

HP iSCSI Boot for Linux User Guide



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Audience assumptions

This document is for the person who installs, administers, and troubleshoots servers and storage systems. HP assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

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Overview

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iSCSI boot overview

The HP iSCSI boot feature allows you to boot from a remote disk (known as the iSCSI target) on a Storage Area Network (SAN) without having to directly attach a boot disk.

Booting from a remote disk on a SAN allows you to centralize the boot process and consolidate equipment resources. Unlike other implementations, iSCSI boot does not require a separate DHCP server or a PXE server.

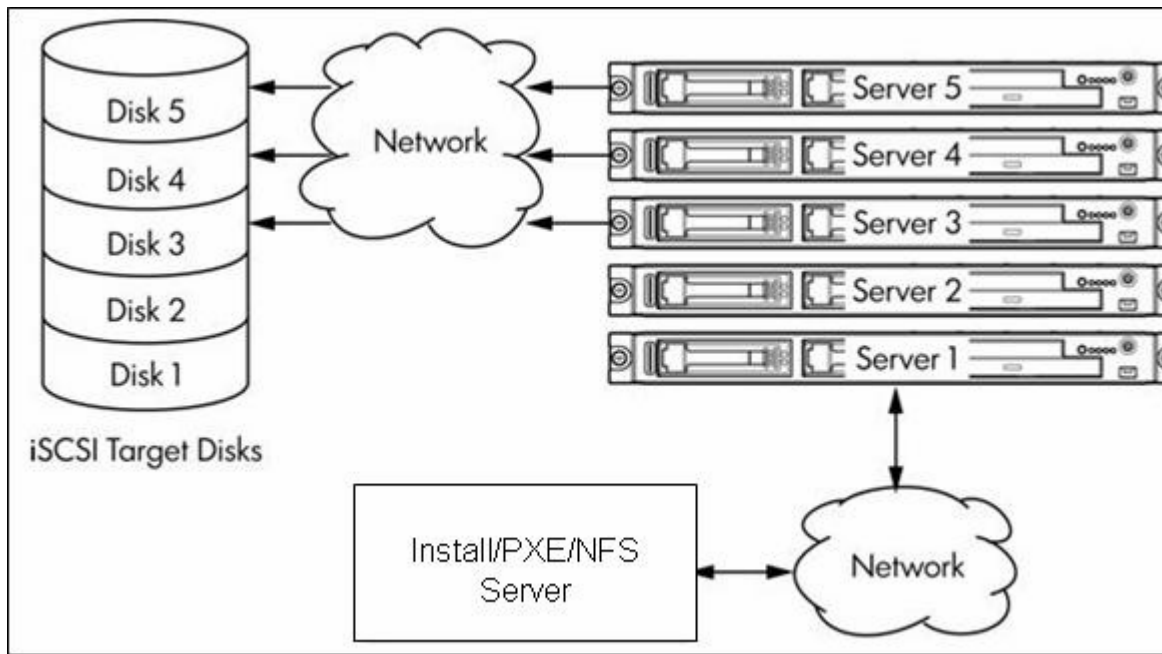
NOTE: Currently, iSCSI boot is functional only when the IP address is configured statically and it cannot be utilized when Dynamic Host Configuration Protocol (DHCP) is used to acquire the IP configuration.

NOTE: Currently, iSCSI boot does not support any discovery protocols, such as Dynamic Host Configuration Protocol (DHCP), Internet Storage Name Service (iSNS), and Service Location Protocol (SLP).

iSCSI boot allows a Linux system with a standup or embedded multifunction NIC to start up from a remote storage device. All iSCSI commands are handled by the Linux operating system.

NOTE: The HP Accelerated iSCSI feature is currently not supported on Linux operating systems.

The following diagram depicts an iSCSI boot implementation.



This guide provides information about installing and using iSCSI boot in Linux-based environments.

System requirements

The following software and hardware support HP iSCSI boot implementations.

Supported operating systems

- Red Hat Enterprise Linux 3 ES/AS for x86_64 (Update 6, 7, and 8)
- Red Hat Enterprise Linux 3 ES/AS for x86 (Update 6, 7 and 8)
- Red Hat Enterprise Linux 4 ES/AS for x86_64 (Update 2, 3, and 4)
- Red Hat Enterprise Linux 4 ES/AS for x86 (Update 2, 3 and 4)
- SUSE Linux Enterprise Server 9 SP3 for x86
- SUSE Linux Enterprise Server 9 SP3 for x86_64

Supported hardware

- **Servers.** ProLiant servers that include an iLO or RILOE management device with a minimum of 256 MB memory with any of the supported operating systems and with access to an iLO virtual floppy drive or USB device
- **Adapters.** The following Multifunction Gigabit Server Adapters are supported.
 - HP NC370T PCI-X Multifunction Gigabit Server Adapter
 - HP NC370F PCI-X Multifunction Gigabit Server Adapter
 - HP NC373F PCI Express Multifunction Gigabit Server Adapter
 - HP NC373T PCI Express Multifunction Gigabit Server Adapter
 - HP NC370i PCI-X Multifunction Gigabit Server Adapter
 - HP NC371i PCI-X Multifunction Gigabit Server Adapter

- HP NC373i PCI Express Multifunction Gigabit Server Adapter
- HP NC373m PCI Express Dual Port Multifunction Gigabit Server Adapter for c-Class BladeSystem
- HP NC374m PCI Express Dual Port Multifunction Gigabit Server Adapter
- HP NC380T PCI Express Dual Port Multifunction
- **iSCSI Targets.** All targets that are supported by the version of the Linux iSCSI Initiator that is included with one of the above supported Linux operating systems.

HP updates networking software frequently to include new functionality and features. For the latest driver, firmware, and documentation updates go to the HP website (<http://h18004.www1.hp.com/products/servers/networking/index.html>).

Limitations

The following are limitations to iSCSI boot for Linux.

