iSCSI Boot User Guide

For use with Chelsio T3-based Hardware

iSCSI Boot Release Version 2.0

Chelsio Communications, Inc.
www.chelsio.com

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1 INTRODUCTION

Thank you for choosing Chelsio Communications as the provider of your iSCSI boot HBA. This document describes the installation, use, and maintenance of Chelsio's iSCSI boot HBA.

iSCSI boot is used for booting computers over an Ethernet network using a network interface adapter such as Chelsio's T3-based Network Interface Cards (NICs).

The iSCSI boot solution is a combination of hardware and software. The hardware consists of one of the wide range of Chelsio's T3-based HBAs including various versions of the S302, S310, S320, N302, N310 for regular servers, and the IBM & HP Mezzanine cards for blade servers. The HBAs offer 1Gb or 10Gb speeds, PCIe or PCI-X system connectivity, one or two network ports, and protocol acceleration.

The software consists of a BIOS Option ROM iSCSI initiator and the Operating system device drivers. There are also a BIOS level configuration utility and flash / installation utilities for DOS or Windows.

In combination, the solution can boot an OS from an iSCSI Target LUN over a network using the iSCSI protocol over a regular Ethernet + TCP/IP network. The BIOS Option ROM resides on the flash memory of the T3-based HBA from where it is loaded by an x86 system BIOS during power on initialization. The initiator connects to the iSCSI target that it is configured with, and provides the configured disk / LUN to the system. This solution does not use or rely on PXE or any other pre-boot protocols besides iSCSI (RFC 3720).

Before booting an OS from an iSCSI disk, the OS must be installed to the iSCSI disk. This document describes that process for both Windows and Linux. Other OS installations are possible given the architecture uses the iBFT, described next.

iSCSI BOOT FIRMWARE TABLE (IBFT)

This solution requires an iSCSI initiator handoff from the Chelsio Option ROM initiator to the initiator running on the OS. The handoff is done through a mechanism called the iSCSI Boot Firmware Table, or iBFT. This is a specification created by Microsoft for the purpose of passing parameters from a pre-boot initiator to the OS-based initiator. It is rapidly being adopted as a de facto standard. Besides the Microsoft boot initiator, Linux's Open-iSCSI initiator, Open Solaris initiator and Chelsio's Linux iSCSI initiator have embraced the specification with others following.

FEATURES

Expanded T3 NIC Support

- TOE Adapters – S Series (S310, S320, S302, IBM & HP Mezzanine cards)
- NIC (non-TOE) Adapters – N Series (N302, N310, N320)

Flash Utilities to install iSCSI boot Option ROM to Chelsio adapters

- Utility available for Windows and DOS
- Also installs adapter firmware if necessary

iSCSI Initiator Features

- RFC 3720 Compliant
- CHAP Support, including mutual / bi-directional authentication
- Target redirection
- Port failover (on 2-port card)

TCP/IP Features

- DHCP for NIC IP configuration
- iSCSI Boot DHCP Options support, as specified in RFC 4173

HARDWARE REQUIREMENTS

- Chelsio T3-based Adapter – This includes various versions of the S302, S310, S320, N302, N310, N320, and the IBM & HP Mezzanine cards.
- A system with x86 or x86_64 based processors
- A system BIOS compliant with both the BIOS Boot Specification (BBS) and POST Memory Management (PMM). A vast majority of systems shipped today are compliant with these
- Appropriate system bus connectivity for the Chelsio adapter selected (PCIe / PCI-X / Mezzanine slot for blade servers)
- An iSCSI Target which provides the disk storage
- Networking components for setting up the network connection between the iSCSI boot system and the target.

iSCSI BOOT PROCESS

iSCSI Boot involves 2 steps:

1. The Option ROM based initiator provides the bootable disk to the System's BIOS, by connecting to the iSCSI Target.

2. Once the BIOS starts booting the disk, the boot loader (for example GRUB or NTLDR) loads the kernel and drivers of the Operating system, and the Operating System's iSCSI initiator takes over. The transition of configuration data between the initiators is done through the iSCSI Boot Firmware Table (iBFT) parameters.

The following Operating Systems support iBFT and have successfully been tested with Chelsio's iSCSI boot solution:

- Microsoft Windows Server 2003 (x86 and x64 versions): MS boot initiator (via cloning)
- Microsoft Windows Server 2008 & Vista (x86 and x64 versions): MS initiator
- Red Hat Enterprise Linux 5 U2 & U3 (x86 and x64 versions): Open-iSCSI initiator and Chelsio iSCSI initiator
- Red Hat Enterprise Linux 4 U8 (x86 and x64 versions): Chelsio iSCSI initiator
- SuSE Linux Enterprise Server 10 SP2 (x86 and x64 versions): Chelsio iSCSI initiator
- SuSE Linux Enterprise Server 11 (x86 and x64 versions): Open-iSCSI initiator (with Chelsio driver disk for NIC driver) and Chelsio iSCSI initiator

Chelsio's Option ROM based iSCSI initiator is active during the initial System initialization process before an OS is started. This initiator will provide disk services until the OS related files are read from the disk and the OS kernel starts executing.

The OS-based initiator depends on the HBA driver to be available and loaded to activate the Network Interface of the HBA. This means that the HBA driver should be a driver available during the initial Kernel load, either as a driver in the initrd image on Linux systems or as a driver that is configured to load during boot on Windows.

Changes to the iSCSI configuration should be done in the Option ROM based initiator, which are automatically propagated to the OS initiator through the iBFT parameters.

PACKAGE CONTENTS

The software supplied is in a .zip file. In it are the following:

a. iSCSI initiator Option ROM based software binaries (4 files: iboot3XX.rom)
b. DOS based Chelsio Flash Utility (cfu.exe)
c. Chelsio iSCSI initiator for Linux driver disk images for RHEL 4 U8, RHEL 5 and CentOS 5.2 and 5.3 and SLES 10 SP2
d. chbootcli utility for Linux, to install and configure the iSCSI Option ROM
e. Windows 2003 cloning utility (bootprep.exe)
f. This document (iSCSI_userguide.pdf)
g. The errata (errata.txt)
h. Chelsio End User License Agreement (EULA.txt)

ABOUT THE EULA

Use of the Option ROM iSCSI boot software and Chelsio's iSCSI initiator for Linux implies acceptance of the terms in the Chelsio End User License Agreement.

2 INSTALLING THE iSCSI OPTION ROM

The Option ROM and firmware must be on the T3-based Chelsio adapter before iSCSI boot can be used. The iSCSI boot Option ROM binary is not installed on the Chelsio adapter (the PXE Option ROM is installed by default). You cannot install or use the PXE and iSCSI Option ROMs simultaneously on the same adapter. The firmware binary is pre-installed on the adapter but if it needs an upgrade please follow the procedure described in the section below.

You can install the Option ROM and/or the firmware to the adapter in Windows or from DOS

Choosing the iSCSI boot Option ROM file

There are four Option ROM files in the iSCSI boot software package but only one of the four is to be installed onto a particular adapter model. The following table describes the file to be used during the installation process:

Chelsio adapter model	# of ports	Link speed	Option ROM filename	PCI Device ID
N310E & S310E-CR (except the XFP+ version of the N310)	1	10 GigE	iboot30.rom	30h
N320 & S320-CR	2	10 GigE	iboot31.rom	31h
S302	2	1 GigE	Iboot32.rom	32h
N310 XFP+ version	1	10 GigE	Iboot35.rom	35h
S320-LP CR	2	10 GigE	Iboot36.rom	36h
N320E-G2-CR	2	10 GigE	Iboot37.rom	37h

If the wrong file is installed to an adapter no harm is done. Simply re-install correct file to the adapter. Attempting to use iSCSI boot with a mis-matched Option ROM file on the card will result in the Option ROM not executing, and the boot option not appearing in the system BIOS.

Firmware version requirements

The firmware version needed by the device driver for proper operation is dependent on the OS and the driver version used. When installing or booting Linux over iSCSI, the correct firmware needs to be present before starting the OS installation.

Non-Linux users: For non-Linux iSCSI boot scenarios, such as Windows, the device driver will automatically update the firmware, hence there are no requirements for the firmware version to be checked.

Linux users: To install or boot from an iSCSI disk successfully, the OS needs to be able to use the Chelsio HBA during the installation or during boot. The correct version of firmware is required for the '*cxgb3*' driver in the Linux driver disk, or the inbox '*cxgb3*' driver in the Linux distribution to load and use the HBA.

Warning: If you use the same adapter to boot in different Operating systems with different versions of the Chelsio driver for the adapter, it may upgrade / downgrade the firmware revision on the adapter. This may cause the adapter to fail to boot successfully unless all the drivers on all the different OS's being used, use the same version of the firmware.

Below are a set of tables that relates the firmware version requirement for each of the supported Linux iSCSI Boot distributions.

Operating system	Chelsio 'cxgb3' driver type	Firmware version required
RHEL 4 U8	Chelsio supplied driver disk	7.7
RHEL 5 U1	Inbox driver	4.0.0
RHEL 5 U2	Inbox driver	5.1.0
RHEL 5 U3	Inbox driver	6.0.0
Fedora Core 8	Inbox driver	4.3.0
SLES 10 SP2	Chelsio supplied driver disk	7.7
SLES 11	Chelsio supplied driver disk	7.7
RHEL 5 U2	Chelsio supplied driver disk	7.7
RHEL 5 U3	Chelsio supplied driver disk	7.7

Warning: If you update or change the cxgb3 driver on a Linux OS booted over iSCSI, please ensure that you update the firmware on the adapter immediately and update the initrd image to use the new driver using 'mkinitrd', **before rebooting the system**. Otherwise it will fail to boot, due to the firmware and driver version mismatch. Refer the driver update procedure section for Linux OS installations.

If the driver used for the T3-based Chelsio adapter is different from the above distribution versions then the driver may have been obtained either from the Chelsio download page or kernel.org. The following shows firmware for recommended drivers from the Chelsio site:

Drivers on Chelsio website	
Driver name	**Firmware version required**
cxgb3toe-1.3.1.9	7.7
cxgb3toe-1.2	7.1.0
cxgb3toe-1.1.022	6.1.0
cxgb3toe-1.0.146	6.0.0

The following shows firmware for drivers from kernel.org:

kernel.org drivers	
Kernel version	**Firmware version required**
2.6.28	7.0.0
2.6.27	7.0.0
2.6.26	6.0.0
2.6.25	5.0.0
2.6.24	4.6.0
2.6.23	4.3.0
2.6.22	4.0.0
2.6.21	3.3.0

Once the firmware version needed is determined from the above tables then one of the flash installation utilities can be used to update the adapter.

Download the required firmware file from the Chelsio website, at www.chelsio.com under the Downloads section.

Installation tool parameters

The following parameter descriptions apply to the syntax in the flash tools described below for Windows, Linux and DOS

- **<Adapter Number>** – 0 (zero) for the first Chelsio adapter in the system, 1 (one) for the second, 2 (two) for the third, etc. For the DOS flash tool only this parameter can be `all` which will affect all Chelsio T3-based adapters of the same type in the system.
- **<Adapter eth# device name>** - This is the eth NIC device in Linux which corresponds to the Chelsio adapter you want to flash the firmware for. The co-relation between the two can be found by viewing the /proc/net/cxgb3/devices file.
- **<Option ROM Image>** – The Option ROM image file that comes in the iSCSI boot download package. Use the iSCSI boot Option ROM guide above for determining the correct file.
- **<FW Image>** – The firmware image file that can be downloaded from the Chelsio download site. Use the firmware guide above for determining the correct file.

INSTALLING BOOT SOFTWARE FROM WINDOWS

The Windows driver package has a utility called cxgen_tool.exe that can be used to flash both the iSCSI boot Option ROM and firmware binary images to the adapter. To proceed, install the card in the Windows system and install the Chelsio drivers for the adapter. The Windows drivers can be downloaded from Chelsio's website at www.chelsio.com in the Downloads section.

Installing the Option ROM

The command to flash the Option ROM is:

```
> cxgen_tool.exe -d <Adapter Number> -p <Option ROM Image>
```

Installing the firmware

In Windows, the firmware is automatically updated when the driver loads. The command to flash the firmware manually is:

```
> cxgen_tool.exe -d <Adapter Number> -p <FW Image>
```

INSTALLING BOOT SOFTWARE FROM LINUX

The iSCSI boot package has a utility called chbootcli that can be used to flash the iSCSI boot Option ROM binary image to the adapter. To proceed, install the card in the Linux system and install the Chelsio drivers for the adapter. The Linux drivers can be downloaded from Chelsio's website at www.chelsio.com in the Downloads section.

Installing the Option ROM

The command to flash the Option ROM is:

```
> chbootcli -u <Adapter Number> <Option ROM Image>
```

Installing the firmware

The firmware is automatically updated on loading Chelsio's 'cxgb3' linux driver for the adapter. There is a cxgbtool utility in the Linux driver package under the tools directory, which can flash the firmware. The command to flash the firmware is:

```
> cxgbtool <Adapter eth# device> loadfw <FW Image>
```

INSTALLING BOOT SOFTWARE FROM DOS

The Flash utility (cfu.exe) in the iSCSI boot download package can be used to flash both the iSCSI boot Option ROM and the firmware to the adapter. The utility can only be used from a DOS prompt on a bootable DOS floppy disk and not from a Windows DOS command box.

Creating a bootable DOS diskette

A bootable floppy DOS diskette can be made from within the Windows OS or from within Linux by use of a free downloadable utility such as FreeDOS.

1. **Windows** – If you have a Windows system you can create a DOS bootable floppy. Right-click on the floppy drive in "My Computer" and select "Format". Now choose to create a DOS bootable disk.

2. **Linux** – For Linux users, a free open source DOS distribution is available from www.freedos.org. There are 2 options to obtain a DOS bootable OS. You can download the LiveCD ISO image, and burn it to a CDROM. A link for a floppy diskette image is also provided. The floppy diskette image can be written to a floppy with the 'dd' program with the following command:

   ```
   > dd if=<floppy.img> of=/dev/fd0
   ```

   `/dev/fd0` is normally the first floppy drive in a Linux system but this may vary by system.

   Note: Chelsio is not responsible for any consequences of downloading or using utilities that are available on the Internet, such as FreeDOS.

Copy the appropriate Option ROM image file and the cfu.exe utility file to the floppy diskette. Also copy the appropriate firmware file to the floppy if needed. Then boot the system with the adapter using the bootable DOS diskette.

Installing the Option ROM

The command to flash the Option ROM is:

```
> cfu.exe –u <Option ROM Image> -d <Adapter Number>
```

The command to flash the Option ROM for all cards of the same type in the system is:

```
> cfu.exe –u <Option ROM Image> -d all
```

Installing the firmware

The firmware can be flashed with the same cfu.exe utility. The command is:

```
> cfu.exe –f <FW Image> -d <Adapter Number>
```

The command to flash the firmware for all cards in the system is:

```
> cfu.exe –f <FW Image> -d all
```

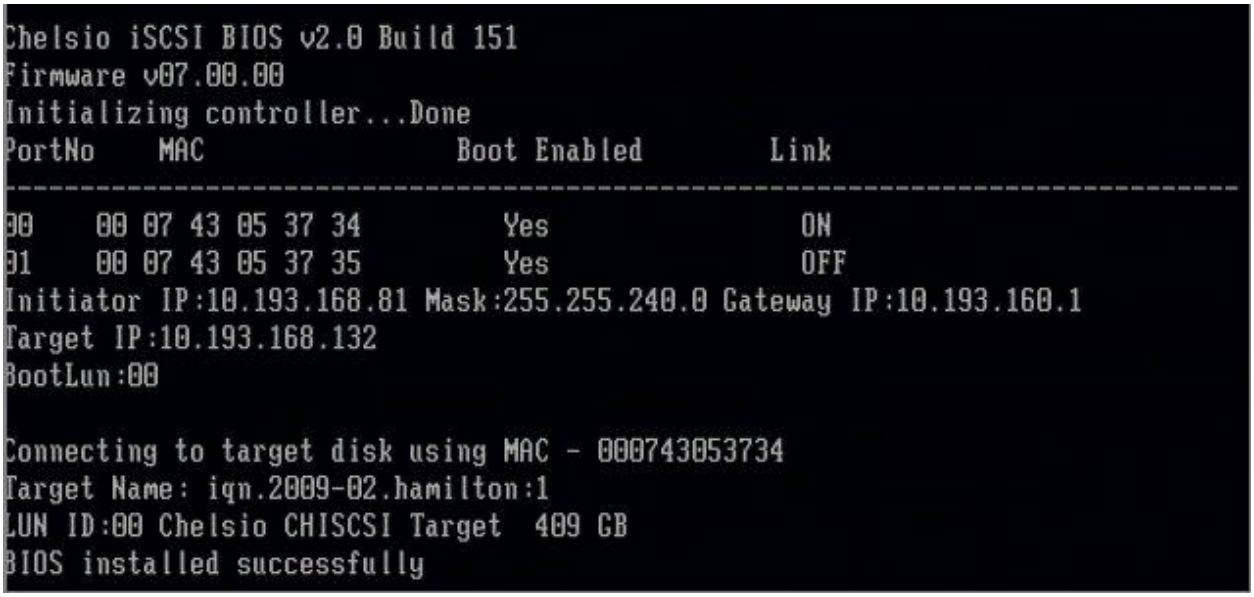
3 OPTION ROM CONFIGURATION

The next step for setting up iSCSI boot is to configure the Option ROM software. It includes a configuration application that's used for setting all of the networking and iSCSI parameters necessary.

ENTERING THE CONFIGURATION UTILITY

After the adapter has the Option ROM flashed, restart the system. During System BIOS initialization or Power On Self Test (POST) a banner can be seen for the Chelsio Option ROM initiator. It prompts to press the [Ctrl] + [E] key combination to enter the configuration utility. It must be pressed within 3 to 4 seconds in order to enter the utility. The Option ROM configuration utility should appear. Alternatively, to skip the iSCSI boot Option ROM from executing entirely, the [Ctrl] + [Q] key combination can be used prior to the banner being displayed.

Screenshot of the iSCSI Boot Option ROM executing during system BIOS initialization.



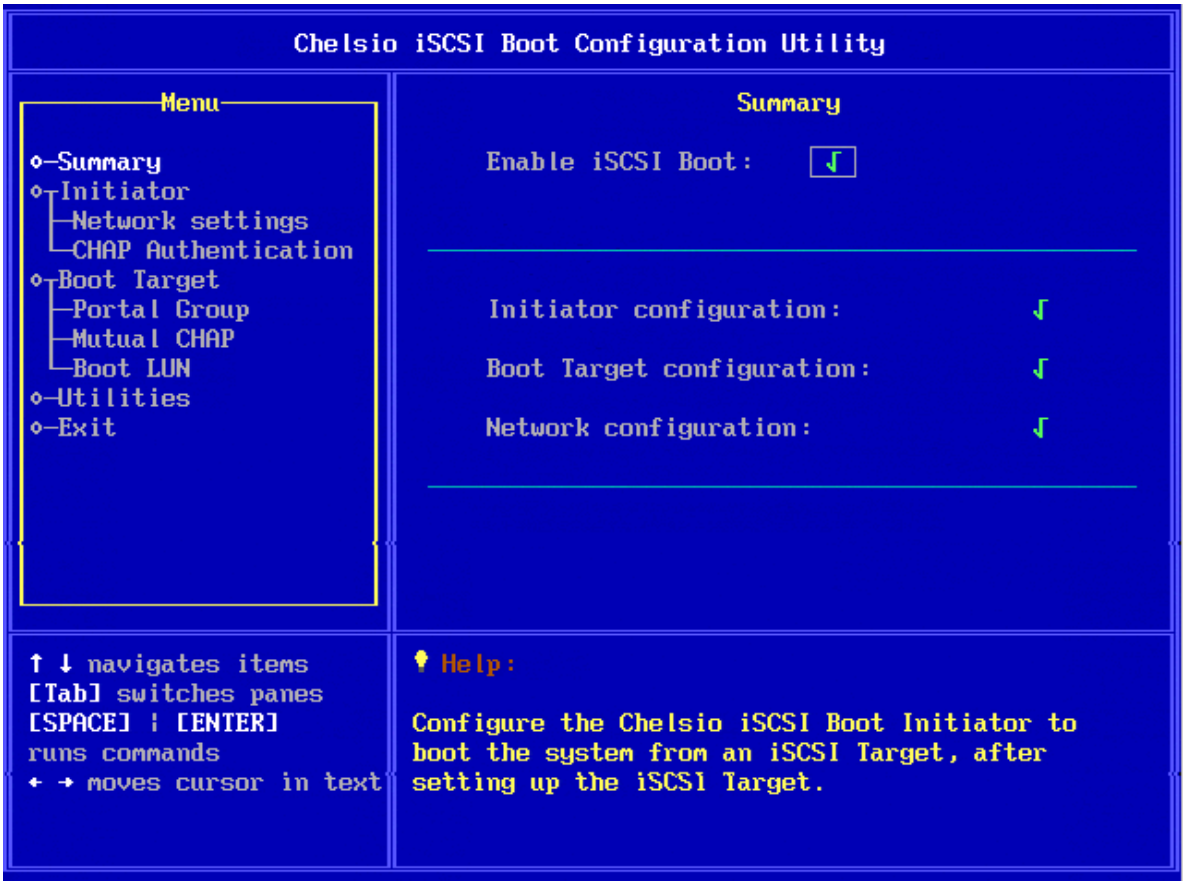
Screenshot of successful iSCSI boot Option ROM load.

THE OPTION ROM MENU LAYOUT & NAVIGATION

The configuration utility is organized into 5 sections as given below:

Chelsio banner	
Menu pane	**Configuration pane**
Keyboard navigation tips	**Help and command status**

For switching between the menu pane and the configuration pane use the [Tab ↹] key. To navigate between menu items or fields within the configuration pane, use the up [↑] or down [↓] arrow keys on the keyboard.



Screenshot of the summary page of the BIOS level configuration utility.

On highlighting a menu item, its configuration page shows up on the right side.

The menu structure is in five main sections:

1. **Summary** – The status of the current configuration is displayed here, with a green tick if completed. It also allows iSCSI boot to be disabled on this HBA.
2. **Initiator** – The initiator's configuration data is set here including network setting, iSCSI settings, and CHAP settings.
3. **Target** – The configuration parameters of boot target are set here. This includes networking, iSCSI, and CHAP settings. The target LUN to use for boot is also configured here.
4. **Utilities** – Currently a ping utility is available for testing network connectivity.
5. **Exit** – Allows for the saving of the configuration and exiting the utility.

