

4 Booting—X Server Loading

This chapter describes the defaults and alternatives for loading and executing the X server and X server modules. The following topics are covered in the chapter:

- ❑ “Configuring the Default X Server Loading Sequence” on page 4-1
- ❑ “Configuring X Server Module Loading” on page 4-10
- ❑ “Using TFTP for X Server Downloading” on page 4-12
- ❑ “Using NFS for X Server Downloading” on page 4-13
- ❑ “Linking X Server Files” on page 4-14
- ❑ “Specifying Boot Hosts” on page 4-16
- ❑ “Booting Manually from the Boot Monitor” on page 4-17

Configuring the Default X Server Loading Sequence

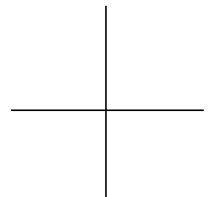
The default sequence for finding an X server and loading it into RAM allows the terminal to load an X server the first time it is powered on.

The Boot Monitor first attempts to download an X server from the following sources: TFTP (Trivial File Transfer Protocol), MOP (Maintenance Operations Protocol), NFS (Network File Service), local (PCMCIA card). If a PCMCIA card is installed in the terminal, NVRAM is still set to factory defaults, and the terminal has never booted from the network, the default order is local, TFTP, MOP, NFS.

If all attempts to load an X server fail, the Boot Monitor displays its prompt (>); you can enter a manual boot command.

The default X server loading sequence (listed in Table 4-1) automatically loads the first X server found in the default TFTP directory (usually **/tftpboot**). The default directory is defined by your implementation of TFTP.

After the request for an X server is answered by a host and is downloaded, no further requests are made. You can disable any of the requests.



Although the sequence uses predefined pathnames, you can use it to boot an X server located in another directory by linking one of the default pathnames to the X server’s true location. For information about linking, see “Linking X Server Files” on page 4-14.

Table 4-1 Default Server Loading Sequence

1.	TFTP Requests: The Boot Monitor asks TFTP to download an X server. Potentially, the Boot Monitor can issue 16 different requests, as follows.	
a.	Requests to the boot host: The Boot Monitor directs the first series of requests to the boot host. The Boot Monitor tries the following pathnames in the order shown.	
	Relative pathnames: The first four requests use relative pathnames in the default TFTP X server directory, /tftpboot .	
	(1)	A file named using the terminal’s Ethernet address; for example, 0000A701395 .
	(2)	A file named using the hexadecimal representation of the terminal’s IP address. For example, C02B997E for the terminal with IP address 192.43.153.126.
	(3)	The file named using the terminal’s product name and the terminal’s memory size as a suffix. The memory size is stated in hundreds of kilobytes. For example, 8 megabytes is the same as 8000 kilobytes, yielding a suffix of 80. The resulting filename for an HMX in this example is Xncdhmx.80 .
	(4)	The file named using the terminal’s product name alone. For example, Xncdhmx .
	Absolute pathnames: The second four requests use the same filenames, but absolute pathnames for the /tftpboot directory. These requests are included for versions of TFTP (such as the System V version) that do not use relative pathnames.	
	(5)	For example, /tftpboot/0000A701395 .
	(6)	For example, /tftpboot/C02B997E for the terminal with IP address 192.43.153.126.
	(7)	For example, /tftpboot/Xncdhmx.80 for an HMX family terminal with 8 megabytes of memory.
	(8)	For example, /tftpboot/Xncdhmx .
b.	Requests to the broadcast address: The Boot Monitor broadcasts the 8 requests shown in (1) through (8) to the network.	

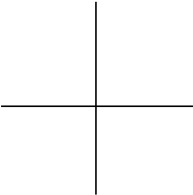


Table 4-1 Default Server Loading Sequence

2.	MOP Requests: The Boot Monitor asks <i>mop_mom</i> to download an X server. Potentially, the Boot Monitor can issue two different multicast requests. The first host responding to a request sends a MOP volunteer packet to the terminal and the terminal attempts to download an X server.	
	a.	The first request does not specify a filename.
	b.	The second request specifies the filename Xncdxxx.sys , where xxx represents the product name. For example, Xncdhmx.sys .
3.	NFS Requests: The Boot Monitor asks NFS to download an X server. Potentially, the Boot Monitor can issue 16 different requests, as described for TFTP in Step 1 in this table. The default NFS X server directory is /tftpboot .	
4.	Local Booting: The Boot Monitor attempts to boot from a local file system on a PCMCIA card. If the terminal has a PCMCIA card, NVRAM contains factory default settings, and the terminal has not booted from the network, this attempt is made before the TFTP, MOP, and NFS requests.	
5.	Boot Monitor: If all attempts to load an X server fail, the Boot Monitor displays its prompt and waits for a command. You can enter a manual boot command.	

