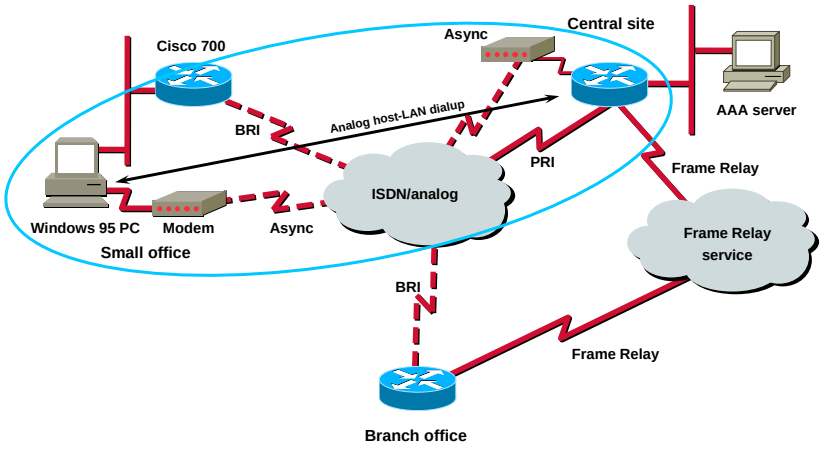
Chapter 2: Configuring Asynchronous Connections to a Central Site with Modems

Objectives

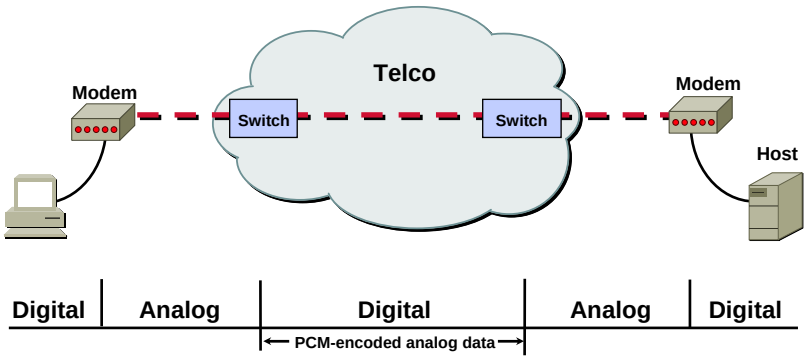
Upon completion of this chapter, you will be able to perform the following tasks:

- **Configure an access server for an attached modem**
- **Use reverse Telnet to configure an external modem**
- **Configure a modem using autoconfigure**