- After the server is booted over iSCSI, bringing down the network interface that iSCSI is using will result in a system hang.
- If the system crashes, the diskdump utility that would normally take a system dump will not work on an iSCSI booted system.
- After booting a system over iSCSI, if the SmartStart Linux PSP is installed it changes the default boot kernel in the boot loader conf file `/boot/grub/grub.conf`. The PSP default kernel does not support iSCSI boot. Update the `/boot/grub/grub.conf` to make the default boot kernel point to the entry that says iSCSI in the title, such as iSCSI Red Hat Enterprise Linux AS (2.4.21-27.ELsmp).
- In RH4 only, the released iSCSI initiator driver no longer supports limiting the LUNs associated with a target that are available to the initiator (for example, if you specify `LUN=<number>` in `/etc/iscsi.conf` on RH4, it is ignored). This means that all LUNs configured for a target name will be visible to the initiator when it connects to the target. This causes problems for iSCSI boot and Direct Install, since the drive `/dev/sda` is always used as the boot device. If multiple LUNs are visible to the initiator, they will be enumerated as `/dev/sda`, `/dev/sdb` etc. and the boot device will be unknown. Therefore, the iSCSI target configuration has limits on the way it can be configured. Some iSCSI targets support limiting the LUNs that are visible to the target. In that case, you must configure the target such that only the LUN for the boot disk is visible to the initiator. If the iSCSI target does not support that option, you must configure your target with only 1 LUN per target name. This is only applicable to RH4.
- The current release does not support 'lilo' boot loader.
- The `ibootcfg` utility for updating EVs only works on an iLO running firmware version 1.48 or later. If you have trouble with the `ibootcfg` utility, please use the supplied DOS `ev` utility to update the EVs.
- Linux iSCSI boot is not supported on HP StorageWorks 1510i Modular Array.
- On some c-Class BladeSystems, certain USB floppy drives will cause the SLES9 installation to hang when loading the USB driver. The workaround for this problem is to use disk images for the iLO virtual floppy. For instructions on setting up disk images for iLO virtual floppy, see [Converting disks for iLO Virtual Floppy setup](#) (on page 16).
- RHEL 3 is not supported on c-Class BladeSystem.
- VLANs are not supported in this release.

- If PXE is used to install the OS on a iSCSI device on a c-Class BladeSystem, disable the internal disk controller with RBSU (F9 during POST). After the install is complete, the internal controller can be re-enabled.
- If the HP StorageWorks SB40c Storage Blade is used with a c-Class BladeSystem, disable the internal disk controller with RBSU (F9 during POST).

Installation and configuration

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Summary of installation and configuration

Currently the method for setting up an iSCSI boot implementation consists of the following.

1. Install a Multifunction Gigabit Server Adapter in your server.
2. Run the HP Multifunction Upgrade Utility to update the firmware to the latest iSCSI boot option ROM.
3. Run the HP Multifunction Upgrade Utility to update to the latest boot code (not required but highly recommended).
4. Initialize the iSCSI boot option ROM data (using the provided ev command).
5. Install the binary RPM **linux-iscsi-install-<version>.rpm** on the iSCSI boot install server.
6. Copy the relevant files from the /opt/hp/iboot_install/ddimages directory onto a diskette or NFS share point to create the driver diskette image Disk 1. Then add the ks.cfg or autoinst.xml file to this image.
7. Copy the iSCSI boot and configuration scripts, bnx2 source RPM, and the linux-iscsi-boot source RPM onto a diskette or USB drive to create **Disk 2**.
8. Use the server that has the updated iSCSI boot option ROM to install the operating system directly on the iSCSI target.

All software required to implement iSCSI boot is included in the HP ProLiant iSCSI Boot Package for Linux. HP updates networking software frequently to include new functionality and features. For the latest driver, firmware, and documentation updates go to the HP website (<http://h18004.www1.hp.com/products/servers/networking/index.html>).

Updating the iSCSI boot option ROM

About the iSCSI boot option ROM

The HP Multifunction Upgrade Utility modifies an adapter's ROM to support iSCSI boot natively by installing a special iSCSI boot firmware image on HP Multifunction Gigabit Server Adapters (NC37xx and NC380x family). The iSCSI boot option ROM provides disk access to configured iSCSI targets. The iSCSI boot option ROM conforms to the BIOS Boot Specification, which enables a ROM-based PCI component to participate in the IPL boot sequence.

During the iSCSI boot process, the option ROM connects to an iSCSI target to facilitate the loading of the operating system directly from the iSCSI target, which eliminates the need for DHCP and PXE. The option

ROM then provides the information that is needed to connect to the iSCSI targets and to locate the root and boot partitions thus allowing the boot sequence to complete.

NOTE: The HP Multifunction Gigabit Server Adapters support either iSCSI boot or PXE boot but not both. Updating to iSCSI boot capability eliminates PXE as an alternate IPL (initial program load) device. Updating the PXE boot eliminates iSCSI boot capability.

The HP iSCSI option ROM offers the following:

- PCI compatible option ROM header that identifies the ROM code to BIOS
- System BIOS Interrupt 13 Disk Interface that translates BIOS disk I/O to iSCSI
- HP iSCSI Data Mover that performs iSCSI PDU Protocol
- Binary image of an UNDI implementation
- Firmware component to perform TCP/IP encapsulation

Updating the iSCSI boot option ROM

Currently there are two utilities that update the iSCSI boot option ROM.

- HP iSCSI Boot Option ROM Upgrade Utility (**insiscsi.bat**)
- HP Gigabit Server Adapter Firmware Upgrade Utility for c-Class BladeSystem (**ccfwupg1.bat**)

The HP iSCSI Boot Option ROM Upgrade Utility (**insiscsi.bat**) installs the iSCSI boot option firmware image on the following adapters:

- HP NC370x Multifunction Gigabit Server Adapter
- HP NC371x Multifunction Gigabit Server Adapter
- HP NC373x Multifunction Gigabit Server Adapter
- HP NC374x Multifunction Gigabit Server Adapter
- HP NC380T Multifunction Gigabit Server Adapter

The HP Gigabit Server Adapter Firmware Upgrade Utility for c-Class BladeSystem (**ccfwupg1.bat**) installs the iSCSI boot option ROM firmware image on the following adapters:

- HP NC370i Multifunction Gigabit Server Adapter
- HP NC373i Multifunction Gigabit Server Adapter
- HP NC373m Multifunction Gigabit Server Adapter

Updating using insiscsi.bat

The insiscsi command upgrades the iSCSI boot option ROM if the iSCSI boot option ROM is already installed and its version is out of date. In addition, it installs the iSCSI boot option ROM to replace the PXE option ROM for NC37xx and NC380x adapters.

NOTE: If the integrated SCSI or RAID adapter is not being used, it is highly recommended that you disable it to provide more option ROM space. This is especially necessary in a system with many adapters.

Replacing PXE option ROM

To update the firmware image to the iSCSI boot option ROM image, complete the following:

1. Copy all firmware files to a bootable diskette.
2. Boot to DOS using the diskette.
3. Type **insiscsi** and press the **Enter** key.
4. At the Update iSCSI Boot Option ROM prompt, enter **Y**. (The available responses are Yes, No, or Quit). The current version of ROM for each installed adapter is compared to the firmware on the diskette and if the installed version is older, you are prompted to accept the upgrade by entering Y or to reject the upgrade by entering N. A confirmation message displays when the upgrade is complete.

Command line options

The following are the available options for the insiscsi.bat command and they are not case sensitive.