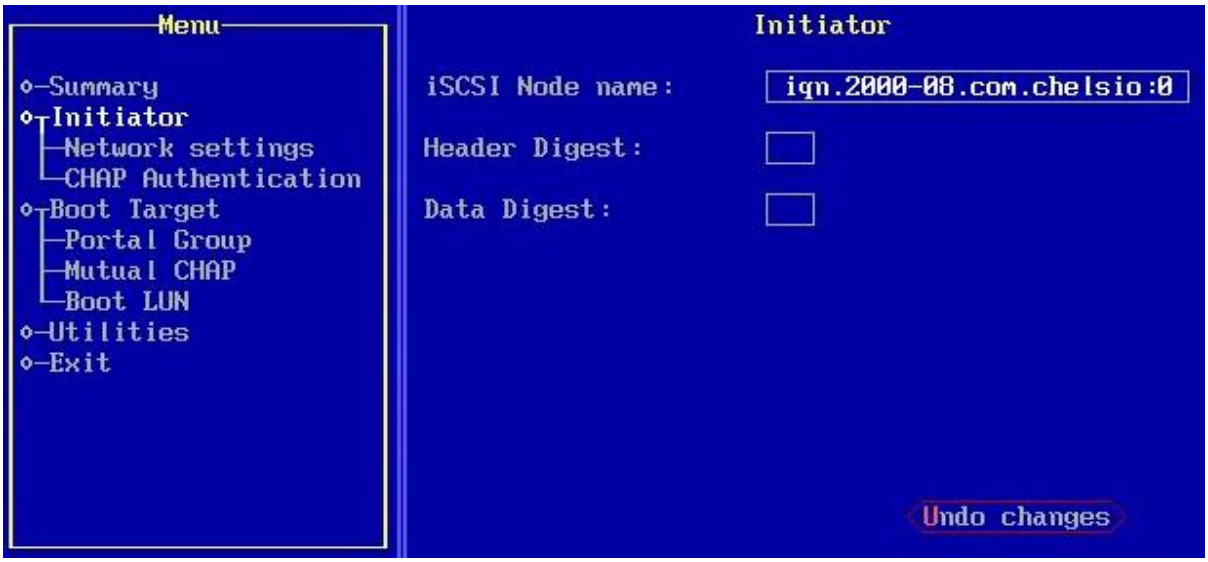
CONFIGURATION OPTIONS

The configuration options are divided into 2 sections, Initiator configuration, and Boot Target configuration.

Initiator Configuration

iSCSI Configuration

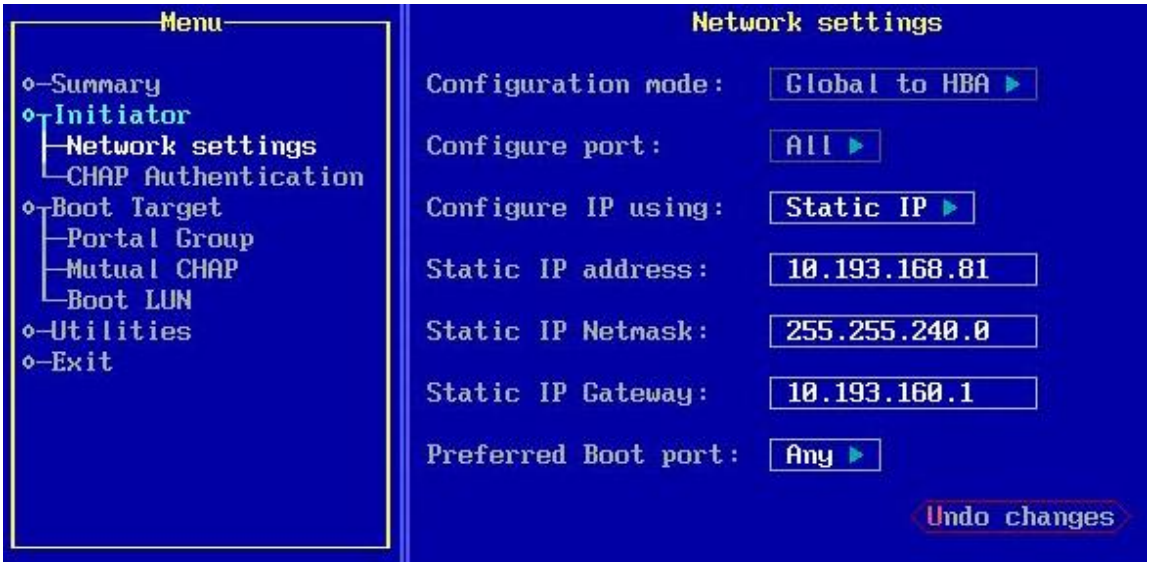
Initiator configuration consists of naming the HBA initiator, using a iSCSI IQN format name, eg.: iqn.2008-07.com.chelsio.bootinitiator. A suggested initiator name is pre-filled, based on the MAC address of port 0 of the HBA. You can enable usage of Header and Data Digests / CRC32C checksumming of all iSCSI traffic. This also requires the target to support this feature of iSCSI. Note: Open iSCSI on Linux does not get automatically configured with Data Digest through iBFT, and fails to login to the target if digests are enforced.



Screenshot of initiator configuration page in BIOS level configuration utility.

Network settings

The Networking configuration of the HBA allows for Static IP addressing or obtaining the IP address and related configuration from a DHCP server. The HBA currently supports only IPv4 networking. The default gateway needs to be specified, in Static IP mode, if the Target is not on the same IP network. DHCP needs to be used here, if choosing to obtain the boot target settings via DHCP, using the DHCP option as specified in RFC 4173. This option can be enabled in the "Boot target" section.
If you wish to use either of the ports on a 2 port card, set the "Preferred boot port" to "Any". Otherwise if you wish to only use a particular port at any time, you may specify the port number.



Screenshot of HBA network configuration page in BIOS level configuration utility.

CHAP Authentication

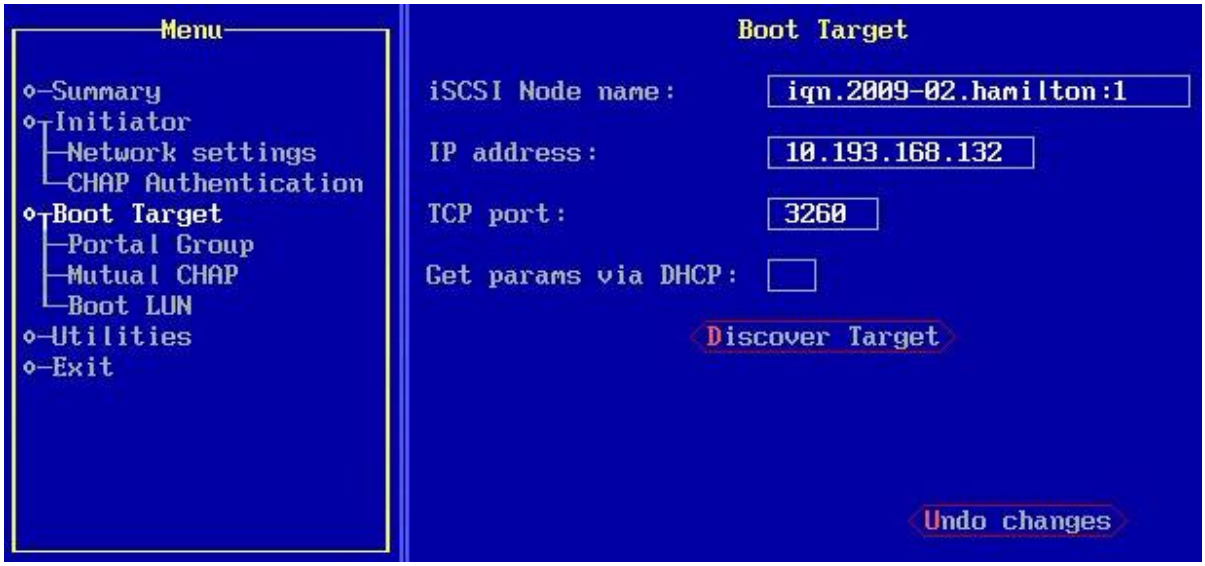
CHAP authentication can be used for securing access to the iSCSI target. One-way CHAP authenticates the initiator to the target, where the initiator proves its credentials. Mutual or two-way CHAP includes one-way CHAP, and authenticates the target to the initiator, ie. the target proves its credentials to the initiator as a valid target.
The CHAP password needs to be 12 to 16 characters in length.

Screenshot of initiator CHAP authentication parameters page.

Boot Target configuration

Discover the target

Specify the target IP address and TCP port for iSCSI which is usually port 3260. On entering the IP address and TCP port, you can run the "Discover Target" command provided in the same page, by highlighting it and pressing the [Enter ↵] key. This tests connectivity to the target from the HBA, and automatically fills the target name in the “iSCSI Node name” field.



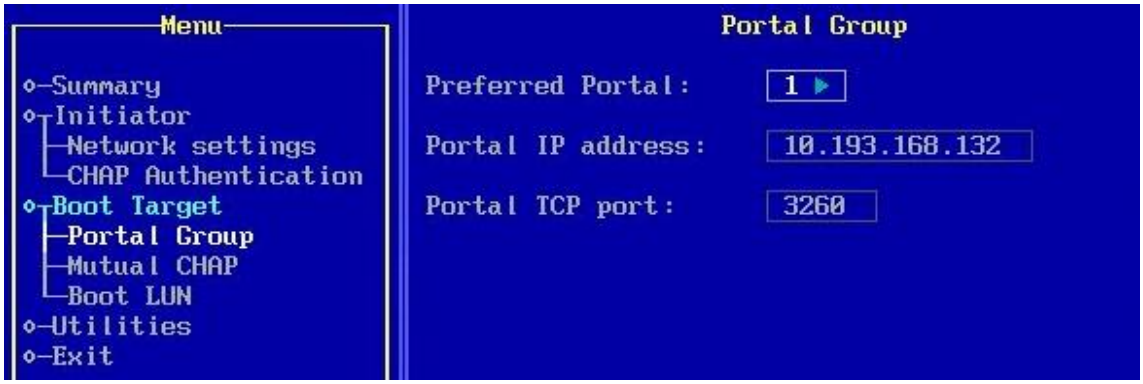
Screenshot of the boot target configuration page in the BIOS level configuration utility.

DHCP options method of obtaining target settings

DHCP options are supported as specified in RFC 4173 for finding the boot target using the DHCP server response. Do not configure any other target options if you are enabling the "Get params via DHCP" option. Ensure that your DHCP server has this option set correctly for the specific MAC address of the HBA. Some tips on configuring a DHCP server is provided in its section below.

Portal Group Selection

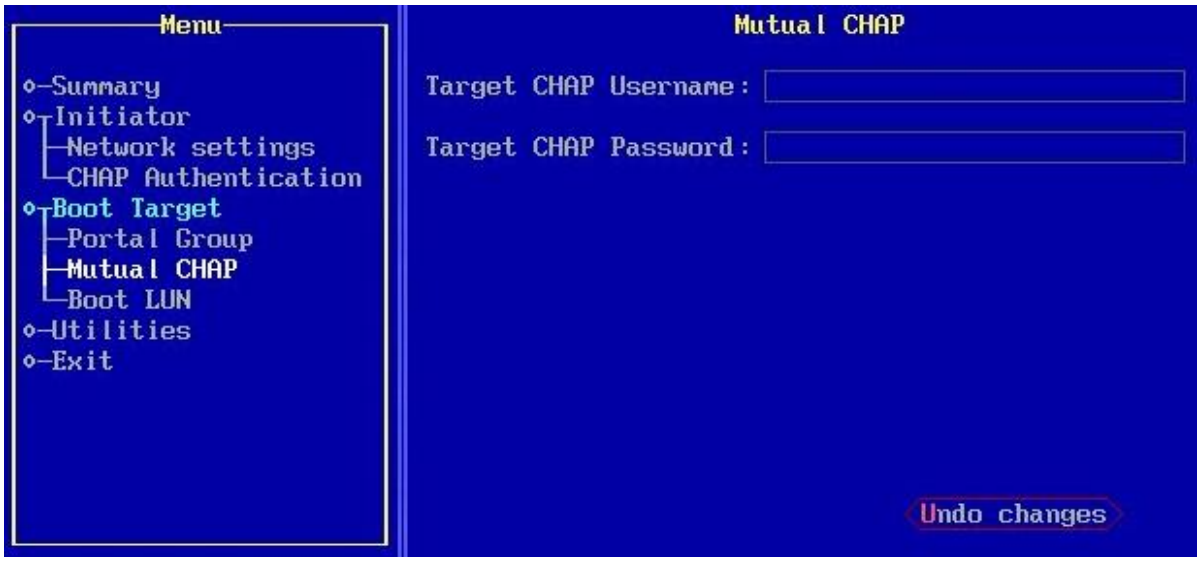
With the target settings set and the target discovered, you can choose the target portal group, which is a combination of the IP address and TCP port of the target. There can be multiple target portal groups defined on the target, in which case you will need to choose which portal group to use. The default is to use the first portal group provided by the target in the list. Use [Enter ↵] or [SPACE] to navigate the list.



Screenshot of the portal group / target network settings page in the configuration utility.

Mutual CHAP Authentication

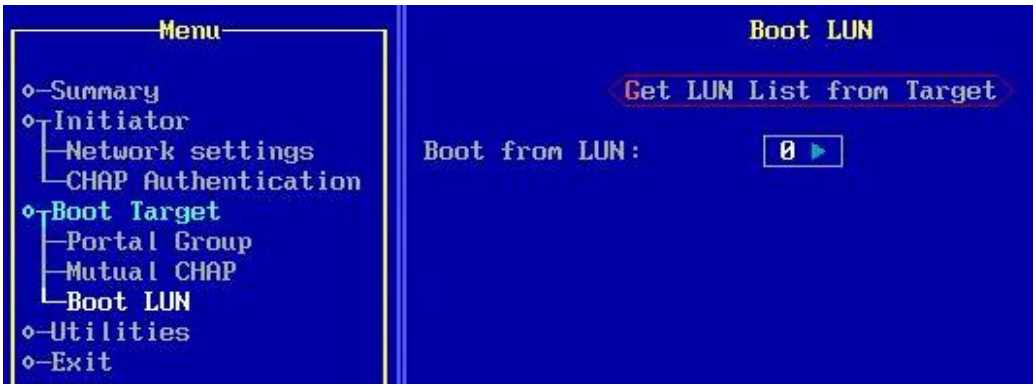
If Mutual or two-way CHAP is enabled, the Target's CHAP settings need to be configured too. CHAP requires a minimum of 12 characters for the secret / password.



Screenshot of the target CHAP parameters page in the BIOS level configuration utility.

Boot LUN Selection

If there are multiple LUNs available on the target, you need to select the LUN to boot from. Run the "Get LUN List" command provided which will allow the initiator to login to the target and query for the list of LUNs. On completion of this command you can choose the LUN you wish to use for booting the system. The “Get LUN List from Target” command also allows you to verify if all settings specified till now are valid, since it connects to the target and establishes a full iSCSI session, transferring data successfully.



Screenshot of the target LUN selection page.

Warning:
Please run the “Discover Target” command before running the “Get LUN List from Target” command, or before using the ping utility described below. You can ping a different IP address than the one used for “Discover Target”.

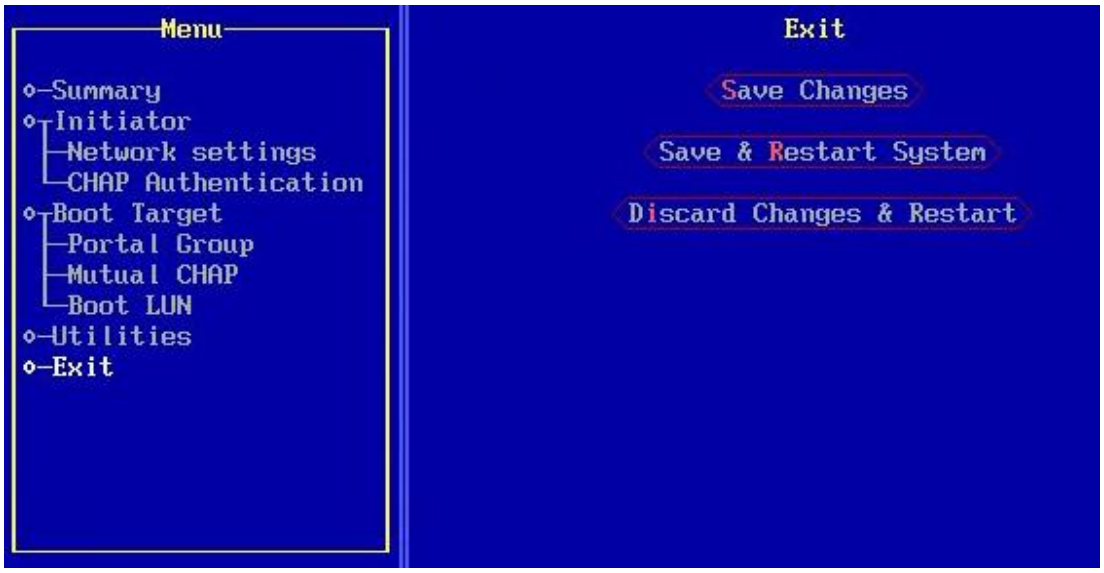
Troubleshooting with the “ping” utility

If the discovery or “Get LUN List from Target” commands fail, check connectivity to the target using the ping utility.

Screenshot of the ping utility in the BIOS level configuration utility.

Saving and exiting the utility

Once all settings have been set, navigate to "Exit" in the menu and choose the "Save & Restart System" command. Now you can begin the OS installation / boot. If you wish to discard all changes made, choose “Discard Changes & Restart”.



Screenshot of the exit page in the BIOS level configuration utility.

LINUX COMMAND LINE CONFIGURATION UTILITY (CHBOOTCLI)

This utility allows you to configure the Option ROM based initiator settings from within Linux. Run the utility at the command line, and it will provide usage instructions and parameters.

If you are making changes to the Option ROM initiator’s network settings, ensure that you make the same changes to the iSCSI-booted OS network settings. After restarting, the changes would take effect for both.

CONFIGURING THE TARGET

The target needs to be configured with the LUN for this initiator, and any CHAP settings or ACLs / permissions / LUN mapping that are required to access the LUN. The target should conform to the iSCSI standard RFC 3720. Other than this, there is no special requirement for the iSCSI Target.

OPTIONAL DHCP SERVER CONFIGURATION

DHCP Options support, as specified in RFC 4173, for finding the Target using the DHCP server response, is supported by the Option ROM initiator. The DHCP "root path" option needs to be configured correctly as per the RFC.

An extract from the RFC is provided below for reference:

```
The option field consists of an UTF-8 [Yergeau98] string.  The string
has the following composition:

"iscsi:"<servername>":"<protocol>":"<port>":"<LUN>":"<targetname>
```

Note: The servername is the IP address of the Target. The value for protocol is 6, for TCP, and port is the Target TCP port number (by default 3260). The LUN number can be an integer number, 0 and above. Target name is the IQN name of the iSCSI Target. Ensure that all parameters are specified and valid, in the DHCP server configuration. **Do not** use the double quotation marks shown above.

4 OS INSTALLATION TO CHELSIO HBA

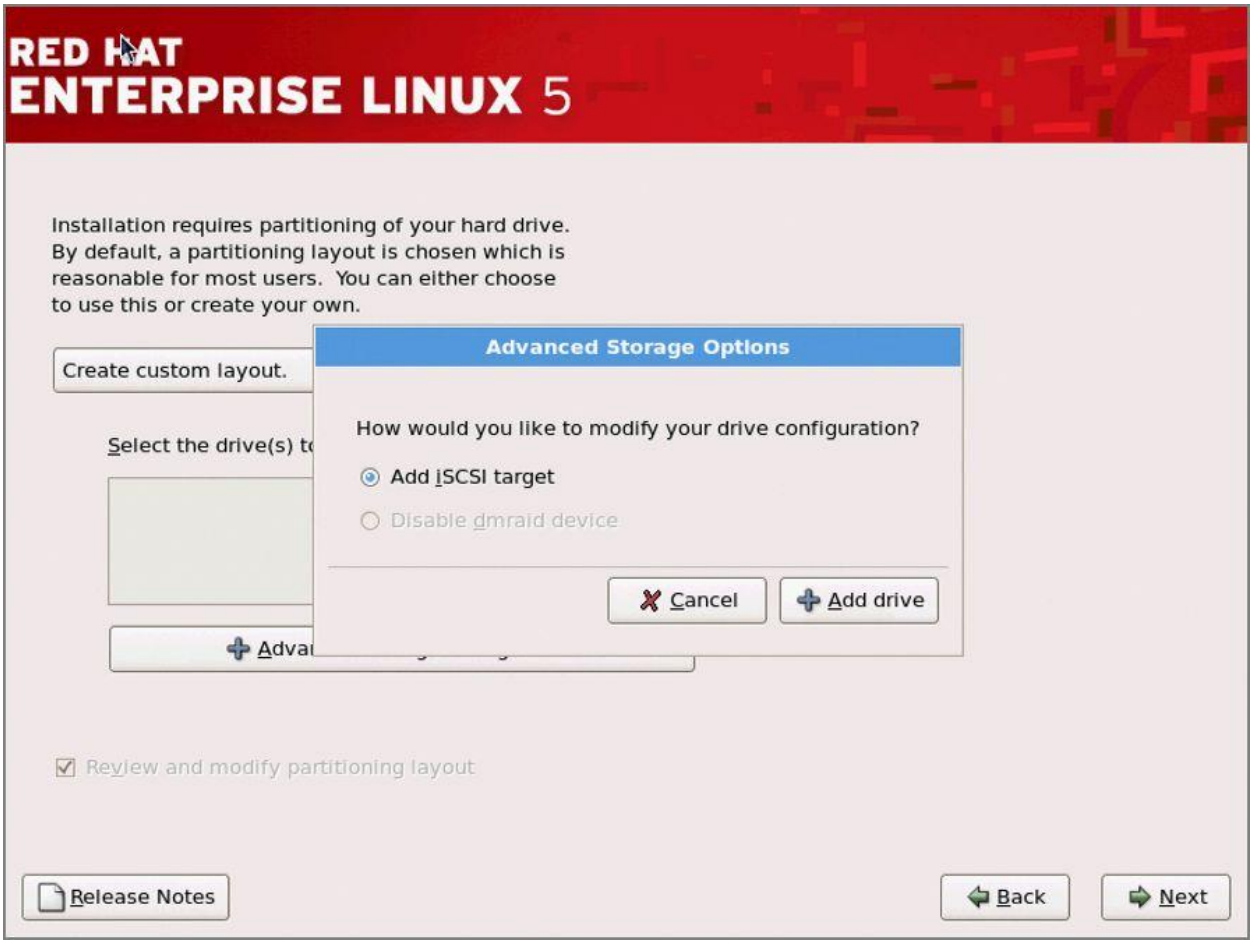
BEFORE STARTING A LINUX OS INSTALLATION

Ensure that you install the correct firmware version for the HBA driver shipping with the Linux OS you are trying to install. Refer to the firmware version table in Section 2 of this document.

