

Configuring Serial Interfaces for E1- and T1-Carrier Lines

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Using the Serial Module for E1- or T1-Carrier Lines

When companies require dedicated, secure point-to-point wide area network (WAN) connections, one of the available solutions is a leased E1- or T1-carrier line. With an E1- or T1-carrier line, the connection is always active. Because there is no dial-up process, data can be immediately transmitted at any time.

In Europe, Australia, South America, and Asia, Public Telephone and Telegraph (PTT) authorities offer E1-carrier lines, which provide 2.048 Mbps bandwidth. In the United States, Canada, and in some areas of Japan, telcos offer T1-carrier lines, which provide 1.544 Mbps bandwidth.

Note

In Japan, PTTs offer T1-carrier lines and sometimes E1-carrier lines for data. For traditional analog voice, these PTTs offer J1-carrier lines. (J1 lines are outside the scope of this *Basic Configuration and Management Guide*.)

Elements of an E1- or T1-Carrier Line

All WAN connections, including E1- and T1-carrier lines, consist of three basic elements:

- the physical transmission media, such as the cabling, switches, routers, and other infrastructure required to create and maintain the connection
- electrical signaling specifications for generating, transmitting, and receiving signals through the various transmission media
- Data Link Layer protocols, which provide logical flow control for moving data between the peers (the devices at either end of a WAN connection)

Physical transmission media and electrical specifications are part of the Physical Layer (or Layer 1) of the Open Systems Interconnection (OSI) model, and Data Link Layer protocols are part of the Data Link Layer (or Layer 2). (See Figure 5-1.)

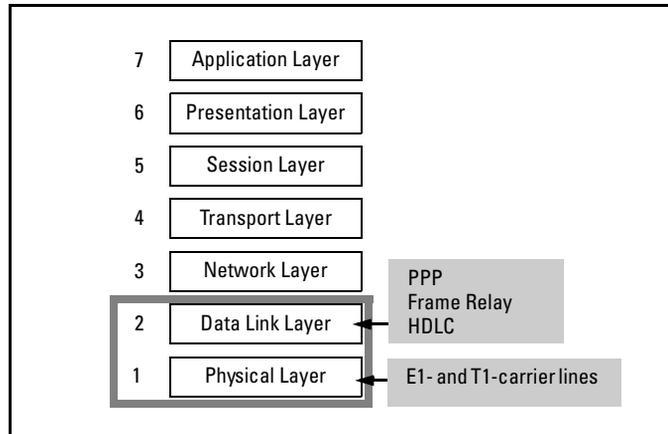


Figure 5-1. Physical and Data Link Layers of the OSI Model

When you configure the ProCurve Secure Router to support an E1 or T1 WAN connection, you must configure:

- the Physical Layer
- the Data Link Layer, which is also called the logical layer

Connecting Your Premises to the Public Carrier's Central Office: the Local Loop

In the United States and Canada, the network that provides the infrastructure for T1-carrier lines is called the public switched telephone network (PSTN). In all other countries, PTT authorities provide the infrastructure for WAN connections.

When you lease an E1- or T1-carrier line, your LAN must be connected to the public carrier's nearest central office (CO). All of the telecommunications infrastructure that is used to connect your LAN to the CO is collectively called the *local loop*. Because the CO may be located miles away from your premises, this telecommunications infrastructure may include repeaters, as well as switches, cable, and connectors. (See Figure 5-2.)

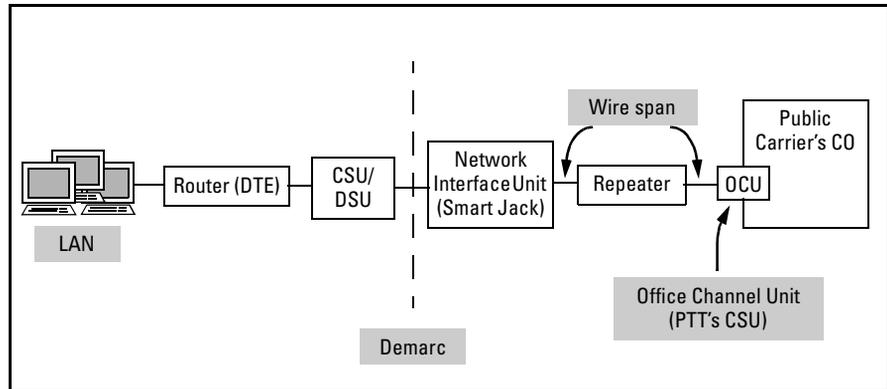


Figure 5-2. Local Loop

All carrier lines require the same basic components on the local loop, although the components may differ slightly in form and design. (See Figure 5-2.) These components are listed below:

