

Configuring Dial-In Terminal Services

This chapter describes how to configure support for asynchronous character stream calls running Telnet, rlogin, local-area transport (LAT), XRemote, or TN3270 and includes the following sections:

- Terminal Service Connections Overview
- Configure Support for Telnet and Rlogin Calls
- Configure Support for Local Area Transport Calls
- Configure Support for TN3270 Calls
- Configure Support for XRemote Calls

Inbound asynchronous character stream calls are routed to virtual terminal lines and virtual asynchronous interfaces, which are used to terminate incoming character streams that do not share a physical connection with the access server or router (such as a physical interface). 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 nonphysical way.

For a complete description of the commands in this chapter, refer to the “Dial-In Terminal Service Commands” chapter of the *Dial Solutions Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

Terminal Service Connections Overview

Configuring support for terminal service connections means to enable network devices running the same protocol (such as LAT or TCP) to connect across a LAN or WAN through network and terminal-emulation software such as Telnet, rlogin, TN3270, LAT, and NetWare Asynchronous Services Interface (NASI).

Terminal Services

Terminal services permit asynchronous devices to be connected to a LAN or WAN through network and terminal-emulation software including Telnet, rlogin, NASI, Digital’s LAT protocol, and IBM TN3270. (See Figure 55.)

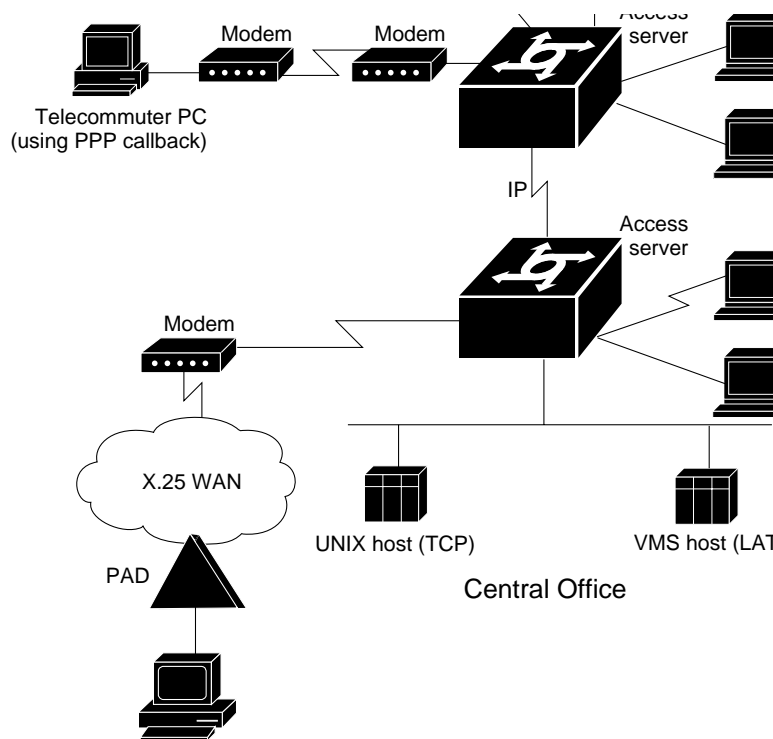
Access services permit terminals to connect with remote hosts using virtual terminal protocols including Telnet, NASI, LAT, TN3270, rlogin, and X.25 packet assembler/disassembler (PAD). You can use a router that supports access services to function as a terminal server to provide terminal access to devices on the network.

A host can also connect directly to an access server. In IBM environments, TN3270 allows a standard ASCII terminal to emulate a 3278 terminal and access an IBM host across an IP network.

In Digital environments, LAT support provides a terminal with connections to VMS hosts. X.25 PAD allows terminals to connect directly to an X.25 host over an X.25 network through the router. X.25 PAD eliminates the need for a separate PAD device. This connection requires use of one of the synchronous serial interfaces on the router supporting access services.

Figure 55 shows some of the terminal connection services available on your router.

Figure 55 Terminal Connection Services



Supported Protocols

The following protocols are supported for dial-in terminal services:

- Telnet and rlogin—Of all protocol suites, Transmission Control Protocol/Internet Protocol (TCP/IP) is the most widely implemented on networks of all media types. TCP/IP is today's standard for internetworking and is supported by most computer vendors, including all UNIX-based workstation manufacturers. TCP/IP includes Telnet and rlogin.
- NASI—Configuring the Cisco IOS software as a NASI server enables NASI clients to connect through your router to network resources.

- LAT—Digital Equipment Corporation’s proprietary terminal connection protocol used with Digital minicomputers.
- TN3270—IBM 3278 terminal emulation provides TN3270-based connectivity to IBM hosts over serial lines.
- Terminal or remote node services using protocol translation—Connecting devices running dissimilar protocols (such as LAT-to-TCP or TCP-to-LAT) and converting one virtual terminal protocol into another protocol.

Configure Support for Telnet and Rlogin Calls

This section describes how to configure access server and router lines to support Telnet and rlogin connections and includes the following sections:

- Cisco’s Implementation of Telnet and UNIX Rlogin
- Configure Telnet and UNIX Rlogin
- Make Telnet and UNIX Rlogin Connections
- Monitor TCP/IP Connections
- Telnet and Rlogin Configuration Examples

Cisco’s Implementation of Telnet and UNIX Rlogin

Telnet and rlogin are protocols that enable TCP/IP connections to a host. Telnet, a virtual terminal protocol that is part of the TCP/IP protocol suite, is the more widely used protocol. The rlogin protocol is a remote login service developed for the BSD UNIX system. It provides better control and output suppression than Telnet, but can only be used when the host (typically, a UNIX system) supports rlogin. The Cisco IOS implementation of rlogin does not subscribe to the rlogin “trusted host” model. That is, a user cannot automatically log on to a UNIX system from the router, but must provide a user ID and a password for each connection.

Telnet allows a user at one site to establish a TCP connection to a login server at another site, then passes the keystrokes from one system to the other. Telnet can accept either an IP address or a domain name as the remote system address. In short, Telnet offers three main services:

- Network virtual terminal connection
- Option negotiation
- Symmetric connection

The Cisco Systems implementation of Telnet supports the following Telnet options:

- Remote echo
- Binary transmission
- Suppress go ahead
- Timing mark
- Terminal type
- Send location
- Terminal speed

- Remote flow control
- X display location

Configure Telnet and UNIX Rlogin

To configure support for Telnet or rlogin calls, perform the following tasks. Unless specified otherwise, all commands are entered in line configuration mode:

Step	Command	Purpose
1	telnet speed <i>default-speed maximum-speed</i>	Negotiate speeds on reverse Telnet lines.
2	telnet refuse-negotiations	Cause Telnet to refuse to negotiate full duplex, remote echo requests on incoming connections.
3	telnet transparent	Set line to send a RETURN (CR) as a CR followed by a NULL instead of a CR followed by a LINE FEED (LF).
4	telnet sync-on-break	Set line to send a Telnet Synchronize signal when it receives a Telnet Break signal.
5	telnet break-on-ip	Set the line to cause the system to generate a hardware Break signal on the RS-232 line that is associated with a reverse Telnet connection, when a Telnet Interrupt-Process command is received on that connection.
6	ip tcp chunk-size <i>number</i>	In global configuration mode, optimize the line by setting the number of characters output before the interrupt executes.
7	ip alias <i>ip-address tcp-port</i>	In interface configuration mode, assign an IP address to the service provided on a TCP port.
8	busy-message <i>hostname d message d</i>	In global configuration mode, define a message that the router displays whenever a Telnet or rlogin connection to the specified host fails.
9	login-string <i>hostname d message [%secp] [%secw] [%b] d</i>	In global configuration mode, define a message that the router displays whenever a Telnet or rlogin connection to the specified host succeeds.
10	notify	Set up a line to notify a user who has multiple, concurrent Telnet connections when output is pending on a connection other than the current one.
11	refuse-message <i>d message d</i>	Define a “line-in-use” message to indicate that the line is currently busy.

The **telnet speed** command sets the line speed to match line speeds on remote systems in reverse Telnet, host machines hooked to an access server or router to access the network, or a group of console lines hooked up to the access server or router when disparate line speeds are in use at the local and remote ends of the connection. Line speed negotiation adheres to the Remote Flow Control option, defined in RFC 1080.

When the **telnet refuse-negotiations** command is set, it suppresses negotiation of the Telnet Remote Echo and Suppress Go Ahead options.

The **telnet transparent** command is useful for coping with different interpretations of end-of-line handling in the Telnet protocol specification.

The **telnet sync-on-break** command sets the line to cause a reverse Telnet line to send a Telnet Synchronize signal when it receives a Telnet Break signal. The Telnet Synchronize signal clears the data path, but still interprets incoming commands.

Issue the **telnet break-on-ip** command to control the translation of Telnet Interrupt-Process commands into X.25 Break indications, and to work around the following situations:

- Several user Telnet programs send a Telnet Interrupt-Process command, but cannot send a Telnet Break signal.
- Some Telnet programs implement a Break signal that sends a Telnet Interrupt-Process command.
- Some RS-232 hardware devices use a hardware Break signal for various purposes.

When used with a correctly operating host, Cisco IOS software implements the Telnet Synchronize and Abort Output signals, which can stop output within one packet's worth of data from the time the user types the interrupt character. Issue the **ip tcp chunk-size** command to configure a faster response to user interrupt characters. Changing the number of characters output, or chunk size, affects neither the size of the packet used nor the TCP window size, either of which would cause serious efficiency problems for the remote host as well as for the access server or router. Instead, the Telnet status is checked after the number of characters specified, causing only a relatively minor performance loss.

Use the **ip alias** command to configure connections to an IP address to act identically to connections made to the server's primary IP address on the TCP port. A user trying to connect is connected to the first free line in a rotary group using the Telnet protocol.

With the **login-string** commands options, you can set a pause, prevent a user from issuing commands during a pause, send a Break character, and use a percent sign (%) in the login string. The **busy-message** command and **login-string** command are only useful with two-step protocol translation sessions. For more information about protocol translation, refer to the "Configuring Protocol Translation" chapter.

For actual sample configurations on how to configure Telnet and rlogin, see the section "Telnet and Rlogin Configuration Examples" later in this chapter.

Make Telnet and UNIX Rlogin Connections

Telnet and rlogin are protocols that enable TCP/IP connections to a host.

Telnet, a virtual terminal protocol that is part of the TCP/IP protocol suite, is the more widely used protocol.

The rlogin protocol is a remote login service developed for the BSD UNIX system. It provides better control and output suppression than Telnet, but can only be used when the host (typically, a UNIX system) supports rlogin. The Cisco IOS implementation of rlogin does not subscribe to the rlogin "trusted host" model. That is, a user cannot automatically log on to a UNIX system from the router, but must provide a user ID and a password for each connection.