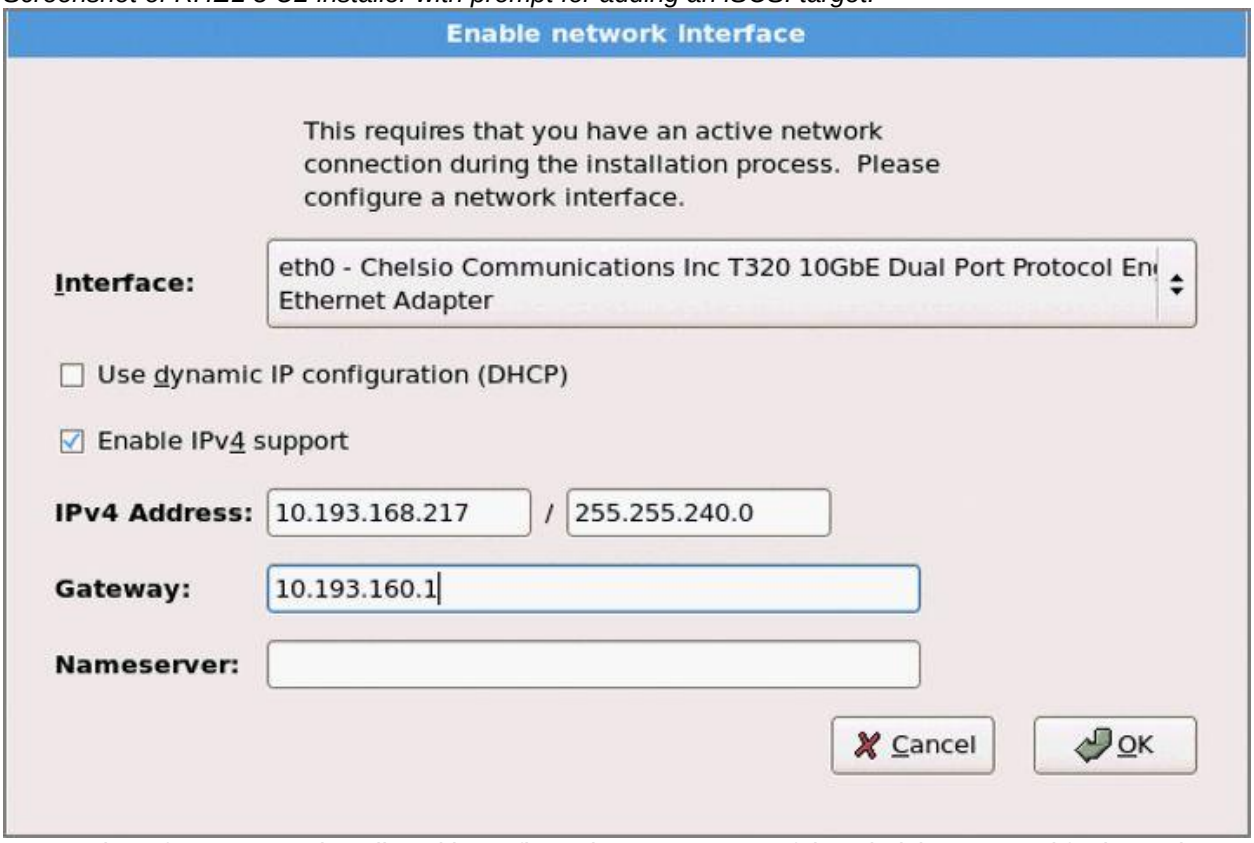
RED HAT ENTERPRISE LINUX 5 U1, U2, U3, CENTOS 5.2 & FEDORA 8, 10 USING THE OPEN-ISCSI INITIATOR

Red Hat Enterprise Linux 5 Update 1, 2 and 3 provide the option of specifying an iSCSI Target to install to in the OS installer.

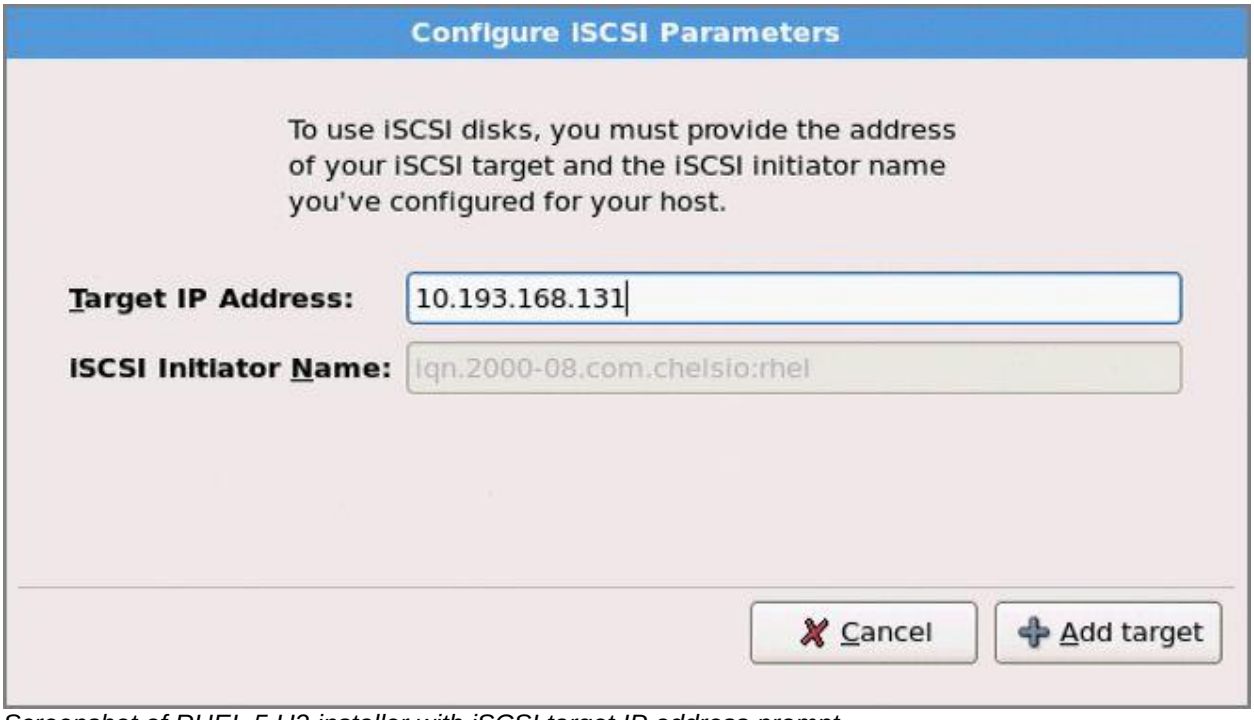
In the installer, select "Advanced Storage configuration", and then choose the Chelsio HBA as the Network device to use for the iSCSI Target. Now specify the iSCSI Target parameters, and continue with the installation. The iSCSI LUN should be available as an option in the disk list. Ensure that you select the iSCSI Target LUN as the disk to install to. After the installation, enable the Chelsio HBA as the Boot device in the System BIOS. The device will be displayed as "PCI SCSI: Chelsio Communications" in the BIOS boot devices list.



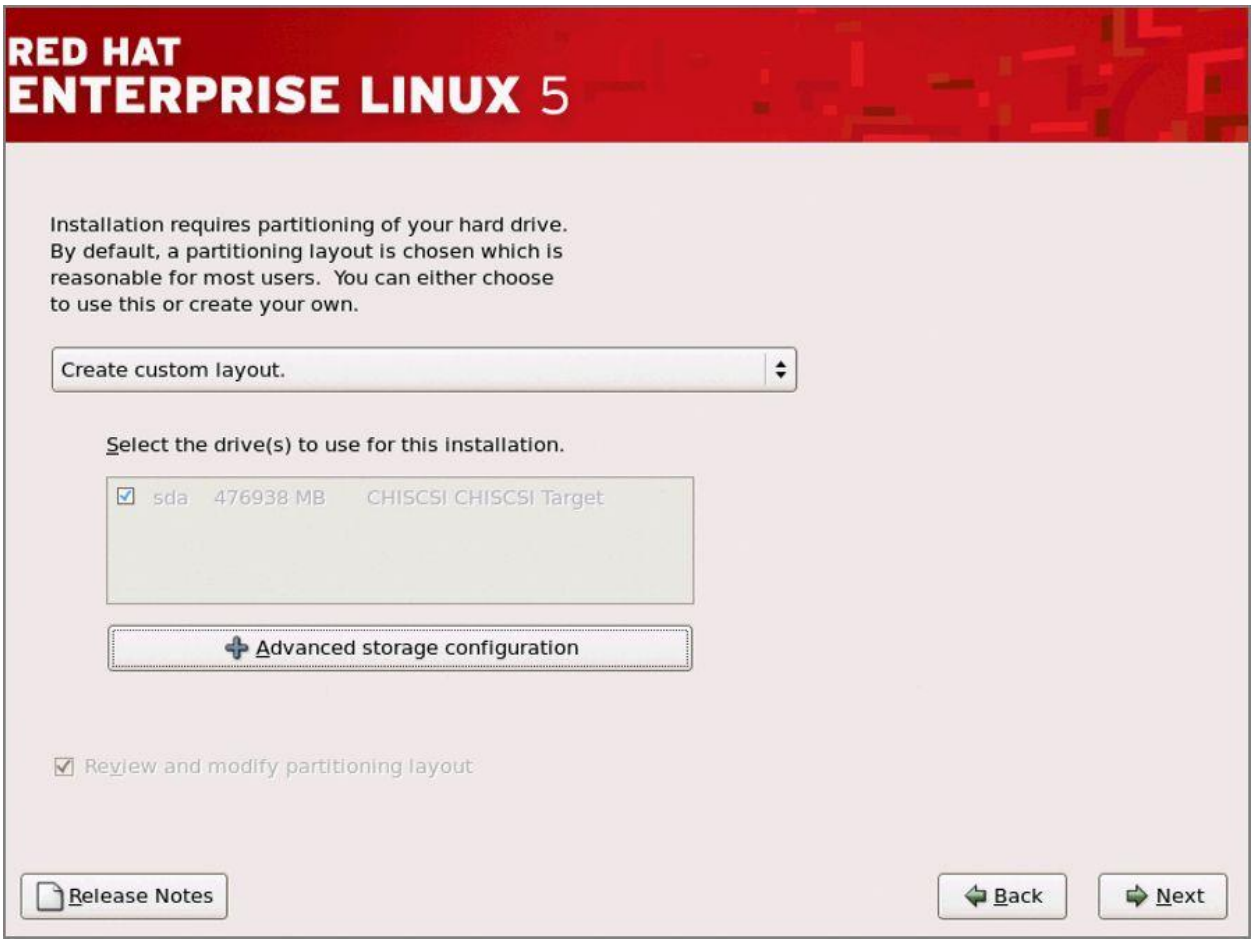
Screenshot of RHEL 5 U2 installer with prompt for adding an iSCSI target.



Screenshot of RHEL 5 U2 installer with configuration parameters of the Chelsio NIC used for iSCSI boot.



Screenshot of RHEL 5 U2 installer with iSCSI target IP address prompt.



Screenshot of RHEL 5 U2 installer after successfully adding the iSCSI Target, the iSCSI disk is listed.

In RHEL 5 U1 or CentOS 5.1, the parameters will not be picked up from the iBFT parameters table. Refer to the following website:

http://www.redhat.com/docs/manuals/enterprise/RHEL-5-manual/release-notes/RELEASE-NOTES-U1-x86-en.html

The details under the section "Using open-iscsi On A System With Firmware Boot Support for iSCSI" describes the details of the limitation.

Distributions such as Fedora 8 / 10 and CentOS 5.2 provide the option to configure an iSCSI Target too.

The appropriate firmware version needs to be flashed to the HBA, prior to installation. All the above Operating Systems have the Chelsio HBA driver included, and will automatically recognize the HBA. Certain newer revisions of Chelsio HBAs may not be recognized on older distributions of Linux.

Warning: If you do not specify the correct parameters for the NIC being used for iSCSI boot, the OS networking scripts may turn off or mis-configure the interface during the first boot. It may be difficult to recover the installation at that point. Also ensure that the device is “Activated on boot”. Also, NetworkManager is not recommended for iSCSI boot installations.

RED HAT ENTERPRISE LINUX 5U2, U3, CENTOS 5.2 AND CENTOS 5.3 USING THE CHELSIO INITIATOR

The Chelsio Linux iscsi initiator provides boot capability on Red Hat Enterprise Linux 5 U2, U3 and CentOS 5.2 and 5.3 for x86 or x64 systems.

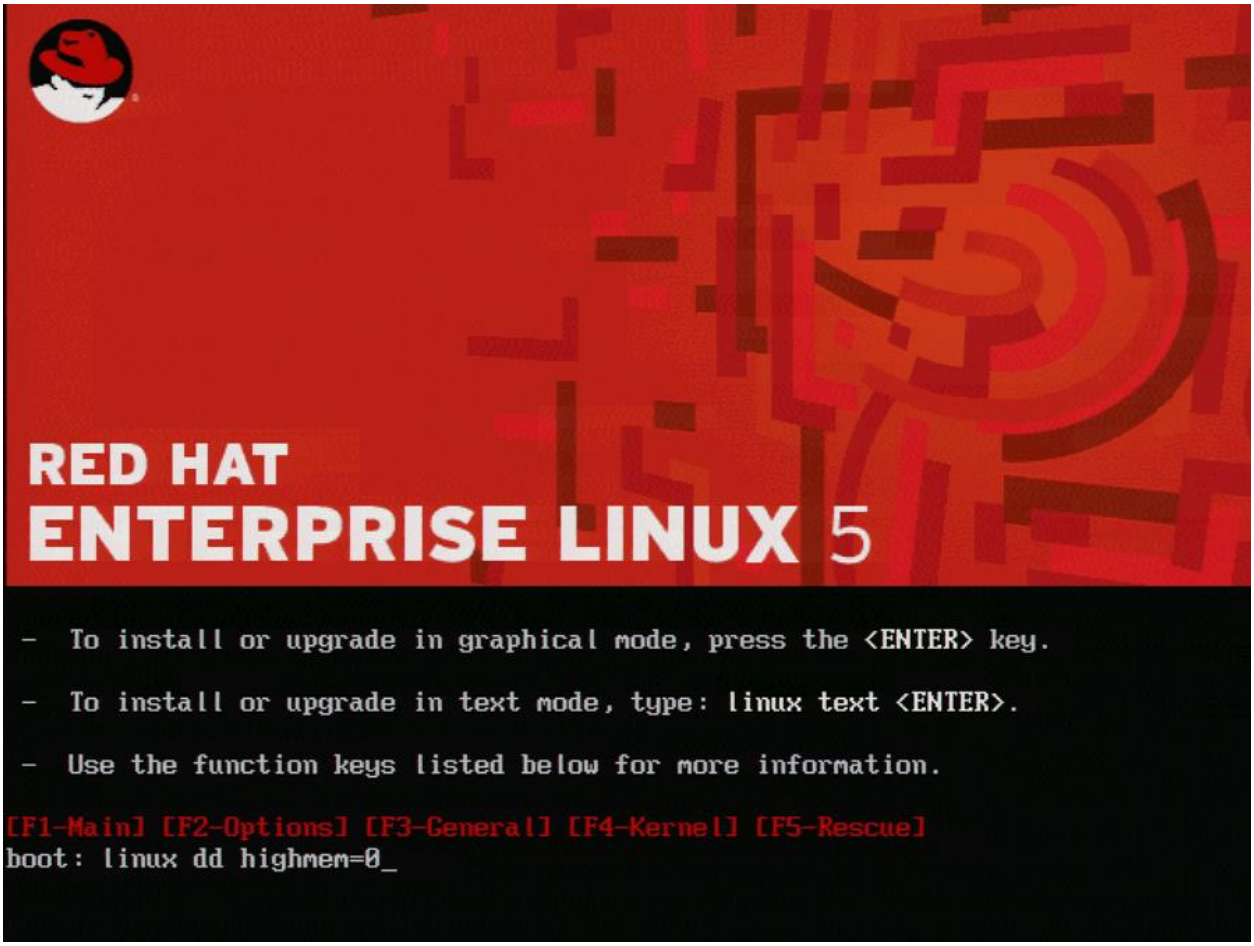
The Chelsio Linux iscsi initiator supports iBFT, and is packaged with the required 'cxgb3' NIC driver, into a "driver update disk" image. This image is larger than the size of a single floppy disk (1.44MB), and hence is usable only on a USB drive. Burn the disk image to a USB drive with the dd command as follows:

```
# dd if=chelsio_driver_disk_rhel5u3..img of=/dev/sd<usb drive letter>
```

Once you have the USB driver update disk ready, boot the system from the CD or DVD of the OS. The initial screen prompts you what type of setup to start, or any arguments to provide.

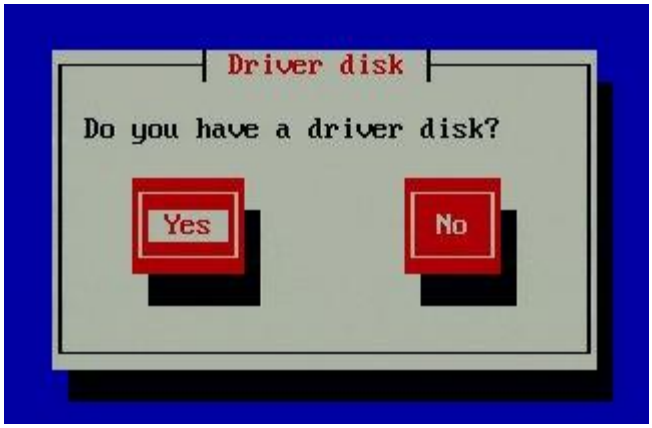
Type "linux dd" here, which specifies that you will provide a driver update disk. Insert the driver update disk into an available USB slot.

Note – Do add "highmem=0" or highmem=4M when using a 32 bit system, if the memory on your system is less than or equal to 2GB or more than 2GB respectively.



Screenshot of RHEL 5 U3 installer for a 32 bit system with <= 2GB of RAM.

The installer will load and prompt you for the driver update disk.



Screenshot of driver update disk prompt.

Now select “Yes” and hit [Enter] to proceed.

You will be asked to select the driver update disk device from a list. USB drives usually show up as SCSI disks in Linux, so if there are no other SCSI disks connected to the system, the USB drive would assume the first drive letter “a”. Hence the drive name would be “sda”. You can view the messages from the Linux kernel and drivers to determine the name of the USB drive, by pressing [Alt] + [F3/F4] and [Alt] + [F1] to get back to the list.

Screenshot of drives found on the system.

Now the installer will search for the appropriate drivers from the driver disk and load them. The Chelsio initiator will login to the target using the iBFT parameters after bringing up the appropriate NIC interface. Once the iSCSI session to the target is successfully established, the disks on the target are accessible to the OS installer. This step may take some time. Check on the [Alt] + [F3] or [Alt] + [F4] screens for log messages.

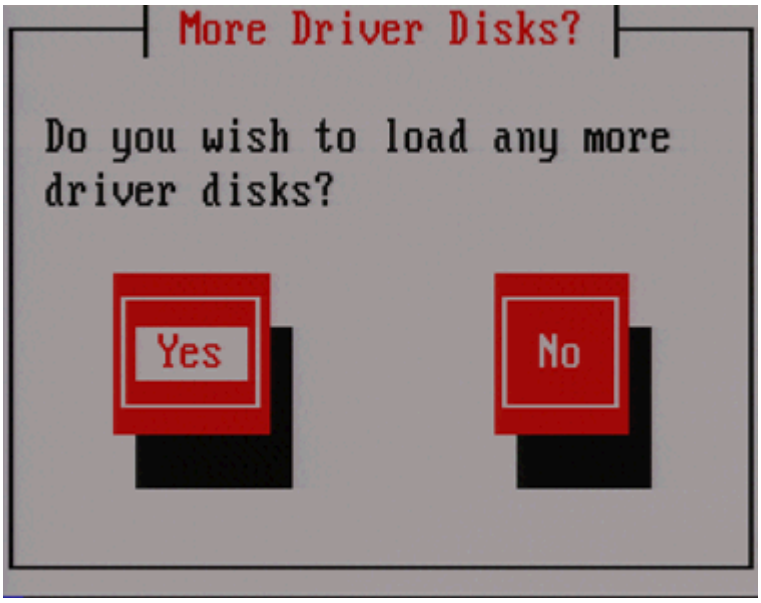
Now select “Yes” and hit [Enter] to proceed.

You will be asked to select the driver update disk device from a list. USB drives usually show up as SCSI disks in Linux, so if there are no other SCSI disks connected to the system, the USB drive would assume the first drive letter “a”. Hence the drive name would be “sda”. You can view the messages from the Linux

kernel and drivers to determine the name of the USB drive, by pressing [Alt] + [F3/F4] and [Alt] + [F1] to get back to the list.