- CSU/DSU—The Channel Service Unit/Digital Service Unit (CSU/DSU) has two purposes: The DSU accepts traffic from the router and translates it from the signaling format used on the LAN to the format necessary for transmission on the WAN. The CSU then generates the signal to be sent across the WAN (or regenerates the signal for transmission across the LAN).
- Demarc—A line of demarcation, or demarc, separates your wiring and equipment from the public carrier's wiring and equipment. As a general rule, you own, operate, and maintain the wiring and equipment on your side of the demarc, and the public carrier owns, operates, and maintains the wiring and equipment on its side of the demarc.
- Network interface unit (NIU)—The NIU automatically maintains the WAN connection and enables public carrier employees to perform simple management tasks from a remote location. The NIU is usually located outside the subscriber's premises so that public carrier employees can always access it. In the United States and Canada, the NIU is commonly referred to as the smart jack.
- Wire span—Because public carrier networks were originally designed to carry analog voice calls, copper wire is still the most common physical transmission medium used on the local loop. Because copper wire has a limited capacity to carry signals, local loops that use copper wire are the slowest, least capable component of the WAN connection.

- Repeater—A repeater receives, amplifies, and retransmits the digital signal so that the signal is always strong enough to be read. The distance between repeaters depends on the type of connection, including the transmission media used. For example, for a T1 connection over unshielded twisted pair (UTP) wiring, the distance between repeaters is one mile or less.
- Office channel unit (OCU)—Located at the CO, the OCU performs the same function at the public carrier's site that the CSU performs at each subscriber's site: it generates the signal to be sent—either to a subscriber's premises or to the public carrier network.

Although you will never see most of these components, having a basic understanding of the local loop can help you work with your public carrier to troubleshoot problems if your E1- or T1-carrier line ever goes down.

In addition, two of these components directly affect your E1 or T1 WAN connection: the demarc and the CSU/DSU. The demarc determines for which part of the E1 or T1 WAN connection you are responsible. Again, this becomes important if your E1- or T1-carrier line ever goes down and you have to work with the public carrier to identify and fix the problem.

The CSU/DSU is important because its form and design not only determines which ProCurve Secure Router module you purchase but also which settings you must configure for the E1- or T1-carrier line.

External or Built-in CSU/DSU

Your public carrier determines the type of CSU/DSU that will be used for your WAN connection. There are three options:

- The public carrier provides the CSU/DSU and installs it on your premises.
- The public carrier provides the CSU but not the DSU.
- The public carrier does not provide the CSU/DSU.

In Europe, Australia, South America, and Asia (except Japan), the PTT authority will provide both the CSU/DSU or just the CSU. In the United States and Canada, public carriers will either provide the entire CSU/DSU, or they will not provide either the CSU or the DSU.

Serial Module for the ProCurve Secure Router

The ProCurve Secure WAN serial modules are used when the public carrier provides an external CSU/DSU for an E1- or T1-carrier line. (See Figure 5-2 on page 5-5.) ProCurve Networking offers two serial modules:

- one-port narrow module
- eight-port, or octal, wide module

If your company is the United States or Canada and your public carrier does *not* provide an external CSU/DSU, you must purchase and use a T1 module. If your company is in another country and the public carrier provides only a CSU, you must purchase and use an E1 module. (For instructions on configuring these modules, see *Chapter 4: Configuring E1 and T1 Interfaces*.)