To provide Telnet and rlogin connection capabilities, perform the following tasks in EXEC mode:

Step	Command	Purpose
1	connect <i>host</i> [<i>port</i>] [<i>keyword</i>] or telnet <i>host</i> [<i>port</i>] [<i>keyword</i>]	Log on to a host that supports Telnet.
2	show hosts	Display a list of available hosts.
3	show tcp	Display the status of all TCP connections.
4	Ctrl^	Log off the host by entering the default escape sequence. ¹

Step	Command	Purpose
5	Choose from the following list of escape sequences, according to your task: <ul style="list-style-type: none"> • Use Ctrl^ b if your task is to break • Use Ctrl^ c if your task is to interrupt a process (IP) • Use Ctrl^ h if your task is to erase a character (EC) • Use Ctrl^ o if your task is to abort an output display (AO) • Use Ctrl^ t if your task is to confirm you are at the host (AYT) • Use Ctrl^ u if your task is to erase a line (EL) 	Log off the host by entering a special escape sequence. ¹ These special Telnet sequences map generic terminal control functions to operating system-specific functions.
6	Ctrl-^ ?	List the available Telnet commands at any time during the active Telnet session. ¹
7	rlogin <i>host</i> [debug] [/user <i>username</i>]	Log on to a host that supports rlogin.
8	exit or logout	Exit a Telnet or rlogin session.

1. Press and hold the **Ctrl** and **Shift** keys while pressing the 6 key. You can enter the command character as you hold down **Ctrl** or with **Ctrl** released; you can enter the command characters as either uppercase or lowercase letters.

With the Cisco IOS implementation of TCP/IP, you are not required to enter the **connect** or **telnet** commands to establish a Telnet connection. You can just enter the learned host name—as long as the host name is different from a command word for the router. Telnet must be the default (you can make it the default with the **transport preferred** command. Use the **show hosts EXEC** command to display a list of the available hosts. Use the **show tcp EXEC** command to display the status of all TCP connections. The Cisco IOS software assigns a logical name to each connection, and several commands use these names to identify connections. The logical name is the same as the host name, unless that name is already in use, or you change the connection name with the **name-connection EXEC** command. If the name is already in use, the Cisco IOS software assigns a null name to the connection. For an example of making a Telnet connection, see the “Telnet and Rlogin Configuration Examples” section later in this chapter.

After the **rlogin** command is issued, you can have several concurrent rlogin connections open and switch between them. To open a new connection, exit the current connection by entering the escape sequence (**Ctrl-Shift-6** then **x** [**Ctrl^x**] by default) to return to the system command prompt, then open a new connection. For an example of making a rlogin connection or switching between connections, see the sections “rlogin Example” or “Switch between Telnet and rlogin Sessions Examples” later this chapter.

Note Cisco recommends that you use Encrypted Kerberized Telnet whenever you establish a Telnet session to a router or access server, which protects the device's integrity. For information about Encrypted Kerberized Telnet, refer to the "Configuring Network Access Security" chapter in the Cisco IOS Release 11.3 *Security Configuration Guide*.

Monitor TCP/IP Connections

To display the status of a TCP connection or view a summary of the TCP connection end points in the system, perform the following tasks in user EXEC mode:

Step	Command	Purpose
1	<code>show tcp [line-number]</code>	Display the status of a TCP connection.
2	<code>show tcp brief [all]</code>	Display a summary of the TCP connection end points in the system.

Telnet and Rlogin Configuration Examples

The following examples are provided:

- Telnet Connection Examples
- Rlogin Example
- Switch between Telnet and rlogin Sessions Examples
- List Supported Telnet Commands Example

Telnet Connection Examples

The following example routes packets from the source system host1 to kl.sri.com, then to 10.1.0.11, and finally back to host1:

```
router> connect host1 /route:kl.sri.com 10.1.0.11 host1
```

The following example connects to a host with logical name host1:

```
router> host1
```

Rlogin Example

The following example makes an rlogin connection to a host at address 108.33.21.2 and enables the message mode for debugging:

```
router> rlogin 108.33.21.2 debug
```

Switch between Telnet and rlogin Sessions Examples

You can switch between sessions by escaping one session and resuming a previously opened session. The following example shows how to escape out of a connection to the host host1 and to resume connection 2. You escape out of the current session and return to the EXEC prompt by entering the command sequence **Ctrl-Shift-6** then **x**. Resume the connection with the **resume** *[connection] [keyword]* command.

```
host1% ^^X
router> resume 2
```

You can omit the command name and simply enter the connection number to resume that connection. The following example illustrates how to resume connection 3:

```
router> 3
```

To list all the open sessions associated with the current terminal line, use the **where** command.

List Supported Telnet Commands Example

At any time during an active Telnet session, you can list the Telnet commands by pressing the escape sequence keys (by default **Ctrl-Shift-6**) followed by a question mark at the system prompt:

Ctrl-^ ?

A sample of this list follows:

```
router> ^^?
```

Note In screen output examples that show two caret (^) symbols together, the first caret represents the Control key and the second caret represents the keystroke sequence Shift-6. The double caret combination (^^) means hold down the **Control** key while you press the **Shift** and the **6** key.

```
[Special telnet escape help]
^^B  sends telnet BREAK
^^C  sends telnet IP
^^H  sends telnet EC
^^O  sends telnet AO
^^T  sends telnet AYT
^^U  sends telnet EL
```

Configure Support for Local Area Transport Calls

The Digital Equipment Corporation (Digital) Local Area Transport (LAT) protocol is the one used most often to connect to Digital hosts. LAT is a Digital-proprietary protocol. We provide LAT technology licensed from Digital. This section describes how to configure the LAT transmission protocol.

The following sections are provided:

- Cisco's Implementation of the LAT Protocol
- LAT Configuration Task List
- Make LAT Connections
- Monitor and Maintain LAT Connections
- LAT Configuration Examples
- LAT Connection Examples

Cisco's Implementation of the LAT Protocol

The LAT protocol allows a user to establish a LAT connection to a host at another site, then pass the keystrokes from one system to the other. A user can establish a LAT connection through a router to a LAT host simply by entering the host name. The Cisco IOS software supports the LAT 5.2 specification.

Unlike the Transmission Control Protocol/Internet Protocol (TCP/IP), LAT was designed to be used on LANs and it cannot be routed because it does not have a routing layer. However, a bridge or combined bridge and router, such as a Cisco router, can be used to carry LAT traffic across a WAN. Protocol translation can be used to carry LAT traffic over a WAN by first translating LAT to X.25 or Telnet, as shown in Figure 56.

Figure 56 Comparing LAT and TCP/IP Protocol Stacks

The following sections describe Cisco's implementation of LAT in more detail:

- LAT Functionality
- LAT Services
- LAT Groups
- LAT Sessions and Connection Support
- Connect a VMS Host Using LAT
- Port Names When Configuring a LAT Printer
- Additional LAT Capability

LAT Functionality

The LAT protocol is asymmetrical; it has master and slave functionality. First, the LAT master starts a LAT circuit by sending a circuit start message, and then a LAT slave responds with its own circuit start message. From 1 to 255 LAT sessions can then be multiplexed on a circuit.

In a typical setup, where the user's terminal is connected to a router, the router acts as the master, and the target VMS host acts as the slave.

For example, the following command results in the device *router1* acting as the master (or server) and the target VMS host, *wheel*, acting as the slave (or host).

```
router1> lat wheel
```

A router can also act as a slave. This happens if the user connects from one access server to another. For example, the following command results in *router1* acting as the master (server) and *router2* acting as the slave (host).

```
router1> lat router2
```

In a LAT host-initiated connection, the VMS system always acts as the LAT slave. For example, a print job originating from a VMS system initiates or triggers the router to which the printer is connected to act as the LAT master. In short, the master-slave relationship also applies to host-initiated sessions from a LAT slave.

LAT Services

Resources such as modems, computers, and application software are viewed in a LAT network as *services* that, potentially, any user in the network can use. A LAT node can offer one or more such LAT services, and more than one LAT node can offer the same LAT service.

A LAT node that offers one or more services, collectively called *advertised services*, broadcasts its services in the form of Ethernet multicast messages, called *LAT service announcements*. Conversely, a LAT node can listen for LAT service announcements on the network. These messages are cached in a dynamic table of known LAT services, collectively called *learned services*.

The Cisco IOS software supports both learned and advertised LAT services; therefore, it also supports incoming and outgoing LAT sessions. The services rating of its advertised nodes are determined dynamically but can also be set statically.

To establish outgoing connections to a LAT service, the Cisco IOS software searches for the service in the learned services cache. If one or more nodes is offering the same service, the node with the highest rating is chosen. For example, a LAT connection to a service offered by a VAX cluster connects to the node in that cluster with the smallest load and thus the highest service rating. This is how load balancing works in relation to a group of nodes offering the same service.

To establish an incoming connection, a LAT session connects from another LAT node to the service advertised by the local LAT node.

LAT Groups

Because potentially any user can access any of the services on a LAT network, a LAT server manager uses the concept of *group codes* to allow or restrict access to the services.

When both the router and the LAT host share a common group code, a connection can be established between the two. If the default group codes have not been changed on either side, a user on any router can connect to any learned service on the network.

However, if you define groups for access servers or routers and LAT hosts, you can partition these services into logical subnetworks. You can organize the groups so that users on one device view one set of services, and users on another device (or another line on the same device) view a different set. You might also design a plan that correlates group numbers with organizational groups, such as departments. The section “LAT Configuration Task List” in this chapter describes how to enter group code lists in your configuration file.

A LAT host node’s services cannot be accessed individually; access is granted, per node, on an all-or-none basis.

LAT Sessions and Connection Support

A LAT session is a two-way logical connection between a LAT service and the router. All this is transparent to the user at a console connected to a LAT session; to the user it appears that connection has been made directly to the desired device or application program. There is no inherent upper limit to the number of LAT sessions you can create from an asynchronous terminal to the router.

When a host print job connects to a router, this is called a *host-initiated connection*. The Cisco IOS software maintains a queue of hosts requesting connection by sending periodic status messages to the requesting host.

You can establish host-initiated connections by specifying a port number or by defining a service. These same services are used for connections from other access servers or routers.

Note If a connection request is received that specifies a service and a destination port number, the port number is used to determine the line number for connection purposes. This allows a user to connect to a specified port simply by specifying any service on the server and a port number. (Earlier versions of the Cisco IOS software ignored the service name on inbound connections.)

Connect a VMS Host Using LAT

The process of connecting to a VMS host is slightly different if you are connecting to a VMS host running VMS Version 5.4 or earlier than when connecting to a VMS host running VMS Version 5.5 or later software.

VMS Version 5.4 or Earlier System

If a host-initiated connection is received that specifies a destination port number that corresponds to a virtual port on the router, a virtual EXEC process will be created for the user to log in with. This process can be used, in conjunction with the Digital **set host/dte** command on VMS, to connect to a router named `router1` from a VMS host node, as shown in the following example:

```
$lcp ::= $latcp
$lcp create port lta300:
$lcp set port lta300:/service=able /node=router1
$set host/dte lta300:
```

VMS Version 5.5 or Later System

To connect to a VMS host running VMS Version 5.5 or later, you must turn on the VMS LAT hosts's outgoing connections and use the Digital **set host/lat** command, as shown in the following example:

```
$lcp ::= $latcp
$lcp set node/connection =outgoing
$set host/lat able
```

Port Names When Configuring a LAT Printer

When you configure a LAT printer, the LAT port name is the line number without the "TTY." For example, if you configure terminal line 10, named ABLE, to be a LAT printer port, you must use the OpenVMS command to associate an arbitrary LAT device to a LAT port name as follows:

```
$lcp ::= $lcp
$lcp create port lta300:
$lcp set port/node=ABLE/port=10 lta300:
```

The LAT port name is the line number without the "TTY," regardless of whether the format of the TTY line number is decimal or octal.

