Overview of Lines, Interfaces, and Controllers on Cisco Routers

This chapter provides information about the different types of calls, interfaces, internal software constructs, and lines used for remote access.

The following sections are provided in this chapter:

- Types of Calls Sent and Received in Dial Networking
- Logical Constructs for Remote Access
- Logical Interfaces for Remote Access
- Physical Interfaces, Lines, and Controllers for Remote Access
- Lines Used for Remote Access

Types of Calls Sent and Received in Dial Networking

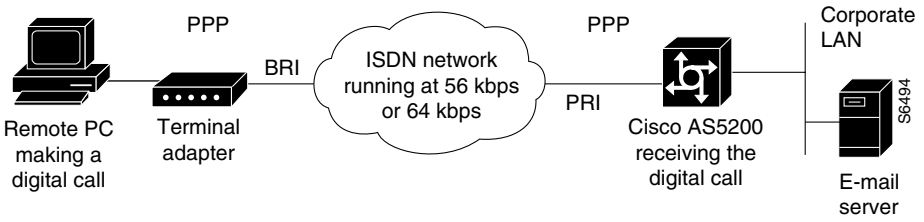
There are three basic types of calls sent and received in dial networking:

- Digital Calls
- Analog Modem Calls
- Asynchronous Character Stream Calls

Digital Calls

Digital calls are generally ISDN 56 kbps or 64 kbps data or voice calls that use the point-to-point protocol (PPP). These calls usually originate from a PC, Macintosh, or digital telephone connected to an ISDN router or terminal adapter and terminate at another access server's or router's ISDN interface. Digital calls are also assigned to use B channels when traveling across ISDN networks. (See Figure 25.)

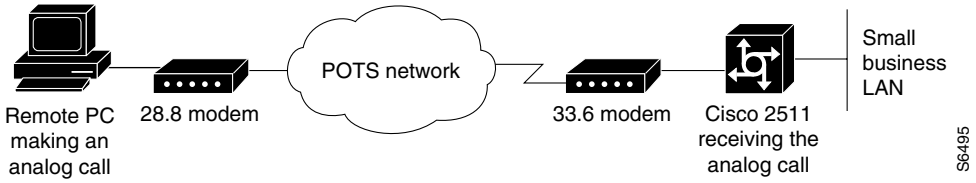
Figure 25 PC Making a Digital Call into a Cisco AS5200



Analog Modem Calls

Analog modem calls travel through standard telephone lines (POTS) or ISDN lines. Regardless if analog calls travel through an asynchronous POTS line or ISDN line, theses calls are eventually routed to an internal modem (such as with the Cisco AS5200) or an external modem (such as used with the Cisco 2500 series). (See Figure 26.)

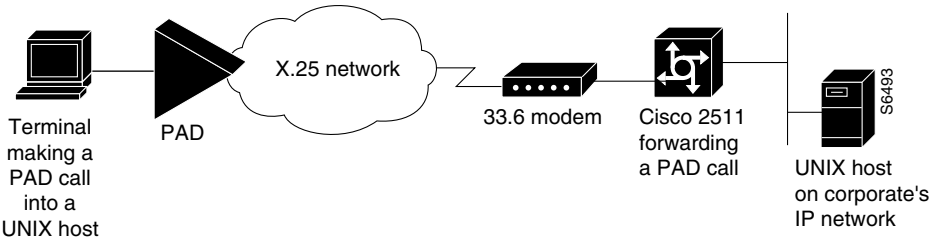
Figure 26 PC Making an Analog Call into a Cisco 2511



Asynchronous Character Stream Calls

These calls get routed to virtual terminal (VTY) lines and virtual asynchronous interfaces (VTY-async), which are used to terminate incoming character streams that do not have a physical connection (such as a physical interface) to the access server or router. A virtual asynchronous interface is the place where inbound Telnet, LAT, V.120, TN3270, and PAD calls or sessions terminate on the router. Virtual terminal lines are used for attaching to the router in a non-physical way. For example, if you begin a PPP session over an asynchronous character stream, a VTY-async interface is created to support the call. (See Figure 27.)