Standards Supported by the Serial Module

The ProCurve Secure Router serial modules are standards based. Specifically, they support the following standards:

- U.S. Federal Communications Commission (FCC) Part 15 Class A
- Norme Européenne EN55022 Class A—EN is also referred to as European Standards.
- EN55024, EN61000-3-2, EN61000-3-3
- European Telecommunications Standards Institute (ETSI) TBR 1 and ETSI TBR 2
- EN60950
- UL/CUL 60950
- Australian Standard/New Zealand Standard (AS/NZS) 60950
- International Electrotechnical Commission (IEC) 60950
- International Organization for Standardization (ISO) 4903 (X.21)
- Comité Consultatif International Téléphonique et Télégraphique (CCITT) V.35 Synchronous (V.35)

Serial Interface: Configuring the Physical Layer

Because the external CSU/DSU manages timing, framing, and signaling for the E1- or T1-carrier line, the serial interface does not have to perform these functions. Consequently, you do not need to configure options to control these functions. As a result, the serial interface requires only minimal configuration.

Making the Physical Connection

To connect the serial module to the CSU/DSU, you will need one of the following cables. (See Figure 5-3.)

- V.35 cable
- X.21 cable
- EIA 530 cable

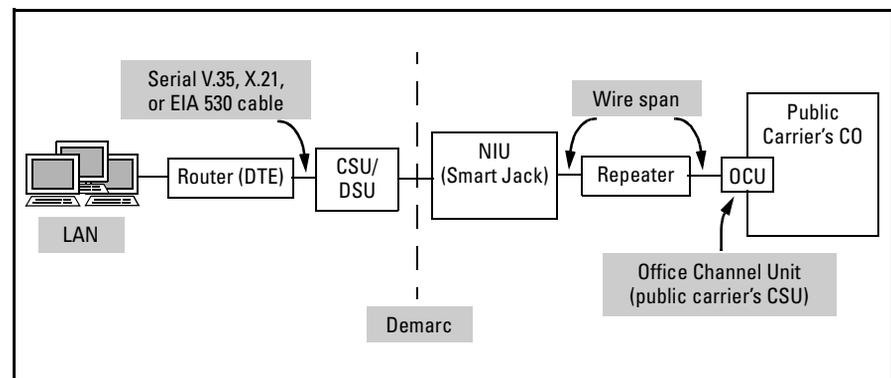


Figure 5-3. The Serial Module Connects Directly to an External CSU/DSU.

The serial module ships with either a V.35 cable or an X.21 cable.

Note

ProCurve Networking does not currently provide an EIA 530 cable.

If you are not sure which type of cable you have, this chapter provides illustrations of the three cable connectors. For example, Figure 5-4 shows the pinouts for ProCurve Networking's implementation of the V.35 cable connector and lists how each pin is used.