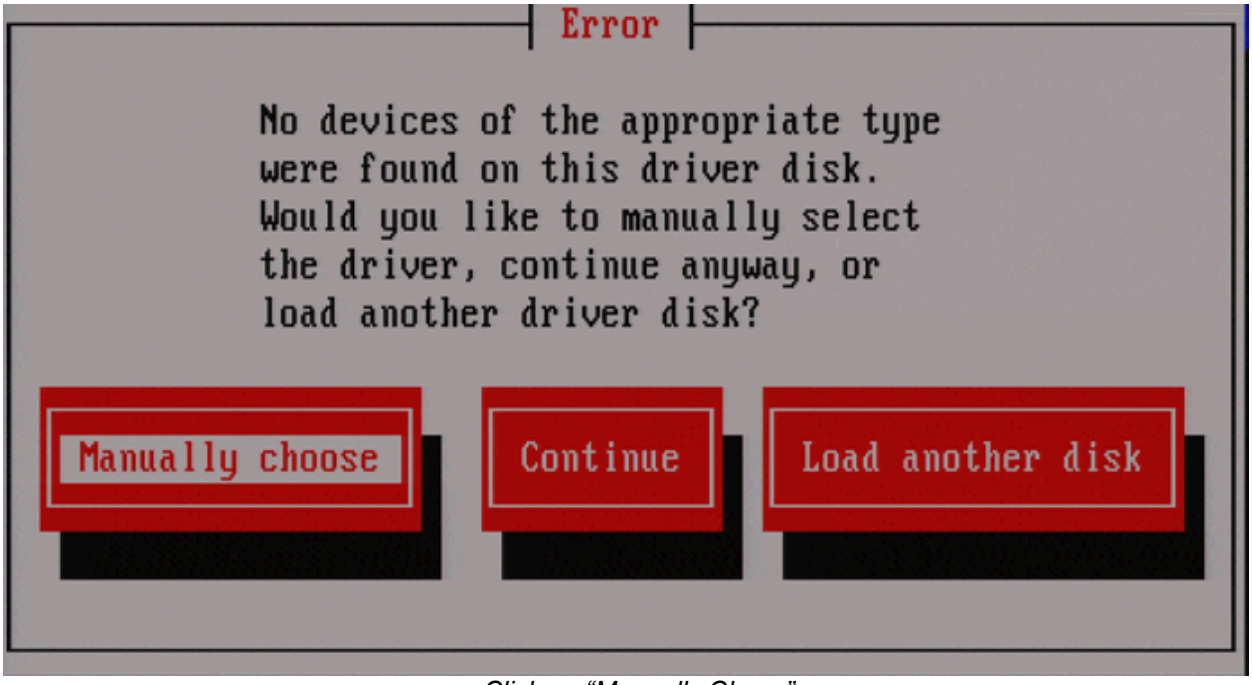
Screenshot of drives found on the system.

Now the installer will search for the appropriate drivers from the driver disk and load them. However, due to the limitations of the RHEL 5 U3 installer, you would have to pass through the following screens –



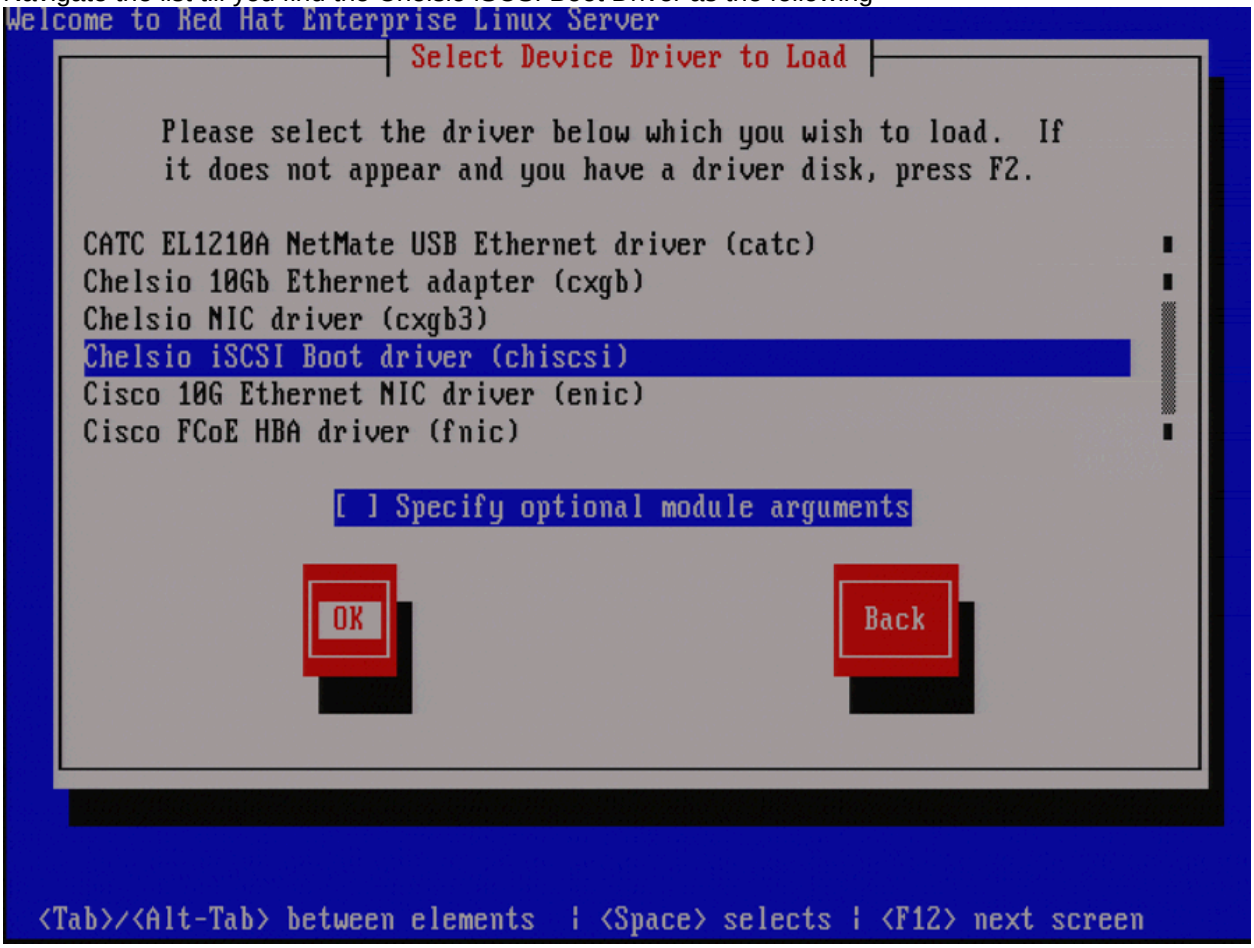
Say Yes here

Continue the previous steps until you reach the following screen -



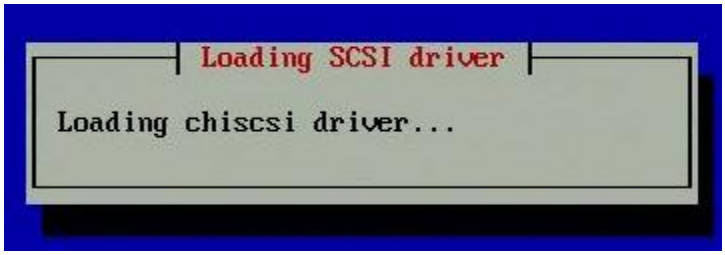
Click on "Manually Chose"

Navigate the list till you find the Chelsio iSCSI Boot Driver as the following -



The Chelsio initiator will login to the target using the iBFT parameters after bringing up the appropriate NIC interface. Once the iSCSI session to the target is successfully established, the disks on the target are accessible to the OS installer. This step may take some time. Check on the [Alt] + [F3] or [Alt] + [F4] screens for log messages.

The installer will display a message about the driver it is loading as below.



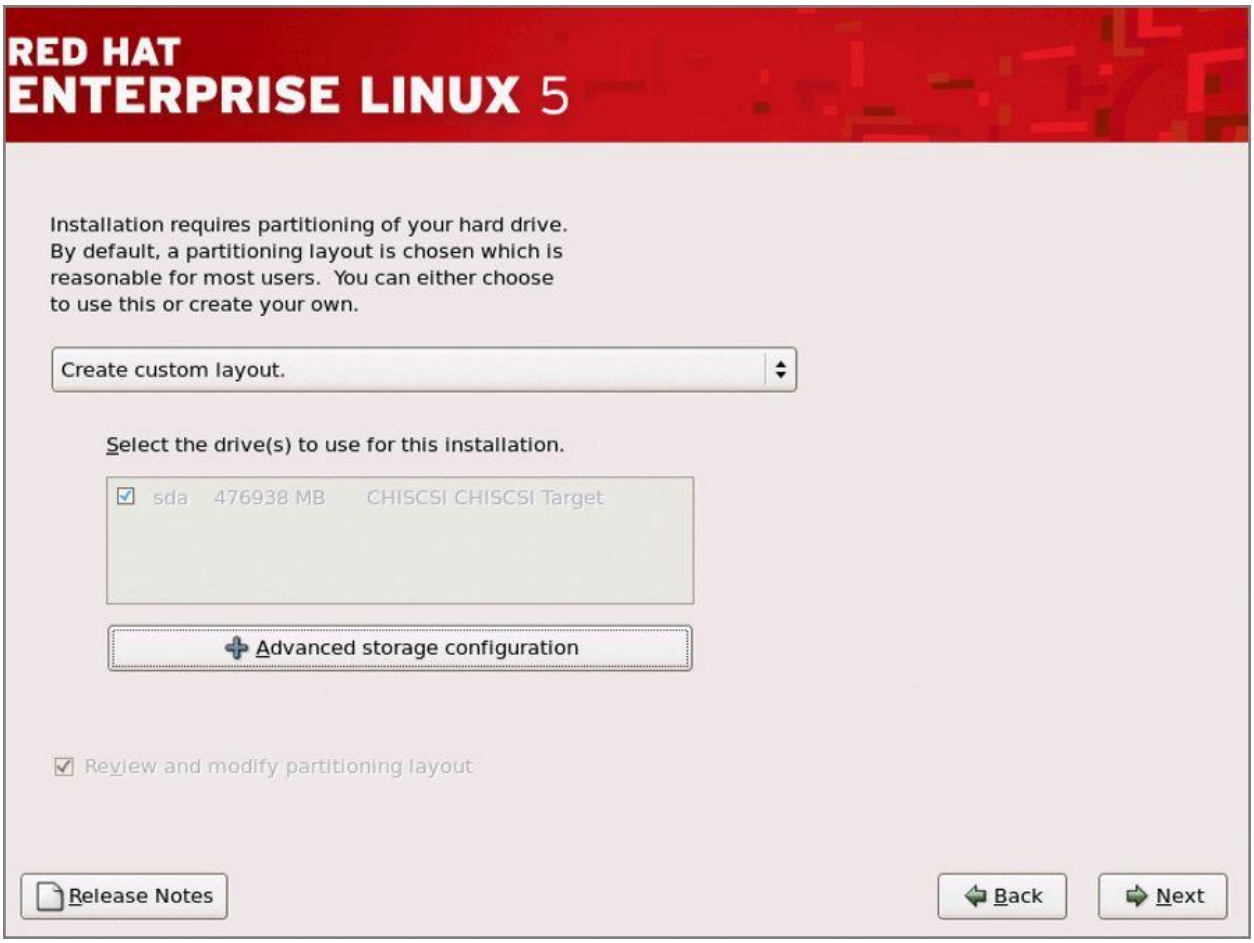
Screenshot of installer loading the Chelsio iscsi initiator driver.

Screenshot of driver update disk completion and additional disks prompt.

Once the drivers are loaded, you will be prompted to load any additional drivers. You may do so if you wish to, or select “No” and proceed to the next step in the installation.

Now in the partitioning tool, you will be able to see the iSCSI target LUN listed here as a disk available to install to, if you choose the option “Manually partition with Disk Druid”.

Warning: Ensure that you select to install to the iSCSI disk, and not the USB driver update disk. The USB driver update disk may be listed as sda, and the iSCSI disk as sdb or sdc. Also ensure that the GRUB bootloader installs to the MBR (Master Boot Record) on the iSCSI disk, which would be sdb or sdc.



Screenshot of RHEL 5 U2 installer after successfully adding the iSCSI Target, the iSCSI disk is listed.

Continue through the installation steps. In the network configuration section of the installation, ensure that you select the iSCSI boot enabled NIC interface to be "Activated on boot" and assign the same IP addressing information here, as you have specified in the Option ROM configuration utility.

Warning: If you do not specify the correct parameters for the NIC being used for iSCSI boot, the OS networking scripts may turn off or mis-configure the interface during the first boot. It may be difficult to recover the installation at that point. Also ensure that the device is "Activated on boot".

After the installation completes, and reboots, enter the system BIOS and ensure that the Chelsio HBA is the preferred boot device. Now the system will boot from the iSCSI target LUN. After completing the first boot wizard in RHEL 4 U8, login as root, and run the following command to ensure that the system is able to shutdown or restart safely from any run level.

```
# chkconfig --level 0123456 network on
```

When updating the 'cxgb3' drivers on the system, ensure that you update the firmware to the required version of the new 'cxgb3' driver. When updating the 'chiscsi' or 'cxgb3' drivers, run the 'mkinitrd'

command with the correct arguments, and with the additional arguments of '--with=cxgb3 –with=chiscsi' to ensure that the updated Chelsio Linux initiator and Chelsio NIC driver are in the initrd image.

You may be able to install the offload capable drivers ('t3_tom.ko' and 'toecore.ko') for the Chelsio 'S' series HBAs, and use that after you have successfully installed and booted the system through iSCSI. To use iSCSI + TCP/IP offload for the boot connection, add the '--with=t3_tom –with=toecore' to the mkinitrd parameters as above.

RED HAT ENTERPRISE LINUX 4 U8

The Chelsio Linux iscsi initiator provides boot capability on Red Hat Enterprise Linux 4 Update 8 for x86 or x64 systems.

The Chelsio Linux iscsi initiator supports iBFT, and is packaged with the required 'cxgb3' NIC driver, into a "driver update disk" image. This image is larger than the size of a single floppy disk (1.44MB), and hence is usable only on a USB drive. Burn the disk image to a USB drive with the dd command as follows:

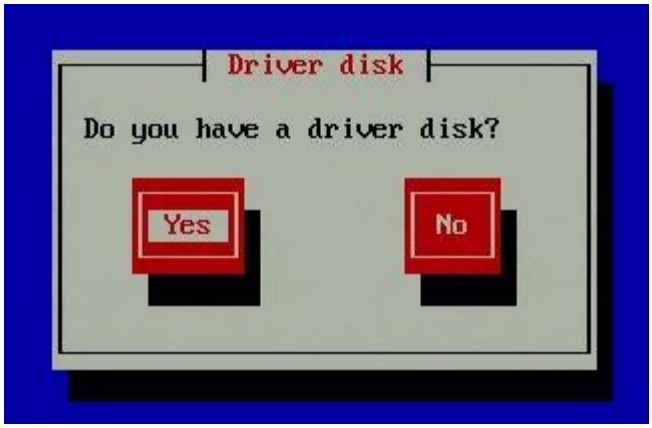
```
# dd if=chelsio_driver_disk_rhel4u8..img of=/dev/sd<usb drive letter>
```

Once you have the USB driver update disk ready, boot the system from the CD or DVD of the OS. The initial screen prompts you what type of setup to start, or any arguments to provide.

Type "linux dd" here, which specifies that you will provide a driver update disk. Insert the driver update disk into an available USB slot.

Screenshot of RHEL4 U8 installer boot prompt, to specify driver disk

The installer will load and prompt you for the driver update disk.



Screenshot of driver update disk prompt.

Now select “Yes” and hit [Enter] to proceed.

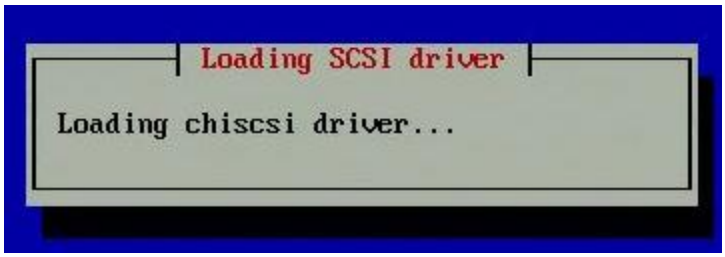
You will be asked to select the driver update disk device from a list. USB drives usually show up as SCSI disks in Linux, so if there are no other SCSI disks connected to the system, the USB drive would assume the first drive letter “a”. Hence the drive name would be “sda”. You can view the messages from the Linux kernel and drivers to determine the name of the USB drive, by pressing [Alt] + [F3/F4] and [Alt] + [F1] to get back to the list.

Screenshot of drives found on the system.

Now the installer will search for the appropriate drivers from the driver disk and load them.

The Chelsio initiator will login to the target using the iBFT parameters after bringing up the appropriate NIC interface. Once the iSCSI session to the target is successfully established, the disks on the target are accessible to the OS installer. This step may take some time. Check on the [Alt] + [F3] or [Alt] + [F4] screens for log messages.

The installer will display a message about the driver it is loading as below.



Screenshot of installer loading the Chelsio iscsi initiator driver.

Screenshot of driver update disk completion and additional disks prompt.

Once the drivers are loaded, you will be prompted to load any additional drivers. You may do so if you wish to, or select “No” and proceed to the next step in the installation.

Now in the partitioning tool, you will be able to see the iSCSI target LUN listed here as a disk available to install to, if you choose the option “Manually partition with Disk Druid”.

Warning: Ensure that you select to install to the iSCSI disk, and not the USB driver update disk. The USB driver update disk may be listed as sda, and the iSCSI disk as sdb or sdc. Also ensure that the GRUB bootloader installs to the MBR (Master Boot Record) on the iSCSI disk, which would be sdb or sdc.

Continue through the installation steps. In the network configuration section of the installation, ensure that you select the iSCSI boot enabled NIC interface to be “Activated on boot” and assign the same IP addressing information here, as you have specified in the Option ROM configuration utility.

Warning: If you do not specify the correct parameters for the NIC being used for iSCSI boot, the OS networking scripts may turn off or mis-configure the interface during the first boot. It may be difficult to recover the installation at that point. Also ensure that the device is “Activated on boot”.

After the installation completes, and reboots, enter the system BIOS and ensure that the Chelsio HBA is the preferred boot device. Now the system will boot from the iSCSI target LUN. After completing the first boot wizard in RHEL 4 U8, login as root, and run the following command to ensure that the system is able to shutdown or restart safely from any run level.

```
# chkconfig --level 0123456 network on
```

When updating the 'cxgb3' drivers on the system, ensure that you update the firmware to the required version of the new 'cxgb3' driver. When updating the 'chiscsi' or 'cxgb3' drivers, run the 'mkinitrd' command with the correct arguments, and with the additional arguments of '--with=cxgb3 –with=chiscsi' to ensure that the updated Chelsio Linux initiator and Chelsio NIC driver are in the initrd image.

You may be able to install the offload capable drivers ('t3_tom.ko' and 'toecore.ko') for the Chelsio 'S' series HBAs, and use that after you have successfully installed and booted the system through iSCSI. To use iSCSI + TCP/IP offload for the boot connection, add the '--with=t3_tom –with=toecore' to the mkinitrd parameters as above.

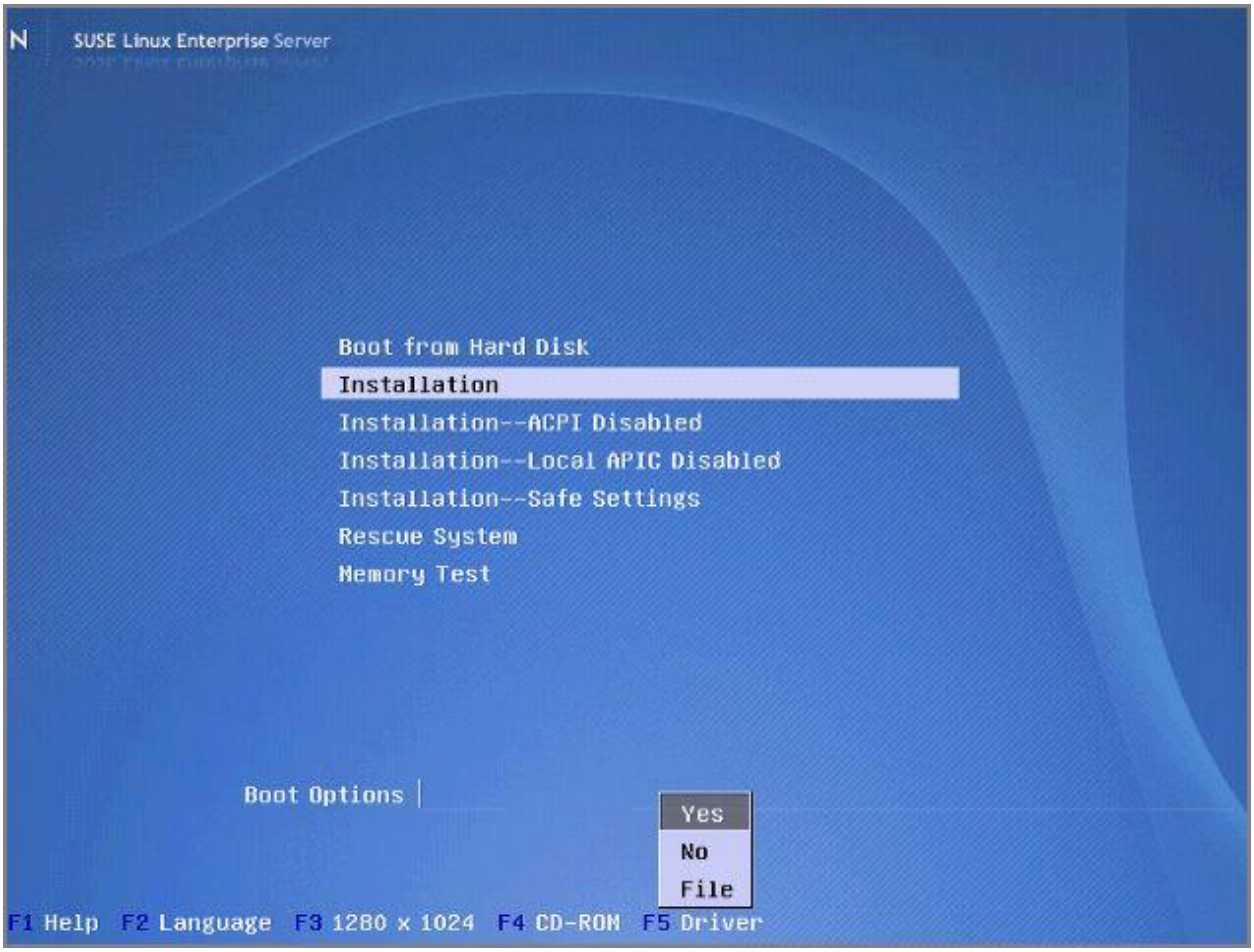
SUSE LINUX ENTERPRISE SERVER 10 SP2

The Chelsio Linux iscsi initiator provides boot capability on SLES 10 SP2 for x86 or x64 systems.

You may use the initiator with iSCSI + TCP/IP protocol offload, if you have the 'S' series Chelsio HBA, which provides offload of the iSCSI protocol, greatly improving its performance.
There are two driver update disk images provided, one with offload drivers bundled in, and one without. Select the driver disk image you wish to use, and burn that to a USB drive. This image is larger than the size of a single floppy disk (1.44MB), and hence is usable only on a USB drive. Burn the disk image to a USB drive with the dd command as follows:

```
# dd if=chelsio_driver_disk_sles10sp2..img of=/dev/sd<usb drive letter>
```

Once you have the USB driver update disk ready, boot the system from the CD or DVD of the OS. The initial screen prompts you what type of setup to start, or any arguments to provide.