Using remote configuration parameters, you can change the default download sequence. The configurable actions are:

- ☐ Disabling automatic booting
- ☐ Disabling all broadcast attempts
- ☐ Disabling the MOP request
- ☐ Disabling some of the TFTP or NFS requests
- ☐ Specifying a non-standard X server filename
- ☐ Specifying a non-standard X server directory
- ☐ Configuring the terminal to persist in trying to boot without going to the Boot Monitor when all attempts fail
- ☐ Configuring the sequence of boot protocols used (sources)

Disabling Automatic Booting

To prevent the terminal from booting automatically, set the **boot-automatically** parameter to “false” (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Boot automatically at power up). If automatic booting is disabled, the terminal displays the Boot Monitor prompt instead of loading an X server. This parameter is saved in NVRAM.

Table 4-2 boot-automatically Parameter

Possible Values	Result
default	true
true	The Boot Monitor attempts to download an X server.
false	The Boot Monitor does not attempt to download an X server.

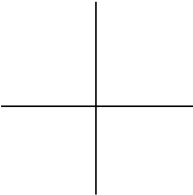
Disabling Broadcast Requests for an X Server

If the boot host does not respond, the Boot Monitor directs X server download requests to the broadcast address.

To prevent broadcasting for an X server, set the **boot-tcpip-broadcast-boot-request** parameter to “false” (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ TCP/IP Broadcast Boot Request). This parameter is saved in NVRAM.

Table 4-3 boot-tcpip-broadcast-boot-request Parameter

Possible Values	Result
default	true
true	The Boot Monitor attempts to download an X server by broadcasting.
false	The Boot Monitor does not attempt to download an X server by broadcasting.



Disabling the MOP Request for an X Server

By default, after trying all of the TFTP requests, the Boot Monitor tries to download an X server using the MOP protocol.

To prevent MOP download requests, set the **boot-mop** parameter to “false” (Setup ⇒ Change Setup Parameters ⇒ Booting [NCDnet Boot Options section] ⇒ Try MOP). This parameter is saved in NVRAM.

Table 4-4 boot-mop Parameter

Possible Values	Result
default	true
true	The Boot Monitor tries to download an X server using the MOP protocol.
false	The Boot Monitor does not try to download an X server using the MOP protocol.

Disabling Selected TFTP or NFS Requests for an X Server

The parameters listed in Table 4-5 control the X server filenames that the Boot Monitor requests via TFTP or NFS during the default X server download sequence.

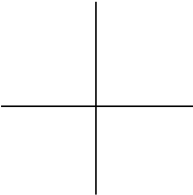
All parameters are “true” by default and are saved NVRAM. To disable a request, set its parameter to “false.” For example:

```
boot-tcpip-unit-address-with-path-file = false
```

Note There are no configuration parameters for the X server file named using the terminal’s Ethernet address. These attempts can only be disabled by using the NVRAM utility. For more information, see Chapter 11, Boot Monitor and NVRAM.

Table 4-5 Download Sequence Parameters

Relative Pathname Requests	
boot-tcpip-unit-address-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Unit Address File)	The file named using the hexadecimal representation of the terminal's IP address.
boot-tcpip-product-name-and-memory-size-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Product Name and Memory Size File)	The file named using the product name with the memory size as a suffix.
boot-tcpip-product-name-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Product Name File)	The file named using the product name alone.
Absolute Pathname Requests	
boot-tcpip-unit-address-with-path-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Unit Address with Path File)	The file named using the hexadecimal representation of the terminal's IP address, prefixed with /tftpboot .
boot-tcpip-product-name-and-memory-size-with-path-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Product Name and Memory Size with Path File)	The file named using the product name with the memory size of the terminal as the suffix and prefixed with /tftpboot .
boot-tcpip-product-name-with-path-file (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ Try TCP/IP Product Name with Path File)	The file named using the product name, prefixed with /tftpboot .