Additional LAT Capability

The Cisco IOS software fully supports the LAT protocol suite, and provides the following features:

- High-speed buffering—Handles a full screen of data (2000 characters) at full speed without requiring additional flow control.
- Protocol transparency—Handles connections transparently. The user needs no protocol information to establish a connection.
- Simplified configuration management—Uses logical names for LAT group codes to simplify the network structure.
- Maintenance Operation Protocol (MOP)—Supports Digital's protocol to support the request ID message, periodic system ID messages, and the remote console carrier functions for Ethernet interfaces.

LAT Configuration Task List

The Cisco IOS software LAT protocol is supplied with a default configuration and does not require additional configuration for you to use it. The software does provide commands for customizing the LAT software for your environment, if desired.

Perform the tasks in the following sections to enable LAT and customize LAT for your particular network environment:

- Configure Basic LAT Services
- Enable Inbound Services
- Control Service Announcements and Service Solicitation
- Configure Traffic Timers
- Optimize Performance
- Define Access Lists
- Enable Remote LAT Modification

Configure Basic LAT Services

To enable basic LAT services, perform the following tasks in global configuration mode:

Step	Command	Purpose
1	lat enabled	In interface configuration mode, enable the LAT protocol. LAT is disabled by default.
2	lat node <i>node-name</i>	Give the router a LAT node name that is different than the host name.
3	lat out-group { <i>groupname</i> <i>number</i> <i>range</i> all }	(Optional) In line configuration mode, define the group list for an outgoing connection on a specified line.
4	lat group-list <i>groupname</i> { <i>number</i> <i>range</i> all } [enabled disabled]	(Optional) Specify logical names for group lists.
5	lat service-group { <i>groupname</i> <i>number</i> <i>range</i> all } [enabled disabled]	(Optional) Specify groups to be advertised.
6	lat remote-modification	(Optional) In line configuration mode, enable remote LAT modification of line characteristics.

Use the **lat out-group** command to define the list of services to which a user can connect. Do this by defining the group code lists used for connections from specific lines. You can limit the connection choices for an individual line by defining the group code lists for an outgoing connection. When a user initiates a connection with a LAT host, the user's line must share a common group number with the remote LAT host before a connection can be made.

Use the **lat group-list** command to specify a name for group lists to simplify the task of entering individual group codes. A name makes it easier to refer to a long list of group code numbers. To display the defined groups, use the **show lat groups** command.

Use the **lat service-group** command to specify a group code mask to use when advertising all services for a node. You can enter more than one group code by listing the numbers. You can also enter both a group code name and group codes.

Use the **lat remote-modification** line configuration command to configure a LAT line so that a remote LAT node can change the operating characteristics of the line.

Enable Inbound Services

Just as LAT services are offered by host computers, they also can be offered by access servers and routers, as they implement both the host and server portions of the LAT protocol. This allows connections from either hosts or local access servers or routers. When a host connects to a local device, this is called a *host-initiated connection*.

The tasks described in this section define support for host-initiated connections. This support includes refining the list of services that the router will support. An incoming session can be to either a port or a service. The port name is the terminal line number, as reported by the EXEC command **show users all**. Perform any of the following optional tasks in global configuration mode:

Step	Command	Purpose
1	lat service <i>service-name</i> password <i>password</i>	Set the LAT password for a service.
2	lat service <i>service-name</i> ident <i>identification</i>	Set the LAT service ID for a specific service.
3	lat service <i>service-name</i> rating <i>static-rating</i>	Specify a static service rating for a specific service.
4	lat service <i>service-name</i> rotary <i>group</i>	Configure a LAT rotary group.

Step	Command	Purpose
5	lat service <i>service-name</i> autocommand <i>command</i>	Associate a command with a specific service for auto-execution.
6	lat service <i>service-name</i> enabled	Enable inbound connections to a specific service.

Use the **show lat advertised EXEC** command to display LAT services offered to other systems on the network.

A service must be specifically enabled, but not all of the attributes in the previous task table are necessary in a particular environment.

Control Service Announcements and Service Solicitation

You can configure the Cisco IOS software to support the service responder feature that is part of the LAT Version 5.2 specification.

Specifically, the DECserver90L+, which has less memory than other DEC servers, does not maintain a cache of learned services. Instead, the DECserver90L+ solicits information about services as they are needed.

LAT Version 5.2 nodes can respond for themselves, but LAT Version 5.1 nodes, for example VMS Version 5.4 or earlier nodes, cannot. Instead, a LAT Version 5.2 node configured as a service responder can respond in proxy for those LAT Version 5.1 nodes.

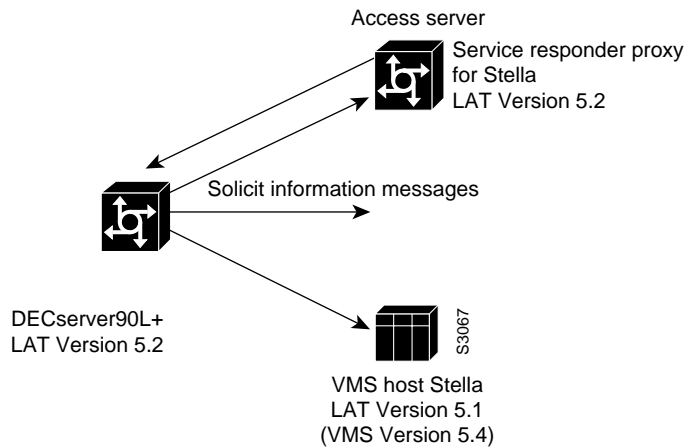
The Cisco IOS software can be configured as a LAT service responder. Of course, if all your nodes are LAT Version 5.2 nodes, you do not need to enable the service responder features.

To control service announcements and service solicitations, perform the following tasks in global configuration mode:

Step	Command	Purpose
1	lat service-responder	Enable a proxy node to respond to solicit-information multicast messages.
2	no lat service-announcements	Disable periodic broadcasts of service advertisements.
3	lat service-timer <i>interval</i>	Adjust the time between service announcements.

Use the **lat service-responder** command to configure the Cisco IOS software to respond to solicit information requests addressed to LAT Version 5.1 nodes. This function allows nodes that do not cache service advertisements to interoperate with nodes that do not respond to solicit requests. Figure 57 shows how a router can act as a proxy for LAT servers.

Figure 57 Router as Proxy for LAT Server



The DECSERVER90L+ broadcasts a solicit information request in search of service “Stella’s” address. The VMS host, Stella, is unable to respond to the request because it is running LAT Version 5.1. The access server is running LAT Version 5.2 with service responder enabled and informs the DECSERVER90L+ of Stella’s address.

Use the **no lat service-announcements** command to disable periodic broadcasts of service announcements. If service announcements are enabled, the LAT node will periodically broadcast service advertisements. If service announcements are disabled, the LAT node will not send service announcements, so a remote node requiring connection to the local node has to use solicit-information messages to look up node information. Only disable service announcements if all of the nodes on the LAN support the service responder feature.

Use the **lat service-timer** command to adjust the time between LAT service advertisements for services offered. This is useful in large networks with many LAT services and limited bandwidth.

Configure Traffic Timers

You can customize the environment for transmitting LAT messages. The Cisco IOS implementation of LAT allows you to set the following features:

- The number of retransmissions before declaring a system unreachable
- The interval of time LAT waits before sending a keepalive message on an idle connection
- The interval of time LAT waits between transmission of messages

These features affect all LAT connection types. Perform the following task in global configuration mode:

Step	Command	Purpose
1	lat retransmit-limit <i>number</i>	Set the message retransmit limit.
2	lat ka-timer <i>seconds</i>	Set the keepalive timer.
3	lat vc-timer <i>milliseconds</i>	Set the virtual-circuit timer.

Optimize Performance

To optimize performance for your LAT environment, perform one or more of the following optional tasks beginning in global configuration mode:

Step	Command	Purpose
1	lat vc-sessions <i>number</i>	Set the maximum number of sessions on a LAT virtual circuit. The maximum, (and default) number of sessions is 255.
2	lat host-buffers <i>receive-buffers</i>	Allow a LAT host node to receive more than one message at a time.
3	lat server-buffers <i>receive-buffers</i>	Allow a LAT server node to receive more than one message at a time.
4	lat host-delay <i>number</i>	Specify the delay acknowledgment for incoming LAT slave connections, where <i>number</i> is milliseconds.

Use the **lat host-buffers** command to set the number of messages received by a host at one time. Increasing this number can enhance performance. Before LAT Version 5.2, LAT allowed only one outstanding message at one time on a virtual circuit. This restriction could limit the performance of the Cisco IOS software processing a large number of messages because only one Ethernet packet of data could be in transit at a time. During virtual circuit startup, each side communicates to the other how many outstanding messages it is willing to accept.

Use the **lat server-buffers** command to set the number of messages received by a server at one time. Increasing this number can enhance performance. Before LAT Version 5.2, LAT allowed only one outstanding message on a virtual circuit at a time. This restriction limited the performance of Cisco IOS software when it processed a large number of messages, because only one Ethernet packet of data could be in transit at a time. With LAT Version 5.2, nodes can indicate that they are willing to receive more than one message at a time. During virtual circuit startup, each side communicates to the other how many outstanding messages it is willing to accept.

Use the **lat host-delay** command to set a user-defined delay for the acknowledgment for incoming LAT slave connections. This is useful in situations where you need to control the delay. For example, if data is being transferred between a Digital server (using LAT) and a UNIX host (using Telnet) via a protocol translator, the protocol translator imposes the LAT delay on the Telnet as well as the LAT service, where Telnet may timeout due to the LAT restriction.

Define Access Lists

Because LAT groups were not intended to implement security or access control, the Cisco IOS software supports *access lists* to provide these functions. An access list is a sequential collection of permit and deny conditions that serve to restrict access to or from LAT nodes on a specific terminal line. Each access list statement defines a permit or deny condition and a matching criterion for the node name.

When a LAT connection is attempted (either incoming or outgoing), the node name of the destination service (*not* the service name) is compared against the regular expression. If they match, the connection is permitted or denied as specified.

Perform the following tasks to define access lists and conditions:

Step	Command	Purpose
1	configure terminal	Enter global configuration mode.
2	lat access-list <i>number</i> { permit deny } <i>nodename</i>	Specify an access condition.
3	line <i>line-number</i>	Enter line configuration mode.

Step	Command	Purpose
4	access-class <i>access-list-number</i> { in out }	Restrict incoming and outgoing connections between a particular terminal line or group of lines and the node names in an access list.

Enable Remote LAT Modification

You can configure a LAT line so that a remote LAT node can change the operating characteristics of the line. To enable remote LAT modification, perform the following task in line configuration mode:

Command	Purpose
lat remote-modification	Enable remote LAT modification of line characteristics.

Make LAT Connections

The Digital Equipment Corporation (Digital) LAT protocol is most often used to connect routers to Digital hosts. LAT is a Digital-proprietary protocol, and the Cisco IOS software uses LAT technology licensed from Digital to allow the following LAT services:

- Make a LAT connection.
- Define a group code list for outgoing LAT connections.
- Switch between LAT sessions.
- Use digital commands on the server.
- Exit a LAT session.