Usage:

```
insiscsi -S [runs the utility automatically without prompting the user for input]
```

Replacing iSCSI boot option ROM

To update the firmware image to the PXE option ROM image, complete the following:

1. Copy all firmware files to a bootable diskette.
2. Boot to DOS using the diskette.
3. Type **inspxe** and press the **Enter** key.
4. At the Update PXE Option ROM prompt, enter **Y**. (The available responses are Yes, No, or Quit). The current version of ROM for each installed adapter is compared to the firmware on the diskette and if the installed version is older, you are prompted to accept the upgrade by entering Y or to reject the upgrade by entering N. A confirmation message displays when the upgrade is complete.

Common installation log file

The upgrade installation activity is written to an installation log file called **nic_fw\fwupglog.txt**.

Updating using ccfwupg1.bat

To update the iSCSI boot option ROM on c-Class BladeSystem, the HP Gigabit Server Adapter Firmware Upgrade Utility for c-Class BladeSystem called **ccfwupg1.bat** is provided in the \apps\ccfwupg\ccfwupg1 folder in the HP ProLiant iSCSI Boot Package for Linux and is used to update the following adapters for c-Class BladeSystem:

- HP NC373i Multifunction Gigabit Server Adapter
- HP NC373m Multifunction Gigabit Server Adapter
- HP NC370i Multifunction Gigabit Server Adapter

The command will upgrade the Boot Code and c-Class option ROM for the adapter.

NOTE: If the integrated SCSI or RAID adapter is not being used, it is highly recommended that you disable it to provide more option ROM space. This is especially necessary in a system with many adapters.

Updating boot code and iSCSI boot option ROM

To update the firmware image to the iSCSI boot option ROM image, complete the following:

1. Copy all files and folders to a bootable diskette or USB drive.

2. Boot to DOS using the diskette for your adapter.
3. Type **ccfwupg1.bat** and press the **Enter** key. A confirmation message displays when the upgrade is complete. This takes several minutes.

Initialize the iSCSI boot path

1. **Create a configuration file.** The configuration file contains the boot path that the iSCSI Initiator needs to connect to the iSCSI targets from which it will boot. This information includes the names of the initiator and target, IP addresses, and so on. Create a configuration file by executing the following command on a system running any supported Linux version.

```
vi evinput
```

2. **Define iSCSI boot path variables.** Enter the following variables and values in the evinput file using this format: "<variable>=<value>". Variable names and values are case sensitive. Comments can be prefixed with a "#" character.

Variable name	Description
InitiatorName	The name to be used for the iSCSI initiator on the booting system.
TargetName	The name of the target from which to boot.
InitiatorNetmask	The IP network mask to be used by the iSCSI initiator. This value is in dotted decimal format.
InitiatorRoute	The default IP route to be used by the iSCSI initiator. This value is in dotted decimal format.
LAA	The Locally Assigned Address (MAC address) to be used by the iSCSI initiator. The value is specified as 12 hex digits. A value of all zeros indicates that the initiator should use the MAC address assigned to the hardware.
LUN	The logical unit number for the target. Some targets do not start numbering iSCSI target data LUNs at 0.
ForceBoot	This value specifies that the iSCSI initiator should override the IPL boot order for disk controllers and install itself as the boot disk. "True", "TRUE", "true", or "1" indicates that the iSCSI boot option ROM should install itself as the handler for the boot device. Any other value is equivalent to "False".
AuthMethod	The authentication method to use. The initiator and target must agree on a mutually agreeable authentication method or the iSCSI initiator will not be able to log in to the target. The AuthMethod values are "None", "CHAP", and "MutualCHAP". If CHAP is specified, the target may still select "None" as the authentication method. If "CHAP" is specified as the AuthMethod value, CHAPUsername and CHAPSecret must also be specified. If "MutualCHAP" is specified as the AuthMethod value, CHAPUsername, CHAPSecret and CHAPMSecret must also be specified.
CHAPUsername	The username for CHAP authentication.
CHAPSecret	The secret (password) for CHAP authentication. Specified either as a string or a long hex value (starting with "0x"). This value must be at least 96 bits (12 bytes, 24 hex digits) long.
CHAPMSecret	The secret (password) for mutual (reverse) CHAP authentication. Specified either as a string or a long hex value (starting with "0x"). This value must be at least 96 bits (12 byte, 24 hex digits) long.
VLAN	The VLAN number that the iSCSI initiator should use for all packets sent and received. This is specified either as the VLAN number or "Disabled" if no VLAN is used.

The following is a sample configuration file.

```
# Copyright 2006 Hewlett-Packard Development Company, L.P.
# All Rights Reserved
# 06/15/06
#
# Consult the IETF iSP iSCSI for details of these items.
#
##
# Name of the iSCSI Target. Must match what the target offers.
# Hard coded Target IP .. No DNS support
#
TargetName=iqn.2003-05.com.hp1510i:Target01
TargetIP=10.10.10.13
#
# local name the iSCSI client will present to the Target
# and local IP settings. No DNS or DHCP support
#
InitiatorName=iqn.client01
InitiatorIP=10.10.10.02
InitiatorNetmask=255.255.255.0
InitiatorRoute=10.10.10.1
TargetPort=3260
## Locally Admin Address (MAC address) and VLAN (Enabled/Disabled)
#
LAA=000000000000
VLAN=Disabled
## LUN Mapping. This should match what the target LUN offers.
#
LUN=0
## Make this persistent BIOS int 13 IPL routine. Replaces Embedded HD
C:\ (if present).
#.
ForceBoot=True
## Digest (Checksum) data or Headers. Must match target setting.
#
DataDigest=False
HeaderDigest=False
## Account Login information
# . The AuthMethod values are: None, CHAP, and (TwoWay) MutualCHAP,
#
AuthMethod=None
##
# If AuthMethod is None, These are ignored.
CHAPUsername=iqn.1991-05.com.microsoft:comfort.txn.cpqcorp.net
CHAPSecret=Some12day123
CHAPMSecret=BetterThanThat
```

3. **Write the boot path to the target server.** The boot path configuration file may be written to the target server with the ev DOS utility (bios editor) or written using the ibootcfg utility.
 - o To write the boot path using the ev DOS utility, boot to DOS and change directories to the ev DOS utility. The ev DOS utility is packaged with the HP iSCSI boot feature.
 - o Execute the following on the server with the option ROM.

```
ev -c <evinput.txt>
```
 - o To use the iLO interface to write the iSCSI boot path parameters to the target server, install the linux-iscsi-install RPM on the install server (see "Installing the iSCSI install RPM (on page 14)") then execute the following command on the install server.

```
/opt/hp/iboot_install/utils/optrom/ibootcfg -l <input file> -s <iLO IP address> -u <iLO username> -p <iLO password>
```

All command line arguments are required. The <input file> is the file created in the previous step.