Specifying a Non-Standard X Server Filename

To specify a non-standard X server filename (not one of the names listed in Table 4-5), use the **boot-custom-file** parameter (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Custom File). This parameter is saved in NVRAM.

Table 4-6 **boot-custom-file** Parameter

Possible Values	Result
default	nil
<i>filename</i>	A non-standard name for the X server file.

Specifying a Non-Standard X Server Directory

To specify a non-standard X server directory, set the **boot-nfs-directory** parameter or **boot-tftp-directory** parameter. For details, see “Using TFTP for X Server Downloading” on page 4-12 or “Using NFS for X Server Downloading” on page 4-13.

Keeping the Terminal from Entering the Boot Monitor at Boot Time

By default, the Boot Monitor prompt appears when attempts to load an X server are unsuccessful. To configure the terminal to continue attempting to boot until it succeeds, set the **boot-persistent-loading** parameter to “true” (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Persist in Loading). This parameter is saved in NVRAM.

Table 4-7 **boot-persistent-loading** Parameter

Possible Values	Result
default	false
false	The Boot Monitor displays its prompt if all download attempts are unsuccessful.
true	The Boot Monitor does not display its prompt if all attempts to load an X server are unsuccessful. It keeps trying the default or specified download sequence until you interrupt the process.

Configuring the Sequence of X Server Loading Methods

The default sequence of methods for finding and loading an X server is configured into NVRAM at the factory to allow the terminal to load an X server the first time it is powered on. The Boot Monitor tries these methods in the following order:

1. TFTP
2. MOP
3. NFS
4. The local file system on a PCMCIA card

If a PCMCIA card is installed, NVRAM values are set to their default values, and the terminal has not booted from the network, the default order is:

1. The local file system on the PCMCIA card
2. TFTP
3. MOP
4. NFS

When booting over a Token-Ring network, the MOP boot attempt is disabled automatically.

You can change the order of booting attempts through the Boot Monitor Setup menus, in a remote configuration file, or in Change Setup Parameters. The changes must be stored in NVRAM.

To specify the first method to try, set the value of the **boot-desired-source** parameter to the desired method (see Table 4-8). (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Primary Boot Source or Setup ⇒ Change Quick Setup ⇒ Booting ⇒ Boot From). This parameter is saved in NVRAM.

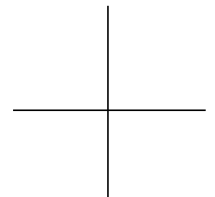


Table 4-8 boot-desired-source Parameter

Possible Values	Result
default	The terminal attempts to boot via TFTP first.
tftp (tcpip)	The terminal attempts to boot via TFTP first. ("tcpip" is included for backward compatibility and also results in first attempting TFTP booting.)
nfs	The terminal attempts to boot via NFS first.
ncdnet	The terminal attempts to boot via MOP over an NCDnet (DECnet) first.
local (prom)	The terminal attempts to boot first from a PCMCIA card. ("prom" is included for backward compatibility and results in attempting local booting first.)

To specify the second and third boot methods to use, set the **boot-second-source** (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Secondary Boot Source) and **boot-third-source** parameters (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ Tertiary Boot Source). These parameters are saved in NVRAM.

The method specified in **boot-second-source** is used if the method specified in **boot-desired-source** does not succeed.

Table 4-9 boot-second-source Parameter

Possible Values	Result
default	None
tftp (tcpip)	The terminal attempts to boot via TFTP. ("tcpip" is included for backward compatibility and also results in TFTP booting.)
nfs	The terminal attempts to boot via NFS.
ncdnet	The terminal attempts to boot via MOP over an NCDnet (DECnet).
local (prom)	The terminal attempts to boot from a local file system on a PCMCIA card. ("prom" is included for backward compatibility and results in local booting.)

The method specified in **boot-third-source** is used if the method specified in **boot-second-source** does not succeed.

Table 4-10 boot-third-source Parameter

Possible Values	Result
default	None
tftp (tcpip)	The terminal attempts to boot via TFTP. (“tcpip” is included for backward compatibility and also results in TFTP booting.)
nfs	The terminal attempts to boot via NFS.
ncdnet	The terminal attempts to boot via MOP over an NCDnet (DECnet).
local (prom)	The terminal attempts to boot from a local file system on a PCMCIA card. (“prom” is included for backward compatibility and results in local booting.)

