Configuring and Managing External Modems

This chapter describes how to configure externally connected modems. These tasks are presented in the following main sections:

- External Modems on Low-End Access Servers
- Automatically Configuring an External Modem
- Manually Configuring an External Modem
- Supporting Dial-In Modems
- Testing the Modem Connection
- Managing Telnet Sessions
- Modem Troubleshooting Tips
- Checking Other Modem Settings

To identify the hardware platform or software image information associated with a feature, use the Feature Navigator on Cisco.com to search for information about the feature or refer to the software release notes for a specific release. For more information, see the "Identifying Supported Platforms" section in the "Using Cisco IOS Software" chapter.
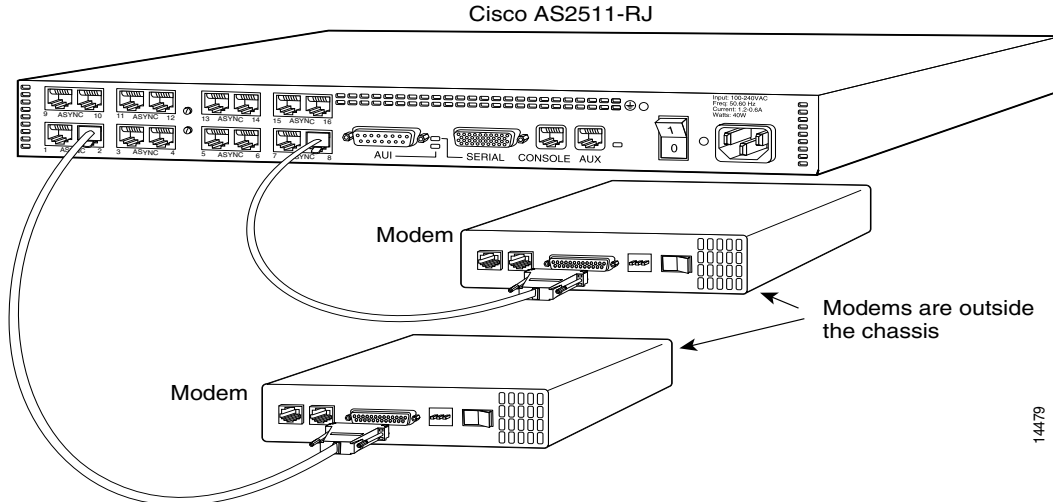
For a complete description of the modem support commands in this chapter, refer to the *Cisco IOS Dial Technologies Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

External Modems on Low-End Access Servers

Some of the Cisco lower-end access servers, such as the Cisco AS2511-RJ shown in Figure 1, have cable connections to external modems. The asynchronous interfaces and lines are inside the access server.

Figure 1   *Cisco AS2511-RJ Access Server*

When you configure modems to function with your access server, you must provide initialization strings and other settings on the modem to tell it how to function with the access server.

This section assumes that you have already physically attached the modem to the access server. If not, refer to the user guide or installation and configuration guide for your access server for information about attaching modems.

Automatically Configuring an External Modem

The Cisco IOS software can issue initialization strings automatically, in a file called a modemcap, for most types of modems externally attached to the access server. A modemcap is a series of parameter settings that are sent to your modem to configure it to interact with the Cisco device in a specified way. The Cisco IOS software defines modemcaps that have been found to properly initialize most modems so that they function properly with Cisco routers and access servers. For Cisco IOS Release 12.2, these modemcaps have the following names:

- default—Generic Hayes interface external modem
- codex_3260—Motorola Codex 3260 external
- usr_courier—U.S. Robotics Courier external
- usr_sportster—U.S. Robotics Sportster external
- hayes_optima—Hayes Optima external[1]
- global_village—Global Village Teleport external
- viva—Viva (Rockwell ACF with MNP) external
- telebit_t3000—Telebit T3000 external
- nec_v34—NEC V.34 external
- nec_v110—NEC V.110 TA external
- nec_piafs—NEC PIAFS TA external

[1]The hayes_optima modemcap is not recommended for use; instead, use the default modemcap.

Enter these modemcap names with the **modemcap entry** command.

If your modem is not on this list and if you know what modem initialization string you need to use with it, you can create your own modemcap; see the following procedure "Using the Modem Autoconfigure Type Modemcap Feature." To have the Cisco IOS software determine what type of modem you have, use the **modem autoconfigure discovery** command to configure it, as described in the procedure "Using the Modem Autoconfigure Discovery Feature."

