

Command	Purpose
<code>clock source {line internal}</code>	Specifies the clock used for sent data.

Synchronous Serial Interface Configuration Examples

This section contains the following examples:

- Basic Serial Interface Configuration
- Serial Interface in DCE Mode
- JT2 6.3-MHz Serial Interface Configuration
- Signal Inversion Examples
- G.703 Serial Interface Configuration
- Interface Shutdown

For more information about synchronous serial interfaces configured on channelized E1/T1 and used for dialing, see the chapter “Configuring ISDN PRI and Other Signaling on E1 and T1 Lines” later in this publication.

Basic Serial Interface Configuration

The following example illustrates how to begin interface configuration on a serial interface. It assigns PPP encapsulation to serial interface 0.

```
interface serial 0
 encapsulation ppp
```

Serial Interface in DCE Mode

The following example configures a serial interface for DCE mode on a Cisco 7500 series. Because the DTE does not return the SCTE signal, the **transmit-clock-internal** is needed.

```
interface serial 0/0
 ip address 170.1.8.2 255.255.255.0
 clockrate 72000
 transmit-clock-internal
```

The following example configures a serial interface for DCE mode on a Cisco 4000 series router. Because the DTE does not return the SCTE signal, the **dce-terminal-timing-enable** command is needed. In this example, the default NRZ encoding and 16-bit cyclic redundancy check (CRC) are accepted.

```
interface serial 1
  clockrate 72000
  dce-terminal-timing-enable
  nrz-encoding
```

JT2 6.3-MHz Serial Interface Configuration

The following example shows a configuration for serial interface 1/0/0 on a PA-2JT2 serial port adapter in a Cisco 7500 series router. In this example, the interface is configured to clock data using an internal clock source rather than the default line-derived clock source and to allow the frame alignment search criteria to use CRC5.

```
interface serial 1/0/0
  ip address 1.1.1.10 255.255.255.0
  clock source internal
  crc bits 5
  no shutdown
```

Signal Inversion Examples

The following example inverts data on serial interface 3/1/0:

```
interface serial 3/1/0
  invert data
```

The following example inverts the clock signal on serial interface 3/0:

```
interface serial 3/0
  invert txclock
```

The following example specifies NRZI mark encoding for serial interface 4/0/2:

```
interface serial 4/0/2
  nrzi-encoding mark
```

G.703 Serial Interface Configuration

The following example shows a basic configuration for serial interface 9/1/3 on an E1-G.703/G.704 serial port adapter in a Cisco 7500 series router. In this example, the interface is configured for framed (G.704) operation, and time slot 16 is used for data.

```
interface serial 9/1/3
  ip address 1.1.1.10 255.255.255.0
  no keepalive
  no fair-queue
  timeslot 1-31
  crc4
  ts16
```

Interface Shutdown

The following example shuts down a T1 circuit number 23 running on a Cisco 7500 series router:

```
interface serial 4/0:23
 shutdown
```

The following example shuts down the entire T1 line physically connected to a Cisco 7500 series router:

```
controller t1 4/0
 shutdown
```