Configuring X Server Module Loading

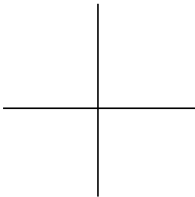
Most of the local clients, extensions, libraries, and protocols included in NCDware exist as X server modules.

All modules are listed in the online file **modsmodel.doc** (*model* is the model on which the modules run, such as **modshmx.doc** for the HMX family of terminals). This file is installed in the modules directory, which is described in “Changing the X Server Module Location” on page 4-11. The modules are also listed in the *Release Notes*.

The Change Quick Setup, Console, Lock Screen, and Logout local clients are not loadable modules. They are always available unless disabled.

Changing X Server Module Load Policy

By default, the terminal loads X server modules when a user or client needs them and unloads them when the user logs out or when the server needs memory. This load method is called *on-demand*.



X server modules can also be loaded at boot time. *At-boot* loading is useful for clients that take a long time to load, such as the local Motif Window Manager. The LAT server module must be loaded at boot to be available for use.

You can also *disable* server modules so that they cannot be loaded. Disabled local clients appear in a dithered (grayed-out) font in the Console menus.

To change X server module load policy, list the modules you want to change and the desired load policies in the **modules-load-policy** remote configuration parameter (not saved in NVRAM). The parameter is a table with entries in the format **name policy** where:

name is the name of the module, as listed in the **modsmodel.doc** file.

policy is the load policy: “on-demand,” “at-boot,” or “disable.”

For example, the following table sets the local Motif Window Manager module to load at boot and disables the Change Setup Parameters menu, touch screen module, and PEX module:

```
modules-load-policy = {
    {mwm at-boot}
    {touchscreen disable}
    {PEX disable}
    {setup disable}
}
```

(Setup ⇒ Change Setup Parameters ⇒ Loadable Modules ⇒ Load Policy).

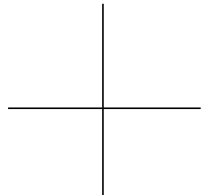
Changing the X Server Module Location

If you install NCDware using **ncdinstall**, X server modules are placed in the **/tftpboot/ncd/release/modsmodel** directory, where:

release is the release version number, such as **Xncd.5.0.xxx**.

model is the terminal model, such as **modshmx** for modules for the HMX series of terminals.

On systems running secure TFTP, **ncdinstall** places the server modules in the **/secure-dir/tftpboot/ncd/release/modsmodel** directory.



When the terminal boots, it looks first for server modules in the directory specified in the **modules-directory** parameter (not saved in NVRAM). The X server sets the value of **modules-directory** based on the location of the X server boot image. If the modules are not there, the terminal looks in */tftpboot/ncd/release/modsmodel*.

If a terminal cannot find X server modules, error messages result. To find out where the X server is looking for modules and correct the location, you can use the Change Quick Setup local client to display and change the current value of Files ⇒ Loadable Modules Directory (or Change Setup Parameters ⇒ Loadable Modules ⇒ Loadable Modules Directory).

If you change the location of the server modules on the host, you must change the value of the **modules-directory** parameter to the new location. For example:

```
modules-directory = /usr/vendor/ncd/modshmx
```

Changes are automatically recorded in the file service table.

Using TFTP for X Server Downloading

The terminal automatically tries to download the X server first using TFTP. You must configure the terminal if the X server is in a non-standard location.

Making Sure TFTP is Enabled

If you are not certain whether TFTP is enable on the boot host, see Chapter 5, Configuring Network Services, for information about enabling TFTP.

Specifying a Custom X Server Directory

You can specify a custom directory for X servers by changing the default value, which is */tftpboot/* or */usr/tftpboot/*.

If you are using secure TFTP, make sure that the directory is physically under the default TFTP home directory and in the same file system partition.

To specify a different directory, change the **boot-tftp-directory** parameter. [Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ (TCP/IP Boot Options section) ⇒ TFTP Directory]. Save the new value in NVRAM.