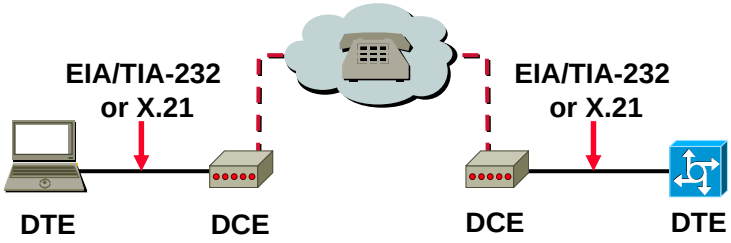
Chapter Activities



A Typical Modem Connection

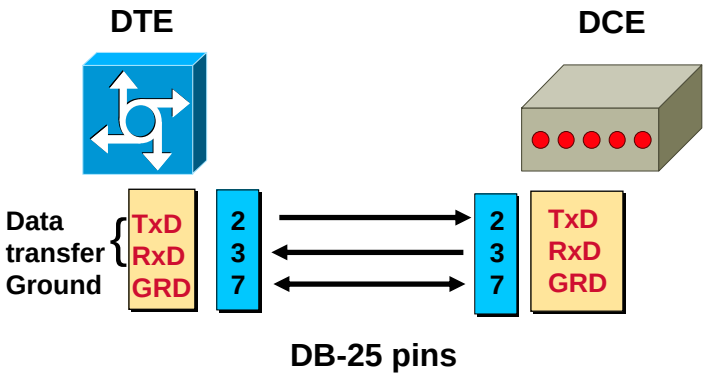


The DTE-DCE Interface

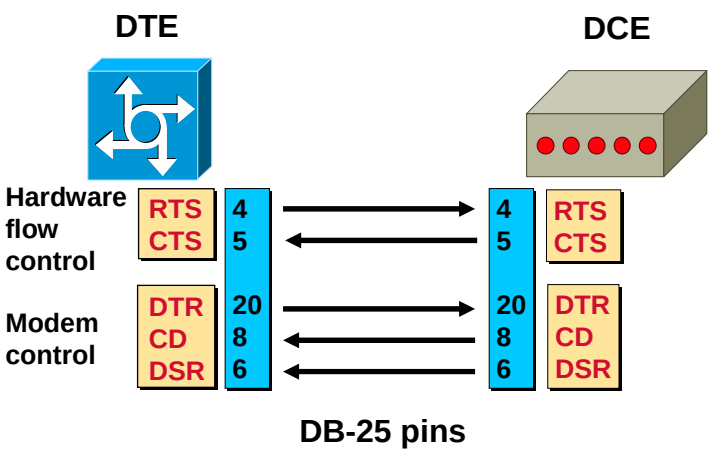


- DTE = Data terminal equipment
- DCE = Data communications equipment

Modem Signaling—Data



Modem Signaling—Control

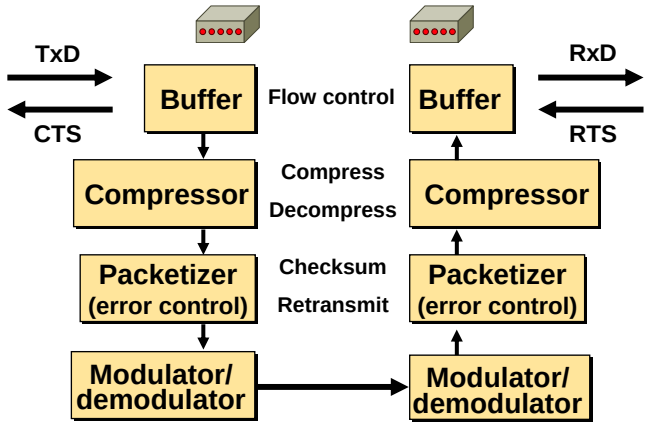


Modem Control Example

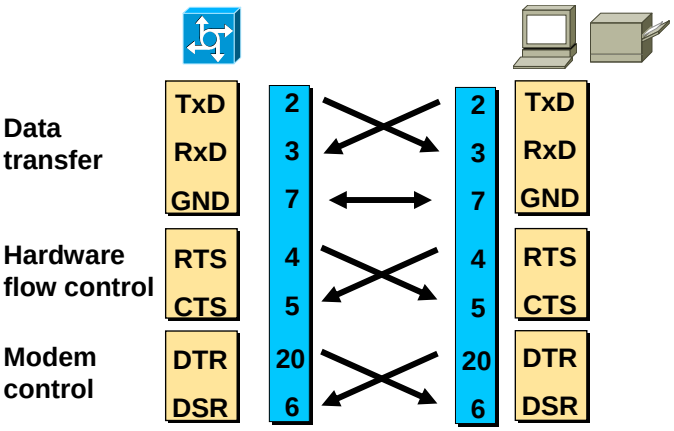
Two ways to terminate an existing connection:

- **DTE-initiated**
  - Access server drops DTR
  - Modem must be programmed to terminate connection on loss of DTR and restore to saved settings in its NVRAM
- **DCE-initiated**
  - Access server detects Carrier Detect (CD) low and terminates connection
  - Modem must be programmed so that CD reflects the state of the carrier