Figure 27 Terminal Making a PAD Call into a Cisco 2511



Logical Constructs for Remote Access

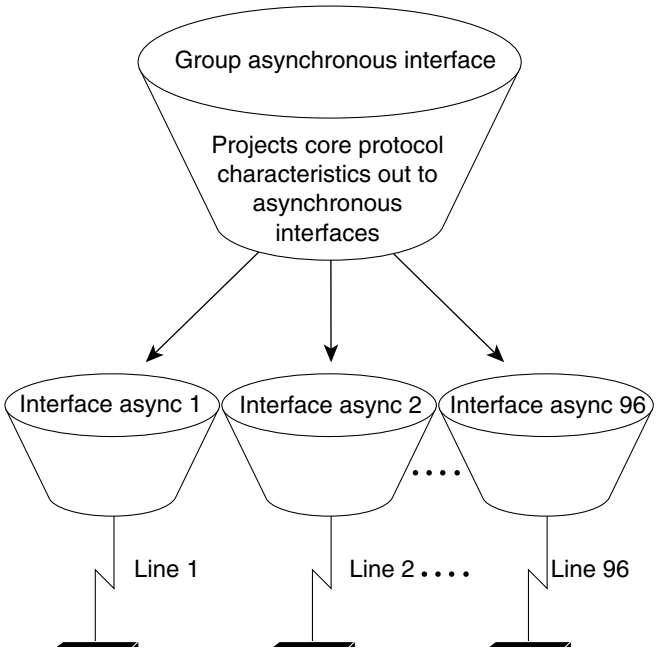
A logical construct is an intangible device in an access server or router that stores data or configuration information for physical interfaces. No data packets are forwarded to a logical construct. Cisco uses two types of logical constructs in its access servers and routers.

- Group Asynchronous Interfaces
- Virtual Interface Templates

Group Asynchronous Interfaces

A group asynchronous interface is a parent interface that applies specified protocol characteristics to a specified range of asynchronous ports. This convenient interface stores and projects configuration information to asynchronous ports, which usually connect to modems. For example, this feature facilitates applying asynchronous configurations such as autoselect PPP to several interfaces at once. No data packets arrive in a group asynchronous interface. (See Figure 28.)

Figure 28 Logical Construct for Group Asynchronous Interface



Configuring a group asynchronous interface eliminates the need to repeatedly configure identical configuration information across several asynchronous interfaces. To configure a group interface, use the **interface group-async** global configuration command.

You must specify the group async number (an arbitrary number) and the group range (beginning and ending asynchronous interface number). The following example shows the process of creating a group asynchronous interface for asynchronous interfaces 1 through 16 on a Cisco 2511 access server:

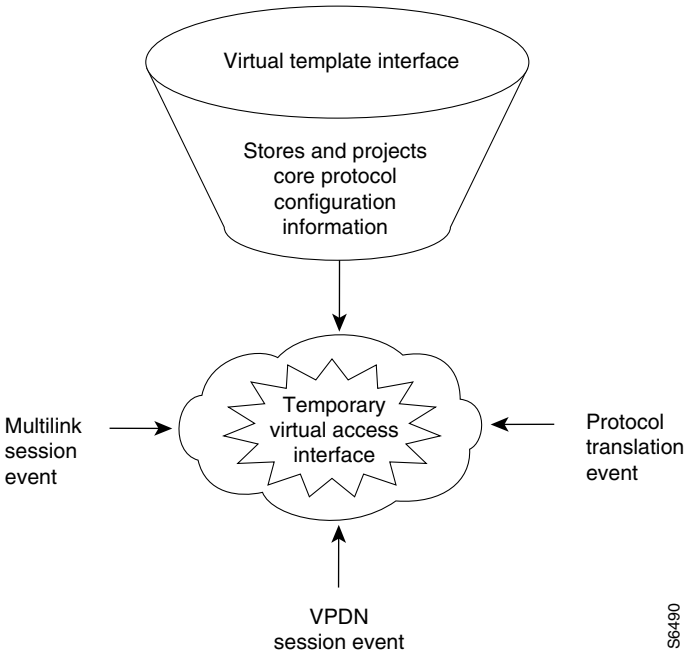
```
router(config)# interface group-async 1
router(config-if)# group-range 1 16

Building configuration...

router(config-if)#
```

For additional information about configuring group asynchronous interfaces, see the chapter "Configuring Modem Support and Asynchronous Devices."

Virtual Interface Templates

A virtual interface template exists inside the router and stores protocol configuration information that is projected or applied to protocol translation sessions or virtual access interfaces. The template is not a physical interface; it is a logical interface. No data packets ever arrive in a virtual interface template. (See Figure 29.)

