



Configuring Windows Server 2008 R2 for iSCSI SAN Boot with EqualLogic Storage

A Dell EqualLogic Best Practices Technical White Paper

Dell Storage Engineering
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Feedback

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Executive summary

This white paper includes:

- Best Practices for using Dell™ EqualLogic™ storage as the storage device for iSCSI boot from SAN using Microsoft® Windows Server® 2008 R2.
- Guidelines for configuring volumes on Dell EqualLogic storage, Dell PowerEdge™ servers, and supported network adapters for iSCSI SAN boot from EqualLogic arrays.
- Reference architectures for 1Gigabit and 10Gigabit Ethernet iSCSI boot from SAN environments with Dell EqualLogic storage arrays and supported network adapters.



1 Introduction

This paper demonstrates Dell best practices for implementing iSCSI boot from a SAN for the 11th generation (11G) and 12th generation (12G) of Dell PowerEdge servers and Dell EqualLogic storage arrays when running Windows 2008 R2.

With its unique peer storage architecture, Dell EqualLogic PS Series storage delivers high performance and availability in a flexible environment with low total cost of ownership. EqualLogic storage solutions deliver the benefits of consolidated networked storage in a self-managing, iSCSI storage area network that is affordable and easy to use, regardless of scale. By eliminating complex tasks and enabling fast and flexible storage provisioning, these solutions dramatically reduce the costs of storage acquisition and ongoing operations.

With the combination of EqualLogic PS Series arrays and a Host Bus Adapter (HBA) that supports boot from SAN, you can now boot Windows Server 2008 R2 servers directly from the storage network. The operation is similar to the traditional boot process, except cost of hardware is reduced and use of network boot instead of traditional boot process.

In most cases, all you need is a supported network adapter on a standard server platform to enable the boot process over the network. EqualLogic PS Series arrays support several network adapters, as outlined in this paper.

With the PS Series arrays, iSCSI boot from SAN enhances the reliability and performance of your Windows server by leveraging the SAN to improve data protection. In addition, it enables centralized storage management and advanced features such as disk image cloning, snapshots, and disaster replication.

Now you can manage Windows 2008 Server boot images consistently and efficiently. As a result, you can easily repurpose servers and improve business continuity. If a server malfunctions, simply boot another server using the original boot image, and you are back in operation immediately. This method is simple, straight-forward, and efficient for large and small deployments.

Some additional benefits of using iSCSI Boot from SAN in your Windows environment:

- Diskless Servers – Eliminate the need for each server to boot from its own disks. This will allow the deployment of diskless servers that consume less facility space, less power, and are less expensive to manage.
- Centralized Management – All Operating System (OS) images are stored on the EqualLogic PS Series Array and can be centrally managed
- Simplified Recovery – Server failures can be quickly recovered by booting a spare server from the SAN
- Rapid Disaster Recovery – With the boot volumes and production data being replicated to a remote site the Recovery Time Objective (RTO) can be reduced by having standby servers that are preconfigured to Boot from SAN
- Rapid Deployment – If there is a period of high workloads, then a new server can be imaged from the clone of the boot image and more servers can be deployed to support the increased workload.



1.1 Objective

The goal of this whitepaper is to:

- Provide guidelines and best practices for configuring Dell PowerEdge servers and supported network adapters for iSCSI SAN boot from EqualLogic arrays.
- Provide a lab tested and validated SAN architecture to support high availability by implementing multi-path I/O and redundant components.
- Provide reference architectures for 1Gb and 10Gb Ethernet iSCSI boot from SAN environments with Dell supported network adapters from Qlogic™, Intel™, and Broadcom™.

1.1.1 Audience

This whitepaper is intended for server and storage administrators that are involved in the design or implementation of servers that boot from an EqualLogic iSCSI SAN volume. This white paper establishes best practices for Dell PowerEdge servers, Dell EqualLogic storage arrays, and several supported network interface cards. Readers should be familiar with EqualLogic iSCSI storage and Dell PowerEdge servers with Windows Server 2008 R2, as well as general concepts around SAN storage and Ethernet networks.

1.1.2 Scope

The configuration process for boot from SAN environments can vary considerably based on the components used in the solution. This document focuses on the steps required to configure the following components for iSCSI boot from SAN.

Note: Data Center Bridging (DCB) test or configuration for iSCSI boot from SAN is not included in the scope of this paper.

Table 1 Components covered by this document

Component	Component details
OS	Windows Server 2008 R2 SP1
Servers	Dell PowerEdge Servers (11G and 12G Family)
Network Adapters	Broadcom NetXtreme II 5709c Gigabit Ethernet NIC (11G) Intel 10GbE x520 Server Adapter (11G and 12G) Intel 10GbE x540 Server Adapter (11G and 12G) Intel 1GbE i350 Server Adapter (12G) Intel Pro 1000 Server Adapter (11G) Qlogic QLE8262 Converged Network Adapter (11G and 12G)
Storage Array	Dell EqualLogic 1Gigabit and 10Gigabit PS Series with firmware 6.0.1 or higher.



1.2 Terminology

11G PowerEdge Servers or **11G**– 11th generation of Dell PowerEdge servers

12G PowerEdge Servers or **12G**– 12th generation of Dell PowerEdge servers

Arrays – Refers to iSCSI EqualLogic PS Series storage arrays

IQN – iSCSI Qualified Name – This is a naming format useful when an end user or service provider wishes to assign iSCSI names for targets and/or initiators. The iSCSI Qualified Name is documented in RFC 3720 (<http://tools.ietf.org/html/rfc3720>) and RFC 3721 (<http://tools.ietf.org/html/rfc3721>)

SAN – Storage Area Network is the network that interconnects storage devices, including host interfaces (NICs) and arrays. SAN may also refer to the storage, switches, and host interconnects as a single entity.

Slipstream - The process of integrating updates into an original installation media. Some Boot from SAN installations require creating a customized bootable DVD media to update the drivers contained on the original Windows 2008 R2 installation media.



2 Process overview

To configure iSCSI boot from SAN, there are four major steps which are explained in detail in the following sections. These steps include:

1. Configure EqualLogic storage arrays and prepare the boot volumes in Section 4.
2. Configure the Server and Network adapter(s) on the server to support boot from iSCSI targets in Section 6 and Section 7.
3. Install the OS onto the iSCSI target volume that was prepared for boot in Section 8.
4. Configure redundant boot paths and multi-path I/O for the boot volumes and any additional SAN volumes in Section 9.

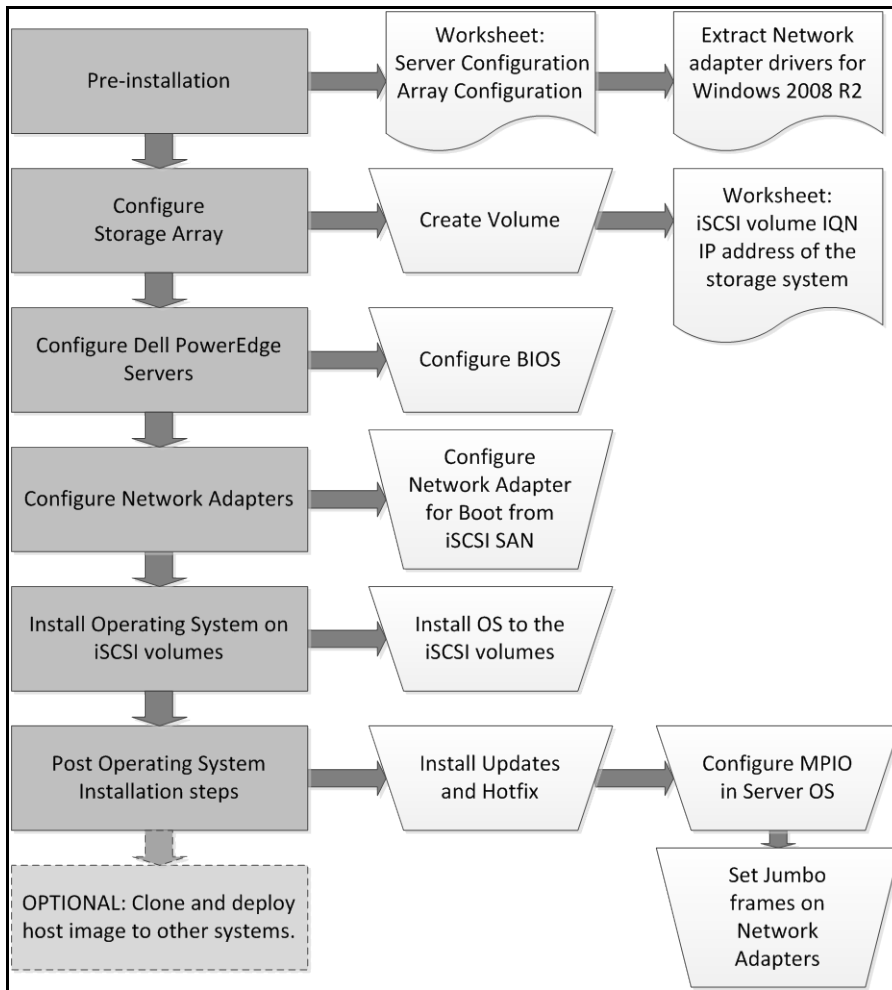


Figure 1 Process for installing Windows 2008 Boot from iSCSI SAN



2.1 Before you begin

Before you start the configuration process, you should complete the following steps:

1. Use a configuration tracking worksheet similar to the example provided in Appendix A.
 - a. Note the IP address, IQN*, subnet mask, and other details about the Network adapter.

Note: The IQN name may also be known as the "initiator name" in the network adapter configuration. See Section 6 for more information.

- b. Note the EqualLogic group details and volume details as needed.
 2. All best practices related to storage, network switches, and servers should be followed. Refer to the following documents for more information:
 - a. Rapid EqualLogic Configuration Portal provides general guidelines for configuring an EqualLogic SAN network at <http://en.community.dell.com/techcenter/storage/w/wiki/3615.rapid-equallogic-configuration-portal-by-sis.aspx>
 - b. Switch Configuration Guides provide information for configuring network switches at <http://en.community.dell.com/techcenter/storage/w/wiki/4250.switch-configuration-guides-by-sis.aspx>
 3. Update your Dell EqualLogic Storage Array with the latest drivers and firmware versions. You can find more information at the Dell EqualLogic website at www.equallogic.com/support.