Argument	Description
-l <input file>	The name of the boot path input file.
-s <iLO IP address>	The IP address of the HP Integrated Lights Out management port from which to boot the iSCSI target
-u <iLO username>	The username of the HP Integrated Lights Out management port from which to boot the iSCSI target.
-p <iLO password>	The password for the user name of the HP Integrated Lights Out management port from which to boot the iSCSI target.

Installing iSCSI boot

About the iSCSI boot driver

The iSCSI boot driver for Linux includes two RPM packages:

- linux-iscsi-boot.<version>.src.rpm, the source RPM that contains the iSCSI boot driver source files for multifunction adapters
- linux-iscsi-install.<version>.rpm, the binary RPM that contains the driver diskette images needed for direct installs of the operating system on iSCSI targets and other scripts necessary for configuring the targets

These files are installed and built on a designated iSCSI boot install server. The linux-iscsi-install RPM contains driver diskette images for direct install in iSCSI targets as well as iSCSI boot configuration scripts. It must be installed on a system running any version of the supported Linux operating systems. The system where this binary RPM is installed is referred to as the install server in the remainder of this document. The term iSCSI target refers to a hardware or software controlled array of storage area network devices.

Source RPM

The source RPM is called `linux-iscsi-boot-<version>.src.rpm` and it contains the sources for the iSCSI driver with iSCSI boot support, which includes iSCSI boot utilities, modules, and documentation.

Binary RPM

The binary RPM is called `linux-iscsi-install-<version>.rpm` and it contains driver diskette images for direct installations of the operating system on iSCSI targets, as well as scripts and configuration files necessary for setting up the targets for iSCSI boot implementations.

Installing the iSCSI install RPM

1. To install the binary RPM, enter the following command on the install server

```
# rpm -ihv /<rpmpath>/linux-iscsi-install.<version>.rpm
```

The following files are installed:

```
/opt/hp/iboot_install/scripts/configure.sh
/opt/hp/iboot_install/scripts/install_bnx2.sh
/opt/hp/iboot_install/scripts/install_iscsi.sh
/opt/hp/iboot_install/scripts/prepare_iscsi_boot.sh
/opt/hp/iboot_install/scripts/setup_kernel_tree.sh
/opt/hp/iboot_install/scripts/ks.cfg
/opt/hp/iboot_install/scripts/autoinst.xml
/opt/hp/iboot_install/Utils/optrom/ibootcfg
```

Additionally, the directory `/opt/hp/iboot_install/ddimages` contains driver diskette images for all supported releases of Linux.

Installing iSCSI boot targets

The iSCSI install RPM must be installed on the install server prior to installing the target disks as described in "Installing the iSCSI install RPM (on page 14)".

Preinstallation requirements

1. Prior to installing an operating system on your iSCSI boot target drives, you must first customize the following configuration and control files:
 - a. For Red Hat installations modify the **ks.cfg** file (described below)
 - b. For SuSE Linux Enterprise Server installations modify the **autoinst.xml** file (described below)
2. In addition, you must copy the linux-iscsi-boot source RPM and bnx2 driver source RPM to the `/opt/hp/iboot_install/SRPMS` directory as follows:

```
# mkdir /opt/hp/iboot_install/SRPMS
# cp <rpmpath>/linux-iscsi-boot<version>.src.rpm
/opt/hp/iboot_install/SRPMS
# cp <rpmpath>/bnx2-<version>.src.rpm /opt/hp/iboot_install/SRPMS
```

RedHat installations

Customizing the ks.cfg file

During an iSCSI install, you must modify the **ks.cfg** file prior to creating the driver diskette image for the iSCSI target. The `ks.cfg` file copies the required scripts and RPMs to a target disk and contains the steps to be executed during post-installation.

1. Open the `ks.cfg` file on the iSCSI boot install server for editing by executing

```
# vi /opt/hp/iboot_install/scripts/ks.cfg
```

2. Modify the following variables as needed to update the hostname and boot loader type. You may use the default variables if you do not wish to set the hostname. The available values for boot loader type are GRUB and LILO and the default value is grub.

```
SYSNAME=<hostname>
```

```
BOOT_LOADER=<boot-loader-type>
```

3. The driver diskette images can be copied to a removable diskette or USB device or they can be accessed through the network (NFS and PXE).
 - a. For removable diskette installations, do not modify the copymethod, NFS server IP, or NFS share-point variables.
 - b. For NFS installations, modify the copymethod, NFS server IP, and NFS share-point variables as follows:

```
COPYMETHOD=nfs
```

```
NFSSERVER=<NFS-server-IP>
```

```
NFSSHARE=<share-point>
```

Then uncomment the following lines before the **%post** section

```
install
```

```
nfs --server=<NFS Server IP> --dir=<path-to-OS-distro-dir>
```

Creating iSCSI boot driver images (Disk 1 and Disk 2)

1. Copy the driver diskette images (Disk 1) to a network or storage device
 - a. For network installs, skip this step and go to step 5.
 - b. For diskette or USB devices, execute the following on the iSCSI boot install server

```
# cd /opt/hp/iboot_install/ddimages
# mount -o loop iboot_install_<release>_driver.dd /mnt
# cp /opt/hp/iboot_install/scripts/ks.cfg /mnt/ks.cfg
# umount /mnt
```
2. Insert a diskette or USB device in the iSCSI boot install server and execute

```
# umount /dev/fd0 (Ignore any mount error messages)
# dd if=iboot_install_<release>_driver.dd of=/dev/fd0
```
3. Upon completion, safely remove the driver diskette or USB device (**Disk 1**).
4. Insert a second diskette or USB device and execute the following to copy the iSCSI boot and configuration scripts, bnx2 source RPM (the bnx2 source RPM is packaged with the iSCSI boot feature), and linux-iscsi-boot source RPM. This diskette or USB device (**Disk 2**) is inserted during the post-installation stage of the operating system install.
 - a. For network installs, skip this step and go to step 5.
 - b. For diskette or USB devices, execute the following on the iSCSI boot install server

```
# umount /dev/fd0 (Ignore any mount error messages)
# mkfs -t ext2 /dev/fd0
# mount /dev/fd0 /mnt
# cp -r /opt/hp/iboot_install/scripts /mnt
# cp -r /opt/hp/iboot_install/SRPMS /mnt
# cp /rpm/path/linux-iscsi-boot-<version>.i386.rpm /mnt/SRPMS
```

```
# cp /rpm/path/bnx2-<version>.src.rpm /mnt/SRPMS
# sync
# umount /mnt
```

5. **For network installs only**, copy the linux-iscsi-boot source RPM and bnx2 source RPM to the SRPMS directory by executing

```
# cp /rpm/path/linux-iscsi-boot-<version>.src.rpm /opt/hp/iboot_install/SRPMS
# cp /rpm/path/bnx2-<version>.src.rpm /opt/hp/iboot_install/SRPMS
```

Export the folder /opt/hp/iboot_install for NFS sharing (as described in nfsd and exportfs man pages) by copying the folder contents from cp /opt/hp/iboot_install/ to /<NFS share folder> (a folder of your choosing that is NFS shared).