Figure 29 Logical Construct for a Virtual Interface Template



Additionally, a virtual interface template enables you to simplify the process of configuring protocol translation to tunnel PPP or SLIP across X.25, TCP, and LAT networks. A virtual interface template is configured independently and applied to any protocol translation session. You can create a virtual interface template with the **interface virtual-template c**ommand and use it for one-step and two-step protocol translation. When a user dials in through a virtual terminal (VTY) line and a tunnel connection is established, the router clones the attributes of the virtual interface template onto a *virtual access interface*. This virtual access interface is a temporary interface that supports the asynchronous protocol configuration specified in the virtual interface template. This virtual access interface is created dynamically and lasts only as long as the tunnel session is active.

A virtual interface template is also used to project configuration information to virtual access interfaces that spawn due to multilink or virtual private dial-up network sessions. When a virtual access interface is created, the configuration information in the virtual template is leveraged and the negotiated parameters are implemented thereon to the connection.

For information about applying virtual templates to protocol translation, see the chapter "Configuring Protocol Translation and Virtual Asynchronous Devices."

Logical Interfaces for Remote Access

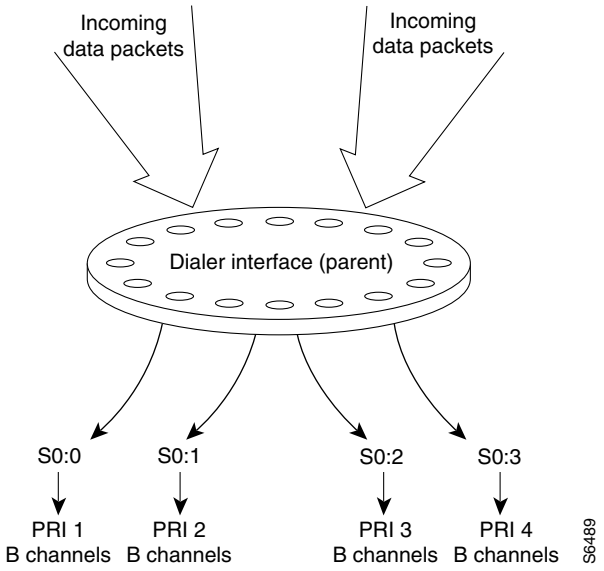
A logical interface is a device in an access server or router that receives and transmits data packets and controls physical interfaces. The Cisco IOS software provides three logical interfaces:

- Dialer Interfaces
- Virtual Access Interfaces
- Virtual Asynchronous Interfaces

Dialer Interfaces

A dialer interface is a parent interface that holds central protocol characteristics for ISDN D channels, which are part of specified dialer rotary groups. Data packets are delivered to dialer interfaces, which in turn initiate dialing for inbound calls. In most cases, D channels get their core protocol intelligence from dialer interfaces. (See Figure 30.)

Figure 30 Dialer Interface and Its Neighboring Components



A dialer interface is user configurable and linked to individual B channels (such as S0:0, S0:1, S0:2), where it delivers data packets to their physical destinations. Dialer interfaces seize physical interfaces to cause packet delivery. If a dialer interface spawns a multilink session, a dialer interface can be in control of a virtual access interface, which in turn controls S0:3 or chassis 2 S0:3 for example. A dialer interface is created with the **interface dialer** global configuration command.