2.2 Additional considerations

The Microsoft MSDN article "*Microsoft iSCSI Boot Step-by-Step Guide*," available at [http://technet.microsoft.com/en-us/library/ee619733\(v=ws.10\).aspx](http://technet.microsoft.com/en-us/library/ee619733(v=ws.10).aspx) gives details about boot from SAN for Windows 2008 R2 environments.

Note the following additional considerations:

1. It is not recommended to configure a gateway for an iSCSI boot adapter if the iSCSI target is in the same subnet as the initiator. For more details, see the Microsoft Knowledge Base article KB960104 on support.microsoft.com at <http://support.microsoft.com/kb/960104>.
2. NIC teaming is not supported for iSCSI boot.
3. iSCSI boot is not supported with IPv6 networks for the network adapters used in this paper.



2.3 Restrictions for Broadcom adapter drivers

The Broadcom network drivers included on the Windows 2008 R2 media do not support booting from an iSCSI SAN volume for Broadcom adapters other than Broadcom NetXtreme II 5709c Gigabit Ethernet NIC. When booting from an iSCSI SAN using Broadcom network adapters, a slipstreamed image of Windows 2008 R2 is required. For more information on creating a slipstreamed Windows image, see Microsoft Knowledge Base article KB974072 at <http://support.microsoft.com/kb/974072>.

The procedure for iSCSI boot using Broadcom network adapters is available on the Broadcom support website in the Broadcom NetXtreme II™ Network Adapter User Guide under the **Using iSCSI** section.

Example (exact link is subject to change as new drivers are released):

http://www.broadcom.com/docs/support/ethernet_nic/Broadcom_NetXtremeII_Server_T7.4.pdf



3 Extracting drivers for a Windows 2008 R2 installation

Before you begin the installation steps, download and extract the latest network adapter drivers from <http://support.dell.com>. Copy the extracted drivers to a USB flash drive so that they can be easily accessed during the Windows 2008 R2 installation.

Choose the appropriate Intel, QLogic, or Broadcom drivers for your configuration. The following steps provide detail on how to extract the drivers for each specific network adapter.

3.1 Extracting Intel NIC drivers (Optional)

1. Download Intel NIC drivers from <http://support.dell.com>.
2. Download the latest Intel_LAN_*.exe file and double click it to unpack the driver set. Select the location for the files.
3. Open the command prompt with administrator rights. (Right click cmd.exe and select "Run as administrator".)
4. Change directory in the command prompt to the location of the unpacked driver files.
5. Run this command to extract the drivers:
`Setup.exe -a`
6. Choose a location to extract the files. You can extract the files to a USB drive so that they can be easily mounted on the system when needed.
7. The drivers for installation can be found at the following location: `\production\W2K8R2-x64\<NIC-Folder>`.

3.2 Extracting QLogic NIC drivers (Optional)

1. The following steps should be done on a compatible system. (i.e, a Windows 2008 R2 system)
2. Download QLogic NIC drivers from <http://support.dell.com>.
3. Download the Qlogic_LAN_*.exe file and double click it to unpack the driver installation files. Select the location for the files.
4. Open the command prompt and change directory to the location of the unpacked driver files.
5. Choose a location to extract the driver files. Run this command to extract the drivers:
`Setup.exe /z"/extractdrivers="<location-for-files>"`

Example:

```
Setup.exe /z"/extractdrivers="C:\temp"
```

6. Proceed with the installation, accept the license terms, and choose "Drivers only" when prompted to select the feature you want to install. Do not select "Install VLAN/TeamingDriver".
7. Unzip the driver package (i.e., `>/production/Win2008R2-x64/p3p_nic_win2k8r2_x64.zip`).
8. The drivers for installation can be found in the unzipped folder.



3.3 Extracting Broadcom NIC drivers (Optional)

1. Download Broadcom NIC drivers from <http://support.dell.com>.
2. Download the Bcom_LAN_*.exe file for your configuration and double click it to unpack the driver installation files. Select the location for the files.
3. Open command prompt and change directory to the location of the unpacked driver files and open the folder named "Driver_Management_Apps_Installer".
4. Run this command to extract the drivers:
`Setup.exe /a`
5. Choose a location to extract files.

Note: Make note of the directory structure where the files are extracted. For example, the Broadcom drivers for Windows Server 2008 x64 are extracted to the following locations:

For VBD:

/Program Files 64/Broadcom/BDrv5706/VBD

For NDIS:

/Program Files 64/Broadcom/BDrv5706/W2k8



4 Configuring the Dell EqualLogic Storage System

This section describes the process of configuring the EqualLogic storage arrays to host the iSCSI boot volumes for a Windows host.

Perform the following steps to create a target volume to boot the Windows host from:

1. Log in to Dell EqualLogic PS Series Group Manager by entering the IP address of the group in your web browser.
2. Click on the "Storage Pools" and select the desired pool in which the volume will be created. Once selected, under "Activities" click on "Create Volumes" to create a volume on the EqualLogic storage.
3. Give the volume a name (do not use spaces in the name) and optionally enter a description. Select a storage pool with free pool space and click next.
4. Assign the size of the volume to be created. You can create a Thin volume by selecting the "Thin provisioned volume" checkbox. The snapshot reserve defaults to 100% and can be changed if needed.

Note: Microsoft recommends a minimum system partition size of 32 GB for Windows Server 2008 R2 installations, depending on system RAM, possible power states, and other considerations. For more information, see the Microsoft Windows Server website at <http://technet.microsoft.com/en-us/library/dd379511>.

Note: For more information on the default allocation of snapshot reserve, see the whitepaper *EqualLogic Snapshots and Clones: Best Practices and Sizing Guidelines* at: <http://en.community.dell.com/dell-groups/dtcmmedia/m/mediagallery/20097871/download.aspx>



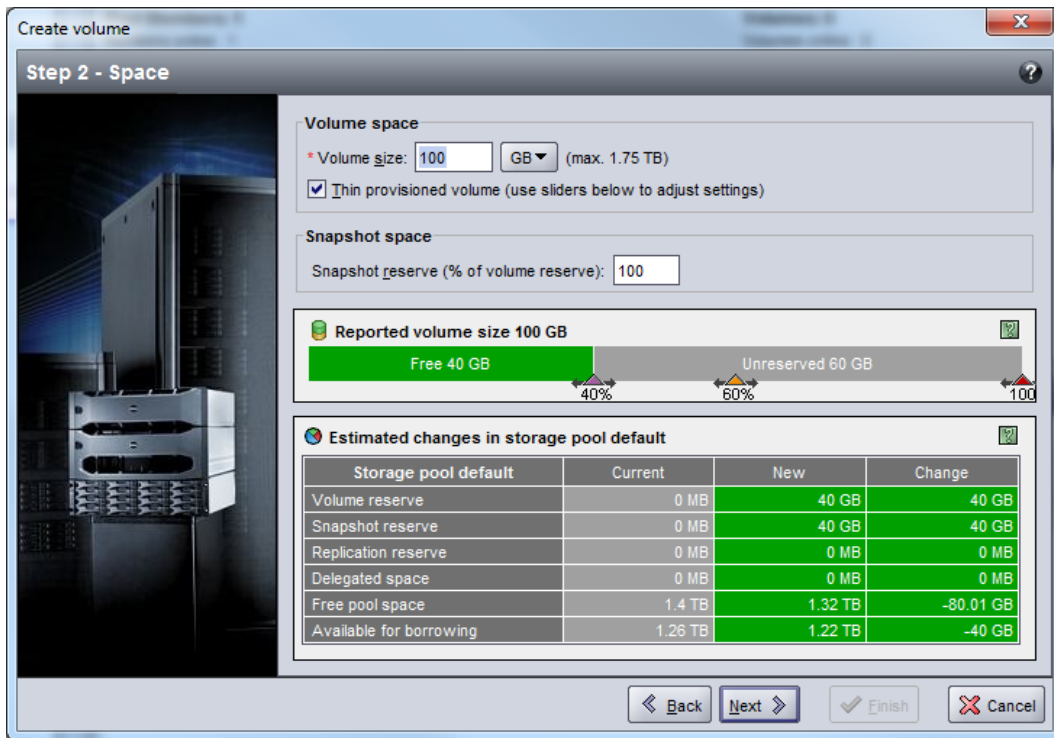


Figure 2 Configuring the volume size via EqualLogic group manager

5. Select one or more of the following iSCSI access modes for the volume you are going to present the Array Disk to:
 - a. Authenticate using CHAP user name
 - b. Limit access by IP Address
 - c. Limit access to iSCSI Initiator Name

Note: If you limit access based on iSCSI initiator name, then the iqn name entered here must match the iqn name of the host server adapter that will be booting from this volume. When using two NIC ports for redundancy, both of the ports may have different iqn names. In this case, you will need to add both iqn names. When creating a volume you can add only one access type, however once the volume is created additional access configuration can be added.