Screenshot of OS installer with prompt for providing driver update disk.

Press [F5] to show the driver update menu, and select "Yes". Now proceed with the installation.

The SuSE installer will prompt you for the driver update medium next. USB drives usually show up as SCSI disks in Linux, so if there are no other SCSI disks connected to the system, the USB drive would assume the first drive letter “a”. Hence the drive name would be “sda”. Select the appropriate device from the list, and press [Enter] to proceed.

Screenshot of SuSE installer prompt for driver update disk device selection.

Screenshot of SuSE installer reading the driver update disk.

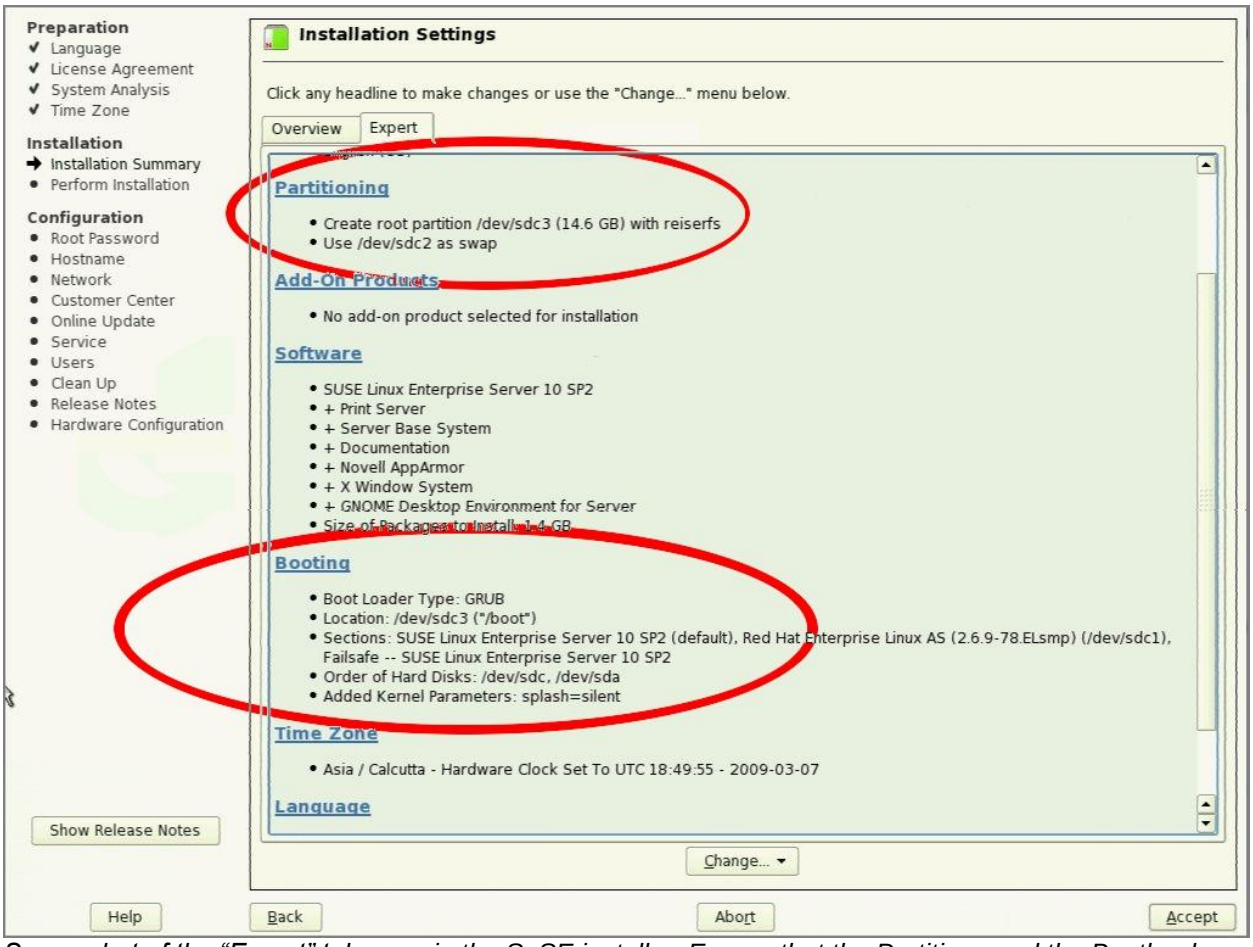
Screenshot of SuSE installer alerting that the driver loaded successfully.

Once the drivers have loaded successfully, the disk will be accessible for use during the installation.

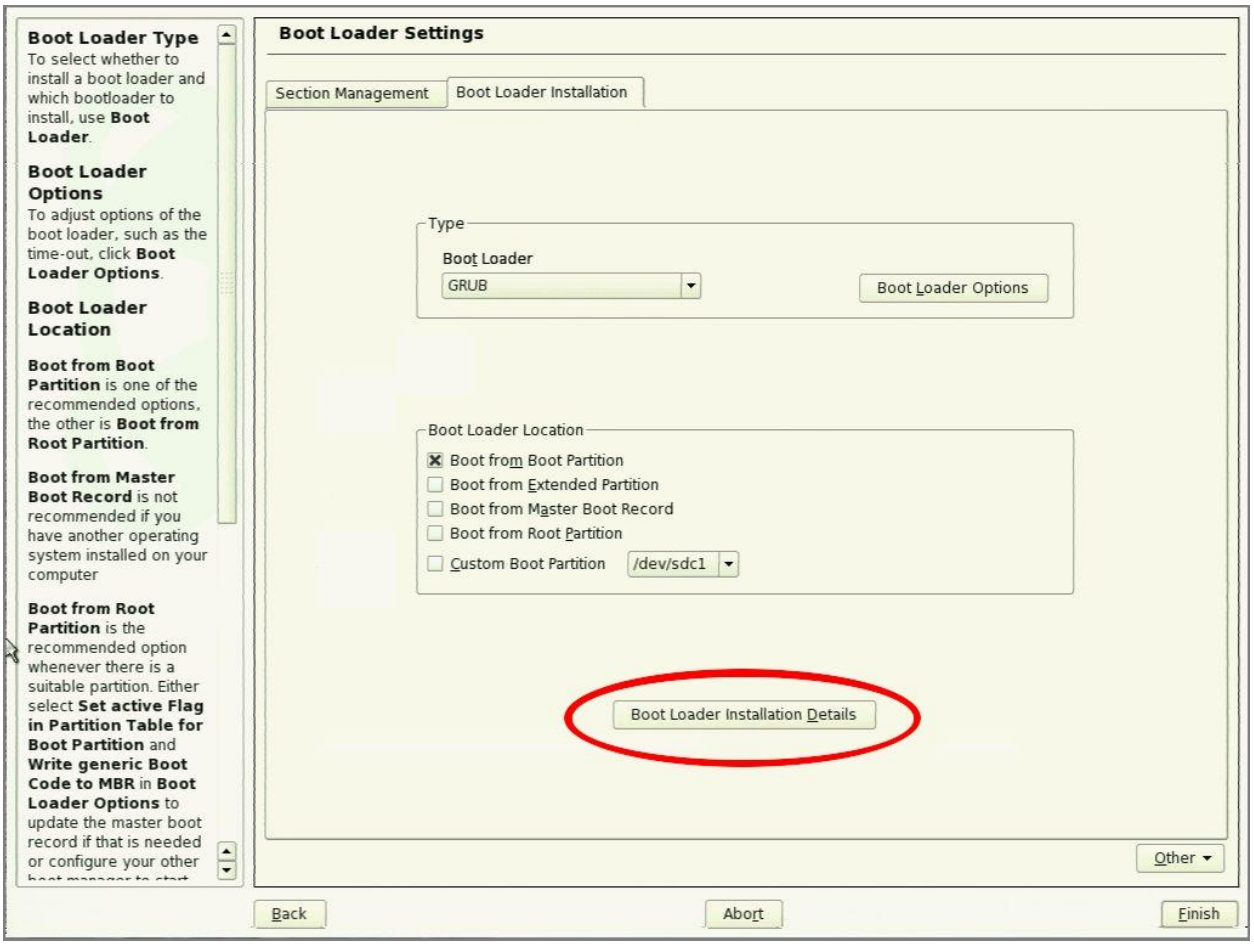
In the Installation summary, ensure that you select the iSCSI disk, by selecting the Partitioning section, and creating the partitions on the iSCSI disk, which is generally sdb or sdc. sda will usually be the USB disk which has the Chelsio driver update.

Screenshot of the SuSE installer, the installation settings page, switching to the Expert tab.

Also ensure that the GRUB bootloader is installing to the MBR (Master Boot Record) on the iSCSI disk, and not the USB disk, sda, which is the default. Click the “Boot Loader Installation Details” to ensure that the drive order is correct. The iSCSI disk should appear as the first item on the list.



Screenshot of the "Expert" tab page in the SuSE installer. Ensure that the Partitions and the Bootloader are installing to the iSCSI disk.

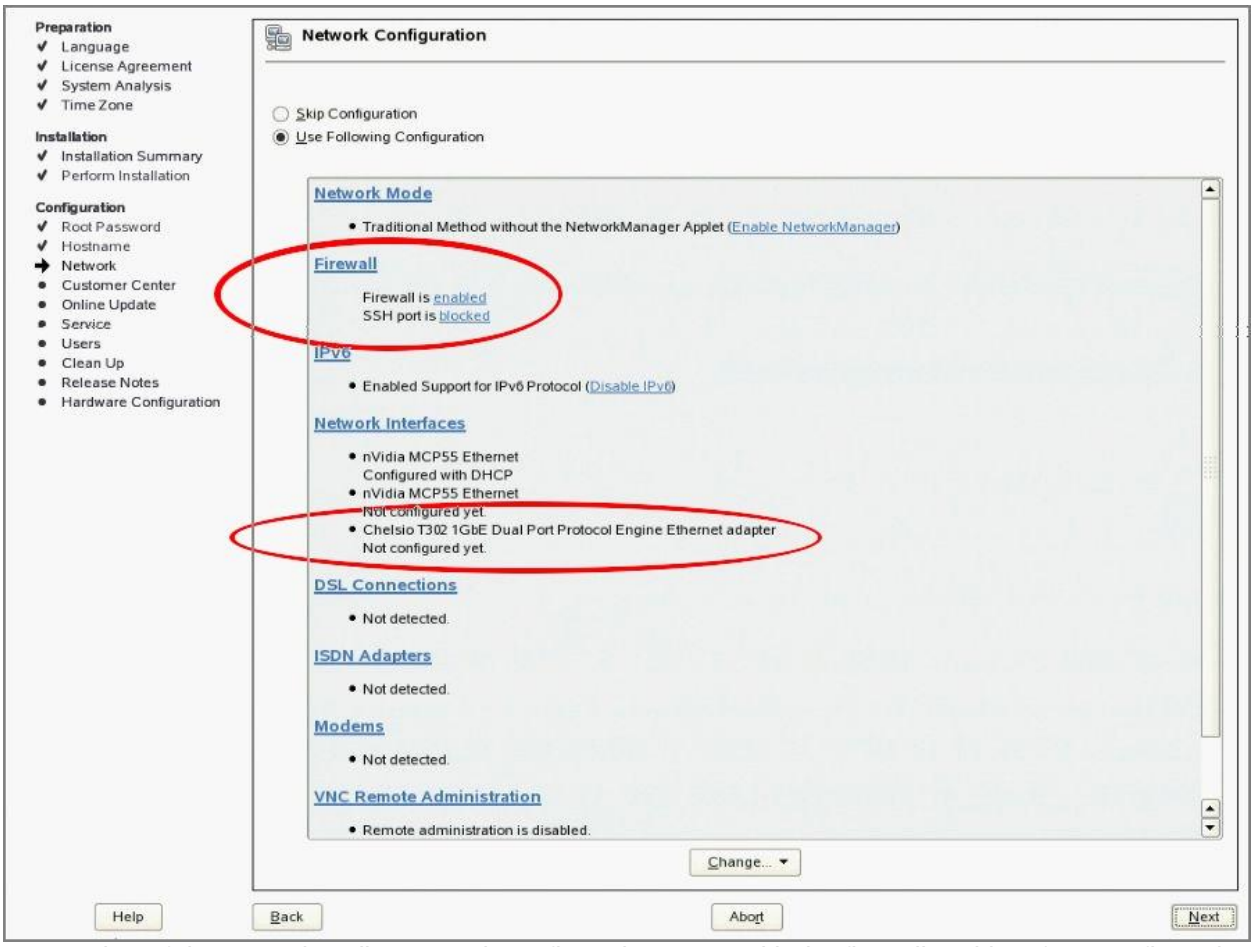


Screenshot of the GRUB boot loader configuration page, where the drive order can be set, to ensure that the boot loader is installed to the iSCSI disk.

After the installation completes, and the system reboots, enter the system BIOS and ensure that the Chelsio HBA is the preferred boot device. Now the system will boot from the iSCSI target LUN. During the first boot wizard, in the network configuration part, press the [Ctrl] + [Alt] + [F2] keys to go to the terminal prompt before editing or saving the network configuration. Now type the following command to ensure that the system does not bring down the NIC that is used for iSCSI boot.

```
# mv /sbin/ifdown /sbin/ifdown.user
```

Do **not** restore this utility to its original name once the first boot wizard is completed. This is due to the SuSE YaST configuration utility bringing down all network interfaces when saving the networking configuration of the system, after making changes. This causes loss of connectivity to the iSCSI target, from the boot initiator driver.



Screenshot of the SuSE installer network configuration page, with the firewall and interface configuration to be changed.

Now press [Ctrl] + [Alt] + [F1/F7] to return to the wizard, and edit the NIC parameters. Ensure that you configure the NIC used for iSCSI boot, to be “activated on boot”, and use the same IP configuration that is configured in the Option ROM configuration utility. Also disable / turn off the firewall.

Warning: Ensure that you configure the NIC being used for iSCSI boot correctly. If you do not specify the correct parameters for the NIC being used for iSCSI boot, the OS networking scripts may mis-configure the interface during system boot. Also ensure that the device is “Activated on boot”. Using NetworkManager with iSCSI boot is not recommended. Disable the firewall to allow the iSCSI boot connection to remain connected.

After logging into the system, run the following command to ensure that the system is able to shutdown or restart safely from any run level.

```
# chkconfig --level 0123456 network on -f
```

When updating the ‘cxgb3’ drivers on the system, ensure that you update the firmware to the required version of the new ‘cxgb3’ driver. When updating the ‘chiscsi’ or ‘cxgb3’ drivers, run the ‘mkinitrd’ command to ensure that the updated Chelsio Linux initiator and Chelsio NIC driver are in the initrd image.

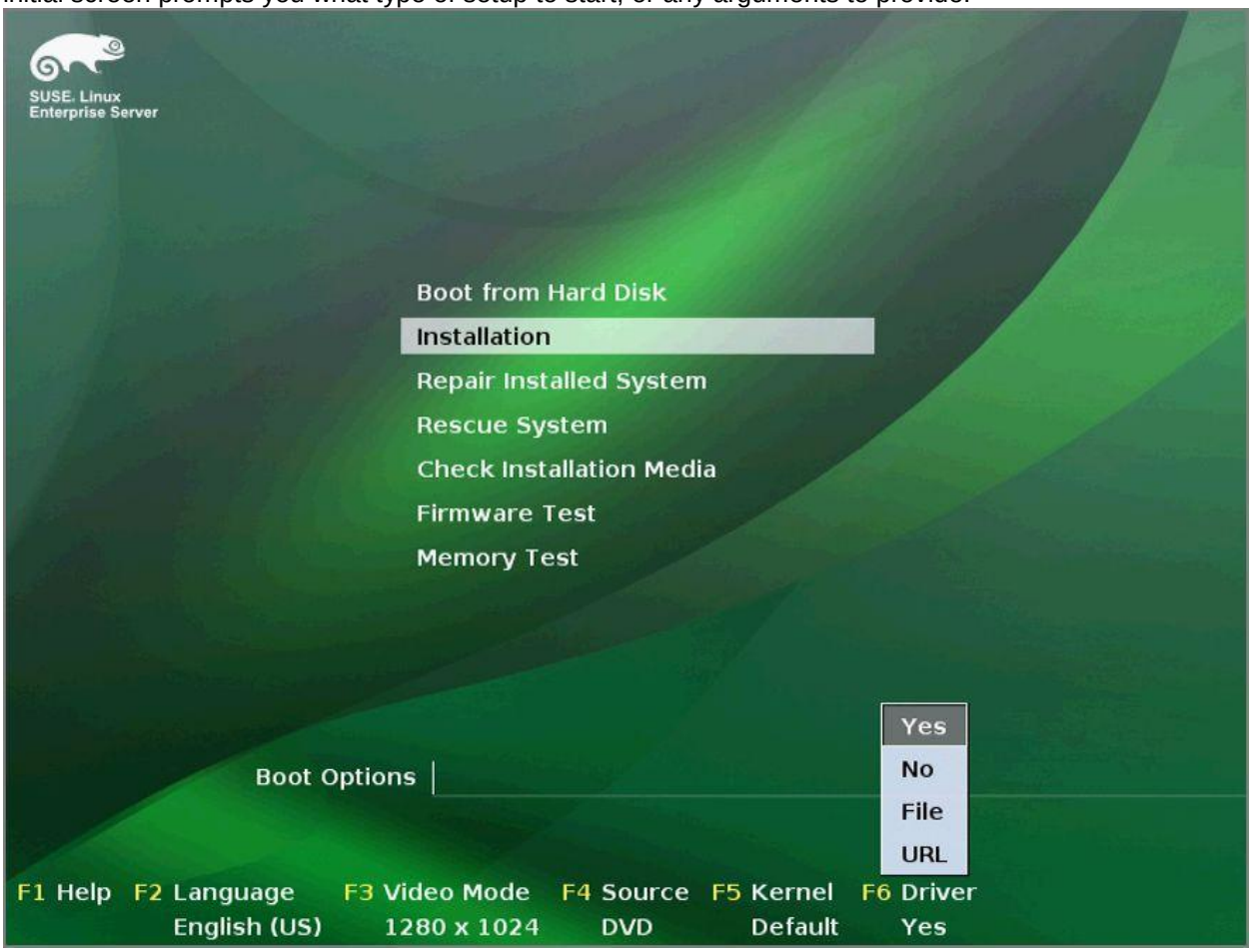
SUSE LINUX ENTERPRISE SERVER 11 WITH OPEN-ISCSI INITIATOR

Both the Open-iSCSI Linux initiator and the Chelsio Boot Initiator provide boot capability on SLES 11 for x86 or x64 systems.

The driver update disk provided in the package, ensures that the driver is correctly loaded during the install and the final installed system. Burn the disk image to a USB drive with the dd command as follows:

```
# dd if=chelsio_cxgb3_driver_disk_sles10sp2..img of=/dev/sd<usb drive
letter>
```

Once you have the USB driver update disk ready, boot the system from the CD or DVD of the OS. The initial screen prompts you what type of setup to start, or any arguments to provide.



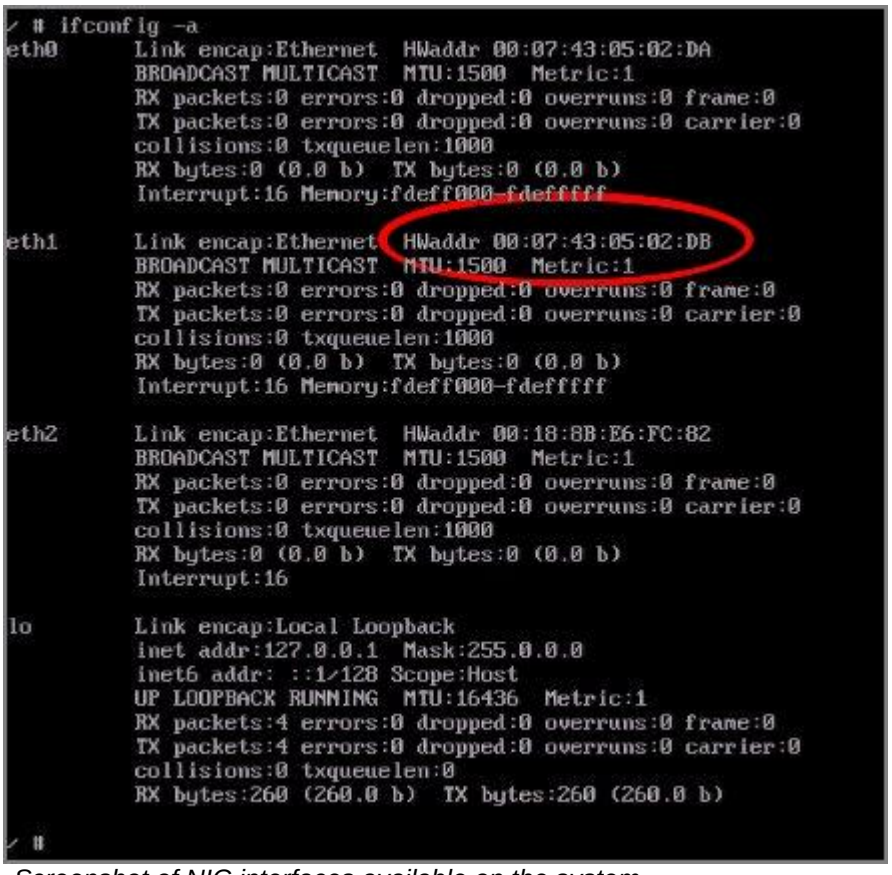
Screenshot of SLES 11 installer DVD, with prompt to load an update driver disk [F6]

Press [F6] at the initial prompt, and select “Yes” to load the driver update disk. Then select the USB drive as the driver update medium. The cxgb3 driver will get loaded correctly, and the Chelsio adapter can be now used for iSCSI boot. The installer may have loaded the driver prior to this step on its own, but that does not guarantee that the driver will get installed correctly for the iSCSI boot scenario.

Screenshot of SuSE installer prompt for driver update disk.