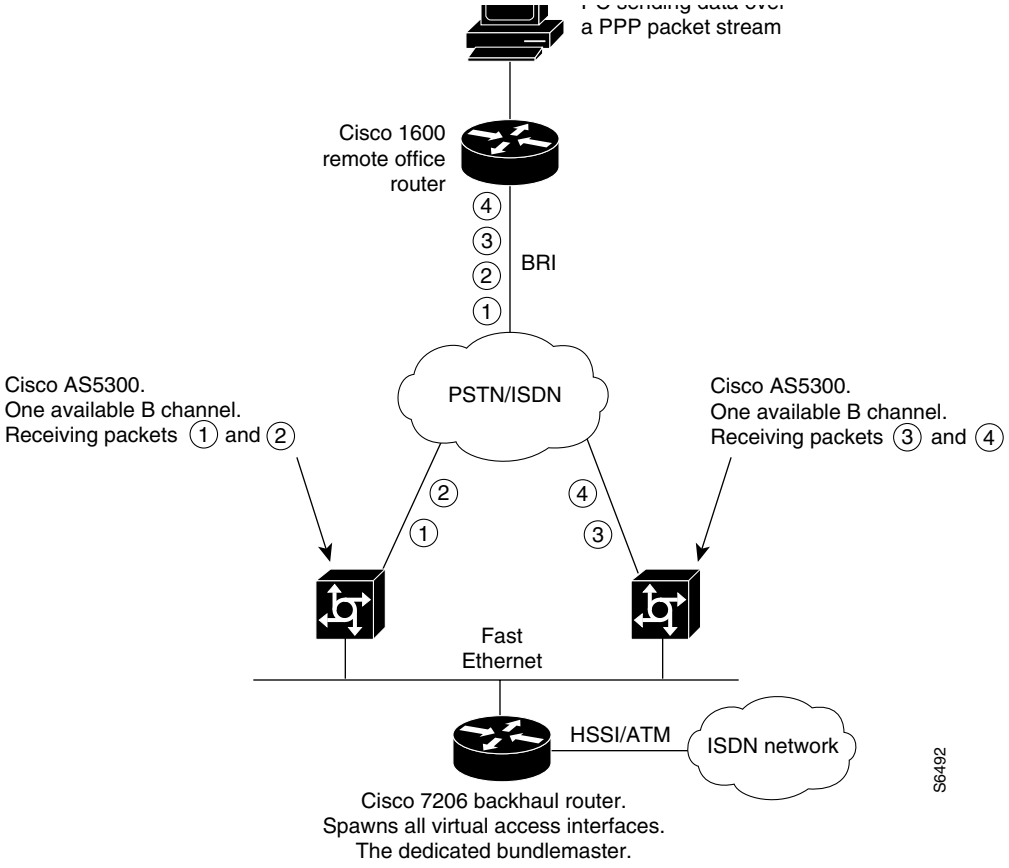
Virtual Access Interfaces

A virtual access interface is a mechanism that is used to terminate incoming PPP steams that do not have a physical connection. PPP streams and L2F frames coming in on multiple channels (also known as multilink sessions) get reassembled by a virtual access interface, which is an interface construct to terminate packets into. (All packets must have some kind of interface to arrive on or land on.) A virtual access interface is also used to clone attributes from a virtual interface template, which is used in protocol translation to tunnel PPP or SLIP across X.25, TCP, and LAT networks.

A virtual access interface is not directly user configurable. All negotiated protocol parameters are configured at the virtual interface template. Use a virtual template to project how a virtual access interface will be configured or spawned. A virtual access interface is created dynamically and lasts only as long as a tunnel or multilink session is active.

Figure 31 shows how a virtual access interface functions to accommodate a multilink session event. Two physical interfaces on two different access servers are involved in a multilink call that originates from one PC. However, only one B channel on each Cisco AS5200 is available to receive the call. Therefore all four packets are equally distributed between the two separate devices. Each Cisco AS5200 receives only half the total packets. A virtual access interface is dynamically created upstream to receive the multilink protocol, track the multilink frames, and reassemble the packets.

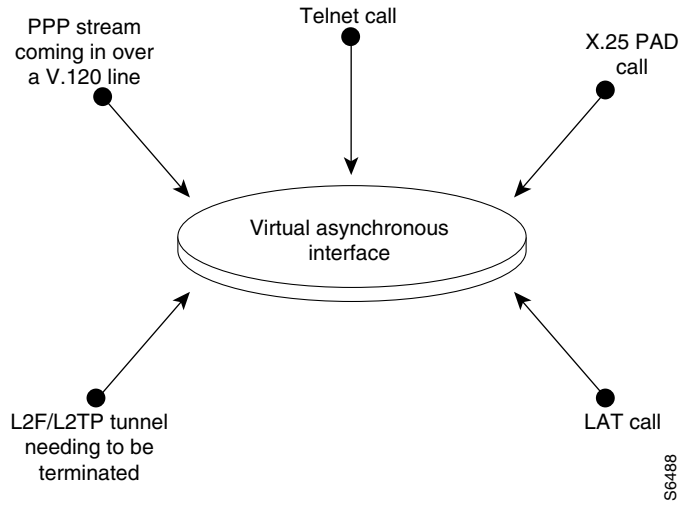
Figure 31 A Virtual Access Interface Used for a Multilink Session Event



Virtual Asynchronous Interfaces

A virtual asynchronous interface (also known as VTY-async) is created on demand to support calls that enter the router through a non-physical interface. For example, asynchronous character stream calls arrive on non-physical interfaces. These types of calls include inbound Telnet, LAT, PPP over character-oriented protocols (such as V.120 or X.25), and PAD calls. A virtual asynchronous interface is also used to terminate L2F tunnels, which are often traveling companions with multilink sessions. Virtual asynchronous interfaces are not user configurable; rather, they are dynamically created and torn down on demand. A virtual asynchronous line is used to access a virtual asynchronous interface. (See Figure 32.)