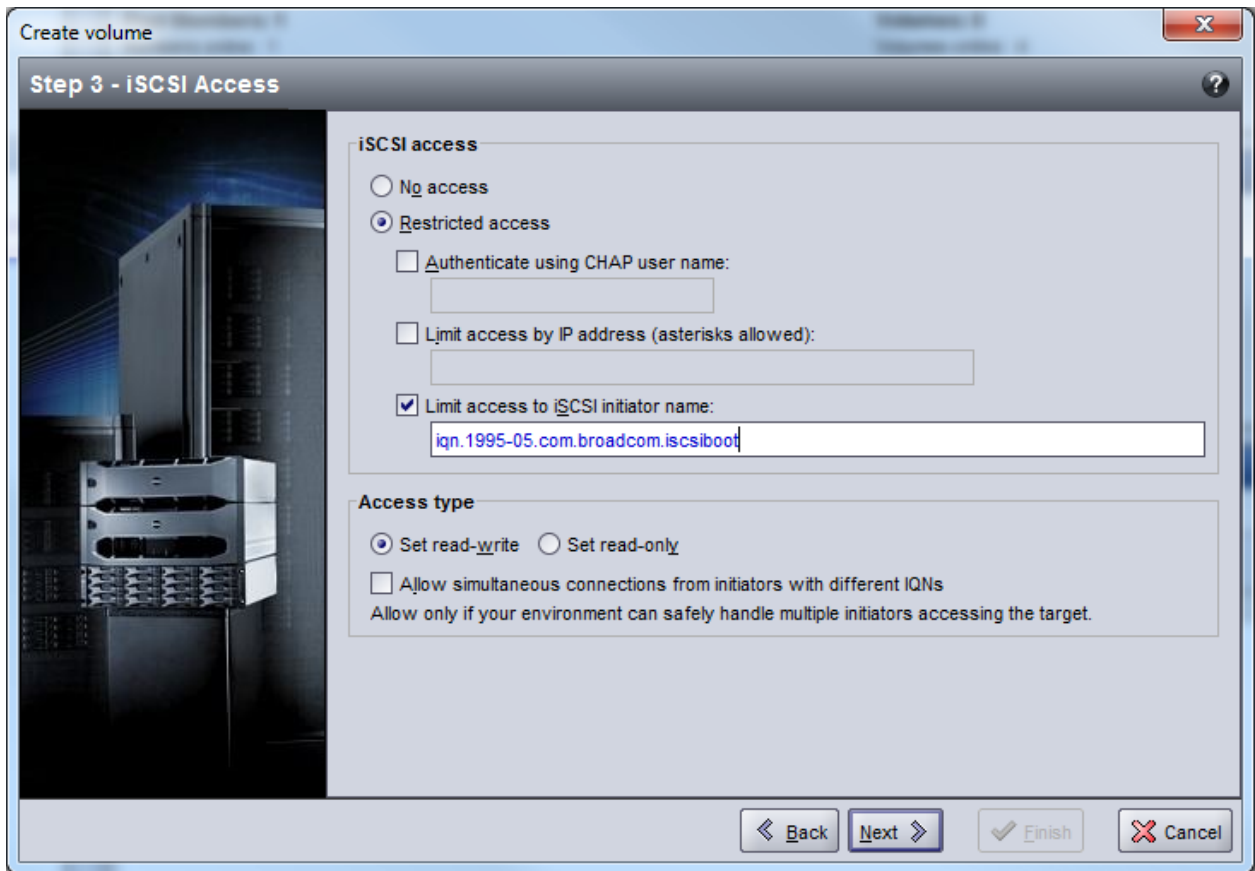


Figure 3 iSCSI access window allows you to choose the access type

6. Keep the default Access type set to “read-write”.

Note: It is usually not necessary to enable shared storage except when the iqn name of two network adapter ports used for iSCSI boot are different. Example: When using a Qlogic 8262 dual-port network adapter, and configuring redundant boot paths, you will need to add the unique iqn name for each individual port. For Broadcom and Intel adapters, the iqn name is the same for all ports on the same card.

7. The summary screen is displayed. Verify the settings and click Finish to create the volume.
8. Go to the Volumes section of the Group Manager by clicking on the lower left “Volume” button. Select the volume recently created which is listed under volumes. Choose the “Connections” tab, and note the iSCSI target name in the **Configuration worksheet** in Appendix A.
9. To add new access parameters, click on **Volumes** on the lower left corner of Group Manager. Choose the volume where access is to be added and click on **Access** tab. Once there click on the **Add** button to add a new access parameter.

5 Preparing Intel Network Adapters for iSCSI boot

Note: Intel network adapters are not shipped with iSCSI enabled in the Boot ROM. You must enable iSCSI so that Intel network adapters are detected as a boot device and are listed in the "Boot Sequence". During the system boot if you do not see the Ctrl+D option to configure the Intel NIC then follow the following the steps in this section to enable iSCSI on the Intel network adapter.

You must perform the following steps to enable iSCSI remote boot in the Boot ROM on the Intel network adapter.

1. Create a DOS bootable USB flash drive.

Note: The open source utility UNetbootin can be used to create a DOS bootable USB flash drive using FreeDOS. The utility can be downloaded from <http://unetbootin.sourceforge.net/>.

2. Download the Intel Boot Agent from the Intel support website. The file is named: "Preboot.exe"

Note: The support site for Intel is www.intel.com/support.

3. Extract the "Preboot.exe" zip file to the bootable USB key created in step 1.
4. With the Intel NIC installed, boot the server using the DOS bootable USB key.
5. Once the system boots from the DOS bootable USB key, change to the directory containing the Boot Agent (\Preboot\Apps\Bootutil\Dos). To enable the capability to run flash firmware on the selected adapter, run the following command:
`bootutil.exe -all -fe`
6. If this command returns an error, then program the flash using this command:
`"bootutil.exe -up=combo -all -File=<path>/bootimg.flb"`

See Figure 4 for more detail.

Then repeat step 5 to enable flash on the network adapter. (bootimg.flb is not in the same location as bootutil.exe, bootimg.flb is available in Preboot\apps\bootutil.)



```

idrac-49CP5M1, PowerEdge R610, User:root, 33.4fps
Virtual Media File View Macros Tools Power Help
=====
 1  001B21CC4AC0  Gigabit YES UEFI,PXE,iSCSI Primary      2.3.52
 2  001B21CC4AC1  Gigabit N/A UEFI,PXE,iSCSI
=====

C:\PREBOOT\APPS\BOOTUTIL\DOS>bootutil -up=combo -all -File=bootimg.flb

Intel(R) Ethernet Flash Firmware Utility
BootUtil version 1.3.45.0
Copyright (C) 2003-2012 Intel Corporation

Programming flash on port 1 with flash firmware image
Create restore image of NIC 1 before proceeding? (Y)es or (N)o: Y

Saving flash firmware image on port 1 to file 10C9401B.FLB...saved

Flash update successful

Skipping port 2 (shared flash with previous port)

Port Network Address Series WOL Flash Firmware      Version
=====
 1  001B21CC4AC0  Gigabit YES UEFI,PXE,iSCSI Primary      2.7.125
 2  001B21CC4AC1  Gigabit N/A UEFI,PXE,iSCSI
=====

C:\PREBOOT\APPS\BOOTUTIL\DOS>bootutil

```

Figure 4 This screen shows the steps to program the flash with "bootimg.flb" file

7. Reboot to apply the new configuration. Boot to the DOS bootable key created previously.
8. Change to the directory containing the Boot Agent (\Preboot\Apps\Bootutil\Dos), and run the following commands:
`bootutil.exe -all -bootenable=iscsiprimary`
`bootutil.exe -all -bootenable=iscsisecondary`

These commands enable network adapter ports as iSCSI primary/secondary for legacy BIOS.



```

D idrac-89CP5M1, PowerEdge R610, User:root, 27.7fps
Virtual Media File View Macros Tools Power Help
C:\PREBOOT\APPS\BOOTUTIL>cd dos
C:\PREBOOT\APPS\BOOTUTIL\DOS>bootutil.exe -all -bootenable=iscsiprimary

Intel(R) Ethernet Flash Firmware Utility
BootUtil version 1.3.45.0
Copyright (C) 2003-2012 Intel Corporation

Port Network Address Series WOL Flash Firmware Version
==== =====
1 A0369F01535C 10GbE N/A UEFI,PXE,iSCSI,FCOE
2 A0369F01535E 10GbE N/A UEFI,PXE,iSCSI Primary,FCOE 2.7.88

C:\PREBOOT\APPS\BOOTUTIL\DOS>bootutil.exe -all -bootenable=iscsissecondary

Intel(R) Ethernet Flash Firmware Utility
BootUtil version 1.3.45.0
Copyright (C) 2003-2012 Intel Corporation

Port Network Address Series WOL Flash Firmware Version
==== =====
1 A0369F01535C 10GbE N/A UEFI,PXE,iSCSI Secondary,FCOE 2.7.88
2 A0369F01535E 10GbE N/A UEFI,PXE,iSCSI Primary,FCOE 2.7.88

C:\PREBOOT\APPS\BOOTUTIL\DOS>

```

Figure 5 Running commands to configuring Intel network adapter ports as Primary and Secondary source for iSCSI boot



6 Configure Dell PowerEdge servers for iSCSI boot

The following sections describe the process for configuring the server BIOS and NICs to support boot from iSCSI targets.

6.1 Preparing 11G PowerEdge servers to use a Network card for iSCSI boot

Change the boot sequence settings.

1. Start or Reboot the system and during boot-up (during POST or Power-On Self-Test), press **[F2]** to enter Setup, select **Boot Settings**, and then **Boot Sequence** and press **[Enter]**.
2. Adjust the boot sequence order so that the onboard Broadcom, Intel, or Qlogic NIC is first in the list, followed by the DVD/CD-ROM device.
 - a. For Intel and Qlogic 1G/10G network adapters – go to **Hard-Drive Sequence**, press enter, and bring the network adapter listed to the top of the list. See an example in Figure 6.

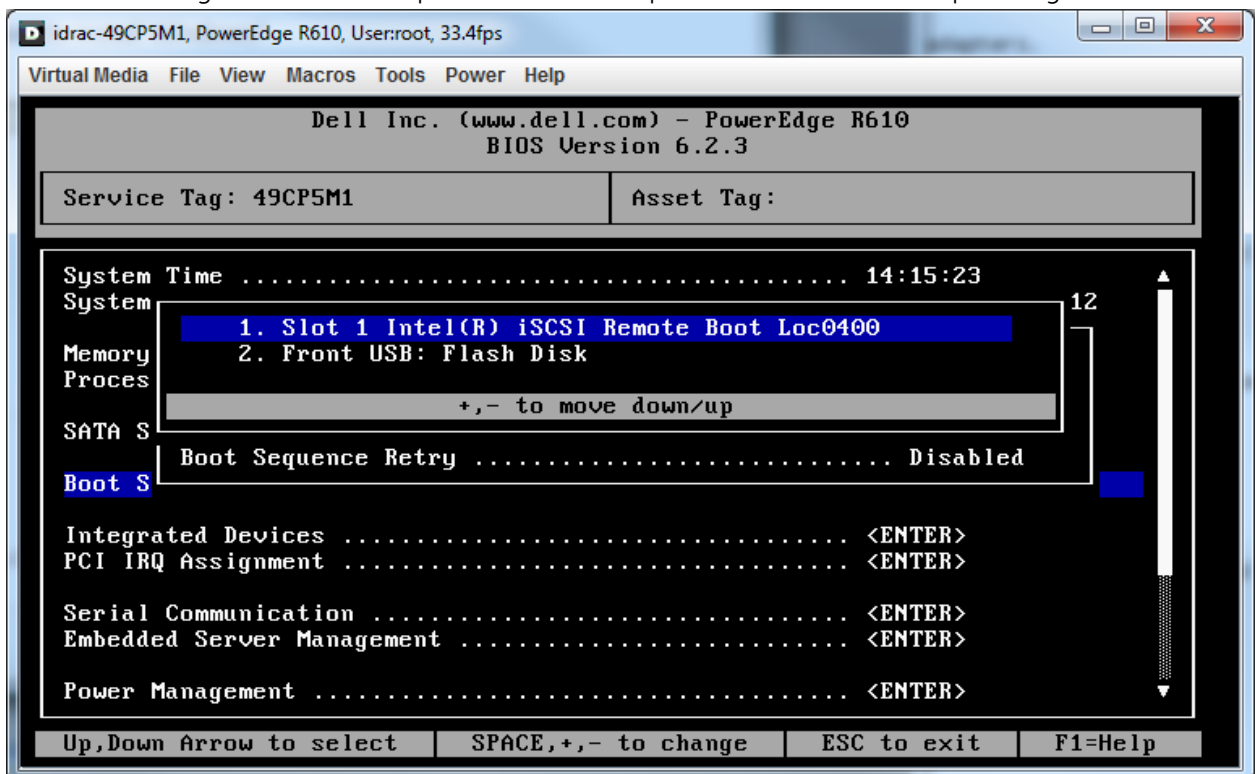


Figure 6 Changing Hard-Disk Drive sequence to put Intel NIC at the top.