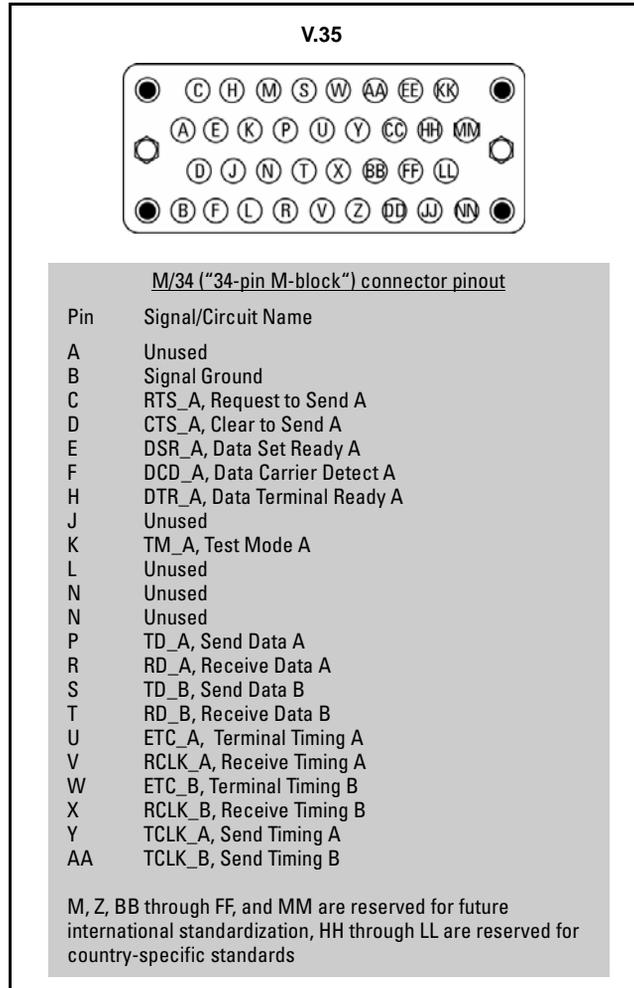


Figure 5-4. ProCurve Networking's V.35 Cable Connector

Configuring Serial Interfaces for E1- and T1-Carrier Lines

Serial Interface: Configuring the Physical Layer

Figure 5-5 shows the pinouts for ProCurve Networking's implementation of the X.21 cable connector and lists how each pin is used.

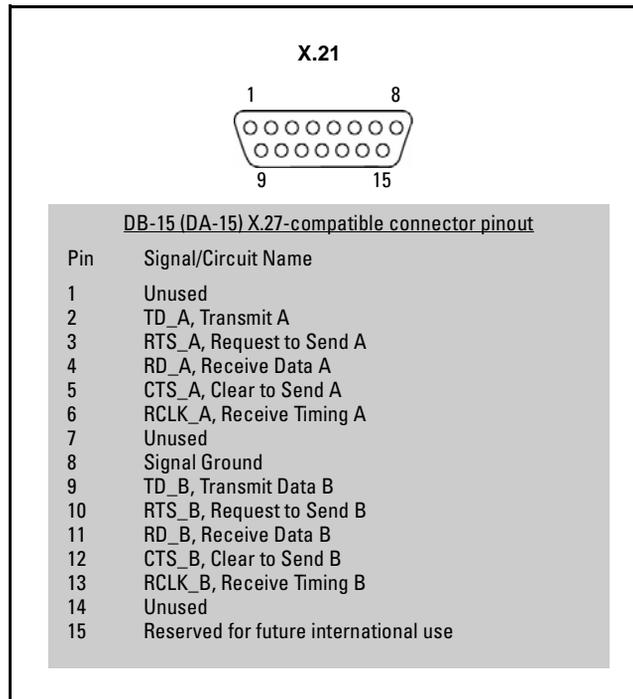


Figure 5-5. ProCurve Networking's X.21 Cable Connector

If you have an EIA 530 cable that you purchased from another vendor, the ProCurve Secure Router supports it. You can also use Figure 5-6, which shows the pinouts for EIA 530, to create this type of connector.