Converting disks for iLO Virtual Floppy setup

If you are using iLO Virtual Floppy then convert the Disk 1 and Disk 2 iSCSI boot diskette images to driver images as follows:

1. Insert the Driver Diskette floppy (section "Creating a Driver Diskette floppy") into the floppy drive on the install server and issue following command:

```
# dd if=/dev/fd0 of=driver_disk1.img
```

Remove the floppy from the drive.

2. Insert the linux-iscsi-boot rpm floppy (2nd floppy for post-install) into the floppy drive and issue the following command:

```
# dd if=/dev/fd0 of=post_install_disk2.img
```

3. Copy these disk images (driver_disk1.img and post_install_disk2.img) to the system where you are planning to use iLO console.

On the iLO Web page go to **Virtual Devices** and then select **Virtual Media** and then select **Virtual Media Applet**.

In the **Virtual Floppy/USB Key** box, select **Local Image File**.

Click **Browse** and select first disk image **driver_disk1.img** and then click **Connect** to activate Virtual floppy. Now you are ready to Start the installation.

4. During Post-Installation when prompted for the second floppy click **Disconnect** and select the second disk image **post_install_disk2.img** and then click **Connect**.

RedHat installations of iSCSI boot targets

The iSCSI target disks must be installed with one of the supported operating systems described in System requirements. Targets can be installed using either

- Diskette or USB device
- NFS network installs
- PXE network installs

The iSCSI boot target drives are installed using the driver diskette images in the **/opt/hp/iboot_install/ddimages** directory and the **linux-iscsi-boot source RPM** on the designated iSCSI boot install server.

When the CD/NFS/PXE installation completes, the system can be rebooted and an iSCSI boot will occur.

Diskette or USB installations of iSCSI boot targets

1. Power on the server and insert disk one of the operating system installation CDs in the CD-ROM drive. During POST review the iSCSI option ROM messages to ensure that the iSCSI boot option ROM initialized successfully and is able to log in successfully onto the target disk.
2. If you are using a local CDROM to install the operating system, execute the following at the boot prompt:
boot: linux dd noprobe ks=floppy
If you are using USB or iLO virtual floppy drive OR you are installing RHEL4 32-bit then type the following at the boot prompt:
boot: linux dd ks=hd:sda:/ks.cfg
3. When prompted insert the **Disk 1** driver diskette or USB device (containing the driver diskette images you created in an earlier step) then select **OK** and press the **Enter** key. Note that if you are using a USB or iLO virtual floppy, select **sda** from the list of devices then select **OK** and press the **Enter** key.
4. When prompted select the **manually choose** option and press the **Enter** key.
5. At the Select Device Driver to Load window, select the **iBOOT_install driver (iboot_install)** from the list then press the **Enter** key. The driver name is located near the end of the list of drivers. The iboot_install driver will read the option ROM data and connect to the target disk.
6. Upon successful connection to the target disk, the target disk mounts as /dev/sda (or /dev/sdb if using USB or an iLO virtual floppy drive), which makes it appear as a local disk. At the following prompt, "Do you want to load another driver?" select **No** then press the **Enter** key.
7. If there are no hard drives on your server, the following message appears "No hard drives have been found. Would you like to select drivers now?" Select **No** then press the **Enter** key. If you have a hard disk on the system, this message is not displayed.
8. When prompted, create partitions on /dev/sda (or /dev/sdb if using a USB or iLO virtual floppy drive) and proceed with the installation.

Post installation

When the installation completes, you are prompted to insert **Disk 2** (linux-iscsi-boot diskette or USB device) unless you modified the **ks.cfg** file to use NFS share.

1. Insert **Disk 2** then press the **Enter** key. If you are using the iLO Virtual Floppy, see Converting disks for iLO Virtual Floppy setup (on page 16).
2. After the target disk is configured for iSCSI boot, complete the standard operating system installation as prompted.

NFS installations of iSCSI boot targets

1. Power on the iSCSI boot target and insert disk one of the operating system installation CDs in the CD-ROM drive. During POST, review the iSCSI option ROM messages to ensure that the iSCSI boot option ROM initialized successfully and is able to log in onto the target disk.

At the boot: prompt execute the following

```
boot: linux dd=nfs:<nfs ip>:/opt/hp/iboot_install/ddimages/<dd_img>
ks=nfs:<nfs ip>:/opt/hp/iboot_install/scripts/ks.cfg
```

For RHEL4 32-bit:

```
boot: linux dd=nfs:<nfs ip>:/opt/hp/iboot_install/ddimages/<dd_img>
ks=nfs:<nfs ip>:/opt/hp/iboot_install/scripts/ks.cfg
```

The driver diskette images are read from NFS and the `iboot_install` module is inserted automatically. The `iboot_install` driver reads the option ROM data and connects to the target disk. Upon successful connection to the target disk, the target disk mounts as `/dev/sda`, which makes it appear as a local disk.

2. Follow the traditional operating system installation procedure and create partitions on `/dev/sda`. The installation copies the packages to be installed from the NFS server. To automate the complete install, refer to RedHat manuals for Kickstart installation details.

NOTE: If you have any local SCSI disks attached, then those will be listed first (as `/dev/sda`, `/dev/sdb...`) and the iSCSI target disks will be listed last (for example, `/dev/sdc`). Ensure that you choose the iSCSI target disk (`/dev/sdc`) for partitioning and not the local disk.

PXE installations of iSCSI boot targets

If the system to be installed contains a network interface card (NIC) with Pre-Execution Environment (PXE) support, you may direct install over PXE.

The following steps must be performed to prepare for a PXE installation:

1. Configure the NFS server to export the installation source.
2. Configure the TFTP server necessary for PXE booting.
3. Start/enable the `tftp` service.
4. Configure the DHCP.
5. Configure the NFS server to export the Driver Diskette images and the iSCSI boot/Configuration related code and utilities. See "NFS installations of iSCSI boot targets (on page 17)".
6. On the PXE server execute the following:

```
# vi /tftpboot/linux-install/pxelinux.cfg/default
```

In this file add the following lines:

```
label <number>
kernel <path-to-OS-distro-dir>/images/pxeboot/vmlinuz
append initrd=<path-to-OS-distro-dir>/images/pxeboot/\
initrd.img ramdisk_size=10000 dd=nfs:<nfs ip>:/opt/hp/\
iboot_install/ddimages/iboot_install_<release>.dd \
ks=nfs:<nfs ip>:/opt/hp/iboot_install/scripts/ks.cfg
```
7. Optional step: Modify `/tftpboot/linux-install/messages/boot.msg` to use custom boot messages.
8. Power up the server.
9. Verify that the Option ROM initialized successfully and is able to log in successfully onto the target disk. This can be confirmed by looking at the iSCSI option ROM messages during POST.
10. Press the **F12** key for PXE installation when prompted.
11. Enter the label number (specified in the above section) at the PXE boot prompt and press the **Enter** key. The installation will start pulling the installation sources from the NFS server.