For actual LAT connection examples, see the “LAT Connection Examples” section later in this chapter.

To enable specific LAT connections or services, perform one or more of the following tasks in EXEC mode:

Step	Command	Purpose
1	lat name [node <i>nodename</i> port <i>portname</i> /debug]	Connect to a LAT host. ¹
2	terminal lat out-group { <i>groupname</i> <i>number</i> <i>range</i> }	(Optional) Define a temporary list of services to which you or another user can connect by defining the group code lists used for connections from specific lines.
3	show lat services	(Optional) List available LAT services.
4	help	(Optional) List the subset of Digital commands that the Cisco IOS software supports.
5	exit	(Optional) Exit a LAT session by logging off the remote system. Then, terminate the active LAT session.

1. You can quit the connection by pressing **Ctrl-C** or complete the connection by entering the password for a given service.

You can also set your preferred connection protocol to any available connection protocol supported in the Cisco IOS software. Your preferred connection protocol is also referred to in the Cisco IOS software as a “preferred transport type.” If your preferred connection protocol is set to **lat**, you can

use the **connect** command in place of the **lat** command. To configure a preferred connection protocol, use the **transport preferred** command. When your preferred connection protocol is set to **none** or to another protocol, you must use the **lat** command to connect to a LAT host.

To specify a temporary list of services to which you or another user can connect, you must define the group code lists used for connections from specific lines. You limit the connection choices for an individual line by defining the group code lists for an outgoing connection. To define a group code list, use the **terminal lat out-group** command. When a user initiates a connection with a LAT host, the user's line must share a common group number with the remote LAT host before a connection can be made. The group code range *must be* a subset of the line's configured group code range.

You can have several concurrent LAT sessions open and switch between them. To open a subsequent session, first enter the escape sequence (**Ctrl-Shift-6** then **x** [**Ctrl^x**] by default) to suspend the current session. Then open a new session. To list the available LAT services, issue the **show lat services EXEC** command.

Monitor and Maintain LAT Connections

To monitor and maintain LAT connections, perform one or more of the following tasks in EXEC mode:

Step	Command	Purpose
1	clear entry <i>number</i>	Delete an entry from the queue.
2	show entry	Display queued host-initiated connections.
3	show lat advertised	Display LAT services offered to other LAT systems.
4	show lat groups	Display defined LAT groups.
5	show lat nodes	Display information about LAT nodes.
6	show lat services	Display information about LAT learned services.
7	show lat sessions [<i>line-number</i>]	Display active LAT sessions.
8	show lat traffic	Display traffic and resource utilization statistics.
9	show node [all <i>node-name</i>] [counters status summary]	Display information about LAT nodes. Information is displayed in the same way as in the Digital interface.
10	show service [<i>service-name</i>]	Display LAT learned services.

LAT Configuration Examples

This section contains the following LAT examples:

- Establishing Basic LAT Service Example
- Establishing a LAT Service with Selected Group Codes Example
- Displaying the LAT Services on the Same LAN Example
- Establishing an Outbound LAT Session Example
- Logically Partitioning LAT Services by the Terminal Line Example
- Configuring LAT Rotary Groups Example
- LAT Access List Example
- Associating a Rotary Group with a Service Example
- LAT Connection Examples

Establishing Basic LAT Service Example

The following example establishes the LAT service *ABLE* for your router. Subsequently, your router advertises *ABLE* (with default group code 0) on the LAN. Other LAT nodes can connect to you using LAT service *ABLE*, provided the group codes on the LAT nodes and the group codes for *ABLE* intersect. By default, most LAT nodes, such as OpenVMS Version 5.5 hosts, have user group code set to 0, so you have default access to *ABLE*.

```
! Create LAT service with password protection and
! identification string using the following global configuration commands
lat service ABLE password secret
lat service ABLE ident Welcome to my machine
```

Establishing a LAT Service with Selected Group Codes Example

The following example establishes the LAT service *ABLE* from your router with selected group codes 1, 4 through 7, and 167. This limits inbound access to those LAT nodes that have group codes that intersect with those for LAT service *ABLE*.

```
! Establish a LAT group list
lat group-list HUBS 1 4-7 167
!
! Enable LAT group list for the service-group
lat service-group HUBS enabled
!
! Create LAT service with password protection and
! identification string
lat service ABLE password secret
lat service ABLE ident Welcome to my machine
```

Displaying the LAT Services on the Same LAN Example

The following example demonstrates how you can check which LAT services are on the same LAN as your router. Note that your router's own LAT service *ABLE* is also listed, with the "Interface" column listing the interface as "Local."

```
able> show lat services
```

Service Name	Rating	Interface	Node (Address)
CAD	16	Ethernet0	WANDER
ABLE	16	Local	
CERTIFY	33	Ethernet0	STELLA

Establishing an Outbound LAT Session Example

The following example establishes a LAT session to remote LAT service *HELLO* using an interactive session:

```
able> lat HELLO
```

Logically Partitioning LAT Services by the Terminal Line Example

The following example illustrates how LAT services are logically partitioned by terminal line. At the example site, lines 1 through 7 go to the shop floor, lines 8 through 11 go to the Quality Assurance department, and lines 12 through 16 go to a common area.

```
! Define LAT groupnames
lat group-list DEFAULT 0
lat group-list FLOOR 3
lat group-list QA 4
```

```
line 1 7
  lat out-group FLOOR enabled
  lat out-group DEFAULT disabled
line 8 11
  lat out-group QA enabled
  lat out-group DEFAULT disabled
line 12 16
  lat out-group DEFAULT QA FLOOR enabled
```

Configuring LAT Rotary Groups Example

The following example illustrates how to configure a range of lines for rotary connections, then establishes the LAT service named Modems for rotary connection:

```
! Establish rotary groups
line 3 7
  rotary 1
!
! Establish modem rotary service
!
  lat service Modems rotary 1
  lat service Modems enabled
```

LAT Access List Example

The following example illustrates incoming permit conditions for all IP hosts and LAT nodes with specific characters in their names and a deny condition for X.25 connections to a printer. Outgoing connections, however, are less restricted.

```
! Permit all IP hosts, LAT nodes beginning with "VMS" and no X.25
! connections to the printer on line 5
!
access-list 1 permit 0.0.0.0 255.255.255.255
lat access-list 1 permit ^VMS.*
x29 access-list 1 deny .*
!
line 5
  access-class 1 in
!
! Meanwhile, permit outgoing connections to various places on all the
! other lines.
!
! Permit IP access within cisco
access-list 2 permit 172.30.0.0 0.0.255.255
!
! Permit LAT access to the Stella/blue complexes.
lat access-list 2 permit ^STELLA$
lat access-list 2 permit ^BLUE$
!
! Permit X25 connections to infonet hosts only.
x29 access-list 2 permit ^31370
!
line 0 99
  access-class 2 out
```

The following example illustrates how to define access lists that permit all connections, thereby conforming to software behavior prior to Software Release 9.0. Keep in mind that the value supplied for the *list* argument in both variations of the **access-class** commands is used for *all* protocols

supported by the Cisco IOS software. If you are already using an IP access list, it will be necessary to define LAT (and possibly X.25) access lists permitting connections to everything, to emulate the behavior of earlier software versions.

```
access-list 1 permit 172.30.0.0 0.0.255.255
access-list 1 permit 172.30.0.0 0.0.255.255
!
line 1 40
  access-class 1 out
! define LAT access list that permits all connections
lat access-list 1 permit .*
```

Associating a Rotary Group with a Service Example

The following example defines a service that communicates with a specific line and defines a rotary with only that line specified. Establish rotary groups using line configuration commands and the **rotary** line configuration command.

```
hostname ciscots
! Service name for the access server as a whole
lat service ciscopt enable
! Set up some lines with unique service names
line 1
  rotary 1
  lat service ciscopt1 rotary 1
  lat service ciscopt1 enable
!
line 2
  rotary 2
  lat service ciscopt2 rotary 2
  lat service ciscopt2 enable
```

LAT Connection Examples

The following example establishes a LAT connection from the router named router to host eng2:

```
router> lat eng2
Trying ENG2...Open
      ENG2 - VAX/VMS V5.2
Username: JSmith
Password: <password>
      Welcome to VAX/VMS version V5.2 on node ENG2
      Last interactive login on Friday, 1-APR-1994 19:46
```

The system informs you of its progress by displaying the messages “Trying <system>...” and then “Open.” If the connection attempt is not successful, you receive a failure message.

The following example establishes a LAT connection from the router named router to our-modems and specifies port 24, which is a special modem:

```
router> lat our-modems port 24
```

The following example establishes a LAT connection from the router named router to our-modems and specifies a node named eng:

```
router> lat our-modems node eng
```

The following example uses the LAT session debugging capability:

```
router> lat Eng2 /debug
Trying ENG2...Open
      ENG2 - VAX/VMS V5.2
```

```
Username: JSmith
Password: <password>
Welcome to VAX/VMS version V5.2 on node ENG2
Last interactive login on Tuesday, 5-APR-1994 19:02
[Set Flow out off, Flow in on, Format 8:none, Speed 9600/9600]
[Set Flow out off, Flow in on, Format 8:none, Speed 9600/9600]
$ set ter/speed=2400
[Set Flow out off, Flow in on, Format 8:none, Speed 2400/2400]
```

A variety of LAT events are reported, including all requests by the remote system to set local line parameters. The messages within brackets ([]) are the messages produced by the remote system setting the line characteristics as the operating system defaults.

The following example defines a group code list for the outgoing group 4 LAT connection:

```
router> terminal lat out-group 4, 6-189
```

Configure Support for TN3270 Calls

IBM 3270 display terminals are among the computing community's most widely implemented and emulated terminals for host-based computing. Information in this section describes the TN3270 terminal emulation environment and how to use and create files that allow terminals connected to the access server or router to be used for TN3270 operation.

This section does not describe how to configure a TN3270 server. For information about configuring TN3270 server support in the Cisco IOS software, refer to the *Bridging and IBM Networking Configuration Guide*.

The following sections are provided:

- Cisco's Implementation of TN3270
- Configure TN3270
- Map TN3270 Characters
- Make TN3270 Connections
- TN3270 Configuration Examples

Cisco's Implementation of TN3270

TN3270 terminal emulation software allows any terminal to be used as an IBM 3270-type terminal. Users with non-3270 terminals can take advantage of the emulation capabilities to perform the functions of an IBM 3270-type terminal. The Cisco IOS software supports emulation of the following terminal types:

- IBM 3278-2 terminal with an 80-by-24 display
- IBM 3278-2 terminal with a 24-by-80 display
- IBM 3278-3 terminal with a 32-by-80 display
- IBM 3278-4 terminal with a 48-by-80 display
- IBM 3278-5 terminal with a 27-by-132 display

True IBM 3270-type terminals use a character format referred to as extended binary-coded decimal interchange code (EBCDIC). EBCDIC consists of 8-bit coded characters and was originally developed by IBM. Emulation is made possible by the *termcap* protocol. Termcap functions translate the keyboard and terminal characteristics for ASCII-type terminals into those required for an IBM host.