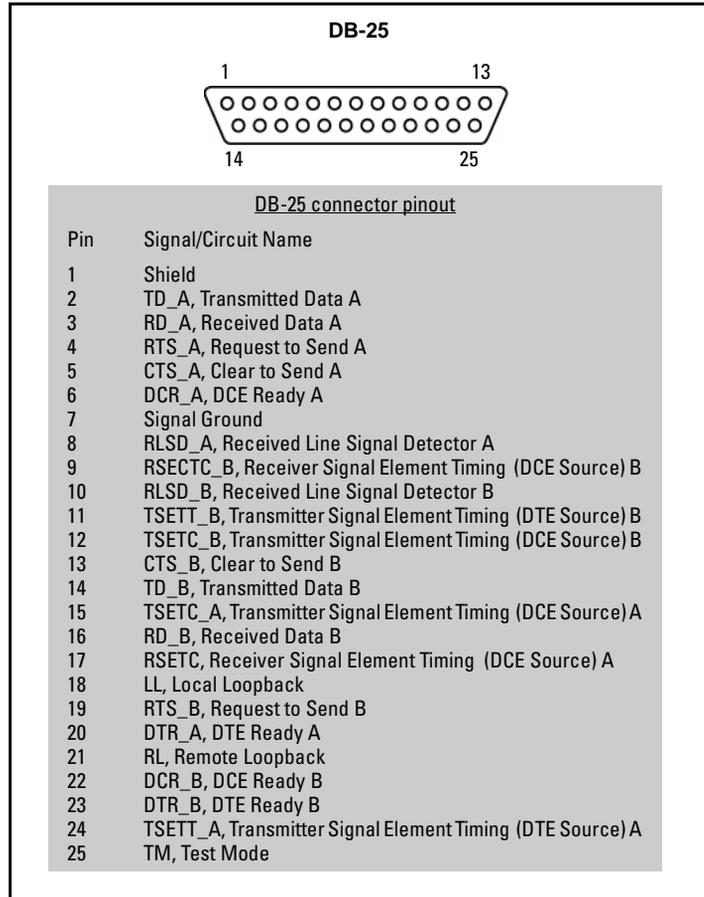


Figure 5-6. Connector for an EIA 530 Cable

Whichever cable you use, the serial module supports up to 10 Mbps.

Serial Interface Configuration Mode Context

To begin configuring the serial interface for the E1 or T1 connection, you must access the appropriate configuration mode context. In the ProCurve Secure Router command line interface (CLI), move to the global configuration mode context and enter:

Syntax: interface serial <slot>/<port>

On the ProCurve Secure Router, the interface for each physical port is identified by its slot number and port number. The possible slot numbers for the serial module are:

- 1 = dl narrow option module slot 1
- 2 = dl narrow option module slot 2
- 3 = dl wide option, or octal, module slot 3 (ProCurve Secure Router SR7203dl only)

For narrow option module slots, there is only one possible port number: 1.

For example, if the serial module is in slot 1, enter:

```
ProCurve(config)# interface serial 1/1
```

For the octal serial module, eight port numbers are possible. For example, if you are configuring port 6, enter:

```
ProCurve(config)# interface serial 3/6
```

After you enter the command, the ProCurve Secure Router prompt should indicate that you are at the serial interface configuration mode context:

```
ProCurve(config-ser 3/6)#
```

Configuring the Interface for the Appropriate Cable

Because the V.35, X.21, and EIA 530 connectors transmit and receive signals across different pins, you must configure the serial interface to use the appropriate signaling so that it can communicate with the CSU/DSU. From the serial interface configuration mode context, enter the following command to configure the interface for the appropriate cable:

Syntax: serial-mode [EIA530 | V35 | X21]

For example, if you are using an X.21 cable, enter:

```
ProCurve(config-ser 1/1)# serial-mode X21
```

The default setting is **V35**.

Configuring the Clock Source

The serial interface must have a clock source to synchronize the transmission of data. The clock source for the serial interface is called the external transmit reference clock (et-clock). By default, the source for et-clock is set to **txclock**, which means that the serial interface takes the clock from the transmit signal.

If you need to configure the clock source for the serial line, enter the following command from the serial interface configuration mode context:

Syntax: et-clock-source <source>

There are two possible sources:

- **txclock**, the default setting
- **rxclock**, which specifies that the serial interface should take the clock from the receive signal

Your public carrier should tell you which setting to use.

Inverting et-clock

If the cable that connects the serial module to the CSU/DSU is long, it may cause a phase shift in the data transmitted. If this happens, you must invert et-clock by entering:

```
ProCurve(config-ser 1/1)# invert etclock
```

After you enter this command, the serial module inverts et-clock in the data stream before transmitting it.

To return et-clock to its default setting, enter:

```
ProCurve(config-ser 1/1)# no invert etclock
```

Inverting txclock or rxclock

If the cable that connects the serial module to the CSU/DSU is long, the CSU/DSU may be configured to invert the transmit clock. You must then configure the serial interface so that it can receive the inverted clock. Enter one of the following commands:

Syntax: invert txclock

Syntax: invert rxclock

If you enter the **invert txclock** command, the serial interface will invert the transmit clock that is taken from the data stream. The serial interface inverts the transmit clock before it transmits a signal.

If you enter the **invert rxclock** command, the serial interface will look for an inverted receive clock in the data it receives from the CSU/DSU.

Activating the Serial Interface

To activate the serial interface, enter the following command from the serial interface configuration mode context:

```
ProCurve(config-ser 1/1)# no shutdown
```

The serial interface should now be activated, and the physical interface should be ready for data transfer.