Using the Modem Autoconfigure Type Modemcap Feature

Step 1   Use the **modemcap edit** command to define your own modemcap entry.

The following example defines modemcap MODEMCAPNAME:

```
Router(config)# modemcap edit MODEMCAPNAME miscellaneous &FS0=1&D3
```

Step 2   Apply the modemcap to the modem lines as shown in the following example:

```
Router# terminal monitor
Router# debug confmodem
Modem Configuration Database debugging is on
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# line 33 34
Router(config-line)# modem autoconfigure type MODEMCAPNAME
Router(config-line)#
Jan 16 18:12:59.643: TTY34: detection speed (115200) response ---OK---
Jan 16 18:12:59.643: TTY34: Modem command:  --AT&FS0=1&D3--
Jan 16 18:12:59.659: TTY33: detection speed (115200) response ---OK---
Jan 16 18:12:59.659: TTY33: Modem command:  --AT&FS0=1&D3--
Jan 16 18:13:00.227: TTY34: Modem configuration succeeded
Jan 16 18:13:00.227: TTY34: Detected modem speed 115200
Jan 16 18:13:00.227: TTY34: Done with modem configuration
Jan 16 18:13:00.259: TTY33: Modem configuration succeeded
Jan 16 18:13:00.259: TTY33: Detected modem speed 115200
Jan 16 18:13:00.259: TTY33: Done with modem configuration
```

Using the Modem Autoconfigure Discovery Feature

If you prefer the modem software to use its autoconfigure mechanism to configure the modem, use the **modem autoconfigure discovery** command.

The following example shows how to configure modem autoconfigure discovery mode:

```
Router# terminal monitor
Router# debug confmodem
Modem Configuration Database debugging is on
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# line 33 34
Router(config-line)# modem autoconfigure discovery
Jan 16 18:16:17.724: TTY33: detection speed (115200) response ---OK---
Jan 16 18:16:17.724: TTY33: Modem type is default
Jan 16 18:16:17.724: TTY33: Modem command:  --AT&F&C1&D2S0=1H0--
Jan 16 18:16:17.728: TTY34: detection speed (115200) response ---OK---
Jan 16 18:16:17.728: TTY34: Modem type is default
Jan 16 18:16:17.728: TTY34: Modem command:  --AT&F&C1&D2S0=1H0--
```

```
Jan 16 18:16:18.324: TTY33: Modem configuration succeeded
Jan 16 18:16:18.324: TTY33: Detected modem speed 115200
Jan 16 18:16:18.324: TTY33: Done with modem configuration
Jan 16 18:16:18.324: TTY34: Modem configuration succeeded
Jan 16 18:16:18.324: TTY34: Detected modem speed 115200
Jan 16 18:16:18.324: TTY34: Done with modem configuration
```

Manually Configuring an External Modem

If you cannot configure your modem automatically, you must configure it manually. This section describes how to determine and issue the correct initialization string for your modem and how to configure your modem with it.

Modem command sets vary widely. Although most modems use the Hayes command set (prefixing commands with **at**), Hayes-compatible modems do not use identical **at** command sets.

Refer to the documentation that came with your modem to learn how to examine the current and stored configuration of the modem that you are using. Generally, you enter **at** commands such as **&v**, **i4**, or ***o** to view, inspect, or observe the settings.

Timesaver You must first create a direct Telnet or connection session to the modem before you can send an initialization string. You can use **AT&F** as a basic modem initialization string in most cases. To establish a direct Telnet session to an external modem, determine the IP address of your LAN (Ethernet) interface, and then enter a Telnet command to port 2000 + *n* on the access server, where *n* is the line number to which the modem is connected. See the sections "Testing the Modem Connection" and "Managing Telnet Sessions" for more information about making Telnet connections.

A sample modem initialization string for a US Robotics Courier modem is as follows:

```
&b1&h1&r2&c1&d3&m4&k1s0=1
```

Modem initialization strings enable the following functions:

- Locks the speed of the modem to the speed of the serial port on the access server
- Sets hardware flow control (RTS/CTS or request to send/clear to send)
- Ensures correct data carrier detect (DCD) operation
- Ensures proper data terminal ready (DTR) interpretation
- Answers calls on the first ring

Note Make sure to turn off automatic baud rate detection because the modem speeds must be set to a fixed value.