SuSE installations

Customizing the `autoinst.xml` file

During an iSCSI direct install, you must modify the **`autoinst.xml`** `autoyast` control file prior to creating the driver diskette image for the iSCSI target to prepare the disk for an iSCSI boot. The `autoinst.xml` file

copies the required scripts and RPMs to a target disk, which contains the steps to be executed during post-installation.

1. Open the autoinst.xml file on the iSCSI boot install server for editing by executing

```
# vi /opt/hp/iboot_install/scripts/autoinst.xml
```
2. Modify the following variables as needed to update the hostname and boot loader type. You may use the default variables if you do not wish to set the hostname. The available values for boot loader type are GRUB and LILO and the default value is GRUB.

```
SYSNAME=<hostname>
BOOT_LOADER=<boot-loader-type>
```
3. The driver diskette images can be copied to a removable diskette or USB device or they can be accessed through the network (NFS or PXE).
 - a. For removable diskette installations, do not modify the copymethod, NFS server IP, or NFS share-point variables.
 - b. For NFS installations, modify the copymethod, NFS server IP, and NFS share-point variables as follows:

```
COPYMETHOD=nfs
NFSSERVER=<NFS-server-IP>
NFSSHARE=<share-point>
```
4. The root password is set to root123 by default. To modify the root password, search for the following line in the autoinst.xml file and enter a new password.

```
<user_password>root123</user_password>
```

Creating iSCSI boot driver images (Disk 1 and Disk 2)

1. Copy the driver diskette images (Disk 1) to a network or storage device
 - a. For network installs, skip this step and go to step 5.
 - b. For diskette or USB devices, execute the following on the iSCSI boot install server

```
# cd /opt/hp/iboot_install/ddimages
# mount -o loop iboot_install_<release>_driver.dd /mnt
# cp /opt/hp/iboot_install/scripts/autoinst.xml /mnt/autoinst.xml
# umount /mnt
```
2. Insert a diskette or USB device in the iSCSI boot install server and execute

```
# umount /dev/fd0 (Ignore any mount error messages)
# dd if=iboot_install_<release>_driver.dd of=/dev/fd0
```
3. Upon completion, safely remove the driver diskette or USB device (**Disk 1**).
4. Insert a second diskette or USB device and execute the following to copy the iSCSI boot and configuration scripts, bnx2 source RPM (the bnx2 source RPM is packaged with the iSCSI boot feature), and linux-iscsi-boot source RPM. This diskette or USB device (**Disk 2**) is inserted during the post-installation stage of the operating system install.
 - a. For network installs, skip this step and go to step 5.
 - b. For diskette or USB devices, execute the following on the iSCSI boot install server

```
# umount /dev/fd0 (Ignore any mount error messages)
# mkfs -t ext2 /dev/fd0
# mount /dev/fd0 /mnt
```

```
# cp -r /opt/hp/iboot_install/scripts /mnt
# cp -r /opt/hp/iboot_install/SRPMS /mnt
# cp /rpm/path/linux-iscsi-boot-<version>.i386.rpm /mnt/SRPMS
# cp /rpm/path/bnx2-<version>.src.rpm /mnt/SRPMS# sync
# umount /mnt
```

5. **For network installs only**, copy the linux-iscsi-boot source RPM and bnx2 source RPM to the SRPMS directory by executing

```
# cp /rpm/path/linux-iscsi-boot-<version>.i386.rpm /opt/hp/iboot_install/SRPMS
# cp /rpm/path/bnx2-<version>.src.rpm /opt/hp/iboot_install/SRPMS
```

Export the folder /opt/hp/iboot_install for NFS sharing (as described in nfsd and exportfs man pages) by copying the folder contents from cp /opt/hp/iboot_install/ to /<NFS share folder> (a folder of your choosing that is NFS shared).

Create the Driver Diskette layout in the root directory of the OS installation source:

```
# cd /opt/hp/iboot_install/ddimages
# mount -o loop iboot_install_<release>_driver.dd /mnt
# cp -r /mnt/01 <path-to-OS-distro-dir>/
# find <path-to-OS-distro-dir>/01 -name "bnx2.*o" -exec rm {} \;
# umount /mnt
```

Converting disks for iLO Virtual Floppy setup

If you are using iLO Virtual Floppy then convert the Disk 1 and Disk 2 iSCSI boot diskette images to driver images as follows:

1. Insert the Driver Diskette floppy (section "Creating a Driver Diskette floppy") into the floppy drive on the install server and issue following command:

```
# dd if=/dev/fd0 of=driver_disk1.img
```

 Remove the floppy from the drive.
2. Insert the linux-iscsi-boot rpm floppy (2nd floppy for post-install) into the floppy drive and issue the following command:

```
# dd if=/dev/fd0 of=post_install_disk2.img
```
3. Copy these disk images (driver_disk1.img and post_install_disk2.img) to the system where you are planning to use iLO console.

On the iLO Web page go to **Virtual Devices** and then select **Virtual Media** and then select **Virtual Media Applet**.

In the **Virtual Floppy/USB Key** box, select **Local Image File**.

Click **Browse** and select first disk image **driver_disk1.img** and then click **Connect** to activate Virtual floppy. Now you are ready to Start the installation.

4. During Post-Installation when prompted for the second floppy click **Disconnect** and select the second disk image **post_install_disk2.img** and then click **Connect**.

SuSE installations of iSCSI boot targets

The iSCSI target disks must be installed with one of the supported operating systems described in System requirements. Targets can be installed using either

- Diskette or USB device
- NFS network installs
- PXE network installs

The iSCSI boot target drives are installed using the driver diskette images in the **/opt/hp/iboot_install/ddimages** directory and the **linux-iscsi-boot source RPM** on the designated iSCSI boot install server.

When the Diskette/NFS/PXE installation completes, the system can be rebooted and an iSCSI boot occurs.