By default, the ProCurve Secure Router immediately notifies you that the interface is administratively up. It will take a few moments to establish the serial connection, however. When the connection goes up, the ProCurve Secure Router displays another message at the CLI, reporting that the serial interface is up. If you want to disable this reporting function, enter **no events** from the enable mode context.

Configuring the Data Link Layer Protocol

You must configure the serial interface to use the same Data Link Layer protocol that your public carrier is using. For information about configuring the protocol, see *Chapter 6: Configuring the Data Link Layer Protocol for E1, T1, and Serial Interfaces*.

Viewing Information about the Serial Interface

You can view information about the E1- and T1-carrier line associated with the serial interface, and you can view the configuration settings that have been entered for the serial interface.

show interfaces serial Command

To view information about the serial interface and the carrier line associated with it, enter the following command from the enable mode context:

Syntax: show interfaces serial <slot>/<port>

You can also use the **do** command to enter this command from any context (except the basic mode context). For example, from the global configuration mode context, enter:

```
ProCurve(config)# do show interfaces serial 2/1
```

This command displays information about the serial interface in slot two. (See Figure 5-7.)

```
ser 2/1 is UP, line protocol is UP
Encapsulation FRAME-RELAY IETF (fr 1)
Transmit clock source is TCLK
DCD=up   DSR=up   DTR=up   RTS=up   CTS=up
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
4624 packets input, 0 bytes, 0 no buffer
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 701 frame
8 abort, 0 discards, 0 overruns
4803 packets output, 0 bytes, 0 underruns
```

Figure 5-7. show interfaces serial Command

The first line reports the status of the interface. The status will be one of the following:

- up
- administratively down
- down

If the interface is administratively down, you must enter **no shutdown** from the serial interface configuration mode context to activate it. If the interface is down, you should begin troubleshooting the problem, as explained in “Troubleshooting a Serial Connection” on page 5-18.

show running-config interface Command

To view the configuration for the serial interface, enter the following command from the enable mode context:

Syntax: show running-config interface serial <slot>/<port>

This command displays only the options that you have configured for the serial interface. If you want to view the entire configuration, including the default settings that are being applied to the interface, include the **verbose** option:

Syntax: show running-config interface serial <slot>/<port> verbose

Figure 5-7 shows the difference between the output of the **show running-config interface serial 2/1** command and the **show running-config interface serial 2/1 verbose** commands.

```
ProCurve# show running-config interface serial 2/1
Building configuration...

interface ser 2/1
  no shutdown

ProCurve# show running-config interface serial 2/1 verbose
Building configuration...

interface ser 2/1
  description
  et-clock-source txclock
  no ignore dcd
  no invert txclock
  no invert rxclock
  no invert etclock
  serial-mode V35
  alias
  snmp trap link-status
  no shutdown
end
```

Only one command was entered →

← Displays all the commands that affect the interface—including both default settings and the settings that were entered

Figure 5-8. show running-config interface serial Commands

View All the WAN Connections Configured on the Router

If your ProCurve Secure Router is providing several WAN connections for your company, you may want to view a list of these connections. The **show connections** command provides a quick view of all the connections on the router. As Figure 5-9 shows, this command lists the logical interface and the physical interface for each connection.

You enter the **show connections** command from the enable mode context.

```
ProCurveSR7203dl#show connections
Displaying all connections...
Conn Id   From           To
-----
1         ppp 1         t1 1/1, tdm-group 1
2         fr 1          t1 3/1, tdm-group 1
3         fr 2          ser 2/1 ← Serial interface with Frame
                                     Relay as the Data Link
                                     Layer protocol
```

Figure 5-9. show connections Command

Troubleshooting a Serial Connection

When you troubleshoot a serial interface, you should isolate the problem to determine if it is a problem with the Physical Layer or the Data Link Layer. Follow this standard process for troubleshooting WAN connections:

1. Check the Physical Layer.
 - a. Check whether the serial interface is up or down.
 - b. Check the configurations to ensure that you are using the correct settings.
 - c. Check the cabling, the connections, and other hardware.
 - d. Check the CSU/DSU settings and compare these settings against those used for the serial interface.
2. Check the logical layer.
 - a. Check to ensure that a Data Link Layer protocol has been defined and is bound to the serial interface.
 - b. Check the configurations to ensure that you are using the correct settings.