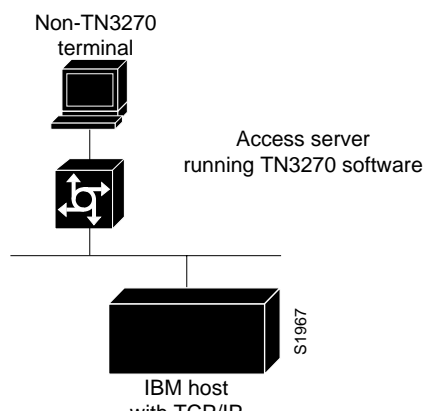
Formally, a termcap is a two-part terminal-handling mechanism. It consists of a database and a subroutine library. The database describes the capabilities of each supported terminal, and the subroutine library allows programs to query the database and to make use of the values it contains. For more information about defining termcaps, refer to the document *termcap & terminfo*, by Jim Strang, Tim O'Reilly, and Linda Mui.

The Cisco IOS software includes a default termcap entry for Digital VT100 terminal emulation. More samples are available directly from Cisco at <http://www.cisco.com/warp/public/494/1.html>. This URL is subject to change without notice.

TN3270 emulation capability allows users to access an IBM host without using a special IBM server or a UNIX host acting as a server (see Figure 58). The IBM host must directly support TCP/IP or have a front-end processor that supports TCP/IP.

A two-step translation method connects IBM hosts from LAT, TCP, and X.25/PAD environments. Refer to the chapter "Configuring Protocol Translation and Virtual Asynchronous Devices" later in this publication for more information about two-step translations. In general, TN3270 support allows outgoing TN3270 connections only. In other words, LAT, TCP, and X.25/PAD users must first establish a connection with the access server or router, then use the TN3270 facility from the Cisco IOS software to make a connection to the IBM host.

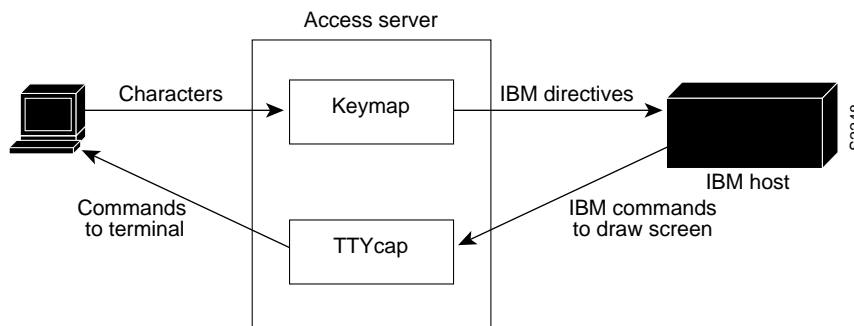
Figure 58 Typical 3270 Connection Environment



Keymaps and TTYcaps

Figure 59 shows how the keymapping and TTYcap functionality in the Cisco IOS software helps IBM hosts and non-IBM terminals to communicate.

Figure 59 Keymaps and TTYcaps



Keymaps and TTYcaps have the following functionality:

- **Keymapping**—Terminals send a key sequence for every key used to send packets to an IBM host. The keymapping function in the Cisco IOS software identifies special sequences and converts them to directives to the IBM host. A minimal level of keymapping is supported by default. Several keys can convert to the same IBM directives.
- **TTYcap**—IBM sends commands to the terminal, including cursor position, clear screen, and so forth. The TTYcap functionality in the Cisco IOS software changes IBM directives into the terminal language. By default, protocol translation on access servers and routers conforms to the ANSI terminal standard, which is VTxxx terminal compatible.

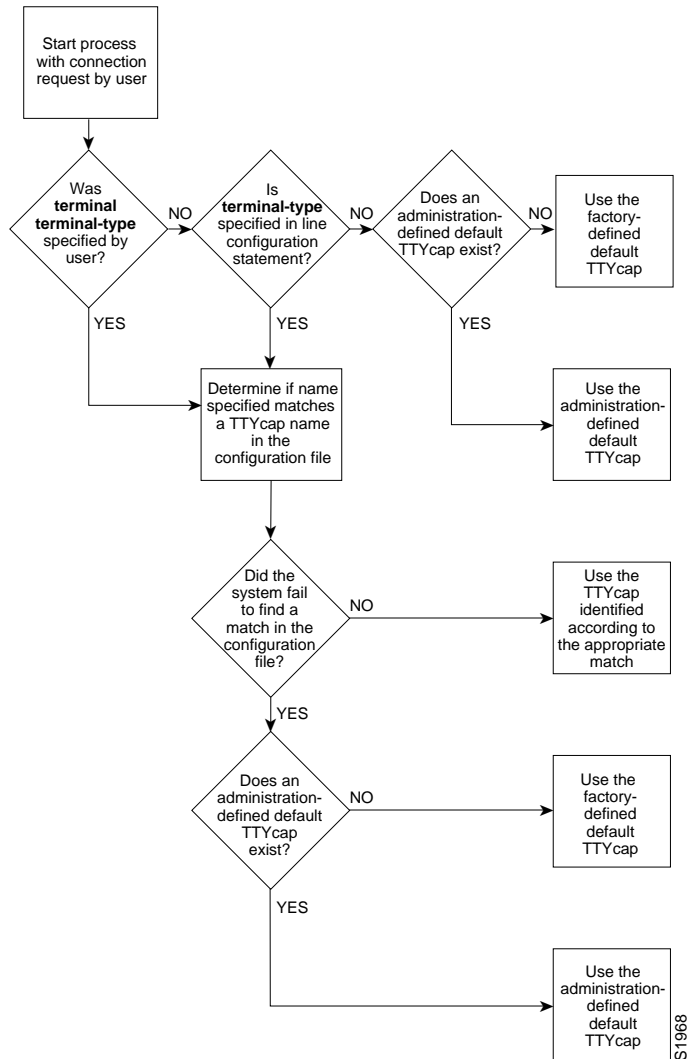
Startup Sequence Priorities

At system startup, the Cisco IOS software uses the following decision sequence when selecting a terminal emulation file, also called a *TTYcap*:

- 1 Use a user-supplied terminal emulation filename.
- 2 Use a terminal emulation filename specified using line configuration commands.
- 3 Use a default terminal emulation filename supplied by the administrator.
- 4 Use the default VT100 emulation.

Figure 60 illustrates the decision process used by the Cisco IOS software to choose a TTYcap for a specific TN3270 session.

Figure 60 Decision Diagram for Cisco IOS Software TTYcap Selection Process



At system startup, the Cisco IOS software uses the following decision sequence when selecting a keyboard map file, also called a *keymap*:

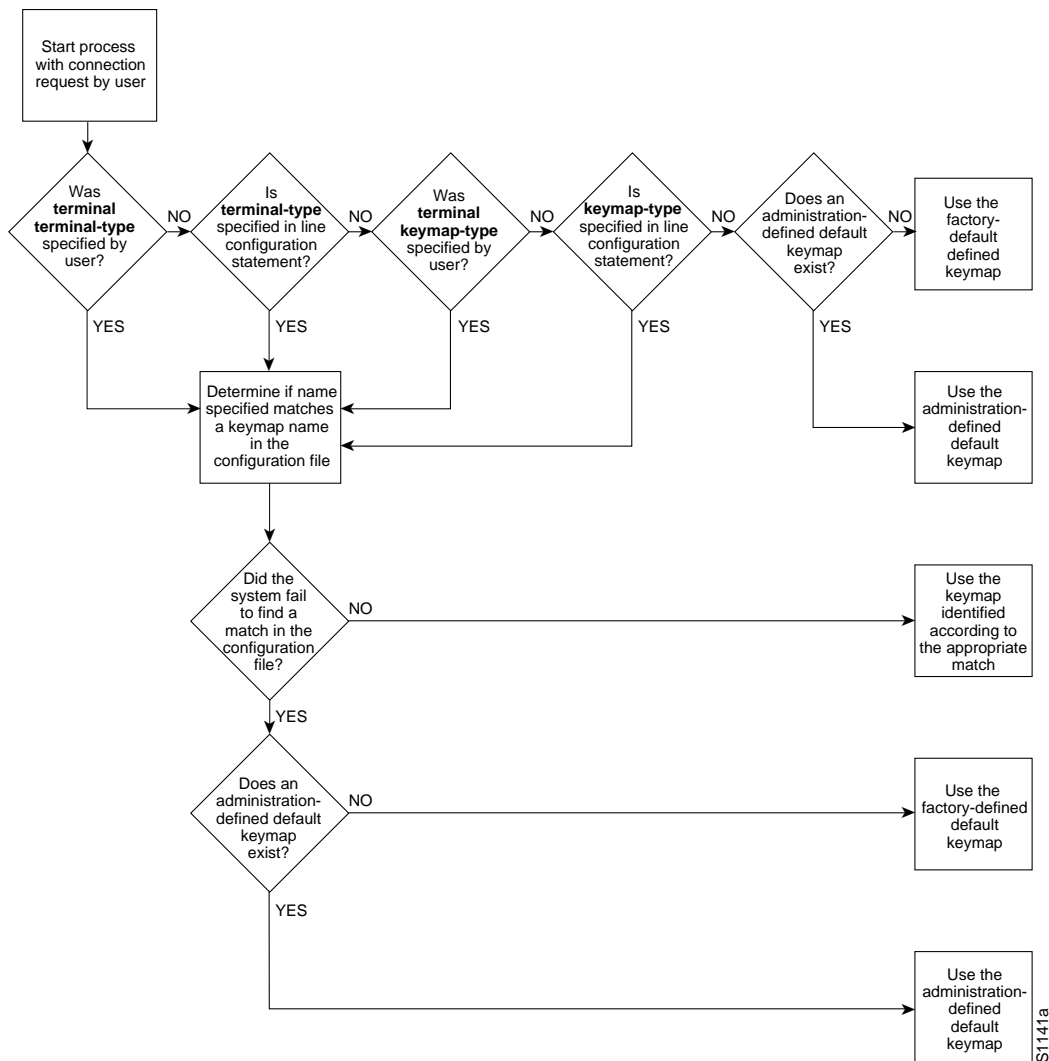
- 1 Use a user-supplied keyboard map filename.
- 2 Use a keyboard map filename specified using line configuration commands.
- 3 Use a user-supplied terminal emulation filename.
- 4 Use a terminal emulation filename specified using line configuration commands.
- 5 Use the default keyboard map filename supplied by the administrator.
- 6 Use the default VT100 emulation.

The software uses the following criteria to determine the file to use:

- If a filename is specified by the user but fails to match any name in the configuration file, the access server or router adopts the default specified by the administrator. If one has not been specifically defined, the factory-default emulation file is adopted.
- If a filename is specified for line configuration that does not match any name in the configuration file, the access server or router adopts the default specified by the administrator. If one has not been specifically defined, the factory-default VT100 emulation file is used.

Figure 61 illustrates the decision process used by the Cisco IOS software to choose a keymap for a specific TN3270 session. When one of the first four priority checks fails (that is, the name specified does not match any name in the configuration file), the same rules listed for the terminal emulation file apply.

Figure 61 Cisco IOS software Keymap Selection Process



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Use the Default Terminal Emulation File to Connect

By default, an ASCII terminal and keyboard connected to the Cisco device emulate a Digital VT100 terminal type.

To connect to an IBM host, enter the **tn3270** command from EXEC mode. This command will make the connection using the terminal emulation file selected using the startup sequence priorities outlined in the section “Startup Sequence Priorities” earlier in this section.