Figure 32 Types of Calls that Terminate on a Virtual Asynchronous Interface



Physical Interfaces, Lines, and Controllers for Remote Access

Data packets travel through physical interfaces and controllers in dial access servers and routers. This section describes different types of physical interfaces and controllers:

- Asynchronous Interfaces
- Asynchronous Modem Lines
- ISDN Interfaces
- Channelized T1 and Channelized E1
- Controllers for T1 or E1 Networks

Asynchronous Interfaces

Remote clients dial in to the network through asynchronous ports, which can be on the back of an access server (for example, the Cisco 2511) or inside an access server (for example, the Cisco AS5300).

To enable clients to dial in, you configure two components of each asynchronous port: lines and interfaces. Asynchronous interfaces correspond to physical terminal (TTY) lines. For example, asynchronous interface 1 corresponds to TTY line 1.

Generally, commands entered in asynchronous interface mode enable you to configure protocol-specific parameters for asynchronous interfaces, whereas commands entered in line configuration mode let you configure the physical aspects for the same port.

Specifically, you configure asynchronous interfaces to support PPP connections. An asynchronous interface on an access server or router can be configured to support the following functions:

- Network protocol support (such as IP, IPX, or AppleTalk)
- Encapsulation support (such as PPP)
- IP client addressing options (default and/or dynamic)
- IPX network addressing options
- PPP authentication
- ISDN BRI and PRI configuration

For additional information about configuring asynchronous interfaces, see the chapter "Configuring Modem Support and Asynchronous Devices."

Asynchronous Modem Lines

Asynchronous line configuration commands configure ports for the following options:

- Physical layer options (such as modem configuration)
- Security for EXEC mode
- ARA protocol configuration (PPP is configured in interface configuration mode)
- Autoselect to detect incoming protocols (ARA and PPP)

To enter line configuration mode, first connect to the console port of the access server and enter privileged EXEC mode. Then enter global configuration mode and finally enter line configuration mode for the asynchronous lines that you want to configure. The following example shows the process of entering line configuration mode for lines 1 through 16:

```
router> enable
router# configure terminal
router(config)# line 1 16
router(config-line)#
```

For additional information about configuring asynchronous modem lines, see the chapter "Configuring Modem Support and Asynchronous Devices."

ISDN Interfaces

There are two types of ISDN interfaces or services that Cisco routers and access servers provide—Basic Rate Interface (BRI) and Primary Rate Interface (PRI).

ISDN BRI

ISDN BRI operates over most of the copper twisted-pair telephone wiring in place today. ISDN BRI delivers a total bandwidth of a 144-kbps via three separate channels. Two of the channels, called B (Bearer) channels, operate at 64 kbps and are used to carry voice, video, or data traffic. The third channel, the D (Data) channel, is a 16-kbps signaling channel used to carry instructions which tells the telephone network how to handle each of the B channels. ISDN BRI is often referred to as "2 B+D."

The flexibility of ISDN comes from its ability to use each of the B channels for separate voice or data applications. For example, a long document can be downloaded from the corporate network over one ISDN 64-kbps B channel connection. While that document is downloading, another B channel can be connected to the Internet to browse a web page.

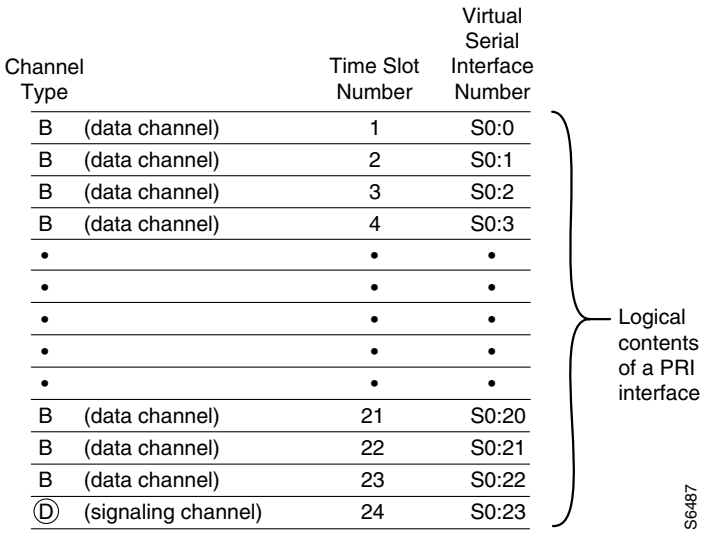
A D channel notifies the central office switch to send the incoming call to particular timeslots on the router. Each one of the bearer or B channels carries data or voice. The D channel carries signaling for the B channels. The D channel also identifies if the call is a digital call or analog call. Analog calls are decoded and then get sent off to the modems. Digital calls are directly relayed off to the ISDN processor in the router.