This chapter explains how to troubleshoot the Physical Layer. For information about the Data Link Layer, see *Chapter 6: Configuring the Data Link Layer Protocol for E1, T1, and Serial Interfaces*.

Checking the LED for the Serial Module

To determine the status of the serial interface, you can quickly check the LED for the slot where the serial module is installed. Table 5-1 shows the possible status of the LED, lists the meaning for this status, and outlines the action you might take next.

Table 5-1. Check the LEDs

Color	Meaning	Action
no light	No module is installed, or the interface is not activated.	<ul style="list-style-type: none"> Use the show interfaces serial <slot>/<port> command to determine if you need to activate the interface. If the line is administratively down, enter no shutdown.
red	Interface is activated, but there are alarms.	<ul style="list-style-type: none"> Use the show interfaces serial <slot>/<port> command to determine what alarms are being reported.
yellow	The interface is in loopback mode.	<ul style="list-style-type: none"> Contact the public carrier to cancel the loopback test. Loopback commands are not available from the serial interface configuration mode context.
green	The Physical Layer is up.	<ul style="list-style-type: none"> Enter the show interfaces serial <slot>/<port> command to ensure that you have configured the correct protocol for the line. (The protocol is the logical interface.) Check the status of the logical interface and follow the troubleshooting steps for the protocol you are using.

No Light

Ensure that you are checking the LED that corresponds to the slot where the serial module is installed. Next, view the status of the serial interface by entering:

```
ProCurve# show interfaces serial <slot>/<port>
```

If the serial interface is administratively down, move to the serial interface configuration mode context and enter:

```
ProCurve(config-ser 1/1)# no shutdown
```

The status of the interface should change.

Red Light

If the LED is red, the interface is administratively up, but it is receiving alarms. View the status of the serial interface by entering:

```
ProCurve# show interfaces serial <slot>/<port>
```

Figure 5-10 shows a serial interface that is down.

```
ser 2/1 is down, line protocol is DOWN
Encapsulation is not set
Transmit clock source is TCLK
DCD=up   DSR=up   DTR=down  RTS=down  CTS=up
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  0 packets input, 0 bytes, 0 no buffer
  0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame
  0 abort, 0 discards, 0 overruns
  0 packets output, 0 bytes, 0 underruns
s
```

Figure 5-10. Using the show interfaces serial Command to Troubleshoot the Serial Interface

Some possible problems and solutions are listed below:

- The router is not receiving a signal from the CSU/DSU.
 - Verify that you have configured the correct **serial-mode** setting for the cable that you are using. For example, if you are using an X.21 cable, verify that you have configured **serial-mode X21** for the interface.
 - Check the connections to make sure that the cable is not loose.
 - If you have an extra X.21, V.35, or EIA 530 cable, try using that cable to connect the serial module to the CSU/DSU.
 - Check the LEDs on the CSU/DSU and ensure that it is up. The CSU/DSU may be turned off, or it may have experienced a hardware failure.
- The serial module is misconfigured.
 - Compare the list of settings that you received from your public carrier with the settings configured on the serial module. To view both the settings you have entered and the default settings for the interface, enter the following command. (See Figure 5-11.)

ProCurve# show running-config interface serial <slot>/<port> verbose
 - Correct any settings so that the configuration for the serial module matches that used on CSU/DSU.

```
interface ser 2/1
  description
  et-clock-source txclock
  no ignore dcd
  no invert txclock
  no invert rxclock
  no invert etclock
  serial-mode V35
  alias
  snmp trap link-status
  no shutdown
```

Figure 5-11. Viewing the Output for the show running-config interface serial verbose Command

- The public carrier is experiencing a problem. For example, the carrier line may be down between the CSU/DSU and the CO, or the line may not be properly connected to the CSU/DSU.
 - Contact your public carrier. You should be prepared to explain the settings that are configured on the serial interface and to answer questions about the troubleshooting steps you have taken.