Diskette or USB installations of iSCSI boot targets

1. Power up the server with the first installation CD of the operating system's Service Pack. During POST, review the iSCSI option ROM messages to ensure that the iSCSI boot option ROM initialized successfully and is able to log in successfully onto the target disk.
2. When prompted insert the **Disk 1** driver diskette or USB device (containing the driver diskette images you created in an earlier step) then select **OK** and press the **Enter** key.
3. If you are using a local CDROM for the install, select **Manual installation** when prompted and pass the following boot options:
`autoyast=floppy:///autoinst.xml`
 Or, if you are using a USB or iLO virtual floppy drive, then pass the following boot options:
`autoyast=device:///sda/autoinst.xml`
4. The modules from the driver diskette (**Disk 1**) will be copied to memory. The iSCSI boot install driver will read the option ROM data and connect to the target disk. Upon successful connection to the target disk the target disk mounts as `/dev/sda` (or `/dev/sdb` if you are using a USB or iLO virtual floppy drive), which makes it appear as a local disk.
5. On some servers, the installation will prompt "Make sure that CD number 1 is in your drive." Select **OK** then press the **Enter** key to continue. Do not replace the CD at this time.
6. The installation prompts you with a warning message "Could not find SUSE Linux Enterprise Server 9 Installation Source." Press the **Enter** key to continue.
7. The installation prompts you to select your language and keyboard layout. Select your installation language (such as English) then press the **Enter** key.
8. Select the layout of your keyboard (for example, English (US)) then press the **Enter** key. Continue by selecting **Main Menu** then press the **Enter** key.
9. Select **Start Installation or System** from the Main Menu and press the **Enter** key.
10. Select **Start Installation or Update** from the submenu and press the **Enter** key.
11. You are prompted for the installation source. Select the appropriate method and proceed with the SLES installation.
12. Insert the SLES Initial Release CD 1 in the CD drive at the following installation prompt: "Make sure that CD number 1 is in your drive."
13. During the Installation Settings prompt, choose **/dev/sda** (or `/dev/sdb` if a USB or iLO virtual floppy drive is used) for partitioning.
14. If the installation is unable to find the 'autoinst.xml' file, then you are prompted to provide the correct location of autoinst.xml. Enter the correct location of autoinst.xml and select **OK**. This may happen if the USB floppy is mounted on a device other than `/dev/sda`. You are not prompted if the 'autoinst.xml' file is located at the location given in step 3.

Post installation

When the installation completes, you are prompted to insert **Disk 2** (linux-iscsi-boot diskette or USB device) unless you modified the autoinst.xml file to use NFS share.

1. Insert **Disk 2** then press the **Enter** key. If you are using the iLO Virtual Floppy, see Converting disks for iLO Virtual Floppy setup (on page 16).
2. After the target disk is configured for iSCSI boot, complete the standard operating system installation as prompted.

NFS installations of iSCSI boot targets

The NFS installation requires the driver diskette (**Disk 1**) that you created in an earlier step. For more information, see Customizing the autoinst.xml file (on page 18).

1. Power on the server and insert disk one of the operating system installation CDs in the CD-ROM drive. During POST, review the iSCSI option ROM messages to ensure that the iSCSI boot option ROM initialized successfully and is able to log in successfully onto the target disk.
2. When the first boot installation window appears, insert **Disk 1** and select **Installation**.
3. At the boot prompt execute

```
boot: autoyast=nfs://<nfs ip>://opt/hp/iboot_install/scripts/autoinst.xml
install=nfs://<nfs ip>:<path-to-OS-distro-dir>
netdevice=eth<N>
```

If the LOMs are not multifunction adapters, then pass the following boot options:

```
boot: autoyast=nfs://<nfs ip>://opt/hp/iboot_install/scripts/autoinst.xml
install=nfs://<nfs ip>:<path-to-OS-distro-dir>
netdevice=eth<N> insmod=tg3 insmod=bnx2
```

If the LOMs are Intel adapters, then replace tg3 with e1000 in the above line.

4. The driver diskette modules are copied into memory. The iSCSI boot install driver reads the option ROM data and connects to the target disk. Upon successful connection the target disk mounts as /dev/sda, which makes it appear as a local disk.

NOTE: If you have any local SCSI disks attached, then those will be listed first (as /dev/sda, /dev/sdb...) and the iSCSI target disks will be listed last (for example, /dev/sdc). Ensure that you choose the iSCSI target disk (/dev/sdc) for partitioning and not the local disk.

5. After the modules are successfully loaded, the installation continues by copying sources from the NFS server. To automate the complete install, see the SUSE documentation for Auto-Installation using AutoYast.

PXE installations of iSCSI boot targets

If the system to be installed contains a network interface card (NIC) with Pre-Execution Environment (PXE) support, you may direct install over PXE.

The following steps must be performed to prepare for a PXE installation:

1. Configure the NFS server to export the installation source.
2. Configure the TFTP server necessary for PXE booting.
3. Start/enable the TFTP service.
4. Configure the DHCP.

5. Configure the NFS server to export the Driver Diskette images and the iSCSI boot/Configuration related code and utilities. See "NFS installations of iSCSI boot targets (on page 17)".
6. On the PXE server execute the following:

```
# vi /tftpboot/linux-install/pxelinux.cfg/default
```

 In this file add the following lines:

```
label <number>
kernel <path-to-OS-distro-dir>/boot/loader/linux
append initrd=<path-to-OS-distro-dir>/boot/loader/\
initrd.img load_ramdisk=1 autoyast=nfs:<nfs ip>:/opt/hp/\
iboot_install/scripts/autoinst.xml \
install=nfs:<nfs ip>:<path-to-OS-distro-dir>
```

 Note that if the LOMs are not multifunction adapters, add the following argument to the boot options: "insmod=bnx2"
7. Optional step: Modify /tftpboot/linux-install/mgs/boot.msg to use custom boot messages.
8. Power up the server.
9. Verify that the Option ROM initialized successfully and is able to log in successfully onto the target disk. This can be confirmed by looking at the iSCSI option ROM messages during POST.
10. Press **<F12>** for PXE installation when prompted.
11. Enter the label number (specified in the above section) at the PXE boot prompt and press the **Enter** key. The installation will start pulling the installation sources from the NFS server.

Uninstalling iSCSI install RPM

The Linux iSCSI boot driver cannot be uninstalled on an iSCSI booted server.

1. Prior to removing the linux-iscsi-boot RPM, stop all iSCSI sessions, stop the iscsid daemon and unload the following iscsi modules

```
iscsi_sfnet
scsi_transport_iscsi
iscsi
```
2. To uninstall the iSCSI install RPM execute the following:

```
#rpm -e linux-iscsi-install
```

Performing an iSCSI boot

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Booting from the iSCSI drive

The following sequence describes the iSCSI boot sequence.