Modem Operation

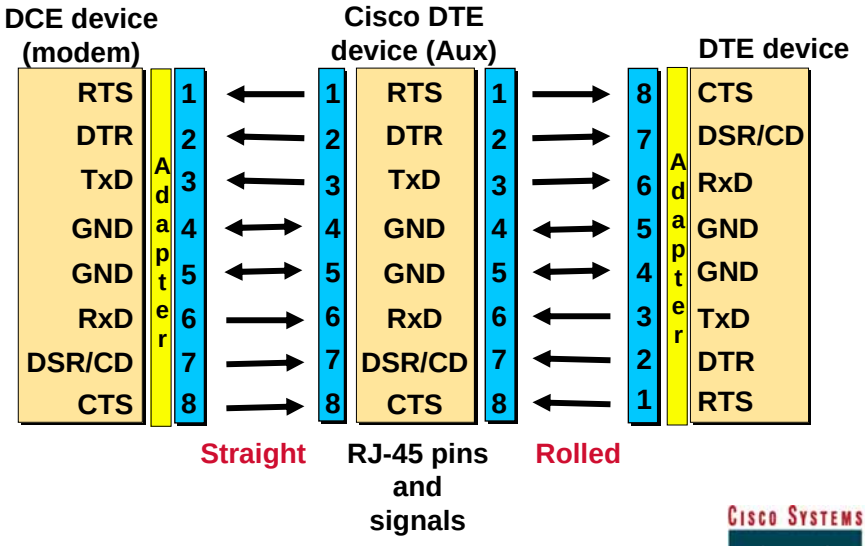


DTE-to-DTE Wiring

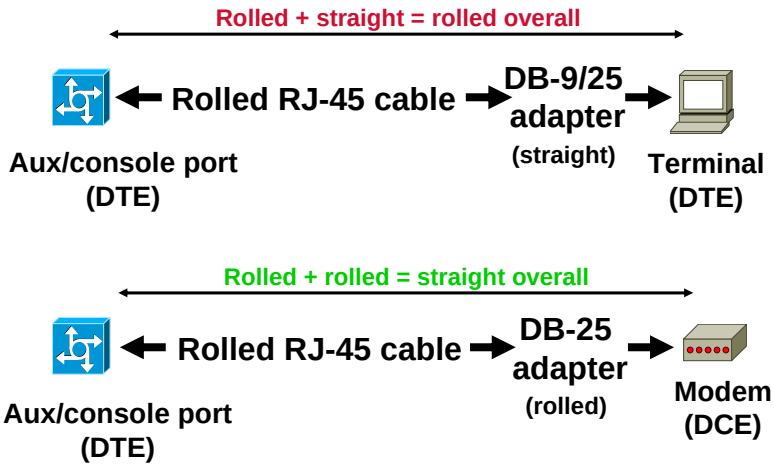


Null modem cable
(with DB-25 connectors)

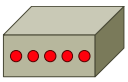
RJ-45 Wiring and Cables

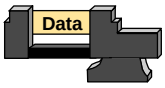


Working Connections



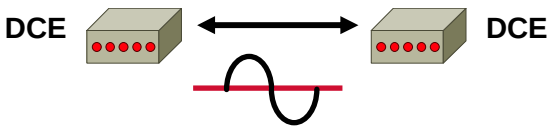
Error Control and Data Compression Standards





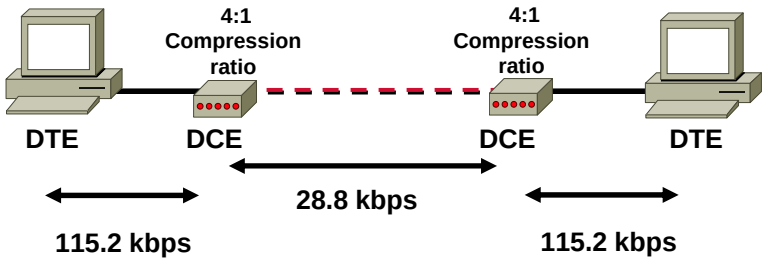
- Error detection/correction
  - Microcom Networking Protocol (MNP)
    - MNP 2–4 in public domain
    - MNP 10 for cellular
  - CCITT V.42
    - LAP-M
    - MNP 4
- Data compression
  - MNP 5: 2:1 ratio
  - V.42*bis*: 4:1 ratio