3. Then select "Integrated Devices". Multiple NIC choices will appear in the list. Select the correct NIC to be used for boot from iSCSI. You should also record the MAC address for this NIC for use later in this procedure. Make the following changes:
 - a. **Integrated RAID Controller:** Disabled (This disables access to any internal hard drives.)
 - b. **Internal USB Port:** Off (To prevent a conflict during Windows 2008 install process.)

- c. **Internal SD Card Port:** Off (To prevent a conflict during Windows 2008 install process.)
 - d. **Embedded NIC:** If using an embedded NIC then enable iSCSI Boot for that particular NIC only. Select "Enabled" option for all the NICs not being used for iSCSI Boot, as shown below.
 - i. Embedded NICx: Enabled
 - ii. Embedded NICx: Enabled with iSCSI Boot
4. These changes are shown in the following figure. After changing, escape out and save. Immediately continue with the process for configuring the network adapters in Section 7.

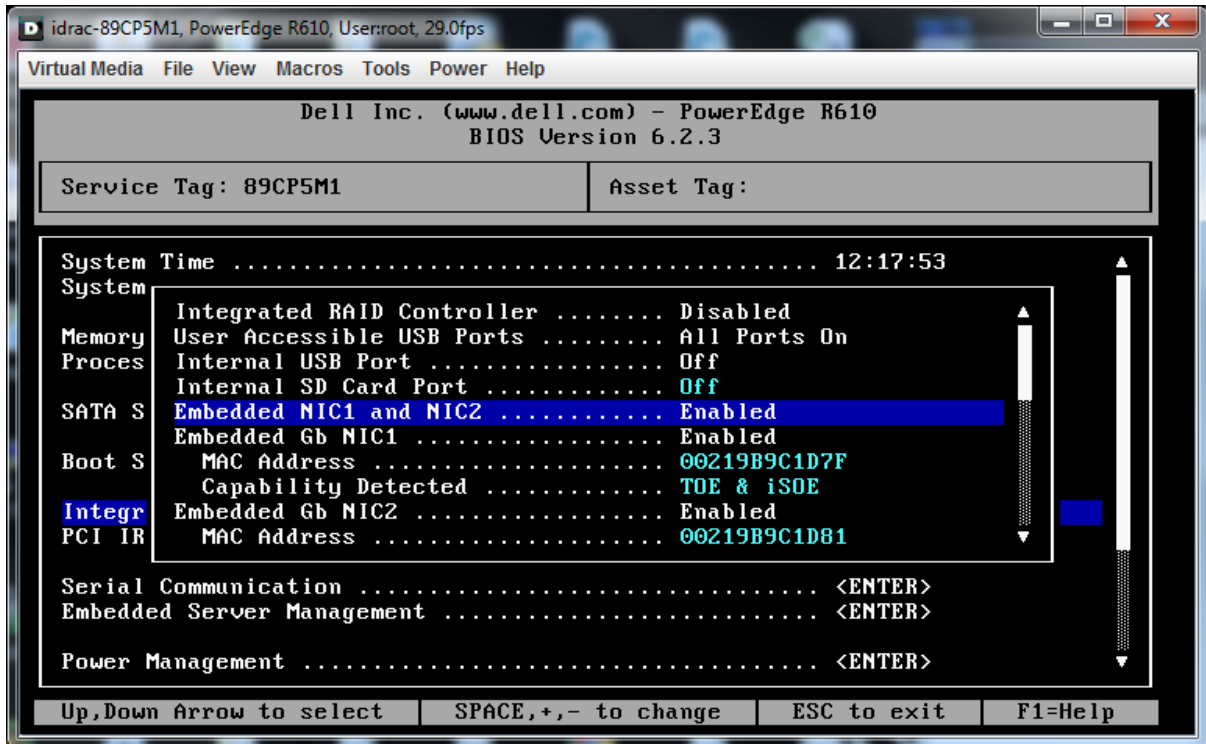


Figure 7 Settings for "Integrated devices"

6.2 Preparing the 12G PowerEdge server to use a Network card for iSCSI boot

1. Start/Reboot the system and during System boot press [F2] to enter Setup, and enter **System BIOS**.
2. Enter "**Integrated Devices**" and disable "Integrated RAID Controller". Once done press "Back".
3. Enter **Boot settings**, then enter the **BIOS Boot Settings** and then enter the **Boot Sequence**.
4. Adjust the boot sequence order so that the Broadcom/Intel/Qlogic NIC is first in the list, followed by the DVD/CD- ROM device.
5. If the network adapter used for iSCSI boot is not listed in the **Boot Sequence**:
 - a. Make **Hard drive C:** the top choice followed by any additional boot devices desired. Intel and Qlogic network adapters are reported in the GUI as "Hard Drive C:".
 - b. Go to "Hard-Disk Drive Sequence" and bring the network adapter to the top. As seen in Figure 6.

Note: The USB drive and Virtual CD are detected if they are loaded.

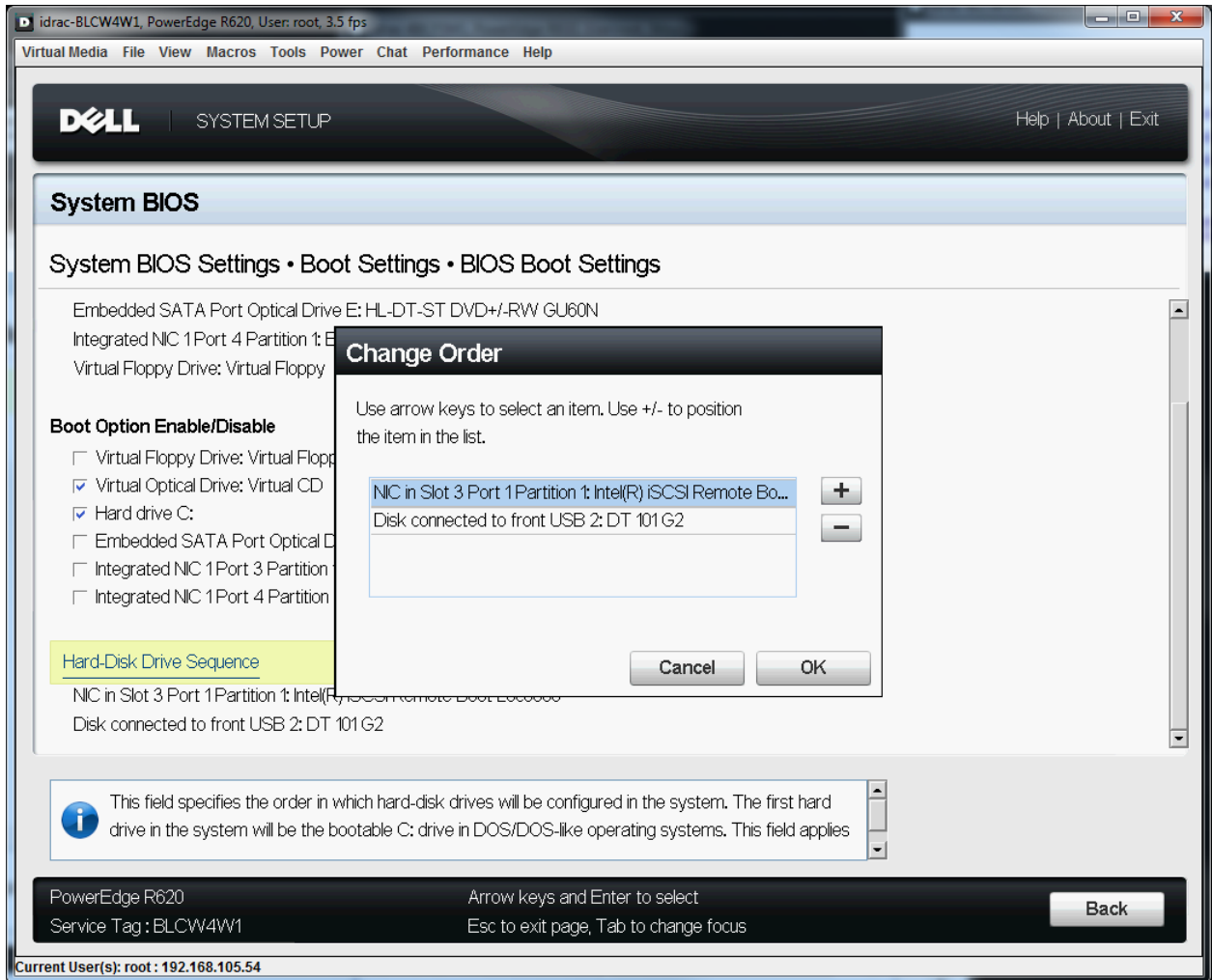


Figure 8 Changing Hard-Disk drive sequence in System Bios

6. Under Boot Option Enable/Disable, add a check mark to the network adapter used for iSCSI boot from SAN and also add a check mark to the Optical or Virtual CD drive. When the network adapters are listed in "Hard-Disk Drive Sequence", also add a check mark for "Hard drive C:".
7. Exit to "System Setup Main Menu" and save the configuration when prompted.



7 Configure Network Adapters for PowerEdge Servers

Once the system is configured, configure the network adapter to connect to an iSCSI volume and later boot from the same. The following steps describe the procedure for Intel, QLogic, and Broadcom network adapters. Use the sections below that apply to your configuration:

- For Intel network adapters see Section 7.1
- For QLogic converged network adapters, see Section 7.2
- For Broadcom network adapters, see Section 7.3
- Section 7.4 contains an alternate method of configuration using UEFI based System Setup for 12G PowerEdge servers.