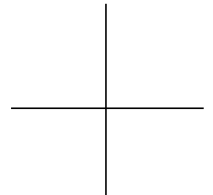


Table 4-11 boot-tftp-directory Parameter

Possible Values	Result
default	/tftpboot/ or /usr/tftpboot/
<i>directory_path</i>	The directory for X server downloading using TFTP.

Using NFS for X Server Downloading

To download an X server using NFS, in addition to configuring the terminal for NFS use, you must do the following:

- ☐ Specify the default load method as NFS.
- ☐ If you do not want to use the default /tftpboot/ or /usr/tftpboot/ directories for X servers, specify the directory that NFS should search.
- ☐ If you do not want to use default X servers, specify the X server to boot.

Making Sure NFS is Available

If you are not certain whether NFS is available and configured on the boot host, see Chapter 5, Configuring Network Services.

Specifying the Directory to Search for an X Server

To specify the directory that the terminal searches for an X server to download (the NFS mount point), you alter a value in NVRAM. If you do not specify a mount point, the Boot Monitor uses the defaults /tftpboot/ or /usr/tftpboot/ directory.

To specify a different directory, set **boot-nfs-directory** to the desired mount point (Setup ⇒ Change Setup Parameters ⇒ Booting ⇒ [TCP/IP Boot Options section] NFS Directory). Save the new value in NVRAM.

Table 4-12 boot-nfs-directory Parameter

Possible Values	Result
default	/tftpboot/ or /usr/tftpboot/
<i>directory_path</i>	The directory for X server downloading using NFS.

The default X server loading sequence automatically loads the first X server it finds in the mounted NFS directory. If you do not specify a mount point, the Boot Monitor loads the first X server it finds in the default directory, **/tftpboot/** or **/usr/tftpboot/**.

As with TFTP booting, you can boot an X server in another directory by symbolically linking one of the default directory pathnames to the true location of the X server. (“Linking X Server Files” on page 4-14 describes using symbolic links for X server directory pathnames.)

When using NFS for X server download, each directory involved in the linkage between the default pathname and the actual X server image location must be exported.

If any directory is non-exportable, the read operation fails and an error message such as the following results:

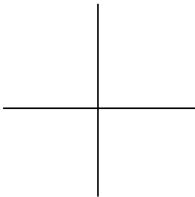
```
Failed to mount /usr/nfs/load
```

If the Boot Monitor succeeds in mounting the directory containing the X server image, messages such as the following result:

```
Loading initial file /usr/nfs/load/Xncdhmx
Loading final file /usr/tftpboot/Xncdhmx
```

Linking X Server Files

If X servers are located in directories other than the default or specified directory (such as subdirectories of the default TFTP directory) you need links between the pathnames used in the default loading sequence and the actual pathnames of the X server files. This ensures that the default loading sequence will work properly.



By default, the **ncdinstall** program installs X servers in a subdirectory named for the release, such as **/tftpboot/Xncd.5.0.120**. Then, **ncdinstall** creates links for the X servers from this subdirectory to the default location, which is **/tftpboot**.

The general format of a link command is:

ln filename server_pathname

where **filename** is one of the filenames from the default download sequence and **server_pathname** is the actual pathname of the X server file.

If you are assigning an X server to an individual terminal, use the request for the hexadecimal representation of the terminal's IP address, which is unique to each terminal. Link this filename to the pathname of the X server you want this terminal to boot. For example, assuming the servers are in the **Xncd.5.0.120** subdirectory of **/tftpboot**:

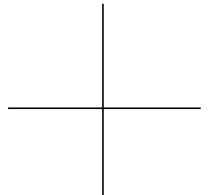
```
# cd /tftpboot
# ln -s Xncd.5.0.120/Xncdhmx C02B9942
```

The hexadecimal equivalent of the IP address is displayed during boot when the X server attempts to download a configuration file with this name. You also can find the hexadecimal equivalent by converting each octet in the IP address to a hexadecimal number. For example:

192	43	153	66
↓	↓	↓	↓
C0	2B	99	42

You can use the **bc(1)** utility to convert from decimal notation to hexadecimal. For example:

```
% bc
obase=16
192;43;153;66
C0
2B
99
42
```



Specifying Boot Hosts

Instead of loading an X server from the first host to respond to the terminal’s request or specifying the boot server using BOOTP/DHCP, you can specify the names of the boot hosts.