Modem Modulation Standards



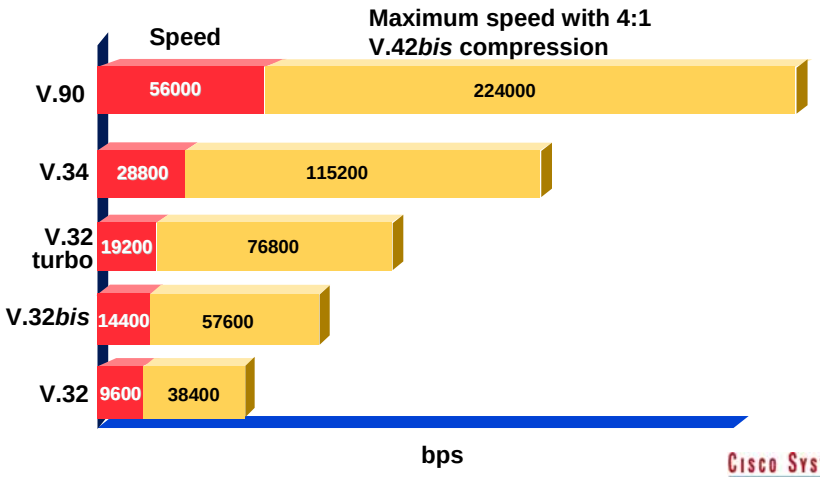
- ITU standards:
  - V.22: 1200 bps
  - V.22*bis*: 2400 bps
  - V.32: 9600 bps
  - V.32*bis*: 14.4 kbps
  - V.34: 28.8 kbps
  - V.34 annex 1201H: 33.6 kbps
  - V.90: 56 kbps
- Proprietary methods:
  - V.32 terbo: 19.2 kbps
  - V.fast: 28.8 kbps
  - V.FC: 28.8 kbps
  - K56Flex: 56 kbps
  - X2: 56 kbps

Modem Speeds and Compression



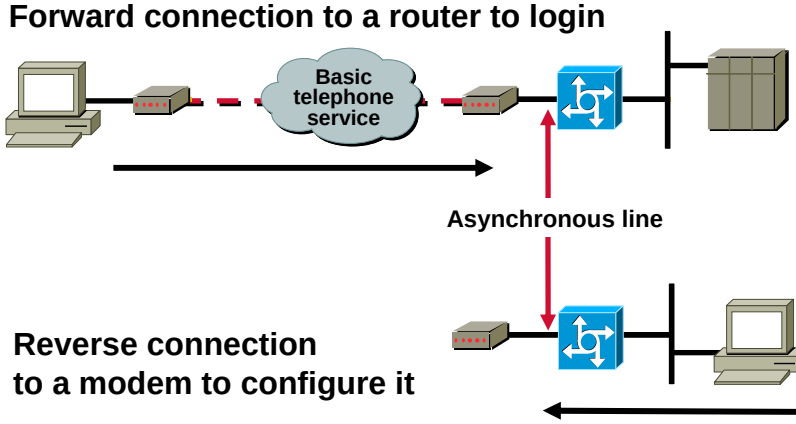
- The speeds and compression ratios shown assume ideal conditions

Theoretical Speeds



Connecting to the Modem

Forward connection to a router to login



Reverse connection to a modem to configure it

EXEC Connection Commands

```
Router>telnet[host][port][/debug]
```

- Makes a connection with the Telnet protocol

```
Router>disconnect [session-number]
```

- Disconnects the specified session or all sessions

```
Router>ctrl-shift-6 x
```

- Suspends a session

Line Types and Numbering

con	line = 0
tty *n*	line = *n*
aux	line = last_tty + 1
vty *m*	line = last_tty + 2 + *m*