7.1 Configuring Intel Network Adapters for iSCSI boot

Intel network adapters are not shipped with the Boot ROM enabled for iSCSI. During the system boot if you do not see the Ctrl+D option to configure the Intel NIC then see Section 5 to enable iSCSI on the Intel network adapter.

Use the following steps to configure the Intel network adapter for iSCSI boot from SAN.

1. Reboot or start the system. When prompted press or Ctrl-D to run setup for the Intel network adapters.
2. In the **iSCSI Port Selection** menu, enter "P" to make a Primary iSCSI boot port, "S" for Secondary iSCSI boot port, and "D" to disable booting from the port. Select the primary network adapter port and press **[Enter]** to configure the initiator and target details.
3. In the **iSCSI port configuration** menu, press **[Enter]** to select **iSCSI Port Selection**. Uncheck **Use dynamic IP configuration** if it is active. See Figure 9.
4. Enter the Initiator Name, Initiator IP and Subnet Mask. Also enter the target details as needed such as Target Name, Target IP, and Target Port (3260) from the configuration worksheet in appendix A. Select **OK** to exit.

Note: The initiator IP will be same as the group IP of the EQL group.



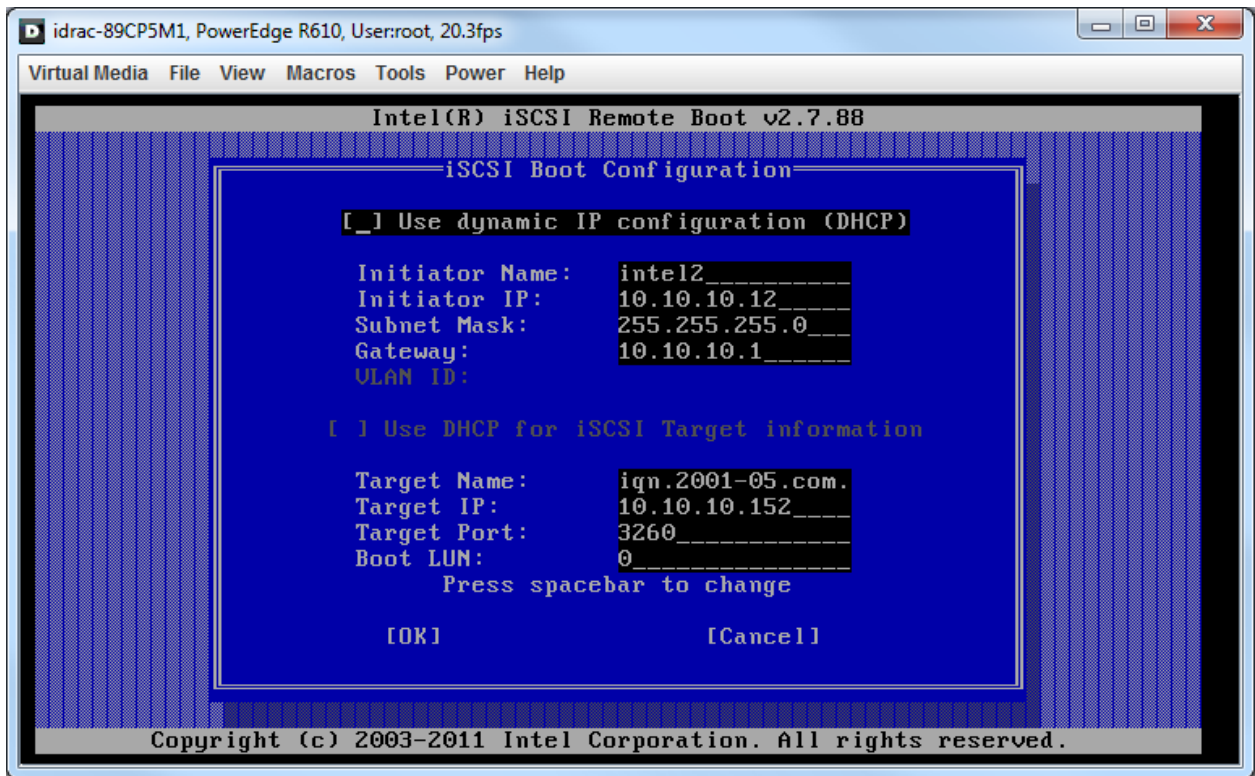


Figure 9 iSCSI boot configuration menu for Intel network adapters

5. Select **iSCSI CHAP configuration** and press **[Enter]** to configure CHAP if needed.
6. Save changes and exit.
7. Configure other Intel network adapter ports if available. Enter "S" to make it secondary boot path. Configure the Secondary network adapter as shown above in steps 3 to 6 and exit after saving. Exit by pressing **[ESC]**.
8. When you exit the Intel iSCSI Remote Boot setup, the network adapter immediately connects to the specified target. Verify that the login to the target is successful as shown in Figure 10.


```
idrac-89CP5M1, PowerEdge R610, User:root, 28.0fps
Virtual Media File View Macros Tools Power Help

Initializing adapter configuration - MAC address(A0369F01535E).
Using STATIC configuration for primary port, please wait.
iSCSI Target Name      : iqn.2001-05.com.equallogic:4-52aed6-5266bb47f-ce70019c
932506dc-10gvolume-intel
iSCSI Target IP Address : 10.10.10.152
LUN ID: 0               Port: 3260
iSCSI Initiator IP     : 10.10.10.22
iSCSI Gateway IP      : 10.10.10.1
iSCSI Initiator Name   : intel2

Initializing adapter configuration - MAC address(A0369F01535C).
Using STATIC configuration for secondary port, please wait.
iSCSI Target Name      : iqn.2001-05.com.equallogic:4-52aed6-5266bb47f-ce70019c
932506dc-10gvolume-intel
iSCSI Target IP Address : 10.10.10.152
LUN ID: 0               Port: 3260
iSCSI Initiator IP     : 10.10.10.12
iSCSI Gateway IP      : 10.10.10.1
iSCSI Initiator Name   : intel2

Attempting to connect to target disk using MAC address(A0369F01535E)
LUN: 0 DEVICE: EQLOGIC 100E-00 100.0 GB
```

Figure 10 Intel network adapter logging to EqualLogic volume after configuration

9. Continue to section 8 for steps to install Windows 2008 R2.

7.2 Configuring Qlogic network adapter for iSCSI boot

Note: The steps shown below use the iSCSI Boot Firmware Table (iBFT) for boot from SAN. For Qlogic QLE8262 there is an alternate method of boot from SAN using *Fast!UTIL* from Qlogic. Information about this alternate method is available in Section 4, "iSCSI Configuration Using *Fast!UTIL*", of the following Qlogic User Guide: <http://i.dell.com/sites/content/shared-content/data-sheets/en/Documents/Qlogic-QME8242-k-User-Guide.pdf>.

Use the following steps to configure the Qlogic QLE8262 network adapter for iSCSI boot from SAN.

1. During the system boot, press **[Ctrl+Q]** when prompted to enter the Qlogic configuration menu.



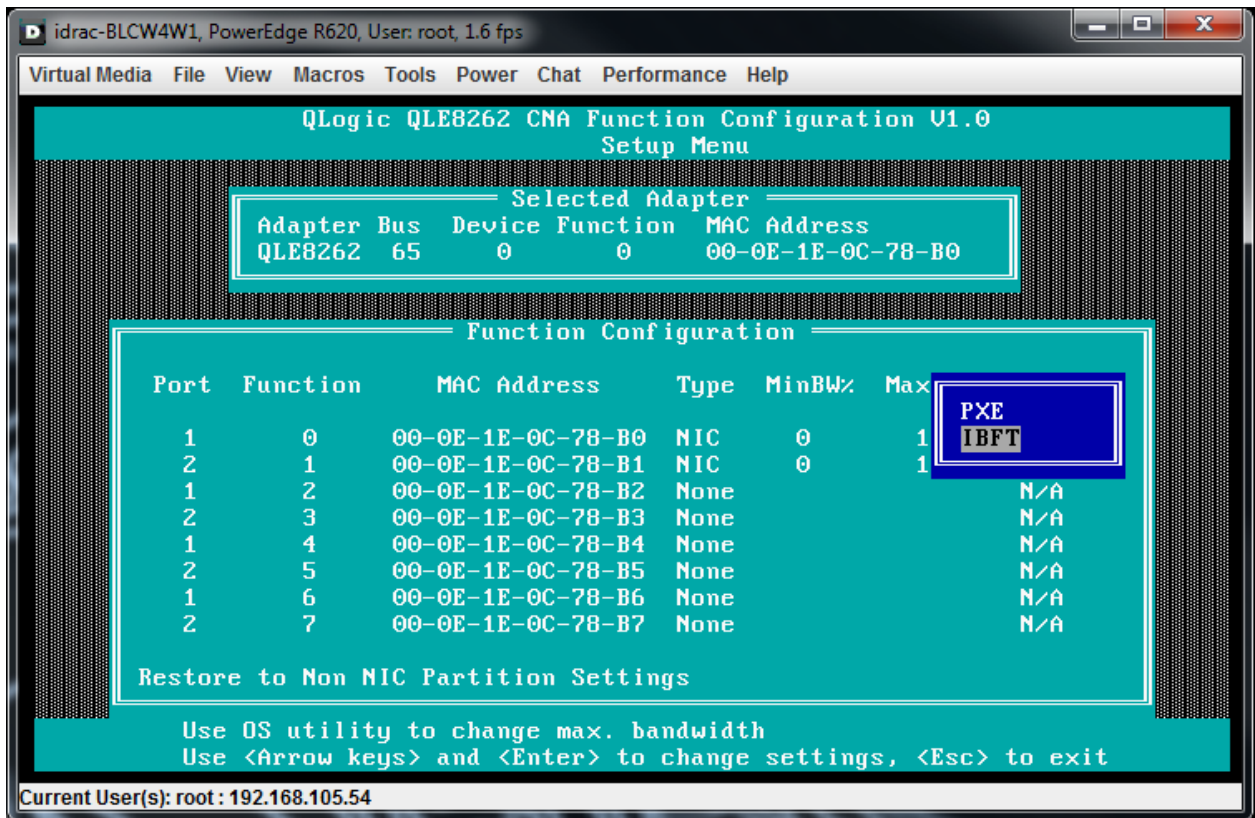


Figure 11 QLogic network adapter configuration menu

2. In the **Function Configuration** menu, change the Protocol type to IBFT for network adapter ports used for iSCSI Boot as shown in Figure 11.
3. Highlight the **Function** column for the network adapter and press **[Enter]** to open the **Adapter Settings** menu for that network adapter port.
4. **Enable ROM** and select the IP format **IPv4**.
5. Enter the **Initiator Settings** menu and disable DHCP, then enter the initiator details such as: Initiator IP address, subnet mask, gateway, and CHAP details as needed. See Figure 12 below.