Specifying the Initial Boot Host

To make sure that the terminal tries to boot first from a specific host, you can set the primary boot host’s IP address using the **boot-tcpip-desired-server** parameter (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options section] ⇒ TCP/IP Desired Server). Save the new value in NVRAM. This parameter is used for both TFTP and NFS booting.

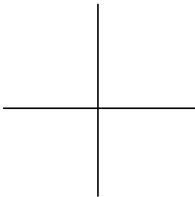
Table 4-13 boot-tcpip-desired-server Parameter

Possible Values	Default
default	0.0.0.0
0.0.0.0	There is no designated boot host. The terminal uses information from the bootptab file or broadcasts requests for a server to the network.
<i>IP address</i>	The IP address of the desired boot host.

Specifying Backup Boot Hosts

You can specify more than one boot host to use in case the initial boot server is unavailable. There are three methods:

- ❑ Using the **-p** and **-l bootpd** options to specify when a secondary host should respond to the terminal’s BOOTP requests.
See the **bootpd** (8) man page for more information.
- ❑ Setting Second Boot Host IP Address and Third Boot Host IP Address in the Network window of the Boot Monitor Setup menus.
See Chapter 11, Boot Monitor and NVRAM, for more information.
- ❑ Setting the **boot-tcpip-second-server** and **boot-tcpip-third-server** parameters (Setup ⇒ Change Setup Parameters ⇒ Booting [TCP/IP Boot Options



section] Secondary TCP/IP Server and Tertiary TCP/IP Server). Set either or both of the following parameters and save them in NVRAM.

Table 4-14 boot-tcpip-second-server Parameter

Possible Values	Default
default	0.0.0.0
0.0.0.0	There is no designated second boot host.
<i>IP address</i> or <i>hostname</i>	If the primary boot host is unavailable, the terminal attempts to boot from the specified host.

Table 4-15 boot-tcpip-third-server Parameter

Possible Values	Default
default	0.0.0.0
0.0.0.0	There is no designated third boot host.
<i>IP address</i> or <i>hostname</i>	If the primary and secondary boot hosts are unavailable, the terminal attempts to boot from the specified host.

Booting Manually from the Boot Monitor

You can boot a terminal manually from the Boot Monitor prompt (>). This is useful if:

- ☐ There is no address determination protocol on the boot host
- ☐ You want to boot from a host other than the normal boot host
- ☐ You want to load a different X server from the one normally loaded by the terminal
- ☐ The terminal cannot locate an X server

You can invoke the Boot Monitor by pressing the Escape key while address requests are being broadcast to the network—before you see the word loaded. After you press the Escape key, the Boot Monitor prompt appears.

You can access the Boot Monitor after the X server is running by using a key combination, listed in Table 4-16. Accessing the Boot Monitor while clients are running, however, may cause unpredictable behavior.

Table 4-16 Boot Monitor Access Key Combinations

Keyboard Type	Key Combination
101-key	Ctrl-Left Alt-Setup
Windows 95-compatible, IBM PS/2, US English, and 102-key	CapsLock-Left Alt-Setup
VT220-compatible	Ctrl-Compose-F3
108-key	Ctrl-Left Alt-F3
97-key	Left Alt-Caps Lock-Setup
107-key (Sun Type-4-compatible)	Stop-A (L1-A)
122-key and 3270-compatible Lexmark	Alt Rule-Home
123-key (Sun Type-5-compatible)	Stop-A (L1-A)

Manual Boot from a PCMCIA Card

To load the server manually from a PCMCIA card, use the **bl** command:

> **bl**

Manual Boot Using TFTP or NFS

To load the server manually using TFTP, use the **bt** command:

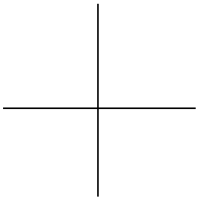
> **bt** [*file*] [*terminal_IP host_IP*] [*gateway_IP*] [*subnet_mask*]]

To load the server manually using NFS, use the **bn** command:

> **bn** [*file*] [*terminal_IP host_IP*] [*gateway_IP*] [*subnet_mask*]]

where:

- file* Is the name of the server to load
- terminal_IP* Is the IP address of the terminal
- host_IP* Is the IP address of the boot host



gateway_IP Is the IP address of the gateway

subnet_mask Is the subnet mask, specified in decimal-dot format or as a hexadecimal number