1. On power up, system BIOS detects the iSCSI boot option ROM
2. iSCSI boot option ROM obtains iSCSI boot parameters from iLO/RILOE memory using the iSCSI environment variables
3. iSCSI boot option ROM establishes an iSCSI session with the iSCSI targets defined in the environment variables
4. Upon session creation, iSCSI boot option ROM establishes the iSCSI target as the local hard disk
5. System BIOS continues to perform I/O requests that are translated to iSCSI messages by the iSCSI boot option ROM

bnx2 driver update

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Upgrading the bnx2 driver

If a newer version of the bnx2 driver needs to be installed on an iSCSI booted system, execute the following steps.

For RedHat installations:

```
# rpm -e bnx2-<old version>
# rpm -ivh bnx2-<new version>.src.rpm
# rpmbuild -bb /usr/src/redhat/SPECS/bnx2.spec
# rpm -ivh --force /usr/src/redhat/RPMS/<arch>/bnx2-<new version>.rpm
# cd /opt/hp/iboot/bin
# ./iboot_config --config /opt/hp/iboot/etc/iboot.conf -r
# reboot
```

Reboot the system.

For SLES installations:

```
# rpm -e bnx2-<old version>
# rpm -ivh bnx2-<new version>.src.rpm
# rpmbuild -bb /usr/src/package/SPECS/bnx2.spec
# rpm -ivh --force /usr/src/package/RPMS/<arch>/bnx2-<new version>.rpm
# cd /opt/hp/iboot/bin
# ./iboot_config --config /opt/hp/iboot/etc/iboot.conf -r
# reboot
```

Reboot the system.

NOTE: Do not issue the 'rmmod bnx2' command. This command will result in system hang.

Troubleshooting

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Using a diagnostic monitor for troubleshooting

If the client is not able to boot from the target server and the problem is not discernable from the immediately available information, you may need to use a network monitor that is capable of parsing the iSCSI protocol to troubleshoot the information.

If the iSCSI target is software running on a server, you may be able to run a software network monitor such as Ethereal directly on the target system. Otherwise, you may need to configure a network switch with port mirroring and direct the mirrored packets to a port where either a hardware or software network monitor can be attached.

Target connection problems

Symptoms:

The initiator is unable to make a connection to the target.

Possible causes:

- The initiator and target are not connected to the same network
- The initiator and target are not in the same VLAN (if any)
- The IP configurations for the initiator and target are not correct
- The initiator's boot path information is not correct
- The target service is not running on the target server

Target login problems

Symptoms:

The iSCSI initiator is able to connect to the target but is unable to log in successfully.

Possible causes:

- The initiator is not configured with the right target name
- The initiator is not configured with the right target IP address
- The initiator is not configured with the right initiator name

- The initiator and target are not configured for the same authentication method
- The initiator and target are using CHAP or Mutual CHAP authentication so they may not be configured with matching user name and secret(s)
- If the target implements some form of Access Control Lists (ACL), the target may not be configured to allow it on the initiator

LUN access problems

Symptoms:

The initiator is able to connect to and log in to the target, but the system doesn't see a disk present (it attempts to boot from an internal disk or PXE).

Possible causes:

- The initiator is not configured with the correct LUN from which to boot (Some targets start numbering at 1 instead of 0)
- The target is not configured to allow access to the specified LUN by the initiator

OS problems

Symptoms:

The initiator is able to connect to and log in to the target and the system sees the disk, but you are unable to install the OS.

Possible causes:

- There are multiple NC37xx adapters enabled in the system
- The drivers are not being loaded in the right order during installation
- The target disk provided is not large enough
- The initiator is not configured with the correct LUN from which to boot (some targets start numbering data devices at 1, not 0)
- The target is not configured to allow access to the specified LUN by the initiator

Symptoms

Post installation fails to read the iSCSI install scripts from the iLO virtual floppy.

Resolution

On the iLO web page select **Virtual Devices > Virtual Media** and then select **Virtual Media Applet**. In the Virtual Floppy/USB Key box, disconnect and reconnect the Virtual Floppy Drive by first clicking **disconnect** and then clicking **connect**.

Symptoms

After successful OS installation, the server will not boot Linux from the iSCSI target.

Resolution

Check the RBSU settings for the adapter that is connected to the target. On some servers and with some versions of the BIOS, you may have to enable iSCSI boot or modify the boot controller order.

Symptoms

During post-install of the OS, the bnx2 rpm fails to install or the kernel tree cannot be set up.

Resolution

The kernel source rpm must be installed during the OS installation so that the bnx2 rpm and the iscsi-boot rpm can be built during post install. Choose the kernel source rpm when installing the OS.

Symptoms

On some BL685c servers with more than 4 Gb of memory, the system fails to finish the boot sequence after a SLES 9 install.

Resolution

Add the parameter "numa=off" to the list of parameters given for "Boot options" or in the PXE configuration file, depending on the type of install.

Symptoms

During a SLES 9 install over a previous RH4 install a message of "cannot create swap partition" or "running low on disk space" appears.

Resolution

Reboot and restart the install. The problem will not occur on subsequent installs.

Technical support

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Before you contact HP

Be sure to have the following information available before you call HP:

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

HP contact information

For the name of the nearest HP authorized reseller:

- In the United States, see the HP US service locator webpage (http://www.hp.com/service_locator).
- In other locations, see the Contact HP worldwide (in English) webpage (<http://welcome.hp.com/country/us/en/wwcontact.html>).

For HP technical support:

- In the United States, for contact options see the Contact HP United States webpage (http://welcome.hp.com/country/us/en/contact_us.html). To contact HP by phone:
 - Call 1-800-HP-INVENT (1-800-474-6836). This service is available 24 hours a day, 7 days a week. For continuous quality improvement, calls may be recorded or monitored.
 - If you have purchased a Care Pack (service upgrade), call 1-800-633-3600. For more information about Care Packs, refer to the HP website (<http://www.hp.com>).
- In other locations, see the Contact HP worldwide (in English) webpage (<http://welcome.hp.com/country/us/en/wwcontact.html>).

Acronyms and abbreviations

BIOS

Basic Input/Output System

CHAP

challenge authentication protocol

DHCP

Dynamic Host Configuration Protocol

EFI

extensible firmware interface

HBA

host bus adapter

iLO

Integrated Lights-Out

IP

Internet Protocol

IPL

initial program load

iSCSI

Internet Small Computer System Interface

LAA

locally administered address

LUN

logical unit number

NFS

network file system

PDU

power distribution unit

PXE

Preboot Execution Environment

RDP

Remote Desktop Protocol

RILOE

Remote Insight Lights-Out Edition

ROM

read-only memory

SAN

storage area network

SSL

Secure Sockets Layer

TCP

Transmission Control Protocol

UNDI

Universal Network Driver Interface

VLAN

virtual local-area network

XML

extensible markup language