Now immediately after the installer reaches a graphical wizard, press [Ctrl] + [Alt] + [F2] to go to the terminal prompt. Here, the Chelsio adapter needs to be identified and brought up on the network using the same settings or method used while configuring the Option ROM based initiator.
List the NIC interfaces available with the command "ifconfig –a".

```
# ifconfig -a
```



Screenshot of NIC interfaces available on the system

Identify the correct NIC interface and configure it with either a static IP address or a DHCP IP address using the appropriate command below.

```
# dhcpcd eth1
```

Configure NIC with DHCP

```
# ifconfig eth1 10.193.169.81 netmask 255.255.254.0 up
```

Configure NIC with a static IP address

To configure the iSCSI boot NIC interface with a DHCP IP address, run the following command:

```
# dhcpcd <eth#>
```

To configure the NIC interface with a static IP address, run the following command:

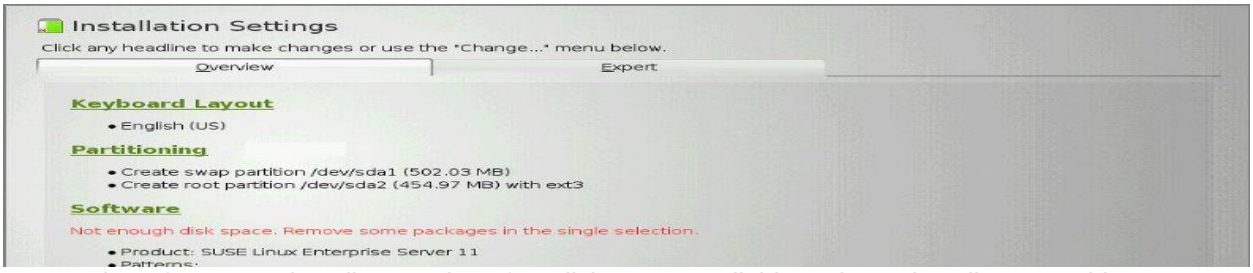
```
# ifconfig <eth#> <IP address> netmask <subnet mask> up
```

Now that the interface is correctly configured, ensure that it is active, by running the following command, and look for the word “RUNNING” in the output:

```
# ifconfig <eth#>
```

If the interface is correctly configured and the network link is present, it is ready for use for iSCSI boot. Switch back to the installer by pressing [Ctrl] + [Alt] + [F6/F7].

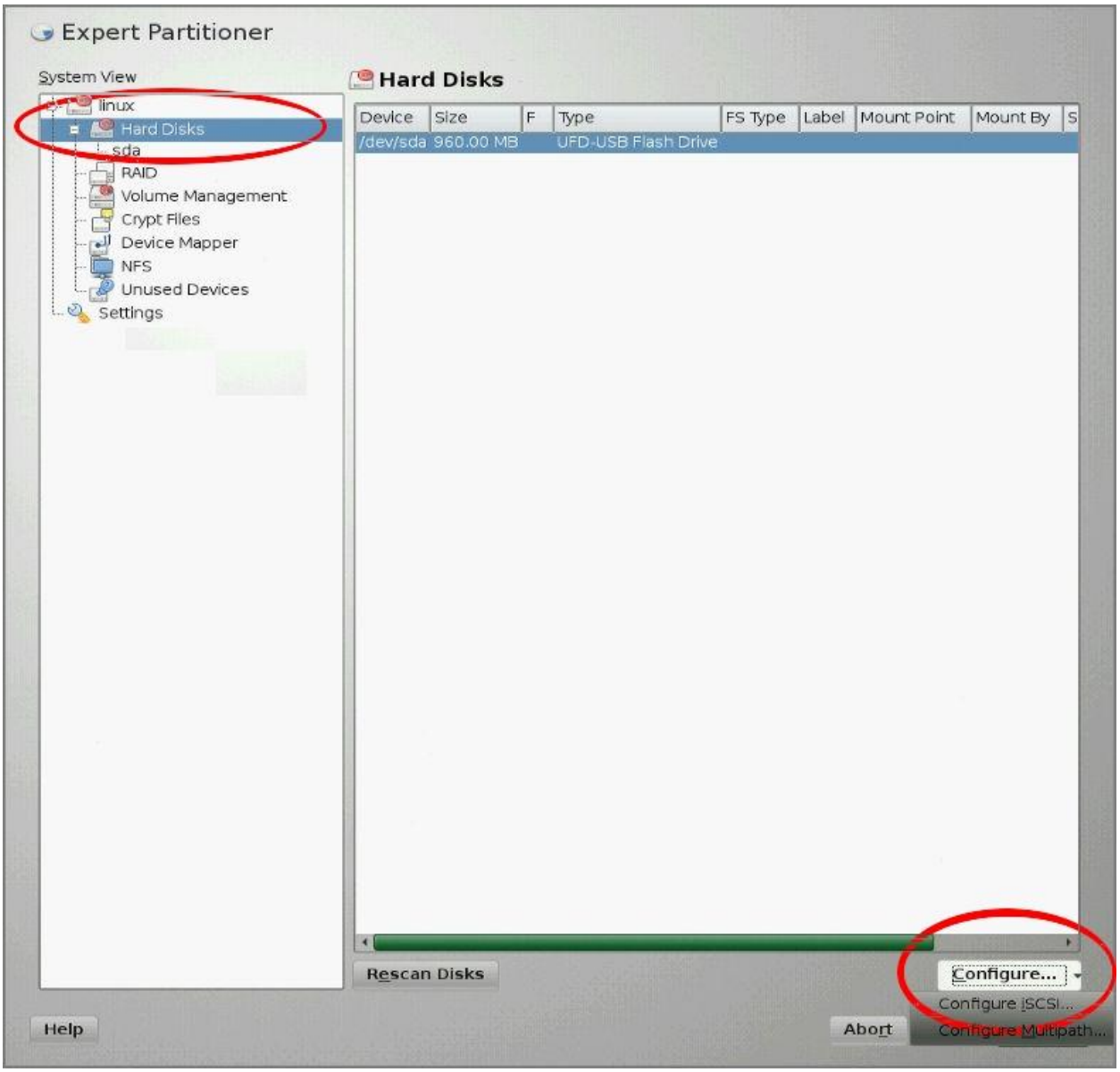
Now the installer may try to select the USB driver update disk to install to, or may warn you that there are no disks available to install to.



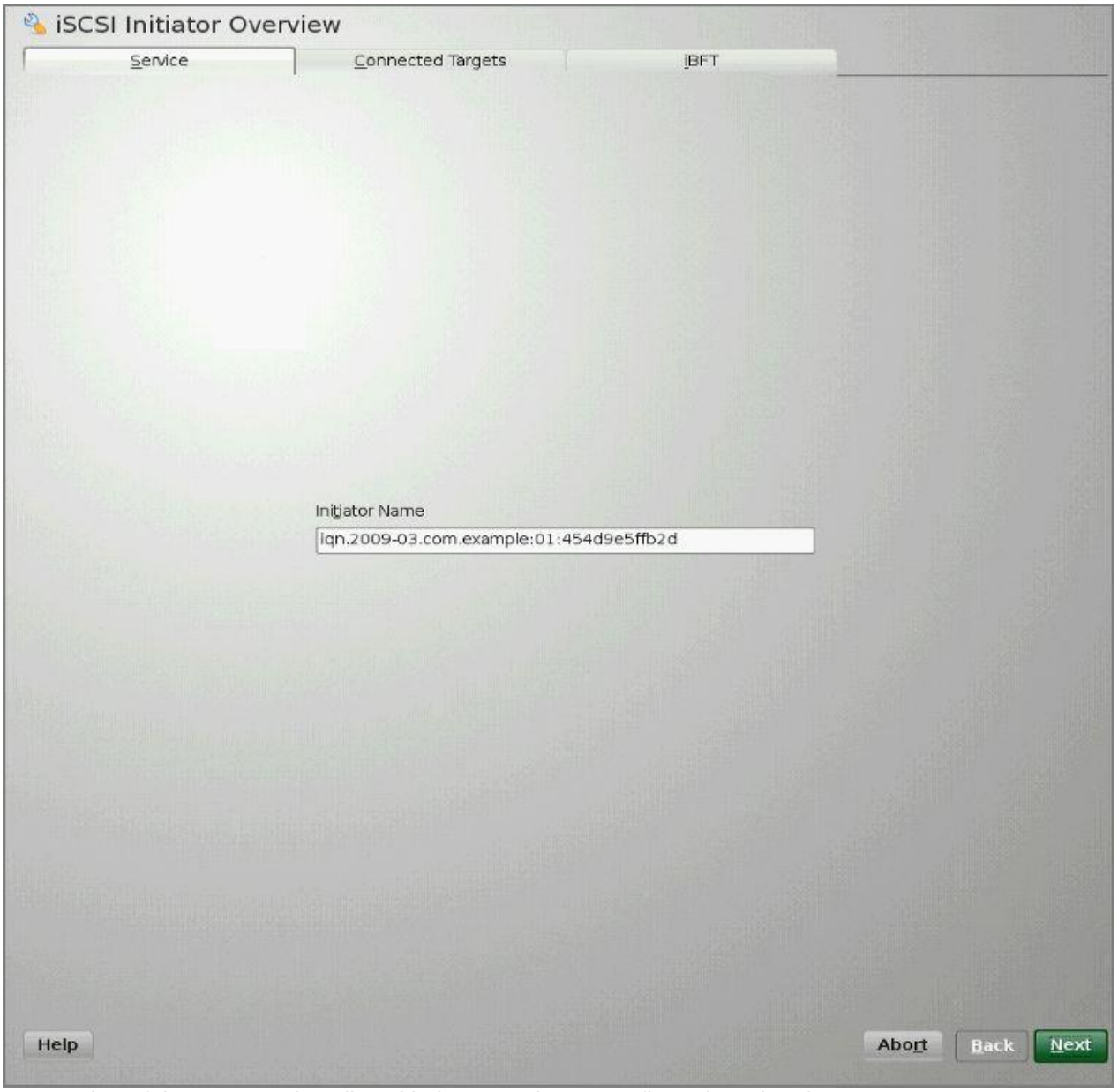
Screenshot of SLES 11 installer warning of no disk space available, trying to install to USB drive.

Select the partitioning option and select the “Custom Partitioning (for experts)” option. Now highlight the “Hard Disks” menu option on the left. Click the “Configure” button at the bottom right corner, and select “Configure iSCSI”.

Screenshot of SLES 11 installer prompt for Partitioning options.



Screenshot of the SLES 11 partitioning tool, where we can configure the Open-iSCSI boot initiator.

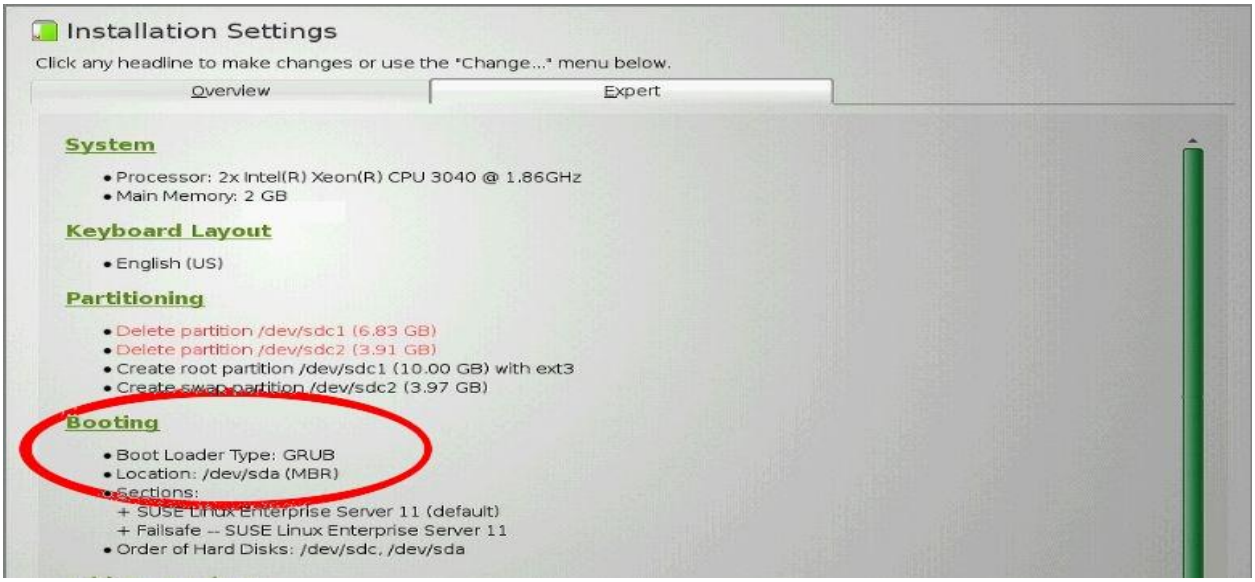


Screenshot of the SLES 11 installer with the Open-iSCSI configuration wizard.

Screenshot of the SLES 11 partitioning tool, listing the newly added iSCSI drive.

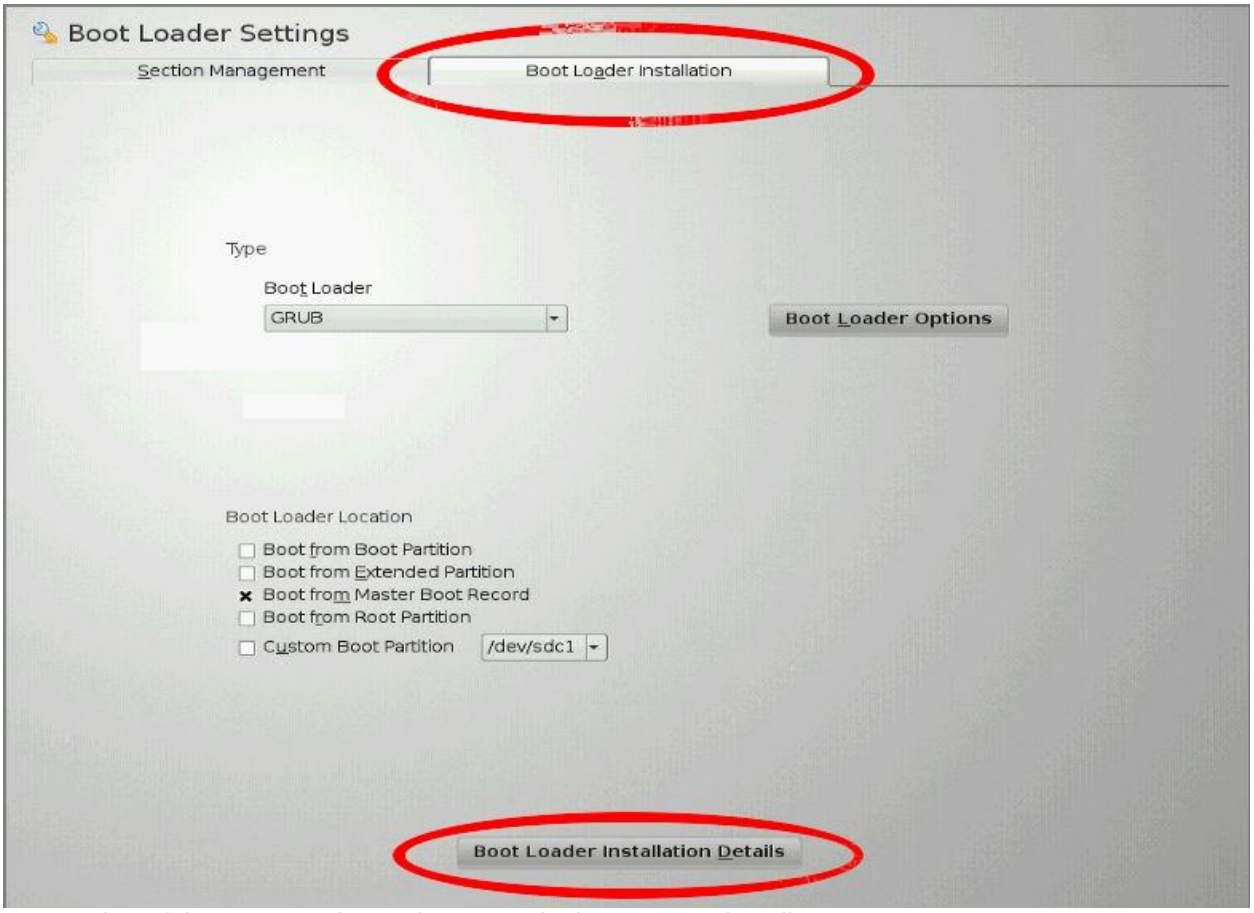
Click next through the wizard, and it should setup the iSCSI connection to the target, and show the iSCSI disk in the list. You would see two drives in the list, the USB drive and the newly added iSCSI drive. Create the required partitions for the install on the iSCSI drive, usually the '/' root and swap partitions.

Click "Accept" finally to finalize the partitioning settings, and the settings should show in the Installer summary page.



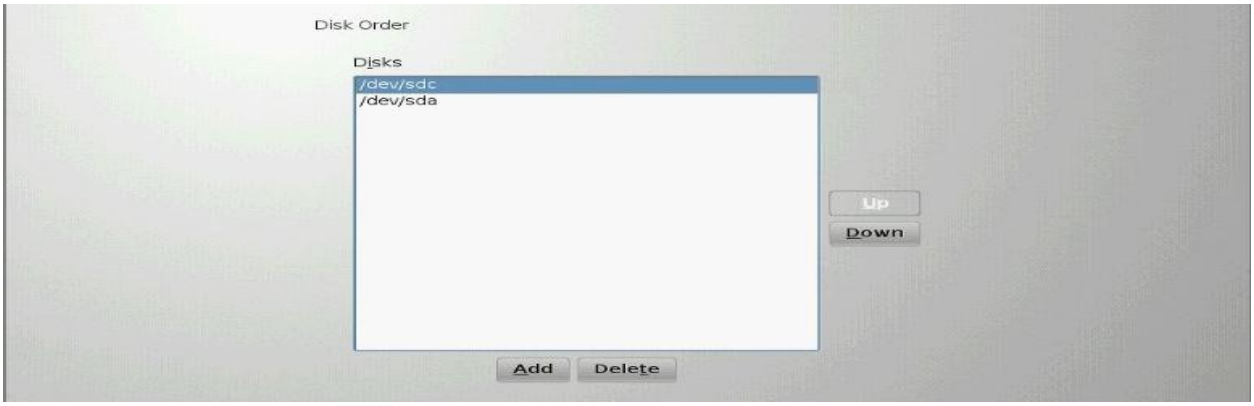
Screenshot of the "Expert" tab of the SLES 11 installation summary, with the boot loader wrongly installing to the USB driver update disk.

Now click the "Expert" tab, and ensure that the boot loader is installing to the iSCSI drive. If it is currently installing to MBR (Master Boot Record) on sda, that would usually be the USB drive, you need to change it, by clicking the "Booting" option.



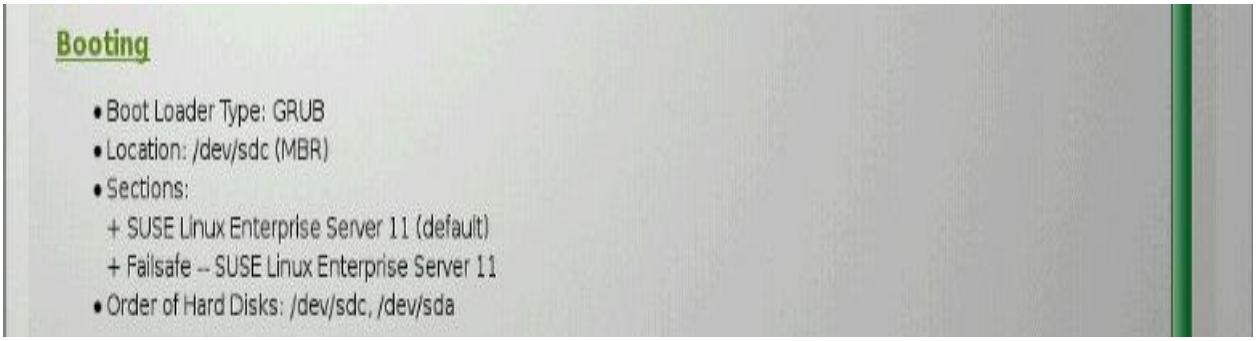
Screenshot of the Boot Loader settings page in the SLES 11 installer.

Now navigate to the “Boot Loader Installation” tab, and click “Boot Loader Installation Details”. Here you can change the order of drives as required, if the iSCSI drive, usually sdb or sdc is listed above the USB drive sda, click “OK” and return to the Installation summary page.



Screenshot of the Disk drive order configuration page in the Boot Loader section of the installer

Once the boot loader is configured correctly, notice that the Installation summary page states that the GRUB boot loader will install to the iSCSI disk.



Screenshot of the SLES 11 installation summary page, listing the correct drive for the boot loader installation.

Now proceed with the installation as usual, and on reboot, configure the iSCSI boot NIC interface with the same settings used in the Option ROM configuration utility.

SUSE LINUX ENTERPRISE SERVER 11 WITH CHELSIO BOOT INITIATOR

Both the Open-iSCSI Linux initiator and the Chelsio Boot Initiator provide boot capability on SLES 11 for x86 or x64 systems.

The driver update disk provided in the package, ensures that the driver is correctly loaded during the install and the final installed system. Burn the disk image to a USB drive with the dd command as follows:

```
# dd if=chelsio_ibft_driver_disk_sles11..img of=/dev/sd<usb drive
letter>
```

Once you have the USB driver update disk ready, boot the system from the CD or DVD of the OS. Connect the USB drive to the system.