Yellow Light

A yellow light indicates a loopback test. Because you cannot initiate a loopback test from the serial interface configuration mode context, you must contact your public carrier to cancel the loopback test or to determine why it was issued.

Green Light

If the serial interface is up, you should begin troubleshooting the logical interface. See *Chapter 6: Configuring the Data Link Layer Protocol for E1, T1, and Serial Interfaces*.

Solving a Specific Problem: the Line Between the Serial Module and the CSU/DSU Keeps Going Down

If the line between the serial module and the CSU/DSU keeps going down, you may want to configure the router to ignore data carrier detected (DCD) signals. Serial cables supported by the ProCurve Secure Router consist of 26 leads. Each lead either:

- transmits a specific signal from the router to the CSU/DSU
- receives a specific signal from the CSU/DSU

The router transmits the following signals to the CSU/DSU:

- data terminal ready (DTR)
- request to send (RTS)

The router receives these signals from the CSU/DSU:

- clear to send (CTS)
- data carrier detected (DCD)
- data set ready (DSR)
- test-mode (TM)

Using these signals, the ProCurve Secure Router and the CSU/DSU negotiate data transfer and signal each other to control data flow. If the CSU/DSU drops the CTS signal, the ProCurve Secure Router stops sending data. In turn, if the ProCurve Secure Router must pause incoming data, it drops RTS, and the CSU/DSU holds the data stream until it once again receives RTS.

The ProCurve Secure Router follows set protocols for dealing with inserted and dropped signals. You can, however, reconfigure the router to respond to dropped signals in different ways. For example, by default, when the serial interface loses the DCD signal, it does not attempt to reestablish a connection.

You can configure the serial interface to ignore the DCD status and continue trying to make a connection without the DCD signal. To do so, enter the following command from the serial interface configuration mode context:

```
ProCurve(config-ser 1/1)# ignore dcd
```

To return the interface to the default setting, enter:

```
ProCurve(config-ser 1/1)# no ignore dcd
```

Quick Start

This section provides the commands you must enter to quickly configure a serial module on the ProCurve Secure Router. Only a minimal explanation is provided.

If you need additional information about any of these options, check “Contents” on page 5-1 to locate the section that contains the explanation you need.

Configure a Serial Interface

To configure a serial interface, complete the following steps:

1. Use a V.35 or X.21 cable to connect the serial module to the external Channel Service Unit/Digital Service Unit (CSU/DSU). (The serial module also supports the EIA 530 cable if you have one available from another vendor.)
2. Establish a terminal session with the ProCurve Secure Router. You are automatically at the basic mode context.

```
ProCurve>
```

3. Move to the enable mode context. If you have configured a password for the enable mode context, enter the password.

```
ProCurve> enable  
Password:
```

4. Move to the global configuration mode context.

```
ProCurve# configure terminal
```

5. Move to the serial interface configuration mode context.

Syntax: interface serial <slot>/<port>

```
ProCurve(config)# interface serial 1/1
```

6. Configure the interface for the cable that you used to connect the serial module to the CSU/DSU. The default setting is **V35**.

Syntax: serial-mode [EIA530 | V35 | X21]

For example, to configure the serial interface to use an X.21 cable, enter:

```
ProCurve(config-ser 1/1)# serial-mode X21
```

7. Activate the serial interface.

```
ProCurve(config-ser 1/1)# no shutdown
```

By default, the ProCurve Secure Router immediately notifies you that the interface is administratively up. It will take a few moments to establish the serial connection, however. When the connection goes up, the ProCurve Secure Router displays another message at the command line interface (CLI), reporting that the line is up. If you want to disable this reporting function, enter **no events** from the enable mode context.

8. View the status of the serial interface.

```
ProCurve(config-ser 1/1)# do show interface ser 1/1
```

Note

The **do** command enables you to enter enable mode commands (such as **show** commands) from any context (except the basic mode context).

You must now configure the Data Link Layer protocol for the serial interface as explained in *Chapter 6: Configuring the Data Link Layer Protocol for E1, T1, and Serial Interfaces*.