Refer to the “Configure TN3270” section later in this document for more information about making connections.

Copy a Sample Terminal Emulation File

If the default file does not work for your terminal and keyboard type or the host that you connect to, you might be able to find a file that will work from the growing list of sample terminal emulation files created by Cisco engineers and customers. You can obtain the TN3270 examples from Cisco Systems Cisco Connection Online (CCO). Numerous emulation files are listed in here, which allow various terminal types to emulate an IBM 3270-type terminal.

Step 1 Obtain a sample configuration file from the following URL. The TN3270 Keymap Examples document appears. Note that this URL is subject to change without notice.

<http://www.cisco.com/warp/public/494/1.html>

```
TN3270 Keymap Examples
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! TN3270 examples file
! For use with the TN3270 on the cisco terminal server
! If you have requests for additions, contact tac@cisco.com
! If you have contributions, send them to remaker@cisco.com
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Example of a ttycap for a televideo 925
! Taken from standard TTYCAP from BSD Unix
!
ttycap televideo \
v8|vi|tvi925|925|televideo model 925:\
      :hs:am:bs:co#80:li#24:cm=\E=%+ %+ :cl=\E*:cd=\Ey:ce=\Et:\

:al=\EE:dl=\ER:im=:ei=:ic=\EQ:dc=\EW:mr=\EG4:mk=\EG1:md=\EG4:me=\EG0:\
:ho=^^:nd=^L:bt=\EI:pt:so=\EG4:se=\EG0:sg#1:us=\EG8:ue=\EG0:ug#1:\
:up=^K:do=^V:kb=^H:ku=^K:kd=^V:kl=^H:kr=^L:kh=^^:ma=^V^J^L :\  
:k1=^A@\r:k2=^AA\r:k3=^AB\r:k4=^AC\r:k5=^AD\r:k6=^AE\r:k7=^AF\r:\
:k8=^AG\r:k9=^AH\r:k0=^AI\r:ko=ic,dc,al,d1,c1,ce,cd,bt:\
:ts=\Ef:fs=\Eg:ds=\Eh:sr=\Ej:xn:ti=\EG0:to=\EG0:\
:is=\E1\E" ^M\E3 ^M      \E1      \E1      \E1      \E1      \E1
\E1      \E1      \E1      \E1      \E1 ^M
!
! Example of a keymap for a 925
! Borrowed from MAP3270 of the BSD TN3270
!
...
```

Step 2 Use a text editor or word processing application to copy the sample terminal emulation file into the configuration file.

Step 3 Load the configuration file onto the host or network. (Refer to the chapter "Loading System Images and Configuration Files" earlier in the Configuration Fundamentals Configuration Guide for information on loading configuration files.)

These steps add new terminal emulation capability to the configuration file. Each time the system is started up, or booted, the settings in the file will be used as the default for terminal emulation.

Configure TN3270

To connect to an IBM host and configure TN3270, perform the following tasks. Unless specified otherwise, all configuration is performed in global configuration mode.

Step	Command	Purpose
1	ttycap <i>ttycap-name termcap-entry</i>	Create a custom terminal emulation file, or TTYcap.
2	keymap <i>keymap-name keymap-entry</i>	Create a custom keyboard emulation file, or keymap.
3	terminal-type <i>terminal-name</i>	In line configuration mode, specify the type of terminal connected to the line.
4	keymap-type <i>keymap-name</i>	In line configuration mode, specify the keyboard map for a terminal connected to the line.
5	show ttycap [<i>ttycap-name</i> all]	(Optional) In EXEC mode, display a list of the available TTYcap files.
6	show keymap [<i>keymap-name</i> all]	(Optional) In EXEC mode, display a list of the available keymap files.
7	tn3270 datastream [extended normal]	(Optional) Enable TN3270 extended features.
8	tn3270 null-processing [3270 7171]	(Optional) Enable null processing.
9	tn3270 reset-required	(Optional) Specify a reset whenever a 3278-x terminal keyboard locks up.

To use a custom emulation file, you must load the emulation settings into the system configuration file. This establishes the settings in the file as the terminal and keyboard defaults and provides several ways in which the emulation settings can be used within the system, as follows:

- You can provide default settings for all terminals in the network or terminals on a specific host.
- You can set up your system to boot, or load, a specific configuration file using configuration commands described in the *Configuration Fundamentals Configuration Guide*.
- You can temporarily override default settings using terminal EXEC commands.
- You can use the local **terminal terminal-type** and **terminal keyboard-type** EXEC command to load in the files.
- You can configure line-specific emulation types for terminal negotiations with a remote host.

If you intend to use an alternate TTYcap and keymap, you must assign the following two characteristics:

- Terminal type
- Keymap type

The terminal and keymap type information is used by the Cisco IOS software when negotiating connections with hosts. Use the **terminal-type** and **keymap-type** line configuration commands to assign TTYcap and keymap line characters. You must assign the terminal and keyboard type to the line if you intend to use alternate TTYcap and keymap files.

Use the **tn3270 datastream** command to cause an “-E” to be appended to the terminal type string sent to the IBM host. This allows you to use the extended TN3270 features.

If a user enters data, uses an arrow key to move the cursor to the right on the screen, and then enters more data, the intervening spaces are filled in with NULLs. To specify how NULLs are handled: enter the command **tn3270 null-processing** either with the argument **3270**, where NULLs are compressed out of the string (as on a real 3278-x terminal), or use the argument **7171**, where NULLs are converted to spaces as on a 7171 controller.

On a 3278-x terminal, the keyboard is locked and further input is not permitted after an input error (due to field overflow, invalid entry, and so on), until the user presses the RESET key. Most TN3270 implementations leave the keyboard unlocked and remove any error message on the next key input after the error. Use the **tn3270 reset-required** command to enable a reset in these situations.

Map TN3270 Characters

To control the mapping of extended binary coded decimal interchange code (EBCDIC) and ASCII characters, perform one or more of the following optional tasks:

Step	Command	Purpose
1	tn3270 character-map <i>ebcdic-in-hex ascii-in-hex</i>	In global configuration mode, create character mappings by configuring a two-way binding between EBCDIC and ASCII characters.
2	no tn3270 character-map {all <i>ebcdic-in-hex</i> [<i>ascii-in-hex</i>]	In global configuration mode, reset character mappings to their default settings.
3	show tn3270 character-map {all <i>ebcdic-in-hex</i> }	In EXEC mode, display character mappings.
4	show tn3270 ascii-hexval	In EXEC mode, display the hexadecimal value of an ASCII character. ¹
5	tn3270 8bit display	In line configuration mode, temporarily configure the Cisco IOS software to use the 8-bit mask.
6	tn3270 8bit transparent-mode	In line configuration mode, temporarily configure the Cisco IOS software to use the 8-bit mask if you use a file-transfer protocol such as Kermit in 8-bit mode.

1. After you enter the **show tn3270 ascii-hexval** command, enter the ASCII character whose hexadecimal value you want to display.

When you create character mappings between extended EBCDIC or extended ASCII characters, you must configure the Cisco IOS software for the correct data character bit length. The default mask used for TN3270 connections is a 7-bit mask. In certain situations, you must use an 8-bit display. When an 8-bit mask has been set by the line configuration command **data-character-bits {7 | 8}** or the EXEC command **terminal data-character-bits {7 | 8}**, you can temporarily configure the software to use the 8-bit mask by issuing the **tn3270 8bit display** line configuration command.

When you use a file-transfer protocol such as Kermit in 8-bit mode or you use 8-bit graphics, which rely on transparent mode, use the **tn3270 8bit transparent-mode** line configuration command to configure the software for the 8-bit mask.

Make TN3270 Connections

You use TN3270 terminal emulation to connect to an IBM 3278-type host. Your system administrator must configure a default terminal emulation file that permits the terminal to communicate with the host. How to specify alternate terminal emulations is described in the earlier section “Configure TN3270.”


```

nl = '^j'; tab = '^i'; btab = '^b';\
left = '\EOD'; right = '\EOC'; up = '\EOA'; down = '\EOB';\
home = '^h'; delete = '^d'; eof = '^e' | '\E^?'; einp = '^w'; insrt = '\EOn';\
pfk1 = '\EOP' | '\E1'; pfk2 = '\EOQ' | '\E2'; pfk3 = '\EOR' | '\E3';\
pfk4 = '\EOw' | '\E4'; pfk5 = '\EOx' | '\E5'; pfk6 = '\EOy' | '\E6';\
pfk7 = '\EOT' | '\E7'; pfk8 = '\EOu' | '\E8'; pfk9 = '\EOv' | '\E9';\
pfk10 = '\EOq' | '\E0'; pfk11 = '\EOr' | '\E-';\
pfk12 = '\EOs' | '\E='; pfk13 = '\Eop\EOP' | '^f13';\
pfk14 = '\Eop\EOQ' | '^f14'; pfk15 = '\Eop\EOR' | '^f15';\
pfk16 = '\Eop\EOw' | '^f16'; pfk17 = '\Eop\EOx' | '^f17';\
pfk18 = '\Eop\EOy' | '^f18'; pfk19 = '\Eop\EOT' | '^f19';\
pfk20 = '\Eop\EOu' | '^f20'; pfk21 = '\Eop\EOv' | '^f21';\
pfk22 = '\Eop\EOq' | '^f22'; pfk23 = '\Eop\EOr' | '^f23';\
pfk24 = '\Eop\EOs' | '^f24';\
pa1 = '^p1' | '\EOS';\
pa2 = '^p2' | '\Eom';\
pa3 = '^p3' | '\Eol';\
}

```

Line Specification for a Custom Emulation Example

The following example sets up a line with specific terminal and keyboard characteristics that are used during negotiation with a host upon connection. The line configuration commands in the example must follow the global **tycap** and **keymap** global configuration commands containing the emulation settings to be used.

```

line 3
  terminal-type ttycap1
  keymap-type ibm7171

```

Character Mapping Examples

The following example shows the configuration of the EBCDIC and ASCII character mappings listed in Table 16:

```

tn3270 character-map 0x81 0x78
tn3270 character-map 0x82 0x79
tn3270 character-map 0x83 0x7A

```

Table 16 Sample EBCDIC, ASCII Character Mapping

EBCDIC	ASCII
a	x
b	y
c	z

The following example displays all nonstandard character mappings:

```

router# show tn3270 character-map all

EBCDIC 0x81 <=> 0x78 ASCII
EBCDIC 0x82 <=> 0x79 ASCII
EBCDIC 0x83 <=> 0x7A ASCII

```

The following example shows the standard key mapping for the letter d and c:

```
router# show tn3270 character-map 83

EBCDIC 0x83 <=> 0x63 ASCII = `c'
EBCDIC 0x84 <=> 0x64 ASCII = `d'
```

The following example unmaps a specific key, first with optional *ascii-in-hex* argument, then without the argument:

```
router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
router(config)# no tn3270 character-map 0x80 0x78
router(config)# ^Z

router# show tn3270 character-map all

EBCDIC 0x82 <=> 0x79 ASCII
EBCDIC 0x83 <=> 0x7A ASCII

router# config term

Enter configuration commands, one per line. End with CNTL/Z.
router(config)# no tn3270 character-map 0x82
router(config)# ^Z
router# show t3270 character-map all
EBCDIC 0x82 <=> 0x79 ASCII
```

The following example displays character mappings, then removes all mappings with the **all** keyword:

```
router# show tn3270 character-map all

EBCDIC 0x81 <=> 0x78 ASCII
EBCDIC 0x82 <=> 0x79 ASCII
EBCDIC 0x83 <=> 0x7A ASCII

router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
router(config)# no tn3270 character-map all
router(config)# ^Z

router# show tn3270 character-map all
```

TN3270 Connection Example

The following example establishes a terminal session with an IBM host named finance:

```
router> tn3270 finance
```

To terminate an active TN3270 session, log out of the remote system by issuing the command specific to that system (such as **exit**, **logout**, **quit**, or **close**). You can also enter the escape sequence (**Ctrl-Shift-6** then **x** [**Ctrl^x**] by default) and enter the **disconnect** command at the EXEC prompt. Because the **disconnect** command can “hang” a port, we recommend that you avoid using it routinely when you exit a session.