Sample Output for *show line*

Rotary group #

Autoselect state

Absolute line number

Line speed

This is vty2 (3rd vty) line 20

```
cherub:18> sh line
  Tty Typ     Tx/Rx    A Modem  Roty AccO AccI   Uses   Noise  Overruns
  * 0 CTY                -      -    -    -      0       0       0/0
  * 1 TTY 115200/115200 - inout     -    4    -     31      26       0/0
  * 2 TTY 115200/115200 - inout     -   30    -     37      23       0/0
  A 3 TTY 115200/115200 - inout     -   25    -     10      24       1/0
  * 4 TTY 115200/115200 - inout     -    4    -     20      63       1/0
  * 5 TTY 115200/115200 - inout     -   45    -     18     325      22/0
  A 6 TTY 115200/115200 - inout     -   25    -      7       0       0/0
  I 7 TTY 115200/115200 - inout     -    -    -      6      36       1/0
  I 8 TTY 115200/115200 - inout     -    -    -      3      25       3/0
  * 9 TTY 115200/115200 - inout     -    4    -      2       0       0/0
  A 10 TTY 115200/115200 - inout    -   56    -      2     470     216/0
  I 11 TTY 115200/115200 - inout    -    -    -      0       0       0/0
  I 12 TTY 115200/115200 - inout    -    -    -      0       0       0/0
  I 13 TTY 115200/115200 - inout    -    -    -      1       0       0/0
  I 14 TTY 115200/115200 - inout    -    -    -      0       0       0/0
  I 15 TTY 115200/115200 - inout    -    -    -      0       0       0/0
  I 16 TTY 115200/115200 - inout    -    -    -      0       0       0/0
    17 AUX   9600/9600      -      -    -    -      2       1       2/104800
  * 18 VTY   9600/9600      -      -    -    -    103       0       0/0
    19 VTY   9600/9600      -      -    -    -      6       0       0/0
    20 VTY   9600/9600      -      -    -    -      1       0       0/0
    21 VTY   9600/9600      -      -    -    -      0       0       0/0
    22 VTY   9600/9600      -      -    -    -      0       0       0/0
    23 VTY   9600/9600      -      -    -    -      0       0       0/0
    24 VTY   9600/9600      -      -    -    -      0       0       0/0
    25 VTY   9600/9600      -      -    -    -      0       0       0/0
    26 VTY   9600/9600      -      -    -    -      0       0       0/0
    27 VTY   9600/9600      -      -    -    -      0       0       0/0
    28 VTY   9600/9600      -      -    -    -      0       0       0/0
    29 VTY   9600/9600      -      -    -    -      0       0       0/0
    30 VTY   9600/9600      -      -    -    -      0       0       0/0
    31 VTY   9600/9600      -      -    -    -      0       0       0/0
    32 VTY   9600/9600      -      -    -    -      0       0       0/0
    33 VTY   9600/9600      -      -    -    -      0       0       0/0
```

Access class in/out

Modem setting

Number of TCP connections made

Interface Async and Line Configuration

Logical configuration

```
Router(config)#interface async 8
Router(config-if)#encapsulation ppp
Router(config-if)#async dynamic address
Router(config-if)#peer default ip address 10.2.3.4
Router(config-if)#async mode interactive
Router(config-if)#ppp authentication chap
```

Physical configuration

```
Router(config)#line 8
Router(config-line)#login local
Router(config-line)#modem inout
Router(config-line)#speed 115200
Router(config-line)#flowcontrol hardware
Router(config-line)#rotary 33
Router(config-line)#autoselect ppp
```


Basic Modem Configuration

On the modem **On the access server**

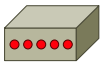
Use modem commands to:
- Set up hardware flow control
- Lock DTE speed
- Hang up on DTR low
- CD reflects carrier state

```
(config)#line x
(config-line)#login
(config-line)#password xxxxx
(config-line)#flowcontrol hardware
(config-line)#speed 115200
(config-line)#transport input all
(config-line)#stopbits 1
(config-line)#modem inout
                or
(config-line)#modem dialin
```


Standard Modem Commands

Action intended	Command
Loads factory default settings	AT&F
Auto answer	ATS0=n
CD truly reflects line state	AT&C1
Hangs up at DTR low	AT&D3
Ignore “+++” (in-band signaling)	ATS2=255
Echo off	ATE0
Turn off speaker	ATM0

Nonstandard Modem Commands



	Microcom	Hayes	USR
Hardware flow control	AT\Q3	AT&K3	AT&H1&R2
Lock DTE speed	AT\J0	AT&Q6	AT&B1
Error correction	AT\N6	AT&Q5	AT&M4
Compression	AT%C1	AT&Q9	AT&K1
Show configuration	AT\S1	AT&V	ATI4
Getting help	AT$H	AT$H	AT$
Saving the configuration	AT&W	AT&W	AT&W

Modem Initialization Strings

U.S. Robotics (USR) Courier

```
at&fs0=1&c1&d3&h1&r2&b1&m4&k1&w
```

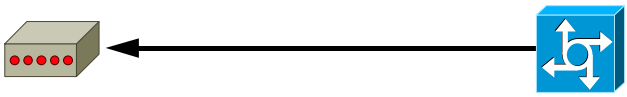
Hayes Optima/Accura

```
at&fs0=1&c1&d3&k3&q9&w
```

Microcom QX4232 series

```
at&fs0=1&c1&d3\q3\j0\n6%c1&w
```


Chat Scripts for Async Lines



```
Router(config)#chat-script script-name expect-string send-string
```