Enter the **interface bri** command to bring up and configure a single BRI interface, which is the overseer of the 2 B+D channels. As soon as this command is issued, the BRI interface is set up to support traffic on both B and D channels. Other than protocol and dialer map information, you do not need to enter any additional configuration commands to prepare the B channels to transmit network traffic. The D channel is not user configurable.

ISDN PRI

ISDN PRI is often referred to as "23 B+D" (U.S.) or "30 B+D" (non-U.S.). PRI is designed to carry large numbers of incoming ISDN calls at corporate offices or other central site locations. All the reliability and performance features of ISDN BRI apply to ISDN PRI, but ISDN PRI also has 23 B channels of 64 kbps each that carry user traffic and a shared 64-kbps D channel that carries signaling traffic. The logical contents of a PRI interface include 24 virtual serial interfaces, 24 timeslots, 23 B channels, and one D channel. (See Figure 33.)

Figure 33 Logical Flow of Traffic between ISDN PRI and an Access Server or Router



ISDN PRI is configured on a T1 or E1 controller, which is also set up to support an ISDN switch type, framing, linecode, and a PRI timeslot range. In T1 networks, the D channel is brought up by specifying the **interface serial 0:23** and **interface serial 1:23** commands in the Cisco IOS software. In E1 networks, the D channel is brought up by specifying the **interface serial 0:15** and **interface serial 1:15** commands. D channels are user configurable and behave precisely like dialer interfaces, which are areas where packets go to initiate dialing. In Figure 33, the D channel Serial 0:23 in turn controls virtual interfaces Serial 0:0 through Serial 0:22. If Figure 33 was for an E1 configuration, the D channel Serial 0:15 would control virtual interfaces Serial 0:0 through Serial 0:14.

Channelized T1 and Channelized E1

A channelized T1 (CT1) or E1(CE1) is an analog line that was originally intended to support analog voice calls, but has evolved to support analog data calls. ISDN or digital calls do not transmit across CT1 or CE1 lines. Cisco routers and access servers can directly connect to channelized lines.

The key difference between traditional channelized lines (analog) and non-channelized lines (digital or ISDN) it that channelized lines do not have built-in D-channel signaling. All 24 channels on a T1 line for example only carries data. The signaling is in-band or associated to the data channels (also known as robbed bit signaling for T1 lines or channel associated signaling for E1 lines). A traditional channelized line cannot support a digitized data call (for example, BRI with 2B+D). The only supported signals on a traditional channelized line are onhook, offhook, relay open, and relay closed. The Cisco AS5200, Cisco AS5300, and Cisco 3600 series support different types of channel associated signalling for receiving and transmitting analog calls, such as ground start, loop start, wink start, immediate start, and E&M. Signaling for CT1 or CE1 is turned on or enabled with the **cas-group** command, which is configured on a T1 or E1 controller.

Controllers for T1 or E1 Networks

A T1 or E1 controller is a device that exists inside a router or access server. You configure the controller to inform the router how to distribute or provision individual timeslots for a connected T1 or E1 line. A controller communicates with the telephone company in a way similar to line coding and framing. Typically, timeslots are distributed to meet the needs of a particular business scenario.

For example to support traffic flow for a ISDN PRI interface, the **pri-group 1-24** is configured. To support traffic flow for analog calls over a channelized T1 line provisioned for E&M signaling (such as feature group b ear and mouth), the **cas-group e&m-fgb 1-24** command is configured. Although supported on Cisco routers, most telephone companies will not provision their switches to support a single T1 or E1 line with a combination of PRI, channel associated signaling, and leased-line grouping, such as communicated by the following router configuration statement on a controller T1:

```
pri-group timeslots 1-10
channel-group 11 timeslots 11-16
cas-group 17 timeslots 17-23 type e&m-fgb.
```

Lines Used for Remote Access

This section describes the different line types used for dial access on Cisco access servers and routers. It also describes the relationship between lines and interfaces.

- Line Types
- Relationship between Lines and Interfaces on Cisco Routers
- Absolute versus Relative Line Numbers
- Interface and Line Numbering Schemes for Specific Access Servers and Routers

Note Cisco devices have four types of lines: console, auxiliary, asynchronous, and virtual terminal lines. Different routers have different numbers of these line types. Refer to the hardware and software configuration guides that shipped with your device for exact configurations.

Line Types

Table 4 shows the types of lines that can be configured on Cisco routers.