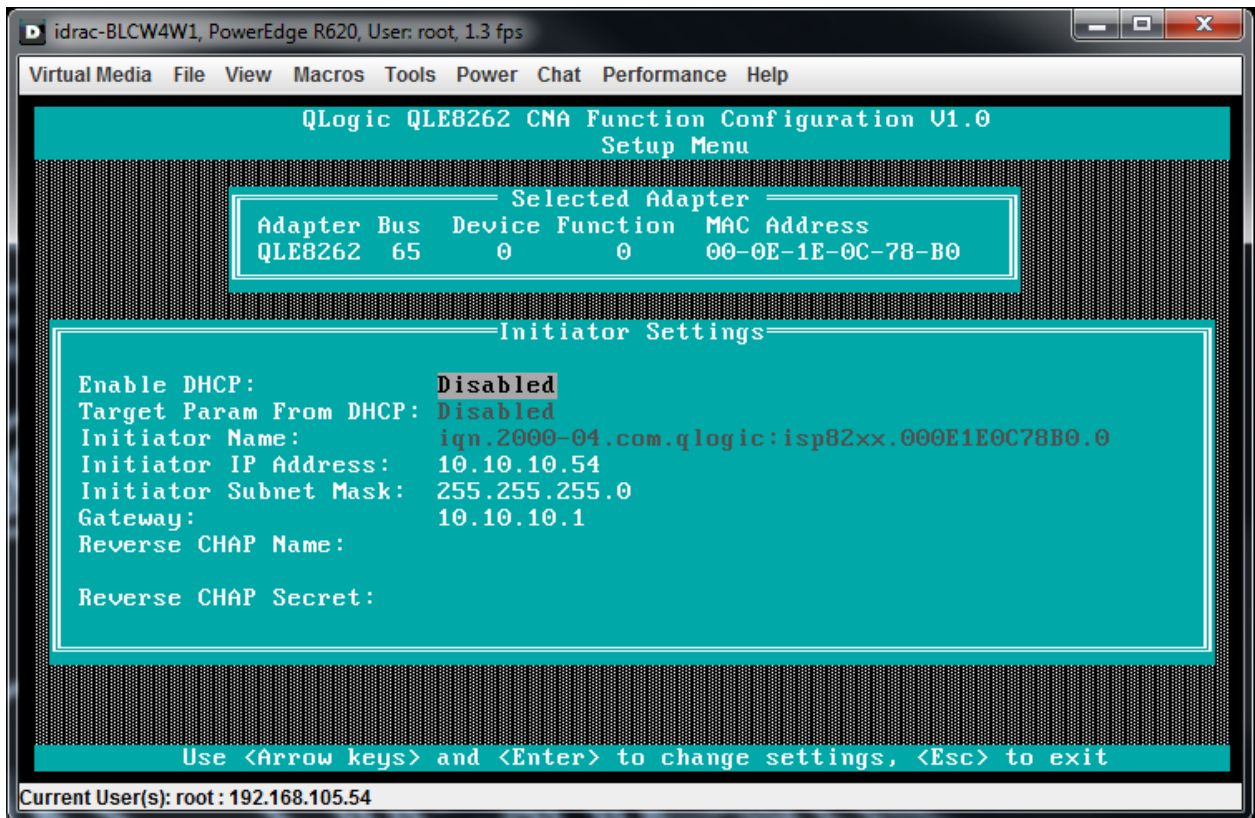


Figure 12 Initiator settings for Qlogic network adapters

6. Exit the **Initiator Settings** menu and enter the **Target Settings** menu. Enter the Target iqn Name, Target IP, Target Port (3260) as shown in Figure 13.

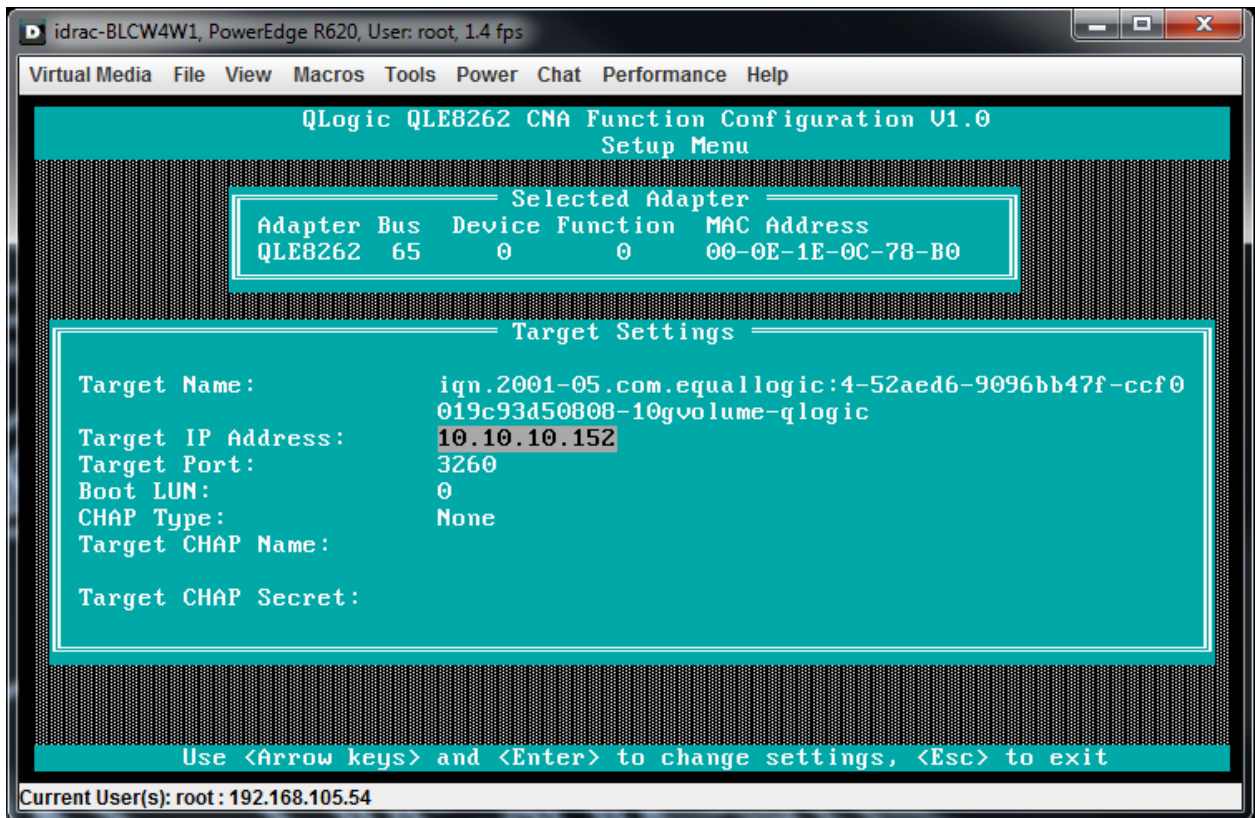


Figure 13 Target Settings for Qlogic network adapter

7. Exit to the **Function Configuration** menu and enter information for other network adapter ports as needed.
8. Once complete, press **[ESC]** and select **Save changes**. Reboot the system when prompted.
9. Continue to Section 8 for steps to install Windows 2008 R2.

7.3 Configuring the Broadcom network adapter for iSCSI boot

Use the following steps to configure the Broadcom network adapter for iSCSI boot from SAN.

1. When booting the system, press **[CTRL+S]** to configure the Broadcom network adapter.
2. In the device list, select the network adapter port used for booting and press **[Enter]**.
3. In the **Main Menu**, choose **MBA configuration**.
4. Change **Boot Protocol** to **iSCSI** and press **[ESC]** to exit to the main menu.

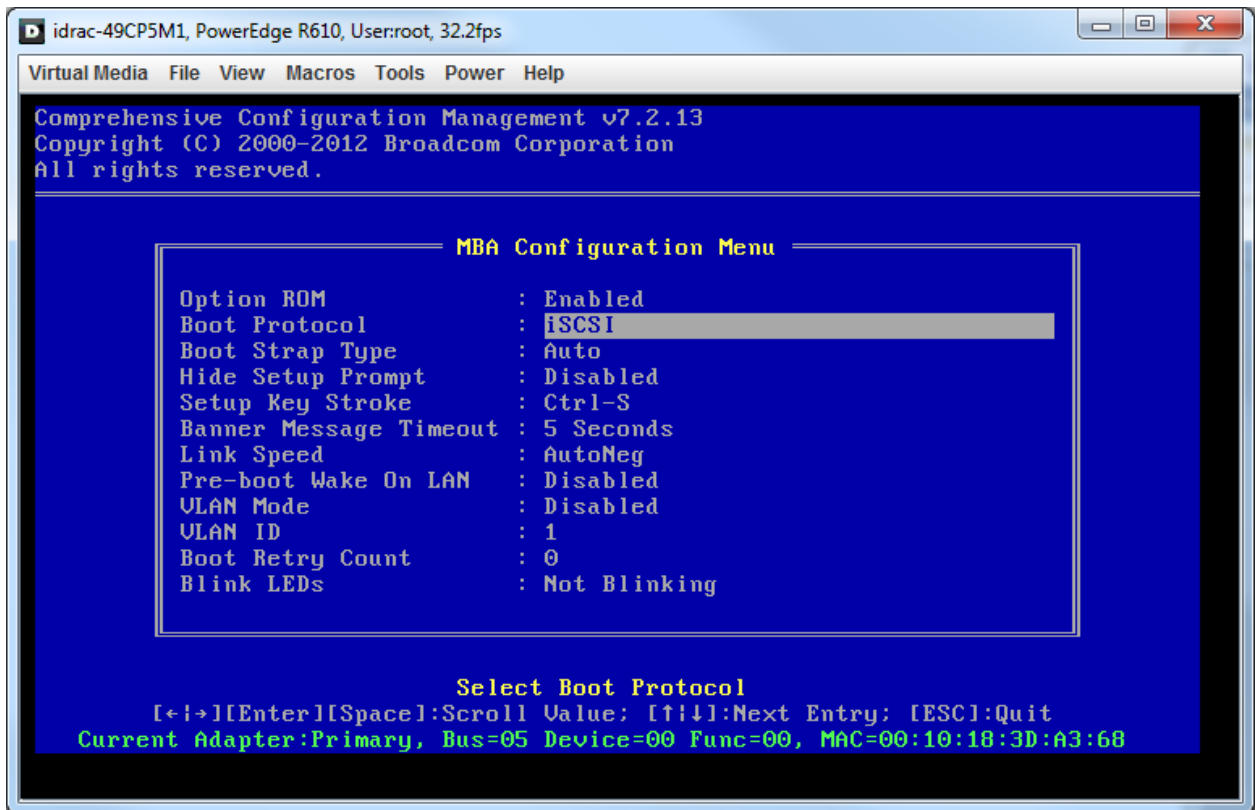


Figure 14 MBA Configuration Menu for Broadcom network adapters

5. Choose **iSCSI Boot Configuration**. Select **General Parameters** and press **[Enter]**.
6. Under **General Parameters**, ensure that all settings match those shown below. You can also see these settings in Figure 15.
 - a. Disable TCP/IP Parameters via DHCP
 - b. Disable iSCSI Parameters via DHCP
 - c. Disable CHAP Authentication
 - d. Change Boot to iSCSI Target to "One Time Disabled"
 - e. Disable HBA boot mode