The port speed must not change when a session is negotiated with a remote modem. If the speed of the port on the access server is changed, you must establish a direct Telnet session to the modem and send an **at** command so that the modem can learn the new speed.

Modems differ in the method that they use to lock the EIA/TIA-232 (serial) port speed. In the modem documentation, vendors use terms such as port-rate adjust, speed conversion, or buffered mode. Enabling error correction often puts the modem in the buffered mode. Refer to your modem documentation to learn how your modem locks speed (check the settings **&b**, **\j**, **&q**, **\n**, or s-register settings).

RTS and CTS signals must be used between the modem and the access server to control the flow of data. Incorrectly configuring flow control for software or setting no flow control can result in hung sessions and loss of data. Modems differ in the method that they use to enable hardware flow control. Refer to your modem documentation to learn how to enable hardware flow control (check the settings **&e**, **&k**, **&h**, **&r**, or s-register).

The modem must use the DCD wire to indicate to the access server when a session has been negotiated and is established with a remote modem. Most modems use the setting **&c1**. Refer to your modem documentation for the DCD settings used with your modem.

The modem must interpret a toggle of the DTR signal as a command to drop any active call and return to the stored settings. Most modems use the settings **&d2** or **&d3**. Refer to your modem documentation for the DTR settings used with your modem.

If a modem is used to service incoming calls, it must be configured to answer a call after a specific number of rings. Most modems use the setting **s0=1** to answer the call after one ring. Refer to your modem documentation for the settings used with your modem.
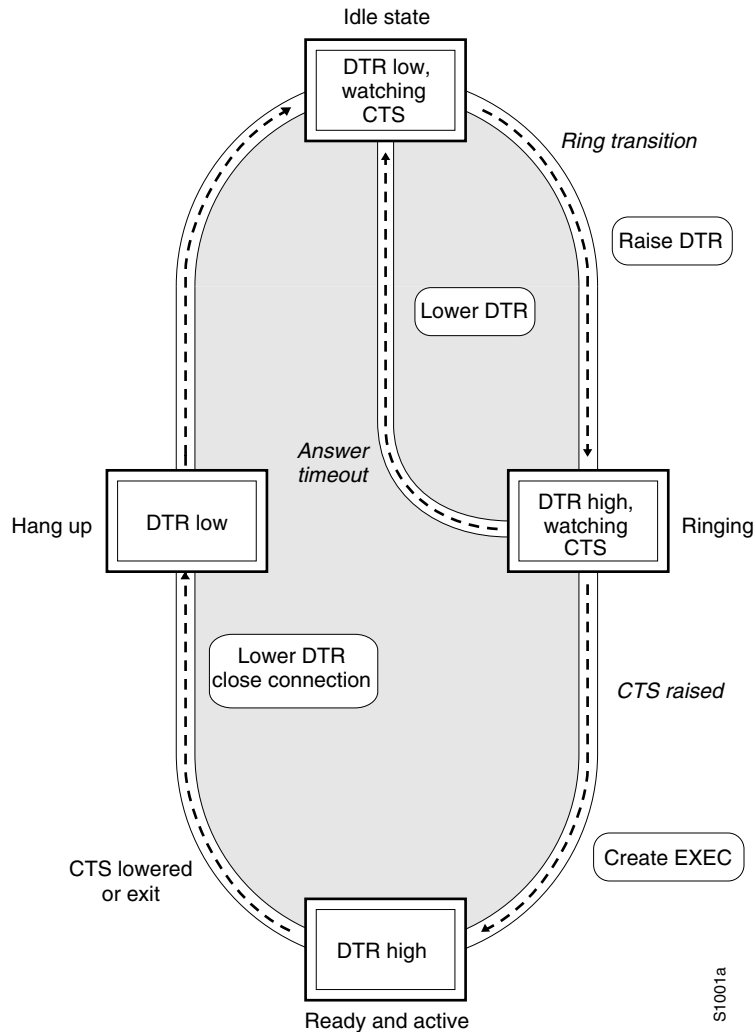
Supporting Dial-In Modems

The Cisco IOS software supports dial-in modems that use DTR to control the off-hook status of the telephone line. This feature is supported primarily on old-style modems, especially those in Europe. To configure the line to support this feature, use the following command in line configuration mode:

Command	Purpose
Router(config-line)# **modem callin**	Configures a line for a dial-in modem.