Table 4 Line Types Available on Cisco Routers

Line Type	Port	Description	Numbering Rules
CON or CTY	Console	Typically used to log in to the router for configuration purposes.	Line 0.
AUX	Auxiliary	RS-232 DTE port used as a backup asynchronous port (TTY). Cannot be used as a second console port.	Last TTY line number plus 1.
TTY	Asynchronous	Same as asynchronous interface. Used typically for remote-node dial-in sessions that use such protocols as SLIP, PPP, and XRemote.	The numbering widely varies between platforms.
VTY	Virtual terminal	Used for incoming Telnet, LAT, X.25 PAD, and protocol translation connections into synchronous ports (such as Ethernet and serial interfaces) on the router.	Last TTY line number plus 2 through the maximum number of VTY lines specified.[1]

1. Increase the number of VTY lines on a router using the **line vty** command. Delete VTY lines with the **no line vty** *line-number* global configuration command. The **line vty** command accepts any line number larger than 5 up to the maximum number of lines supported by your router with its current configuration.

Relationship between Lines and Interfaces on Cisco Routers

This section describes the relationship between lines and interfaces on Cisco routers:

- Asynchronous Interfaces and TTY Lines
- Synchronous Interfaces and VTY Lines

Asynchronous Interfaces and TTY Lines

Asynchronous interfaces correspond to physical terminal (TTY) lines. Commands entered in asynchronous interface mode enable you to configure protocol-specific parameters for asynchronous interfaces; commands entered in line configuration mode let you configure the physical aspects of the line's port.

For example, to enable IP resources to dial in to a network, configure the lines and asynchronous interfaces as follows:

Step 1 Configure the physical aspect of a line that leads to a port. You might enter the following commands to configure lines 1 through 16 (asynchronous TTY lines on a Cisco 2511 access server):

```
line 1 16
 login local
 modem inout
 speed 115200
 flowcontrol hardware
 ! configures the line to autosense PPP; physical line attribute
 autoselect ppp
```

Step 2 On asynchronous interface 1, you configure your protocol-specific commands. You might enter the following commands:

```
interface async 1
 encapsulation ppp
 async mode interactive
 async dynamic address
 async dynamic routing
 async default ip address 198.192.16.132
 ppp authentication chap
```

The remote node services SLIP, PPP, and XRemote are configured in asynchronous interface mode. AppleTalk Remote Access (ARA) is configured in line configuration mode on virtual terminal (VTY) lines or TTY lines.