- Modem configuration
- Dialing and remote login commands
- Failure detection

```
Router(config)#chat-script Central ABORT ERROR ABORT BUSY
          "" "ATZ" OK "ATDT \T" TIMEOUT 30 CONNECT \c
```

- Sample chat script

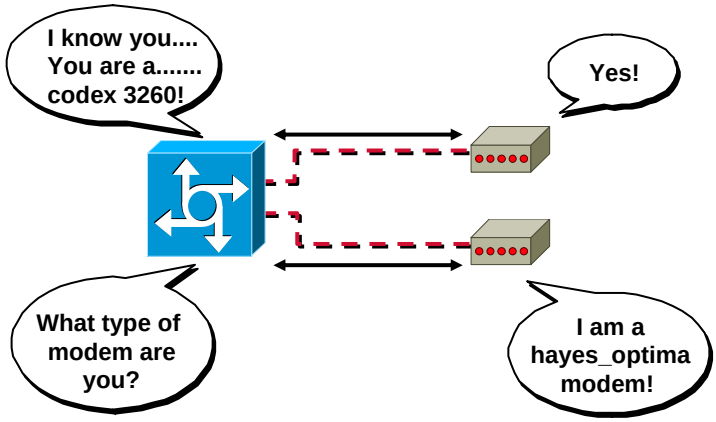
Modem Autoconfiguration

- **Autoconfiguration is used to:**
  - **Configure modems without using modem configuration commands**
  - **Autodiscover modems**
- **Operational areas:**
  - **Automatic modem configuration**
  - **Modem autodiscovery**
  - **Modemcap database management**

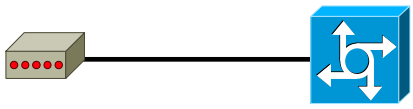
Automatic Modem Configuration

- **With modem autoconfiguration, modems:**
  - **Are reconfigured each time the line is reset (AT commands are sent)**
  - **Can use a customized line configuration**
  - **Are configured to match current line settings**

Modem Autodiscovery



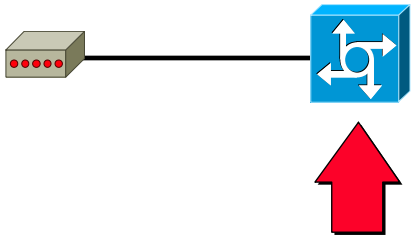
Configuring Modem Autoconfiguration



- Configuration may include:
  - Configuring modem autodiscovery

    or
  - Specifying a specific modem type
  - Managing the modemcap database

Configuring Modem Autodiscovery

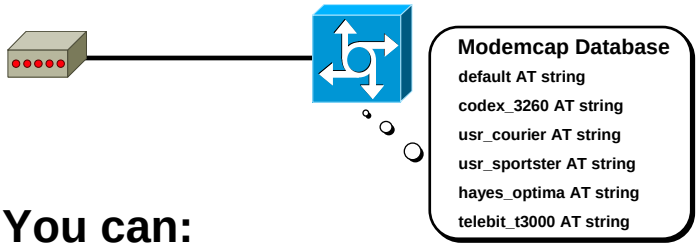


```
Router#configure terminal
Router(config)#line 1 16
Router(config-line)#modem autoconfigure discovery
Router(config-line)#end
Router#copy running-config startup-config
```


Specifying a Known Modem Initialization String

```
Router#configure terminal
Router(config)#line 1
Router(config-line)#modem autoconfigure type usr_sportster
Router(config-line)#end
Router#copy running-config startup-config
```

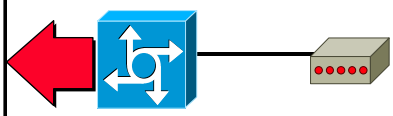
Modemcap Database



- You can:
  - View the modemcap database
  - Add entries to the modemcap database

Managing the Modemcap Database

```
Router#show modemcap
default
codex_3260
usr_courier
usr_sportster
hayes_optima
global_village
viva
telebit_t3000
microcom_hdms
microcom_server
nec_v34
nec_v11
nec_piafs
cisco_v110
mica
```