Figure 2 illustrates the **modem callin** command. When a modem dialing line is idle, it has its DTR signal at a low state and waits for a transition to occur on the data set ready (DSR) input. This transition causes the line to raise the DTR signal and start watching the CTS signal from the modem. After the modem raises CTS, the Cisco IOS software creates an EXEC session on the line. If the timeout interval (set with the **modem answer-timeout** command) passes before the modem raises the CTS signal, the line lowers the DTR signal and returns to the idle state.

Figure 2   *EXEC Creation on a Line Configured for Modem Dial-In*

Idle state

DTR low,
watching
CTS

Ring transition

Raise DTR

Lower DTR

*Answer
timeout*

DTR high,
watching
CTS

Ringing

Hang up   DTR low

Lower DTR
close connection

CTS raised

Create EXEC

CTS lowered
or exit

DTR high

S1001a

Ready and active

✎

Note   The **modem callin** and **modem cts-required** line configuration commands are useful for SLIP
operation. These commands ensure that when the line is hung up or the CTS signal drops, the line reverts
from Serial Line Internet Protocol (SLIP) mode to normal interactive mode. These commands do not
work if you put the line in network mode permanently.

Although you can use the **modem callin** line configuration command with newer modems, the **modem
dialin** line configuration command described in this section is more appropriate. The **modem dialin**
command frees up CTS input for hardware flow control. Modern modems do not require the assertion
of DTR to answer a phone line (that is, to take the line off-hook).

Testing the Modem Connection

To test the connection, send the modem the AT command to request its attention. The modem should
respond with "OK." For example:

```
at
```

```
OK
```

If the modem does not reply to the **at** command, perform the following steps:

Step 1   Enter the **show users** EXEC command and scan the display output. The output should not indicate that the line is in use. Also verify that the line is configured for **modem inout**.

Step 2   Enter the **show line** EXEC command. The output should contain the following two lines:

```
Modem state: Idle
Modem hardware state: CTS noDSR  DTR RTS
```

If the output displays "no CTS" for the modem hardware state, the modem is not connected, is not powered up, is waiting for data, or might not be configured for hardware flow control.

Step 3   Verify the line speed and modem transmission rate. Make sure that the line speed on the access server matches the transmission rate, as shown in Table 1.

Table 1   ***Matching Line Speed with Transmission Rate***

Modem Transmission Rate (in bits per second)	Line Speed on the Access Server (in bits per second)
9600	38400
14400	57600
28800	115200

To verify the line speed, use the **show run** EXEC command. The line configuration fragment appears at the tail end of the output.

The following example shows that lines 7 through 9 are transmitting at 115200 bits per second (bps). Sixteen 28800-kbps modems are connected to a Cisco AS2511-RJ access server via a modem cable.

```
Router# show run

Building configuration...

Current configuration:
. . .
!
 line 1 16
  login local
  modem InOut
  speed 115200
  transport input all
  flowcontrol hardware
  script callback callback
  autoselect ppp
  autoselect during-login
```

Step 4   The speeds of the modem and the access server are likely to be different. If so, switch off the modem, and then switch it back on. This action should change the speed of the modem to match the speed of the access server.

Step 5   Check your cabling and the modem configuration (echo or result codes might be off). Enter the appropriate **at** modem command to view the modem configuration, or use the **at&f** command to return to factory defaults. Refer to your modem documentation to learn the appropriate **at** command to view your modem configuration.

Managing Telnet Sessions

You communicate with an external modem by establishing a direct Telnet session from the asynchronous line on the access server, which is connected to the modem. This process is also referred to as *reverse Telnet*. Performing a reverse Telnet means that you are initiating a Telnet session out the asynchronous line, instead of accepting a connection into the line (called a *forward* connection).

Note   Before attempting to allow inbound connections, make sure that you close all open connections to the modems attached to the access server. If you have a modem port in use, the modem will not accept a call properly.

To establish a direct Telnet session to an external modem, determine the IP address of your LAN (Ethernet) interface, and then enter a Telnet command to port 2000 + *n* on the access server, where *n* is the line number to which the modem is connected. For example, to connect to the modem attached to line 1, enter the following command from an EXEC session on the access server:

```
Router# telnet 172.16.1.10 2001
Trying 172.16.1.10, 2001 ... Open
```

This example enables you to communicate with the modem on line 1 using the AT (attention) command set defined by the modem vendor.