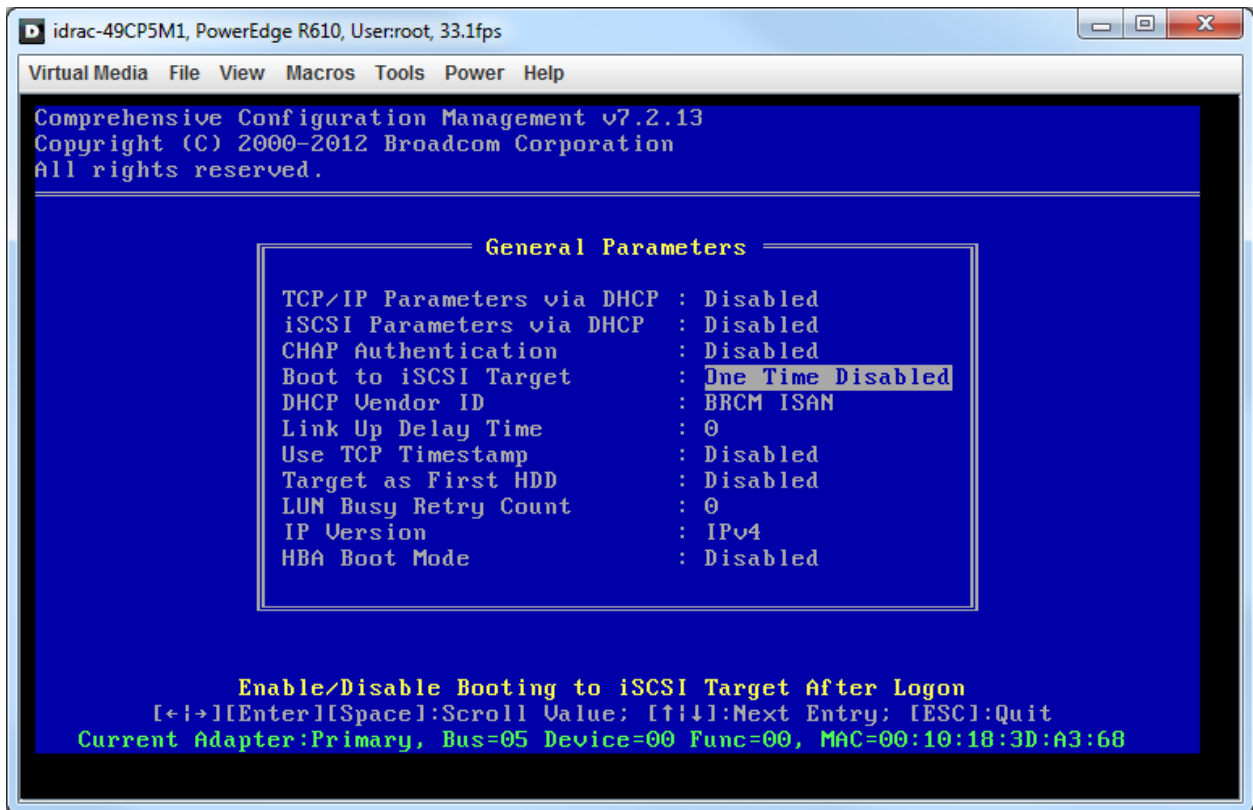


Figure 15 General parameters for a Broadcom network adapter enabled for iSCSI boot

7. Press **[ESC]** to return to **iSCSI Boot Main Menu**, select **Initiator Parameters**, and press **[Enter]**.
8. Under **Initiator Parameters**, enter the IP Address, subnet mask, iSCSI Name (optional), and other details as required.

Note: The server will auto-generate an IQN name for this host. If the target is set to control access based on IQN name, then add the IQN name to the volume access as shown in Section 4, step 5.

9. Press **[ESC]** to return to the **Main Menu**, and select **1st Target Parameters** and press **[Enter]**.
10. Under **1st Target Parameters**, enter the following information:
 - a. Connect: This option should be enabled
 - b. IP Address: This should be set to the iSCSI target IP address. For an EqualLogic based target this will be the Group IP address.
 - c. TCP Port: Default is 3260. This can be changed to match specific target information.
 - d. Boot LUN: Default is 0.
 - e. iSCSI Name: Manually entered IQN name of the iSCSI target.
 - f. CHAP ID: (optional)
 - g. CHAP Secret: (optional)

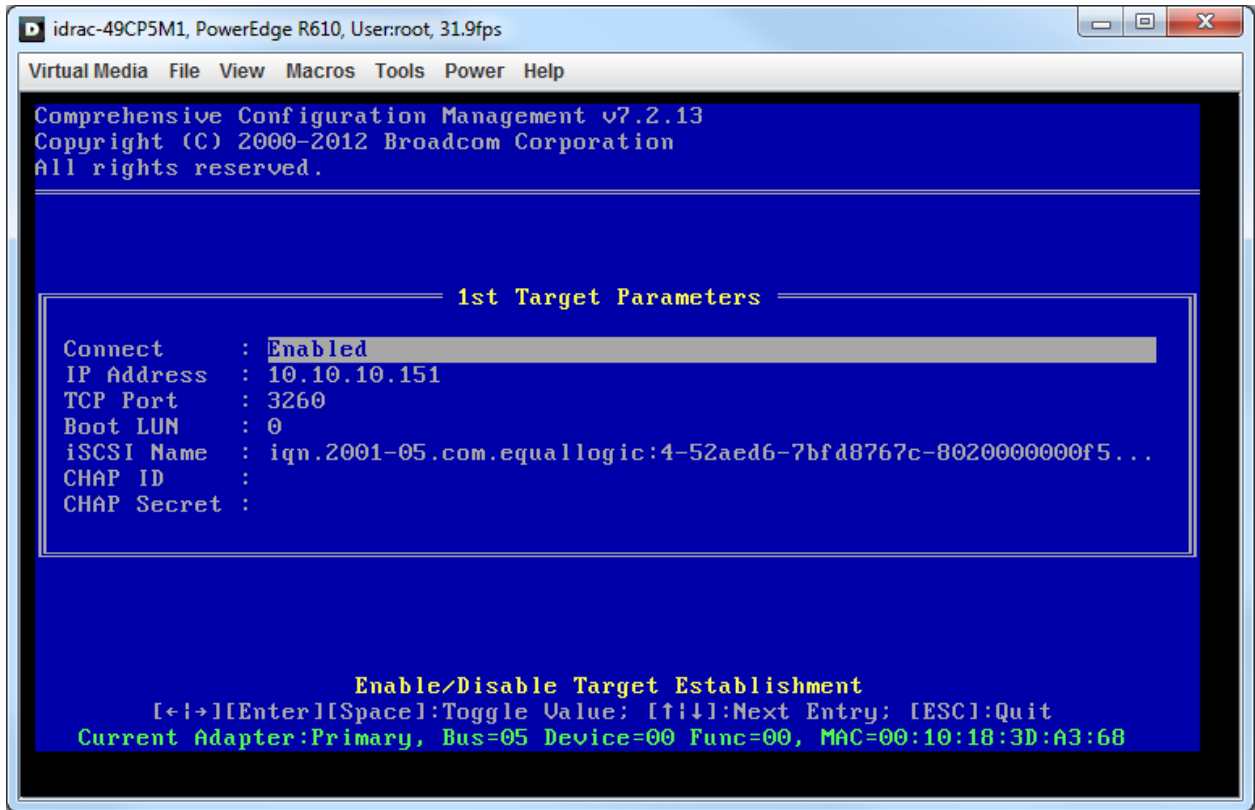


Figure 16 1st Target Parameters configuration for a Broadcom network adapter

11. Press [ESC] to return to the **Main Menu**. Enter the **2nd Target Parameter** if needed or ensure that there is no information entered for **2nd Target Parameters**.
12. Press [ESC] to return to **iSCSI Boot Main Menu**. Save the configuration.
13. Repeat the steps in this section for a second network adapter port if redundancy is desired.
14. Exit the Broadcom Utility by pressing [ESC].

Note: Ensure that the Windows 2008 R2 installation media is connected.

15. Upon exiting the Broadcom utility, the server should immediately connect to the iSCSI target.
16. Continue to Section 7 for steps to install Windows 2008 R2.

7.4 Alternate method to configure network adapters for iSCSI boot (12G servers only)

The 12th generation of Dell PowerEdge servers comes with a new version of the BIOS which is easy to navigate and easy to make changes to the system configuration. These steps show a generic method to configure a network adapter.

Note: iSCSI boot must be enabled on Intel network adapters prior to this configuration. See Section 5 for more information.

1. Start or reboot the system and during System boot press **[F2]** to enter Setup.
2. Enter the **Device Settings** menu. Select the network adapter port that is used for iSCSI boot and press **[Enter]** to configure the network adapter.