Configure Support for XRemote Calls

The following sections describes the X Windows system and how to configure the Cisco IOS software to support XRemote connections.

- Cisco's Implementation of XRemote
- Configure XRemote
- Select Fonts for X Terminal Applications
- XRemote Connections
- Establish XRemote Sessions between Servers
- Monitor XRemote Connections
- XRemote Configuration Example
- XRemote Connection Examples

Cisco's Implementation of XRemote

The X Window System, also called X, is a network-based graphics window system originally developed for workstations running UNIX. Cisco Systems, Inc. has developed an XRemote application that allows the XRemote capabilities of X terminals to run on an access server or router.

Previous window systems for terminals were *kernel-based* and therefore were closely linked to the operating system running on the workstation itself. They typically only ran on discrete systems, such as a single workstation. The X Window System is not part of any operating system, but instead, is composed of application programs. Thus, the X Window System enables flexible, graphics-based network computing across a wide range of operating systems and hardware platforms.

X and the Client-Server Model

The underlying architecture of the X Window System is based on a *client/server* model. The system is split into two parts: *clients* and *display servers*. Clients are application programs that perform specific tasks, and display servers provide specific display capabilities and track user input. These two parts can reside on the same computer or can be separated over a network. In an X terminal environment, such as in NCD terminal implementations, the display server resides on the display station and the client resides on a host computer.

Because the X Windows System employs this client/server partitioning and is independent of both the hardware and operating environment, X terminal users can access different types of computers to simultaneously access several applications and resources in a multivendor environment. A user at an X terminal can run and display a calendar program on a VAX, a spreadsheet program on a PC, and a compiler on a workstation concurrently.

How XRemote Works

XRemote is a protocol developed specifically to optimize support for the X Windows System over a serial communications link. Its compression and decompression algorithms are designed to handle bit-mapped displays and windowing systems.

There are two basic parts to XRemote:

- Server-side helper process
- Client-side helper process

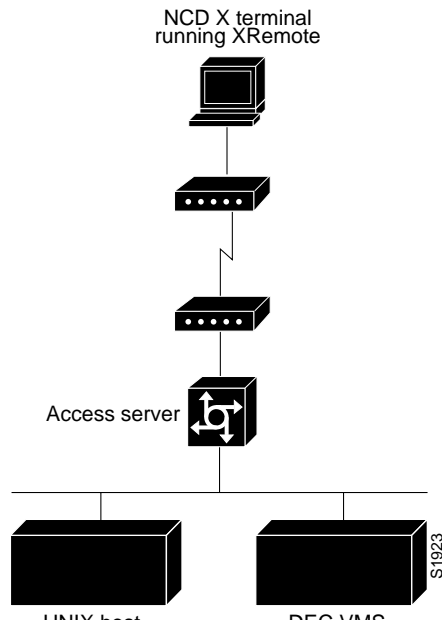
These two helper processes communicate with each other using the XRemote protocol. The client-side helper communicates with X clients using the standard X protocol. The server-side helper communicates with the server using the standard X Window System. The server-side helper might operate as part of the X server or it might be external and accessed across the network; for example, the server-side helper can operate in an access server or router at your house or work site. If the server-side helper is in the X terminal, it must have XRemote PROMs installed.

XRemote enables a user of a display station to run the X Window System via 9600-baud (and faster) modem connections with performance that is superior to using conventional serial protocols, such as Serial Line Internet Protocol (SLIP). An X display station must either implement XRemote or be connected to a network configuration that includes an access server or router.

Connection Capability

The Cisco implementation of XRemote is fully compatible with the NCD XRemote protocol. Figure 62 illustrates an XRemote connection between an X terminal and an access server. In Figure 62, the server-side helper runs on the X terminal, and the client-side helper runs on the access server.

Figure 62 XRemote Session from an X Display Server Running XRemote



Remote Access to Fonts

Remote access to fonts is provided in three ways:

- Using the industry-standard protocol for transporting X traffic over Transmission Control Protocol/Internet Protocol (TCP/IP) networks
- Using the Digital Equipment Corporation protocol for transporting X traffic over local-area transport (LAT) networks
- Using the Internet standard Trivial File Transfer Protocol (TFTP) for TCP/IP networks

A single XRemote user can use any combination of TCP/IP and LAT client connections and any combination of TFTP and LAT font access.

Configure XRemote

To allow host connections using the NCD's XRemote feature and the access server or router, perform the following tasks. Unless specified otherwise, all commands in this task table are issued from global configuration mode.

Step	Command	Purpose ¹
1		Verify that a modem is externally or internally connected with your access server or router.
2	xremote tftp host <i>hostname</i>	Define a specific TFTP font server as the source for fonts.
3	xremote tftp buffersize <i>buffersize</i>	Set the buffer size used for loading font files.
4	xremote tftp retries <i>retries</i>	Increase the number of times that the font loader tries to load the fonts. ²
5	show xremote	(Optional) In EXEC mode, display current XRemote connections and monitor traffic.
6	show xremote line <i>number</i>	(Optional) In EXEC mode, display XRemote traffic and line statistics.

1. The X Server for the X terminal and the network and serial parameters for the X terminal must be configured as described in the publications for the specific X terminal you are using. In general, the X terminal configuration determines the mode of operation for the terminal, the source of font information, and the source of remote configuration information (when applicable).

2. This feature is particularly useful when the font servers are known to be heavily loaded.

In general, you can use any modem that provides acceptable performance for your application. The following guidelines apply to an XRemote operation using a modem (refer to the user manual for your modem for specific connection procedures):

- Attach cables and set up your modem for use with XRemote (access over asynchronous lines only), or cable the X terminal directly to the access server or router.
- Disable any error correction and compression features of the modem. Because XRemote implements its own compression and error correction, the modem's compression and error correction actually impair performance.
- If you must use a flow control mechanism, hardware flow control (such as RTS/CTS or DTR/DSR) is recommended. Software flow control (such as XON/XOFF) is discouraged.
- The modem should incur minimal delays in round-trip transmissions, even when transmitting small packets, and should be transparent to the data stream.
- The modem should provide true full-duplex transmission at 9600 baud or faster. Half-duplex modems are not suitable for use with XRemote.

Refer to the chapter "Configuring Modem Support and Asynchronous Devices" earlier in this publication for more information about configuring modems.

When the X terminal requests that a font file be loaded, the Cisco IOS software must first load the font file into an internal buffer before passing it to the X terminal. The default value for this buffer is 70000 bytes, which is adequate for most font files, but the size can be increased as necessary for nonstandard font files using the **xremote tftp buffersize** global configuration command. This task can be performed for both TFTP and LAT font access.

Select Fonts for X Terminal Applications

The NCD terminal contains a small set of built-in fonts in local ROM. You should use these fonts because loading fonts over a serial line can increase application startup time. The default for an NCD terminal is to use built-in fonts, unless you log in using DECwindows over LAT. When using DECwindows over LAT, the standard DECwindows fonts are used automatically.

Perform the following two tasks to select fonts:

- Access Nonresident Fonts Using TFTP
- Select DECwindows Fonts

Access Nonresident Fonts Using TFTP

When an X terminal application requests a font that is not stored in the terminal's ROM, the X terminal makes a request for a font file from the access server or router. The Cisco IOS software uses the Trivial File Transfer Protocol (TFTP) to load the font from the font server, and then passes the font to the X terminal using the XRemote protocol. The process of loading fonts from the access server or router to the X terminal can take 30 to 45 seconds, depending on the size of the font file.

An X server can display only the fonts it finds in the directories in its font path. The X server's default font path includes only the built-in fonts. To access fonts stored on a host, you must add the host's font directories to the X server's font path. To do this, use the UNIX command **xset** with the **fp+** argument to add fonts to the end of the server's font path.

For example, to allow your display station to access the 100 dots per inch (dpi) fonts found in the standard font directory, run the following command at the host system prompt:

```
host_prompt% xset fp+ /usr/lib/x11/ncd/fonts/100dpi
```

For more information, refer to the *NCDware XRemote User's Manual*.

Select DECwindows Fonts

Downloading of fonts occurs automatically when you initiate a remote DECwindows login session using the EXEC **xremote lat** command. Instead of relying on TFTP to download the fonts, the fonts are read in via the LAT protocol.

If you want to use DECwindows fonts while running standard X applications on a UNIX host, you need to use the UNIX **xset** command or an application that issues an XSetFontPath request to set a font path. You might want to do this if you are primarily a TCP/IP user, but also run some DECwindows applications.

Execute **xset**, or the application to issue an XSetFontPath request, to set the following path:

```
/LAT/SERVICE
```

In this path, *SERVICE* is a LAT service name with DECwindows support; case is not significant.

When the Cisco IOS software sees a request for font files in that directory, it uses LAT instead of TFTP to access the specified service.

XRemote Connections

You use the XRemote protocol with an X display station and a modem to connect to remote hosts via TCP/IP and LAT. This section outlines the steps for starting XRemote in several typical environments and for exiting XRemote sessions. It contains the following sections:

- Connect through Automatic Session Startup with an XDMCP Server
- Connect through Automatic Session Startup with a DECwindows Login via LAT
- Connect through Manual XRemote Session Startup
- Establish XRemote Sessions between Servers
- Exit XRemote Sessions

When possible, use the automated processes. Make sure that your system administrator has already configured a path for loading fonts.

You can run the XRemote protocols between two servers. This is useful if you use an X display server that does not support XRemote, or if an X display station is connected to a LAN and you want to use the LAN rather than a dial-in link to connect to a server. (Note that XRemote is faster when the X display station connects to a server over a dial-in link.) See the section “Establish XRemote Sessions between Servers.”

For an example of making an XRemote connection, see the “XRemote Connection Examples” section.

Connect through Automatic Session Startup with an XDMCP Server

If your host computer supports a server for XDMCP (such as the `xm` program included in X11R4 or later), you can use automatic session startup to make an XRemote session connection. To do so, perform the following task in EXEC mode:

Command	Purpose
<code>xremote xdm [hostname]</code>	Create a connection with XRemote and an XDMCP server.

This command sends an XDMCP session startup request to the host computer. If you do not specify a host name, a broadcast message is sent to all hosts. The first host to respond by starting up a session is used.

The server and X terminal stay in XRemote mode until either the display manager terminates the session, or a reset request is received from the X terminal.