Timesaver   Use the **ip host** configuration command to simplify direct Telnet sessions with modems. The **ip host** command maps an IP address of a port to a device name. For example, the **modem1 2001 172.16.1.10** command enables you to enter **modem1** to initiate a connection with the modem, instead of repeatedly entering **telnet 172.16.1.10 2001** each time you want to communicate with the modem.

Suspending Telnet Sessions:

When you are connected to an external modem, the direct Telnet session must be terminated before the line can accept incoming calls. If you do not terminate the session, it will be indicated in the output of the **show users** command and will return a modem state of ready if the line is still in use. If the line is no longer in use, the output of the **show line** *value* command will return a state of idle. Terminating the Telnet session requires first suspending it, then disconnecting it.

To suspend a Telnet session, perform the following steps:

Step 1   Enter Ctrl-Shift-6 x to suspend the Telnet session:

```
- suspend keystroke -
Router#
```

✍

Note Ensure that you can reliably issue the escape sequence to suspend a Telnet session. Some terminal emulation packages have difficulty sending the Ctrl-Shift-6 x sequence. Refer to your terminal emulation documentation for more information about escape sequences.

Step 2 Enter the **where** EXEC command to check the connection numbers of open sessions:

```
Router# where
Conn Host              Address           Byte  Idle Conn Name
*  1 172.16.1.10        172.16.1.10          0     0  172.16.1.10
   2 172.16.1.11        172.16.1.11          0    12  modem2
```

Step 3 When you have suspended a session with one modem, you can connect to another modem and suspend it:

```
Router# telnet modem2
Trying modem2 (172.16.1.11, 2002) ... Open

- suspend keystroke -
Router#
```

Step 4 To disconnect (completely close) a Telnet session, enter the **disconnect** EXEC command:

```
Router# disconnect line 1
Closing connection to 172.16.1.10 [confirm] y
Router# disconnect line 2
Closing connection to 172.16.1.11 [confirm] y
Router#
```

Modem Troubleshooting Tips

Table 2 contains troubleshooting tips on modem access and control.

Table 2   Modem Troubleshooting Tips

Problem	Likely Cause
Connection refused.	Someone already has a connection to that port.
	or
	an EXEC is running on that port.
	or
	The modem failed to lower the carrier detect (CD) signal after a call disconnected, resulting in an EXEC that remained active after disconnect.
	To force the line back into an idle state, clear the line from the console and try again. If it still fails, ensure that you have set **modem inout** command for that line. If you don't have modem control, either turn off EXEC on the line (by using the **exec-timeout** line configuration command) before making a reverse connection or configure the modem using an external terminal. As a last resort, disconnect the modem, clear the line, make the Telnet connection, and then attach the modem. The prevents a misconfigured modem from denying you line access.

Table 2 Modem Troubleshooting Tips (continued)

Connection appears to hang.	Try entering "^U" (clear line), "^Q" (XON), and press Return a few times to try to establish terminal control.
EXEC does not come up; autoselect is on.	Press Return to enter EXEC.
Modem does not hang up after entering **quit**.	The modem is not receiving DTR information, or you have not set up modem control on the router.
Interrupts another user session when you dial in.	The modem is not dropping CD on disconnect, or you have not set up modem control on the router.
Connection hangs after entering "+++" on the dialing modem, followed by an ATO.	The answering modem saw and interpreted the "+++" when it was echoed to you. This is a bug in the answering modem, common to many modems. There may be a switch to work around this problem; check the modem's documentation.
Losing data.	You may have Hardware Flow Control only on for either the router's line (DTE) or the modem (DCE). Hardware Flow Control should be on for both or off for both, but not for only one.
Using MDCE.	Turn MDCE into an MMOD by moving pin 6 to pin 8 because most modems use CD and not DSR to indicate the presence of carrier. You can also program some modems to provide carrier info via DSR.

Checking Other Modem Settings

This section defines other settings that might be needed or desirable, depending on your modem.

Error correction can be negotiated between two modems to ensure a reliable data link. Error correction standards include Link Access Procedure for Modems (LAPM) and MNP4. V.42 error correction allows either LAPM or MNP4 error correction to be negotiated. Modems differ in the way they enable error correction. Refer to your modem documentation for the error correction methods used with your modem.

Data compression can be negotiated between two modems to allow for greater data throughput. Data compression standards include V.42*bis* and MNP5. Modems differ in the way they enable data compression. Refer to your modem documentation for the data compression settings used with your modem.