Viewing Modemcap Modem Entries

```
Router#show modemcap codex_3260
Modemcap values for codex_3260
Factory Defaults (FD): &F
Autoanswer (AA): S0=1
Carrier detect (CD): &C1
Drop with DTR (DTR): &D2
Hardware Flowcontrol (HFL): *FL3
Lock DTE speed (SPD): *SC1
Best Error Control (BER): *SM3
Best Compression (BCP): *DC1
No Error Control (NER): *SM1
No Compression (NCP): *DC0
No Echo (NEC): E0
No Result Codes (NRS): Q1
Software Flowcontrol (SFL): [not set]
Caller ID (CID): &S1
Miscellaneous (MSC): [not set]
Template entry (TPL): default
```

- AT commands for a specific modem

Creating and Editing a Variant Modemcap Entry

```
Router#configure terminal
Router#modemcap edit usr_new caller-id *U1
Router#modemcap edit usr_new speed &B1
Router#modemcap edit usr_new template usr_courier
```

```
Router#show modemcap
codex_3260
usr_courier
usr_sportster
hayes_optima
global_village
usr_new
...
```

New entry

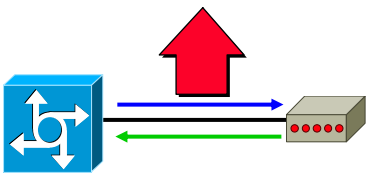
Viewing a Variant Modemcap Entry

```
Router#show modemcap usr_new
Modemcap values for usr_new
Factory Defaults (FD):  &F
Autoanswer (AA):  S0=1
Carrier detect (CD):  &C1
Drop with DTR (DTR):  &D2
Hardware Flowcontrol (HFL):  &H1&R2
Lock DTE speed (SPD):  &B1
Best Error Control (BER):  &M4
Best Compression (BCP):  &K1
No Error Control (NER):  &M0
No Compression (NCP):  &K0
No Echo (NEC):  E0
No Result Codes (NRS):  Q1
Software Flowcontrol (SFL):  [not set]
Caller ID (CID):  *U1
Miscellaneous (MSC):  [not set]
Template entry (TPL):  usr_courier
```

2
1
3

Verifying Modem Autoconfiguration Operation

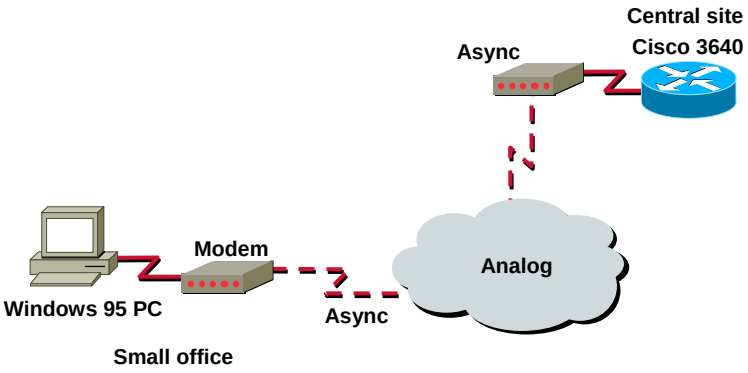
```
Router#debug confmodem
TTY97: detection speed (115200) response ---OK---
TTY97: Modem command:  --AT--
TTY97: Modem configuration succeeded
TTY97: Detected modem speed 115200
TTY97: Done with modem configuration
TTY97: detection speed (115200) response ---OK---
TTY97: Modem command:  --AT&F&C1&D2&H1&R2&M4&K1&B1S0=1H0--
TTY97: Modem configuration succeeded
TTY97: detection speed (115200) response ---OK---
TTY97: Done with modem configuration
```



Troubleshooting Modem Autoconfiguration

- Common problems with modem autoconfiguration:
  - The modem does not respond
  - The modem is not recognized by modem autodiscovery
  - There is an original modemcap entry problem

Laboratory Exercise: Visual Objective



Summary

After completing this chapter, you should be able to perform the following tasks:

- Configure an access server for an attached modem
- Use reverse Telnet to configure an external modem
- Configure a modem using autoconfigure

Review Questions

- What does the lock DTE modem attribute do?
- A user dials into a line and ends up in someone else's session. What is one possible cause?
- What is reverse Telnet? Describe how it is used with modems.
- What are the modem autoconfiguration options?