Do keep the following in mind for the Boot Options:

For EDD enabled systems add “edd=off” to the commandline

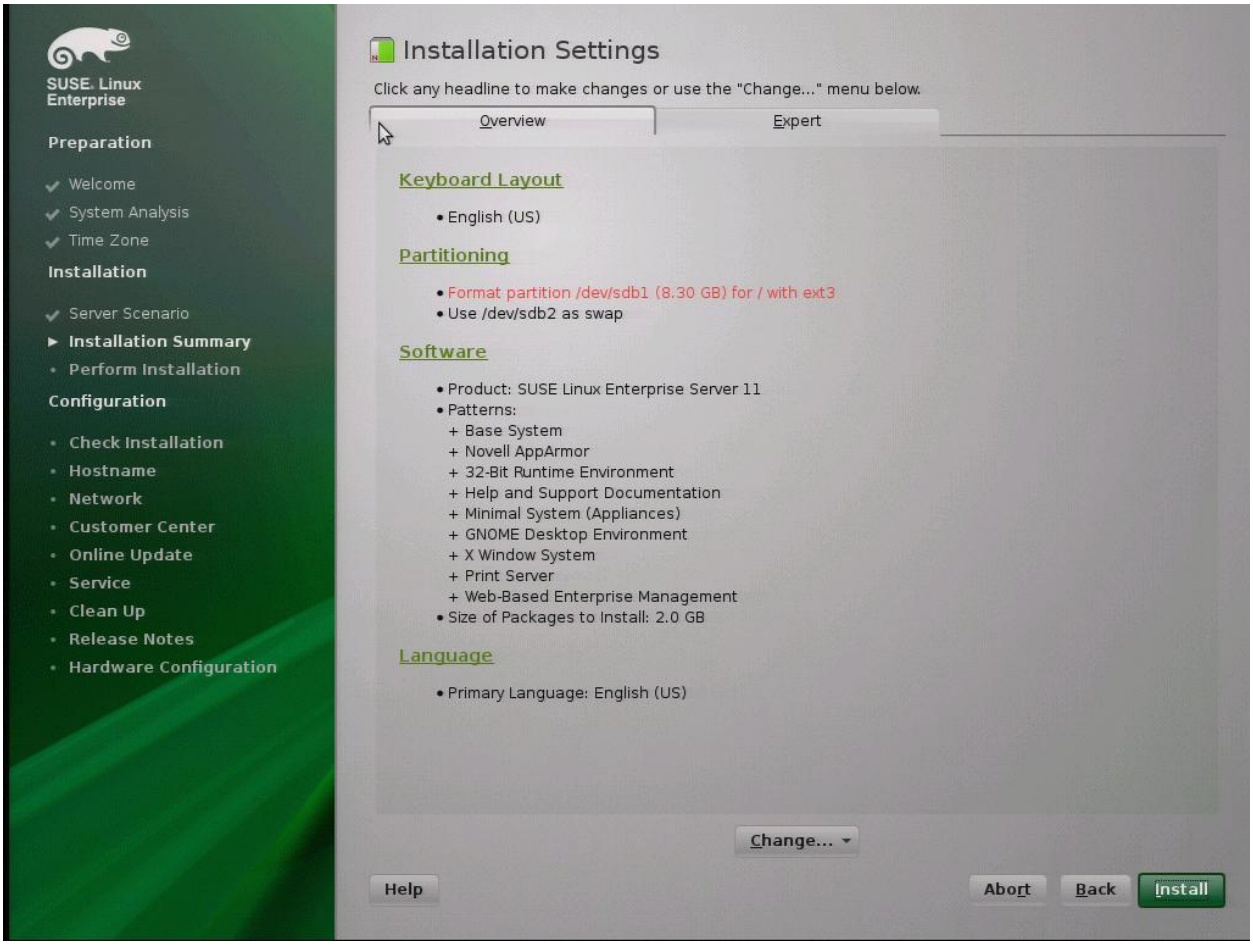
For 32 bit systems with < 2GB of RAM, add “highmem=0” to the commandline

For 32 bit systems with > 2GB of RAM, add “highmem=4M” to the commandline.

Note – You don’t have to press F6 here, as if the USB drive is connected, the installer will automatically

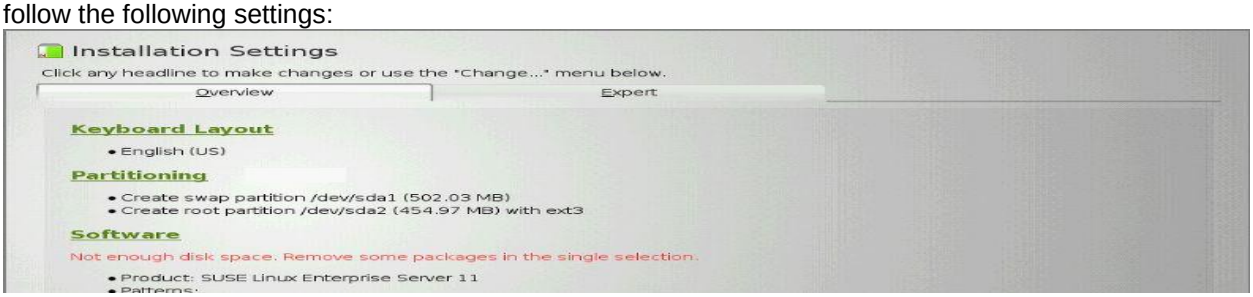
proceed normally to install as you would with any other SLES11 install.

Now the installer will load the Driver Update disk and automatically display the disks in the Installation Settings, if the drive is already partitioned.



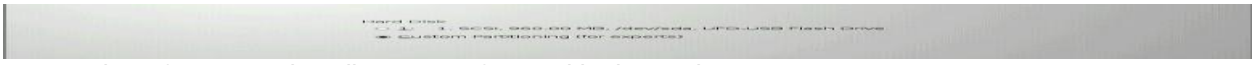
Screenshot of SLES 11 installer – sdb1 and sdb2 are exposed over iSCSI, if already partitioned

If the drive is not already partitioned, the SLES 11 installer may try to install to the USB drive. In this case, follow the following settings:



Screenshot of SLES 11 installer warning of no disk space available, trying to install to USB drive.

Select the partitioning option and select the “Custom Partitioning (for experts)” option. Now highlight the “Hard Disks” menu option on the left, and partition the iSCSI drive appropriately.

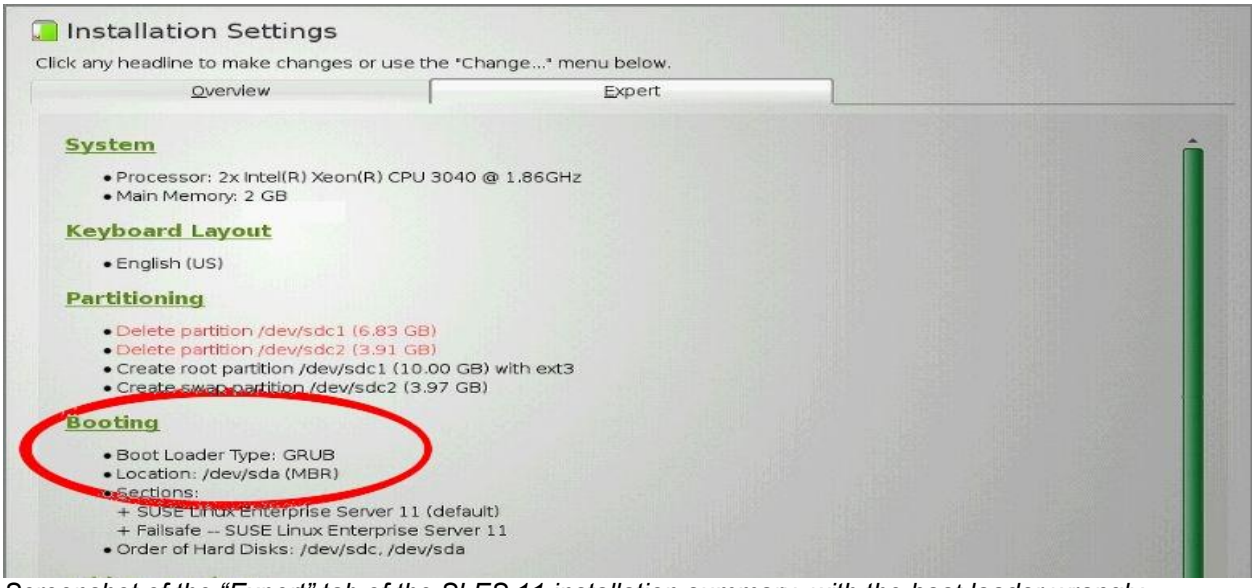


Screenshot of SLES 11 installer prompt for Partitioning options.

Screenshot of the SLES 11 partitioning tool, listing the newly added iSCSI drive.

Click next through the wizard, and it should setup the iSCSI connection to the target, and show the iSCSI disk in the list. You would see two drives in the list, the USB drive and the newly added iSCSI drive. Create the required partitions for the install on the iSCSI drive, usually the '/' root and swap partitions.

Click "Accept" finally to finalize the partitioning settings, and the settings should show in the Installer summary page.



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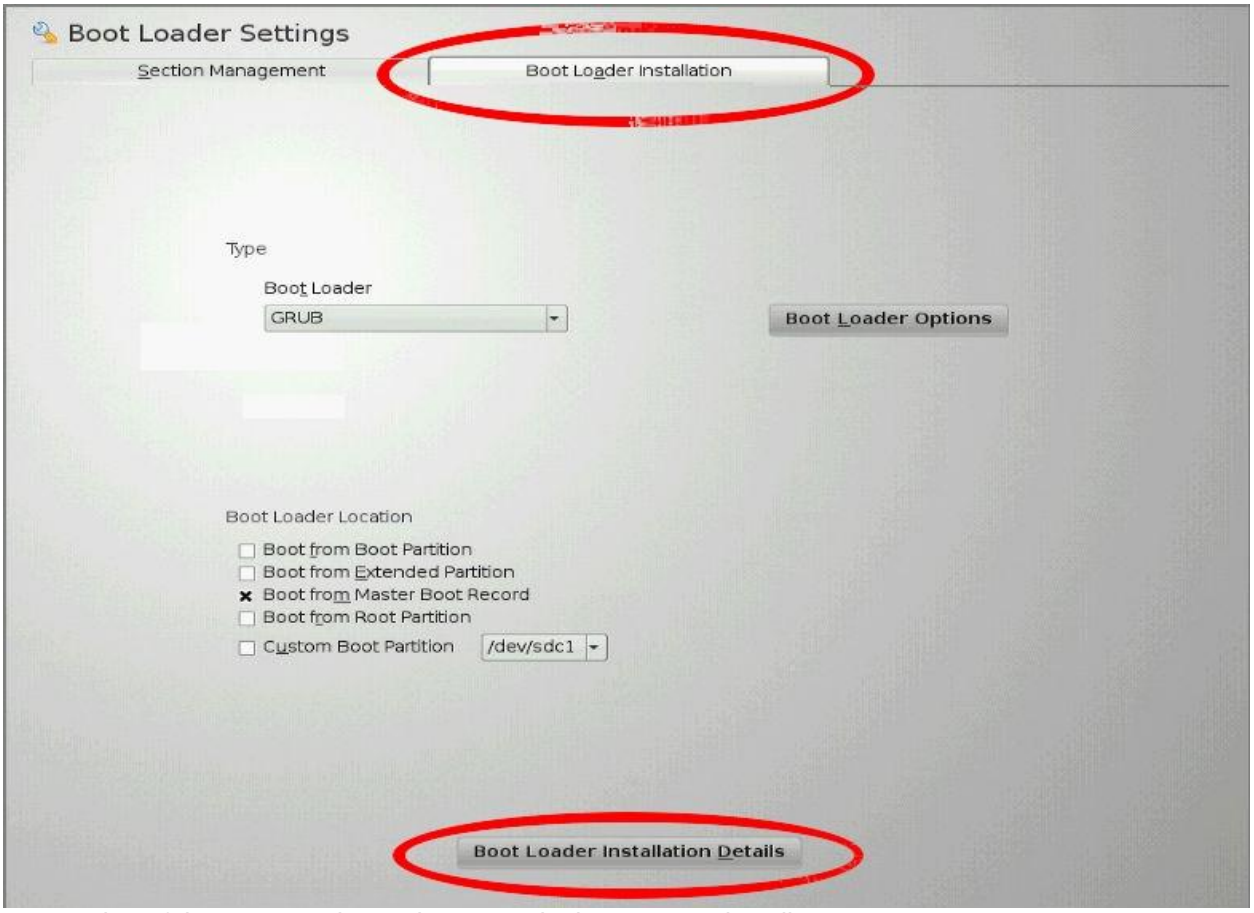

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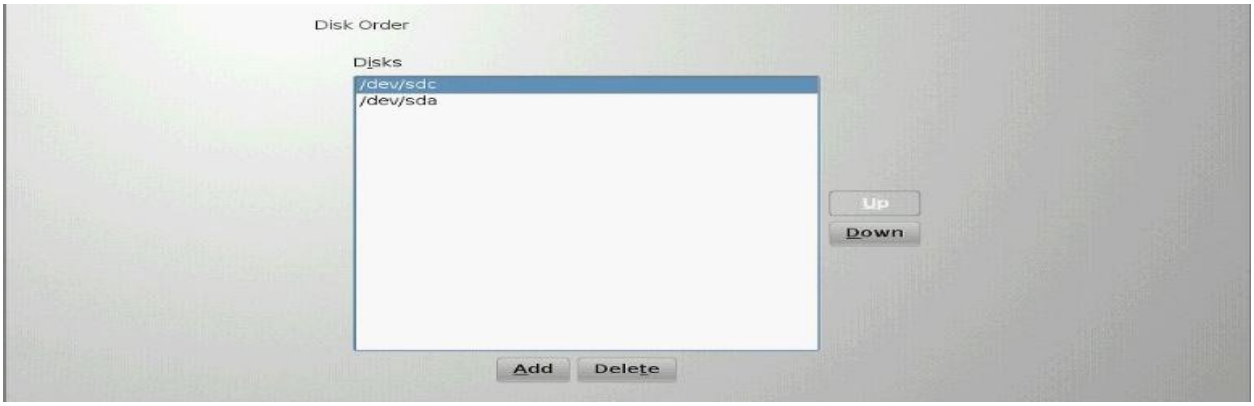

Screenshot of the Disk drive order configuration page in the Boot Loader section of the installer

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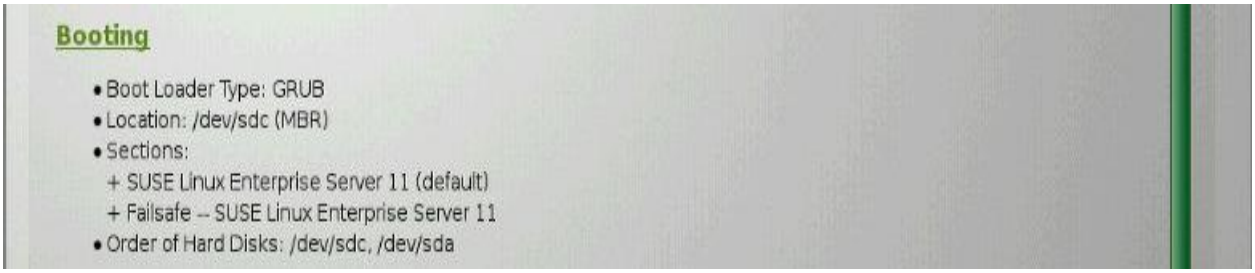


Screenshot of the SLES 11 installation summary page, listing the correct drive for the boot loader installation.

Now proceed with the installation as usual, and on reboot –

1. For the 32bit install, configure the iSCSI boot NIC interface with the same settings used in the Option ROM configuration utility.

2. For the 64 bit install, do not configure the interface used for iscsi boot.

Use the Other interfaces normally as you would.

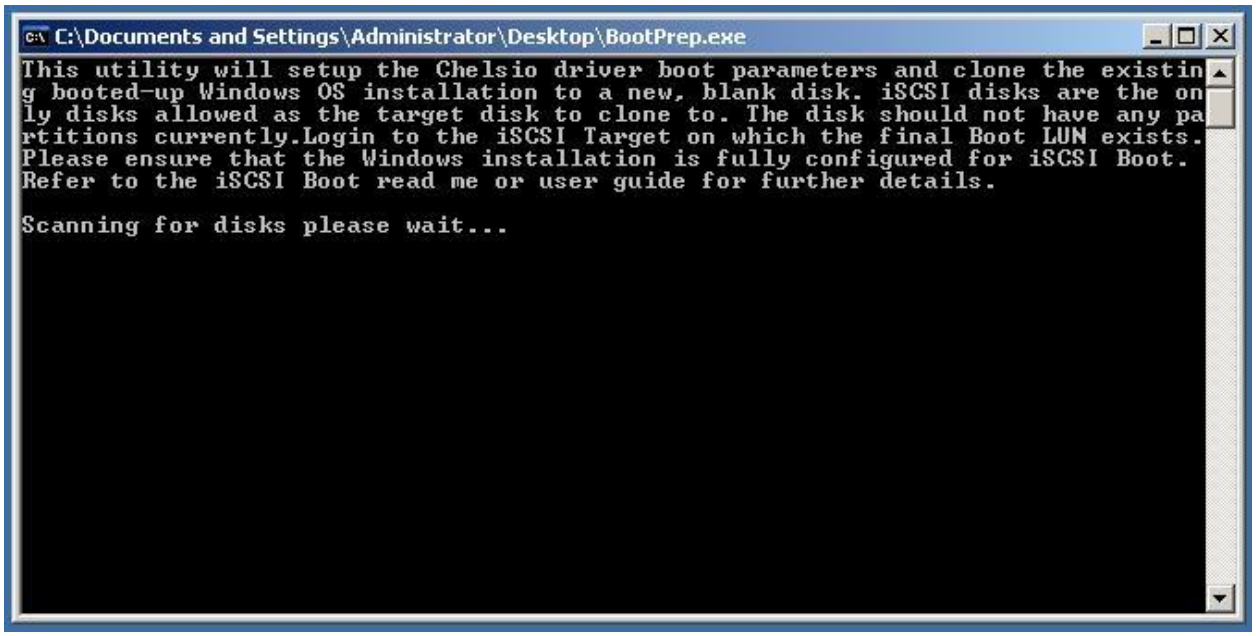
MICROSOFT WINDOWS SERVER 2003

Microsoft Windows 2003 server for 32 and 64 bit platforms can be booted from an iSCSI target. But there is no mechanism to directly install the OS to the target LUN.

a. Install the OS to a local disk, such as an IDE / ATA or SATA disk.
b. Once the OS installation is complete, install the Chelsio HBA in the system.
c. Now reboot and install the drivers for the HBA. WHQL certified Windows drivers are available on Chelsio's website at www.chelsio.com under the Downloads section.
d. Install the Microsoft iSCSI Boot initiator (available as a free download on Microsoft's website) and select the "Chelsio T3 Ndis Function driver" Network device as the boot-capable device during its installation wizard. Make sure it has a valid static IP address set. Note: It is important that the normal (non-Boot) initiator from Microsoft is not used as it will not work with this solution. Be sure it is the special Boot initiator that is installed.

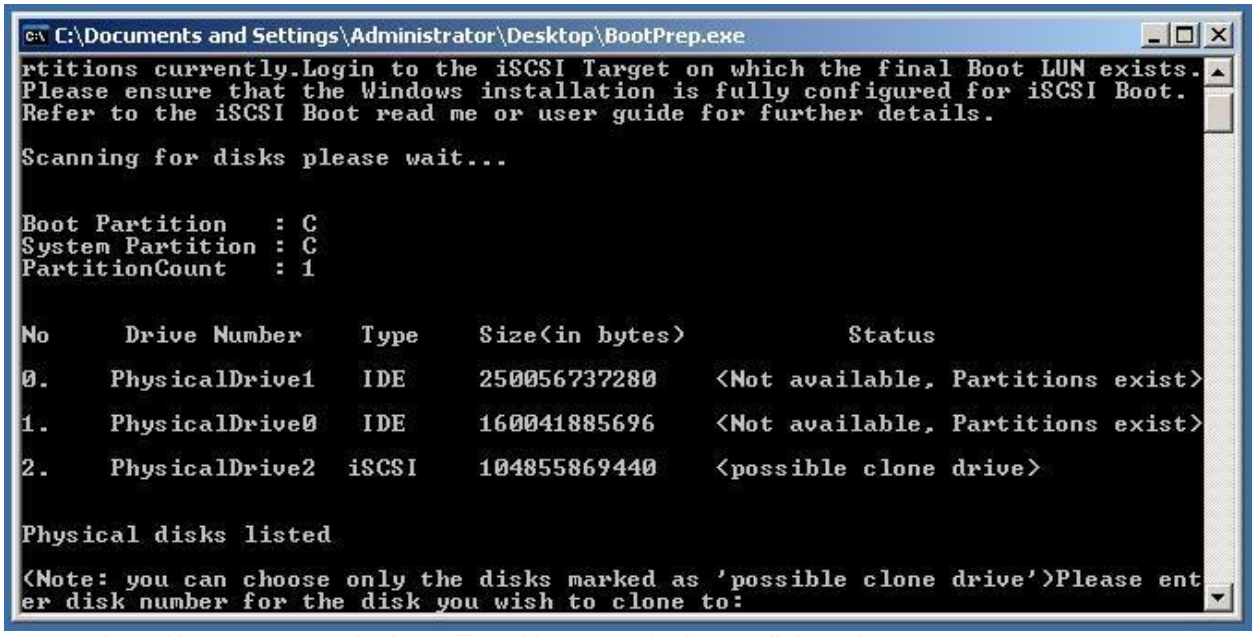
Warning: Do **not** use DHCP to configure the NIC being used for iSCSI boot. DHCP is not supported as a valid configuration for iSCSI boot in Windows 2003. Ensure that you configure the NIC being used for iSCSI boot correctly, in the OS and in the Option ROM configuration utility, with identical settings.

e. Install any Windows updates that are required, or fully update the system prior to cloning it to the iSCSI target LUN, and reboot as required, after the updates are complete.
f. Login to the iSCSI target in Windows, using the Microsoft initiator, and mark the target as persistent when logging into it.
g. Now install the vc_redist 2008 redistributable from Microsoft's download site. This utility is required to run Visual C/C++ applications, and provides the runtime libraries required for using such applications.
h. Copy the bootprep.exe cloning tool provided by Chelsio in the iSCSI boot package, to this system.
i. Open a command prompt and change directory to the location of bootprep.exe, and execute it. Do not have any other programs running during the cloning process.



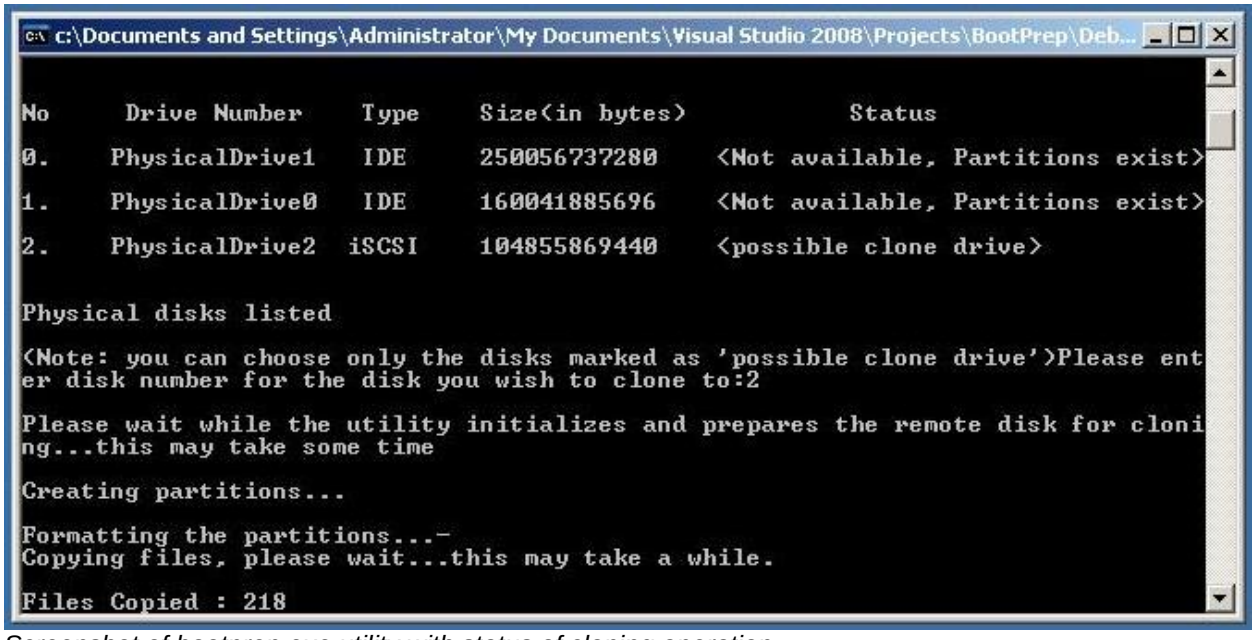
Screenshot of bootprep.exe cloning utility when it is launched.

j. Select the iSCSI target LUN as the disk to clone to, in the physical devices list. Only a disk with no partitions currently defined, should be selected.