Synchronous Interfaces and VTY Lines

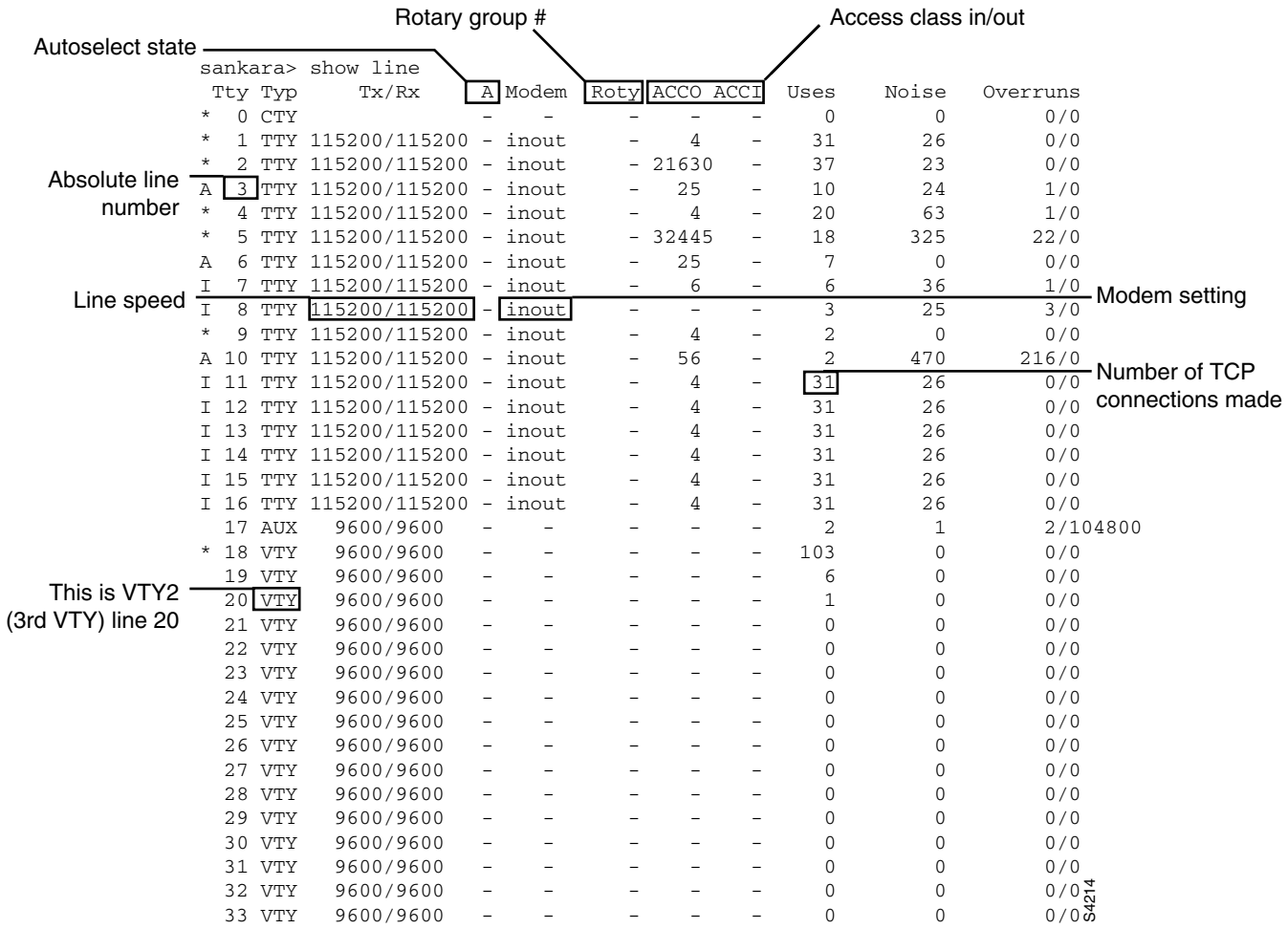
Virtual terminal (VTY) lines provide access to the router through a synchronous interface. VTY lines do not correspond to synchronous interfaces in the same way that TTY lines correspond to asynchronous interfaces. This is because VTY lines are created dynamically on the router, whereas TTY lines are static physical ports. When a user connects to the router on a VTY line, that user is connecting into a *virtual* port on an interface. You can have multiple virtual ports for each synchronous interface.

For example, several Telnet connections can be made to an interface (such as an Ethernet or serial interface).

The number of VTY lines available on a router are defined using the **line vty** *number-of-lines* global configuration command.

Use the **show line** command to see the status of each of the lines available on a router (see Figure 34).

Figure 34 Sample Show Line Output Showing CTY, TTY, AUX, and VTY Line Statistics




```
sankara> show 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      - 21630   -    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      - 32445   -    18     325      22/0
A  6 TTY 115200/115200 - inout      -   25    -     7       0       0/0
I  7 TTY 115200/115200 - inout      -    6    -     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      -    4    -    31      26       0/0
I 12 TTY 115200/115200 - inout      -    4    -    31      26       0/0
I 13 TTY 115200/115200 - inout      -    4    -    31      26       0/0
I 14 TTY 115200/115200 - inout      -    4    -    31      26       0/0
I 15 TTY 115200/115200 - inout      -    4    -    31      26       0/0
I 16 TTY 115200/115200 - inout      -    4    -    31      26       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
```

Absolute versus Relative Line Numbers

When you enter line configuration mode, you can specify an *absolute line number* or a *relative line number*. For example, in Figure 34, absolute line number 20 is VTY2 (line 18 is VTY0). Referring to lines in a relative format is often easier than attempting to recall the absolute number of a line on a large system. Internally, the router uses absolute line numbers.

You can view all of the absolute and relative line numbers with the **show users all** EXEC command. In the following sample display, absolute line numbers are listed at the far left under the heading "Line." Relative line numbers are in the third column, after the line type. In this example, the second virtual terminal line, VTY 1, is absolute line number 3.

```
   Line       User     Host(s)              Idle Location
   0 con 0
   1 aux 0
   2 vty 0             incoming             0 SERVER.COMPANY.COM
   3 vty 1
   4 vty 2
   5 vty 3
   6 vty 4
```

Compare the line numbers in this sample display to the output from the **show line** command, as shown in Figure 34.

Interface and Line Numbering Schemes for Specific Access Servers and Routers

Interface and line numbering schemes vary between access servers and routers and the type of assembled hardware configuration. Refer to the hardware and software configuration guides that shipped with your device for specific interface and line numbering information.