Connect through Automatic Session Startup with a DECwindows Login via LAT

If your host computer supports DECwindows login sessions, you can use automatic session startup to make an XRemote session connection. If the system administrator at the remote host configures support for DECwindows over LAT, perform the following task in EXEC mode to initiate the connection:

Command	Purpose
<code>xremote lat service</code>	Create a connection with XRemote and DECwindows over LAT.

After you issue this command, expect the following to occur:

- The XRemote font server loads several initial fonts for the DECwindows login display.
- The terminal displays the Digital logo and DECwindows login box.

Log on to the system. Upon completion of login, more fonts are loaded, and the remote session begins.

Note Because of heavy font usage, DECwindows applications can take longer than expected to start when you use XRemote. After the application starts, performance and access times should be normal.

Connect through Manual XRemote Session Startup

If you do not use a host computer that supports XDMCP or LAT, you must use manual session startup. To use manual session startup, perform the following tasks in EXEC mode:

- 1 Enable XRemote Manually
- 2 Connect to the Remote Host Computer
- 3 Set the Location of the X Display
- 4 Start Client Applications
- 5 Return to the EXEC Prompt
- 6 Re-enable XRemote Manually

The following sections describe these tasks.

Enable XRemote Manually

To prepare the XRemote server for manual startup, perform the following task in EXEC mode:

Command	Purpose
<code>xremote</code>	Prepare the XRemote server for manual startup.

After you issue this command, instructions prompt you through the process of manually enabling XRemote.

Note In manual operation, the server and X terminal remain in XRemote mode until all clients disconnect or the server receives a reset request from the X terminal. A session might terminate during startup because you invoked transient X clients that set some parameters and then disconnected (such as `xset` or `xmodmap` parameters). There must always be one session open or the connection is reset.

Connect to the Remote Host Computer

To connect to a host, perform one of the following tasks in EXEC mode:

Command	Purpose
telnet or lat or rlogin	Prepare the server for XRemote manual startup.

After entering the command, you can log on as usual.

Set the Location of the X Display

At this point, you are logged in to the remote host computer.

Note If you are using a version of Telnet on the remote host that supports the “X Display Location” option (RFC 1096), skip this step and go on to the “Start Client Applications” section.

Inform the host computer of your X display location that the server provided when you enabled XRemote manually.

For most versions of the UNIX operating system, the X display location is set by using the **setenv** command to set the Display environment variable. Refer to your UNIX system’s online X(1) manual page for more information.

On VAX/VMS systems, use the **SET DISPLAY** command to set the X display location. For more information, refer to the *VMS DCL Dictionary*.

Note To set the location of the X display for VAX/VMS client systems, you must install either the TCP/IP transport from Digital or a third-party TCP/IP transport. Contact your VAX/VMS system administrator for the appropriate TCP/IP transport name.

Start Client Applications

Now you can start your client applications for your host operating system, as specified in the documentation for the client applications.

The server accepts the X connection attempt from the client application and places the client in a dormant state.

Return to the EXEC Prompt

If it is possible to log off the host computer and keep your X clients running in the background, you can do so now. This conserves resources on both the host and the server that would otherwise be inaccessible until you exited from the XRemote state.

If you cannot log off the host computer and keep your clients running, escape back to the access server’s EXEC prompt using the escape sequence (**Ctrl-Shift-6** then **x** [**Ctrl^x**] by default).

Re-enable XRemote Manually

To begin a manual remote session again, refer to the “Enable XRemote Manually” section earlier in this chapter. If the X clients connected successfully, the session is put into XRemote mode, and the clients complete their startup.

If no clients are found, you see the following message:

```
No X clients waiting - check that your display is darkstar:2018
```

Check your hosts to determine whether an error has occurred when the session started. The most likely causes are that there is an improperly specified display location, or the host computer did not recognize the name of your server.

Establish XRemote Sessions between Servers

If you are on an X display server that does not support XRemote, you can still run the XRemote protocols. An X display server (such as a PCX, MacX, or UNIX workstation) connected to an Ethernet network can dial out through an access server on a conventional modem to access an X client program on a host residing on another network. The access server provides the server-side helper process.

To run XRemote, connect to one of the XRemote ports.

Note The NCD helper process does not support X display devices that use a maximum request and response size larger than 64 Kb.

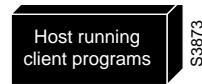
Find out from your administrator whether the connection from your X display server is configured as an individual line or a rotary connection.

- To connect to an individual line, use Telnet to connect from the X display server to port 9000 plus the decimal value of the line number.
- To make a rotary connection, use Telnet to connect from the X display server to port 10000 plus the decimal value of the line number.

For information about how to configure individual lines and rotary connections, refer to the “Configuring Modem Support and Asynchronous Devices” chapter.

Figure 63 illustrates a configuration in which a display server is not running XRemote. In this configuration, the server-side XRemote helper is running on Access Server 1, and the client-side XRemote helper is running on Access Server 2.

Figure 63 XRemote Session between Servers



Exit XRemote Sessions

When you exit XRemote, you must quit all active X connections, usually with a command supported by your X client system. Usually, when you quit the last connection (all client processes are stopped), XRemote closes and you return to the EXEC prompt. Check your X client system documentation for specific information about exiting an XRemote session.

Monitor XRemote Connections

To list XRemote connections and monitor XRemote traffic through the router, perform one of the following tasks in user EXEC mode:

Step	Command	Purpose
1	show xremote	List XRemote connections and monitor XRemote traffic through the router or access server.
2	show xremote line <i>number</i>	List XRemote connections and monitor XRemote traffic for specific lines on an XRemote server.

XRemote Configuration Example

The following example illustrates how to specify IBM-1 as the host name of the TFTP font server, specify 7 retry attempts at accessing the server, and reduce the buffer size to 20,000 bytes.

```
xremote tftp host IBM-1
xremote tftp retries 7
xremote tftp buffersize 20000
```

XRemote Connection Examples

Use the examples in this section to understand how to make the following XRemote connections:

- Connect through Automatic Session Startup with XDMCP Server Example
- Connect through Automatic Session Startup with DECwindows Login via LAT Example
- Enable XRemote Manually Example
- Connect an X Display Terminal Example
- Make XRemote Connections between Servers Example

Connect through Automatic Session Startup with XDMCP Server Example

The following example starts a session with a remote host named star:

```
router> xremote xdm star
```

Connect through Automatic Session Startup with DECwindows Login via LAT Example

The following example begins connection with a LAT service named WHIRL:

```
router> xremote lat WHIRL
```

Enable XRemote Manually Example

The following example illustrates how a successful manual XRemote session begins:

```
dialup> xremote
XRemote enabled; your display is dialup:2006
Start your clients and type XRemote again
```

The system replies with a message informing you of your X display location. Use this information to tell the host the location of your X display server.

If no clients are found, you see the following message:

```
No X clients waiting - check that your display is darkstar:2006
```

Check your hosts to determine whether an error has occurred when the session started. The most likely causes are that there is an improperly specified display location or the host computer did not recognize the name of your server.

Connect an X Display Terminal Example

The following example shows how to make a connection from an X display terminal through a server to a host running client programs:

Step 1 Enter the **xremote** command at the EXEC prompt.

```
dialup> xremote
```

Step 2 Read and follow the instruction from the host.

```
XRemote enabled; your display is dialup:2006
Start your clients and type XRemote again
```

Step 3 Connect to the client.

```
dialup> telnet eureka
Trying EUREKA.NOWHERE.COM (252.122.1.55)... Open

SunOS UNIX (eureka)
```

Step 4 Log on at the prompt.

```
login: deal
Password:
Last login: Fri Apr 1 17:17:46 from dialup.nowhere.com
SunOS Release (SERVER+FDDI+DBE.patched) #14: Fri Apr 8 10:37:29 PDT 1994
```

Step 5 At the client prompt, enter the display name from Step 2 in this procedure and the **xterm** command.

```
eureka% setenv DISPLAY dialup:2006
eureka% xterm &
[1] 15439
```

Step 6 Disconnect from the client.

```
eureka% logout

[Connection to EUREKA closed by foreign host]
```

Step 7 Begin the XRemote session.

```
dialup> xremote
Entering XRemote
```

The server and X terminal stay in XRemote mode until either the display manager terminates the session, or a reset request is received from the X terminal.

```
Connection closed by foreign host.
eureka%
```

Make XRemote Connections between Servers Example

This section provides two examples of XRemote connections between servers.

The following example shows how an XRemote connection is established for a configuration such as the one shown in Figure 63 in the “Establish XRemote Sessions between Servers” section earlier in this chapter. This example assumes that the administrator has set the display environment variable to identify and match the user’s X display terminal.

Step 1 From the PCX, MacX, or UNIX machine in Figure 63, the user connects to port 9003 on Access Server 1. If your administrator has configured a rotary number 7, the user connects to port 10007. For more information about rotary groups, refer to the chapter “Configuring Modem Support and Asynchronous Devices” in this publication.

Access Server 1 connects the user to a modem.

The modem calls Access Server 2.

- Step 2** Enter the **xremote** command at the Access Server 2 prompt.
- Step 3** Connect to the remote host from Access Server 2 using the **telnet** command.
- Step 4** Start the X client program that runs on the remote host and displays on the X display server (PCX, MacX, or UNIX host).
- Step 5** Escape from the remote host back to the Access Server 2, or log out if clients were run in the background, and enter the **xremote** command again at the Access Server 2 prompt.

The following example shows the steps to make an XRemote connection between servers. The number 9016 in the first line of the display indicates a connection to individual line 16. If the administrator had configured a rotary connection, the user would enter 10000 plus the number of the rotary (instead of 9016).

- Step 1** Enter the **telnet** command to make the connection.

```
space% telnet golden-road 9016
Trying 192.31.7.84 ...
Connected to golden-road.cisco.com.
Escape character is '^]'.
```

- Step 2** Supply the password for TACACS verification.

```
User Access Verification

Password:<password>
Password OK

--- Outbound XRemote service ---
Enter X server name or IP address: innerspace
Enter display number [0]:

Connecting to tty16... please start up XRemote on the remote system
```

- Step 3** Dial in to the remote system using the modem, and then log in.

```
atdt 13125554141
DIALING
RING
CONNECT 14400

User Access Verification
Username: deal
Password:
Welcome to the cisco dial-up access server.
```

- Step 4** Enter the **xremote** command at the EXEC prompt, then follow the instructions from the host.

```
dialup> xremote
XRemote enabled; your display is dialup:2006
Start your clients and type XRemote again
```

- Step 5** Connect to the client.

```
dialup> telnet sparks
Trying SPARKS.NOWHERE.COM (252.122.1.55)... Open

SunOS UNIX (sparks)

login: deal
```

```
Password: <password>
Last login: Fri Apr 1 17:17:46 from dialup.nowhere.com
SunOS Release (SERVER+FDDI+DBE.patched) #14: Fri Apr 8 10:37:29 PDT 1994
```

Step 6 At the client prompt, enter the display name from step 4 and the **xterm** command.

```
sparks% setenv DISPLAY dialup:2006
sparks% xterm &
[1] 15439
```

Step 7 Disconnect from the client.

```
sparks% logout

[Connection to SPARKS closed by foreign host]
```

Step 8 Begin the XRemote session.

```
dialup> xremote
Entering XRemote
```

When the connection is closed by the foreign host, the Xterm window appears on the local workstation screen.

```
Connection closed by foreign host.
sparks%
```