Screenshot of bootprep.exe cloning utility with prompt for iSCSI disk to clone to.

k. The cloning process will begin and show its progress. It will setup necessary settings for the drivers, and clone the boot / system partition to the iSCSI target LUN.



Screenshot of bootprep.exe utility with status of cloning operation.

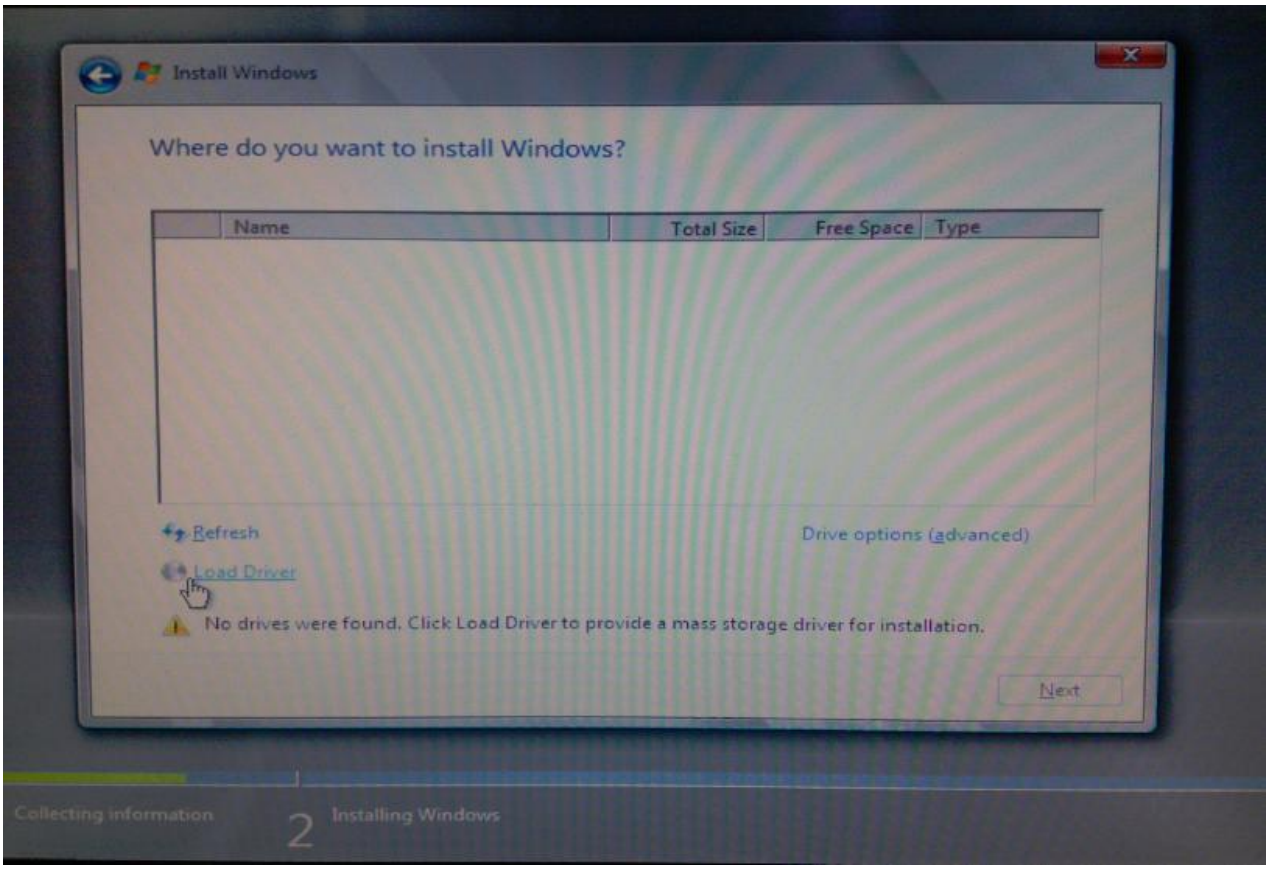
l. The OS is now setup for booting over iSCSI. Shutdown the system and disconnect the local IDE / SATA drive. Enable the Chelsio HBA as the Boot device in the System BIOS. The device will be displayed as "PCI SCSI: Chelsio Communications" in the BIOS boot devices list.

MICROSOFT WINDOWS SERVER 2008 / VISTA

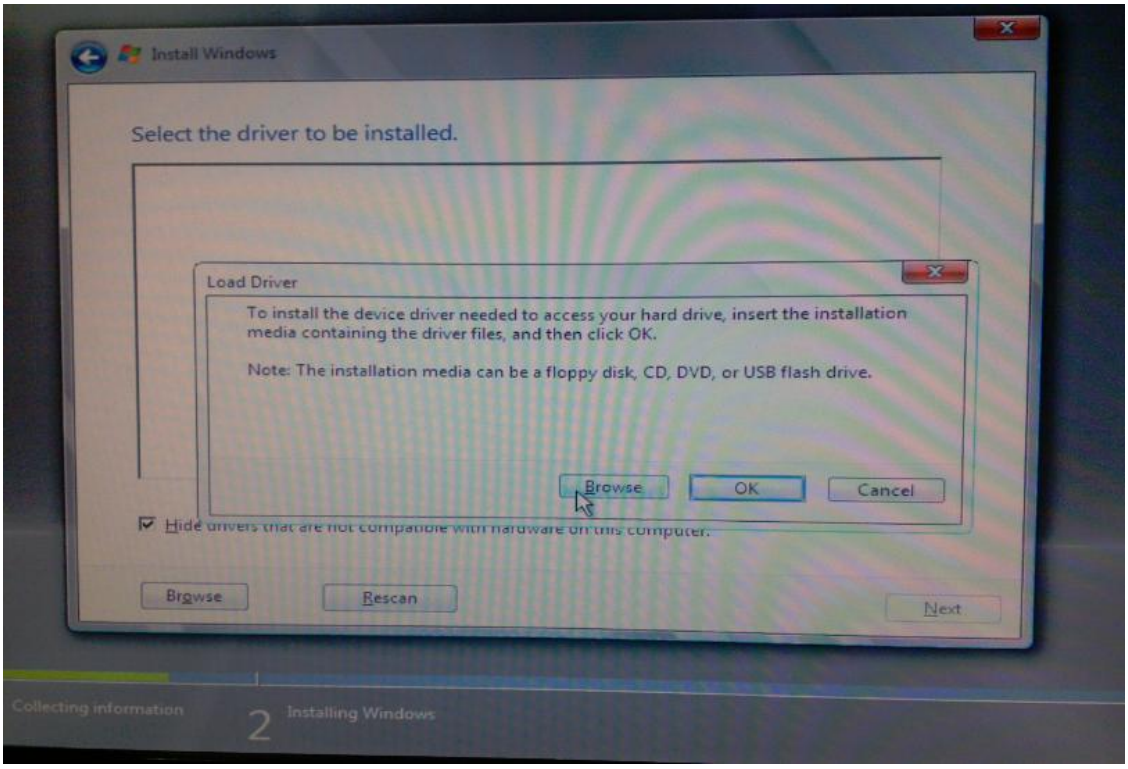
Microsoft Windows Server 2008 and Vista for 32 and 64 bit platforms can be booted from an iSCSI Target. Before booting it first needs to be installed to the target LUN.

Following are the instructions on how to load the Chelsio iSCSI Driver during the Operating System Installation.

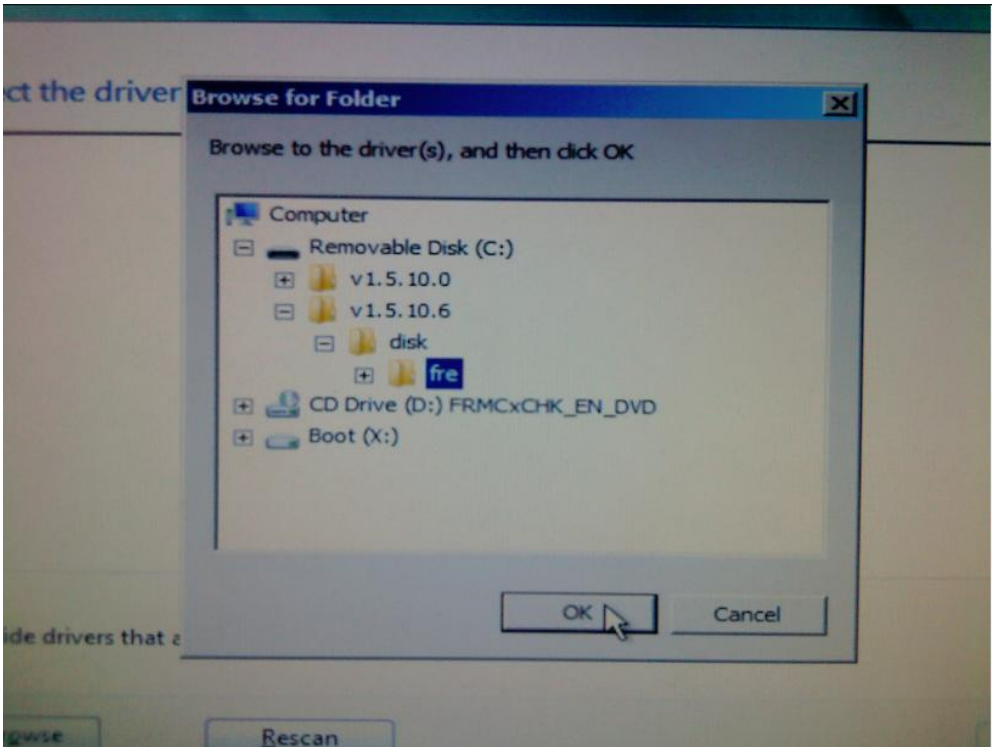
1. Store the script Chelsio_iscsiboot_starttype.vbs, Chelsio VBD – v1.5.10.6 and Chelsio iSCSI – v1.5.10.0 drivers in USB/CD.
2. Once the BIOS is installed successfully and the machine boots through the first boot device, say CD.
3. Select load driver option to load the drivers from USB/CD.



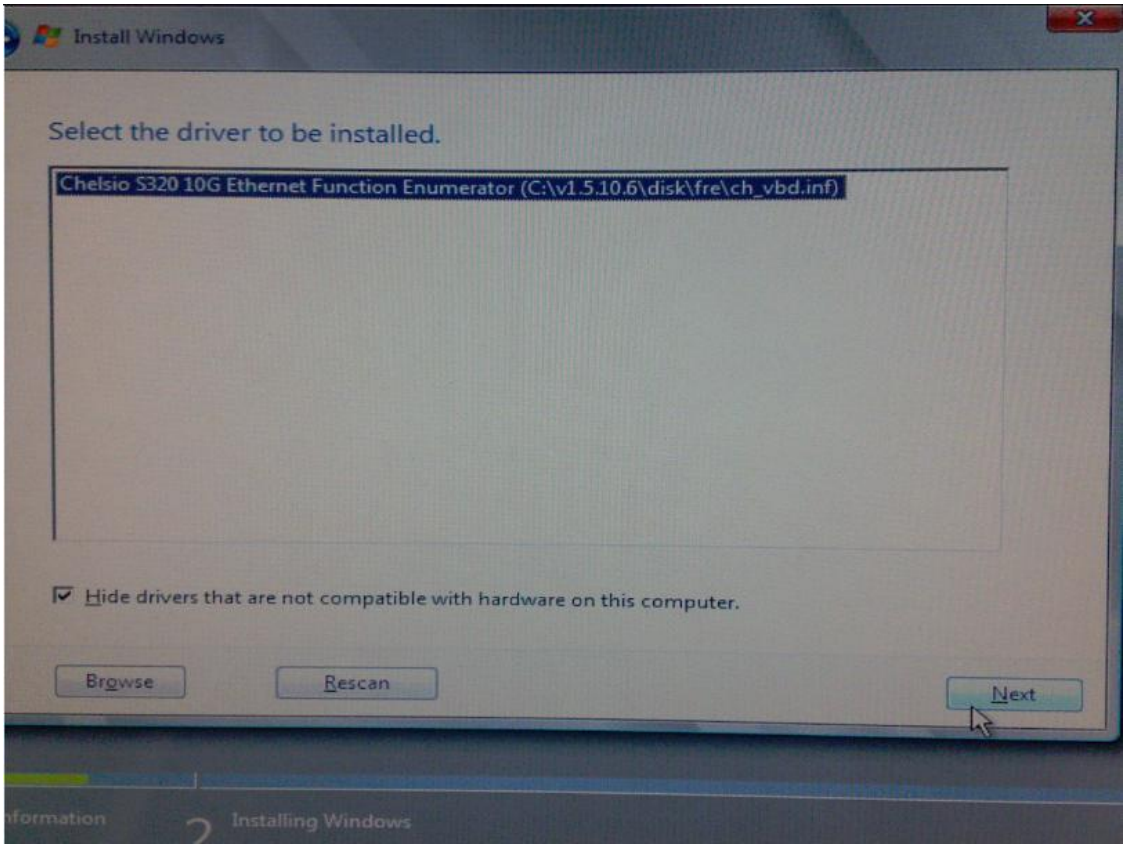
4. Browse to the respective USB/CD where the drivers are stored.



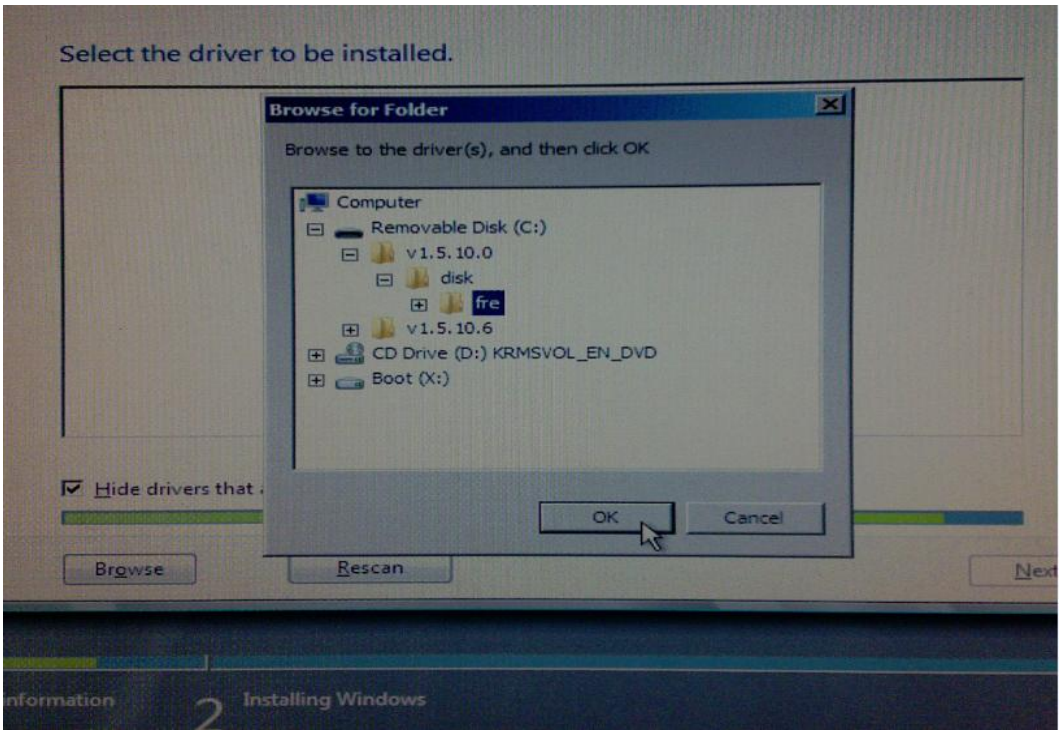
5. Browse to v1.5.10.6 → disk →fre and click on OK.



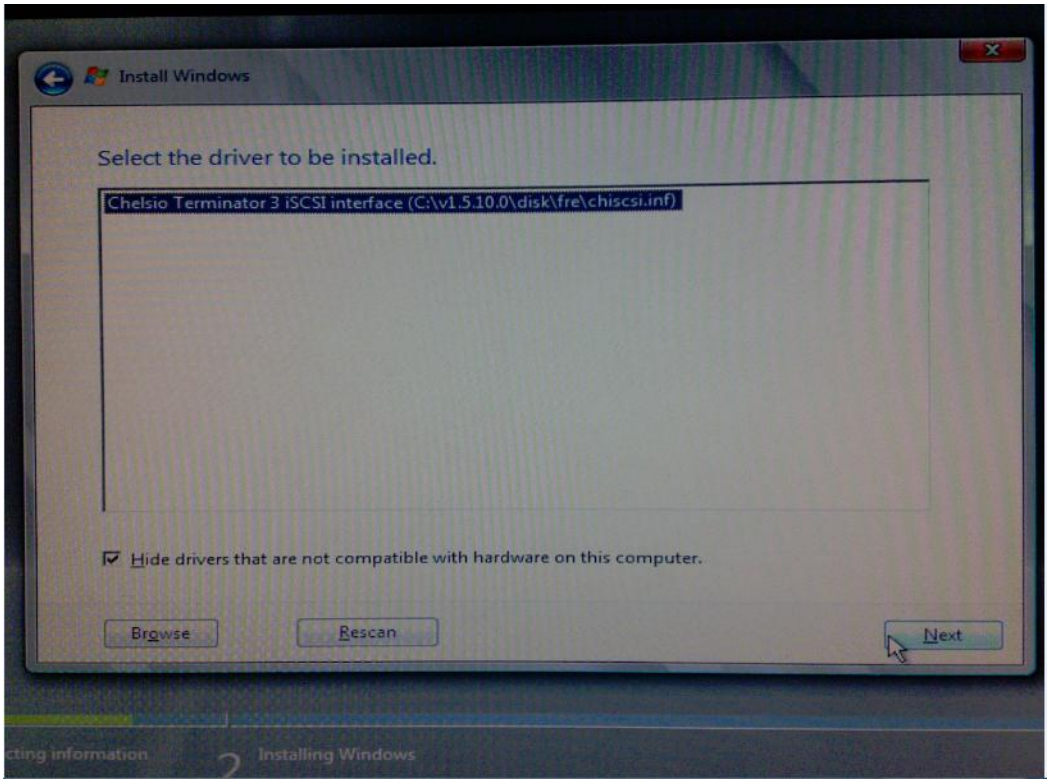
6. The following screen will displayed, Click on Next to load the Chelsio VBD driver.



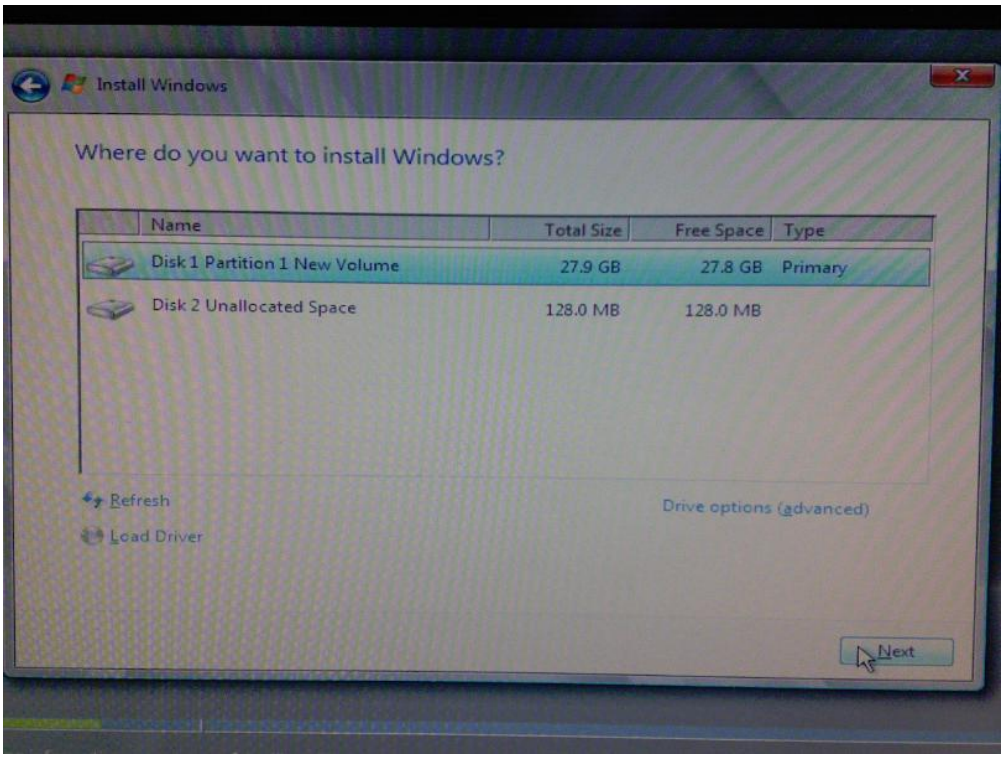
7. Similarly, select load driver option and browse to v1.5.10.0 → disk →fre to load Chelsio iSCSI driver and click on OK.



8. The following screen will displayed, Click on Next to load the Chelsio iSCSI driver.



9. Once both the drivers are loaded, the target LUN will be shown.



5 CUSTOMER SUPPORT

Please check the ERRATA file that is included in the distribution before contacting support as the answer to some questions can be found there. To contact Chelsio support for any issues regarding this product, email us at support@chelsio.com. Also check our website at www.chelsio.com for additional information.

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