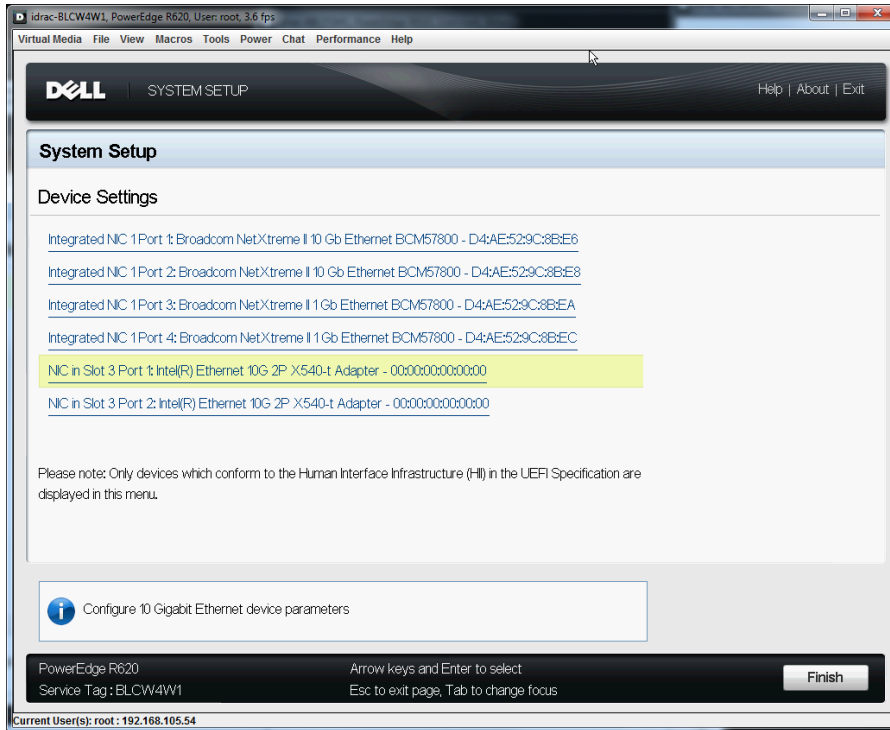


Figure 17 Device Settings menu lets you make changes to connected network adapters

3. In this menu, you can configure the network adapter settings as desired. Also you can configure the IP address, iqn name, and other settings for the initiator and the target.
4. After configuring all the network adapter ports required, continue to Section 8 for steps to install Windows 2008 R2.



8 Installing Windows on the iSCSI volume

Perform the following steps to install the Windows 2008 R2 OS on the iSCSI volume:

1. Insert the Windows Server 2008 R2 media into the system.
2. Turn on or reboot the system.

Note: Do not use [F11] with the BIOS Boot Manager. Doing so may prevent Windows Server 2008 R2 from detecting network boot devices that use the inbox drivers.

3. Press any key when prompted to boot from the CD/DVD.
4. The **Install Windows** dialog box appears. Select the appropriate Language, Time, and Keyboard options. Click **Next** and then, **Install Now** to continue the installation.
5. The **Operating System Selection** page appears. Select **Full Installation** and click **Next** to continue.
6. The **License Agreement** screen appears. Read the license agreement and select "**I accept the license terms**" to continue with the installation. Click **Next**.
7. The **Installation Type** page appears. Select **Custom**.
8. Determine if the target volume is available in the list of drives. If the target volume is available, proceed to step 15 below.
9. Insert the removable media containing the drivers for the network adapter extracted in Section 3.
10. Click **Load Driver**. The **Load Driver** dialog box appears.
11. Click **Browse**. The **Browse for Folder** dialog box appears.
12. Navigate to the location containing the driver for the Network device and click **OK**.

Note: For the Broadcom NetXtreme adapter you will need to install both the Virtual Bus Driver (VBD) and Network Driver Interface Specification (NDIS) driver.

13. Click **Next** to load the drivers. The available drives list containing the targeted volume appears.

Note: If the list of available drives does not contain the iSCSI volume, click **Refresh**. You may have to wait for up to a minute before seeing the drives.



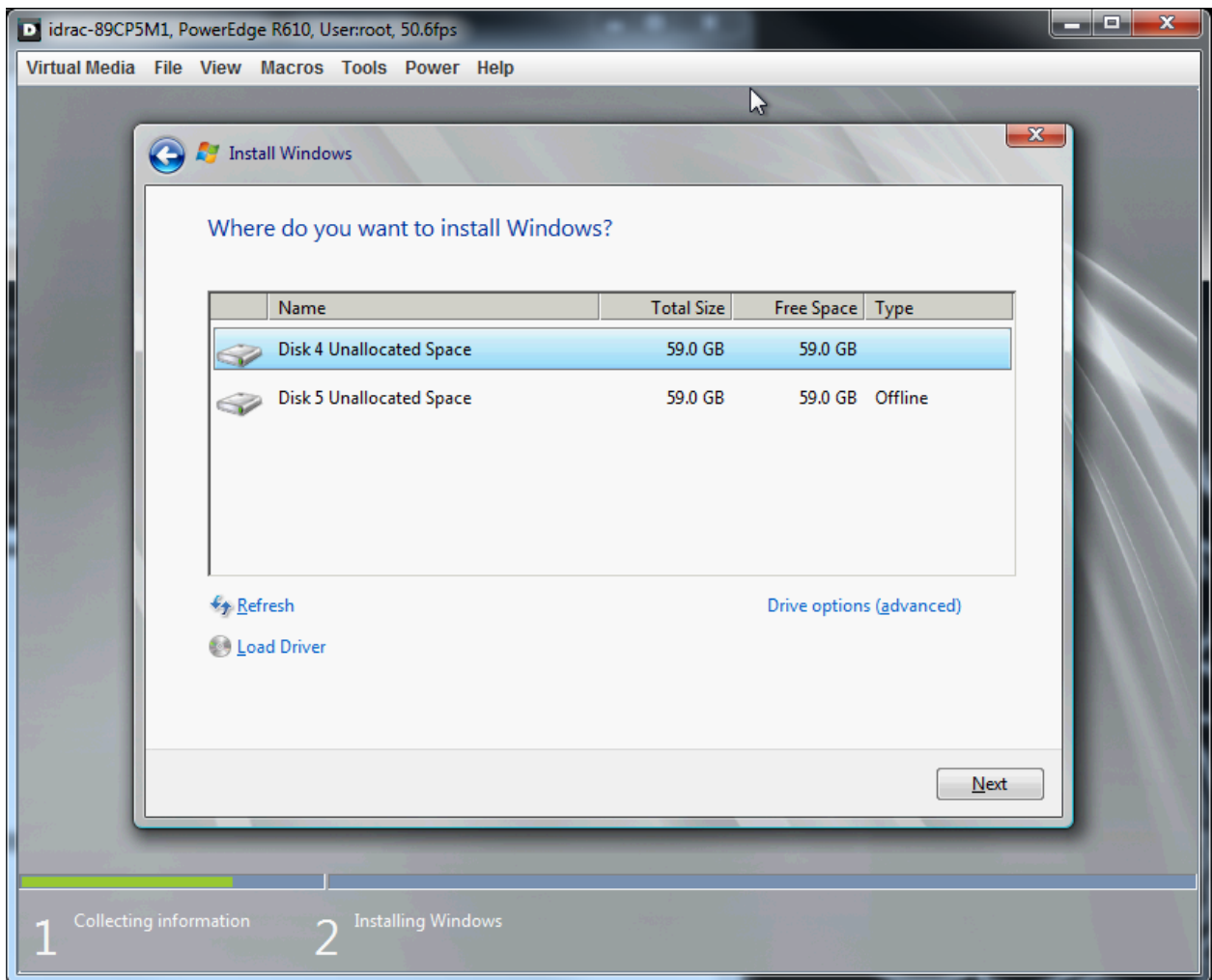


Figure 18 Selecting location for Windows 2008 R2 installation

14. Select the drive and click **Next** to start the Windows installation.

Note: When redundant network adapter ports are configured for iSCSI boot, the EqualLogic iSCSI volume might appear as two disks. Select the volume that is not listed as "Offline".

15. The Windows installer copies and expands files and installs features and updates. Once the installation is complete, the server reboots.
16. The system then boots from the iSCSI volume and completes Windows setup.
17. Continue to configuration steps in Section 9 to setup the system according to the best practices.

9 Post Windows 2008 R2 OS installation steps

The following section contains additional steps that should be performed after Windows 2008 R2 SP1 is initially installed on the bootable iSCSI volume. These additional steps complete the configuration of a bootable iSCSI SAN by configuring multi-path I/O and redundancy as well as implementing other best practices and optimization.

9.1 Installing Hotfixes

9.1.1 Hotfix KB976042

The Microsoft Knowledge Base article KB976042 states that “Windows may fail to boot from an iSCSI drive if networking hardware is changed”. This hotfix must be installed on a system using iSCSI boot from SAN. Details about this Hotfix can be found here: <http://support.microsoft.com/kb/976042>.

9.1.2 Hotfix KB2727330

The Microsoft Knowledge Base article KB2727330 states that “Default gateway is set to 0.0.0.0 if you start a Windows Server 2008 R2-based computer from an iSCSI boot device”. This hotfix will fix the slow network performance issue on systems using iSCSI volume to boot. Details about this Hotfix can be found here: <http://support.microsoft.com/kb/2727330/en-us>.

Note: You might need to install other Microsoft Hotfixes on the system. You should also check for Microsoft updates.

9.2 Installing the EqualLogic Host Integration Tool (HIT) Kit

The Host Integration Tool Kit or HIT Kit is a device specific module (DSM) for Dell EqualLogic arrays that is installed on Windows 2008 R2 systems to create redundant connection paths from the host system to EqualLogic arrays. The HIT Kit also installs other utilities and configures the host system according to the best practices for Dell EqualLogic arrays.

Complete the following steps to install HIT Kit on the system.

1. Go to <https://support.equallogic.com> to download HIT Kit. An EqualLogic support account is required.
2. Go to **Downloads->HIT Kit for Microsoft**. Download the latest Host Integration Tools for Microsoft.
3. Double click **Setup64.exe** (for x64 bit system) to install HIT Kit on the system.
4. Click **Next** on the Welcome page to proceed.
5. Read and accept the license agreement and click **Next** to proceed.
6. Install Dell EqualLogic Host Integration Tools at the default location. Click **Next** to proceed.
7. Select **Complete** setup type, and click **Next**.
8. Click **Install** to proceed with installation.



9. Select **Launch Remote Setup Wizard** and click **Finish**.
10. When the window for **Remote Setup Wizard** appears, choose **Configure MPIO settings for this computer** and click **Next**.
11. Include only the subnet used for the SAN (iSCSI network) for MPIO, exclude all other the subnets from MPIO. Click **Finish**. (If any other subnets are added in the future, exclude them from MPIO if they are not a part of the SAN.)

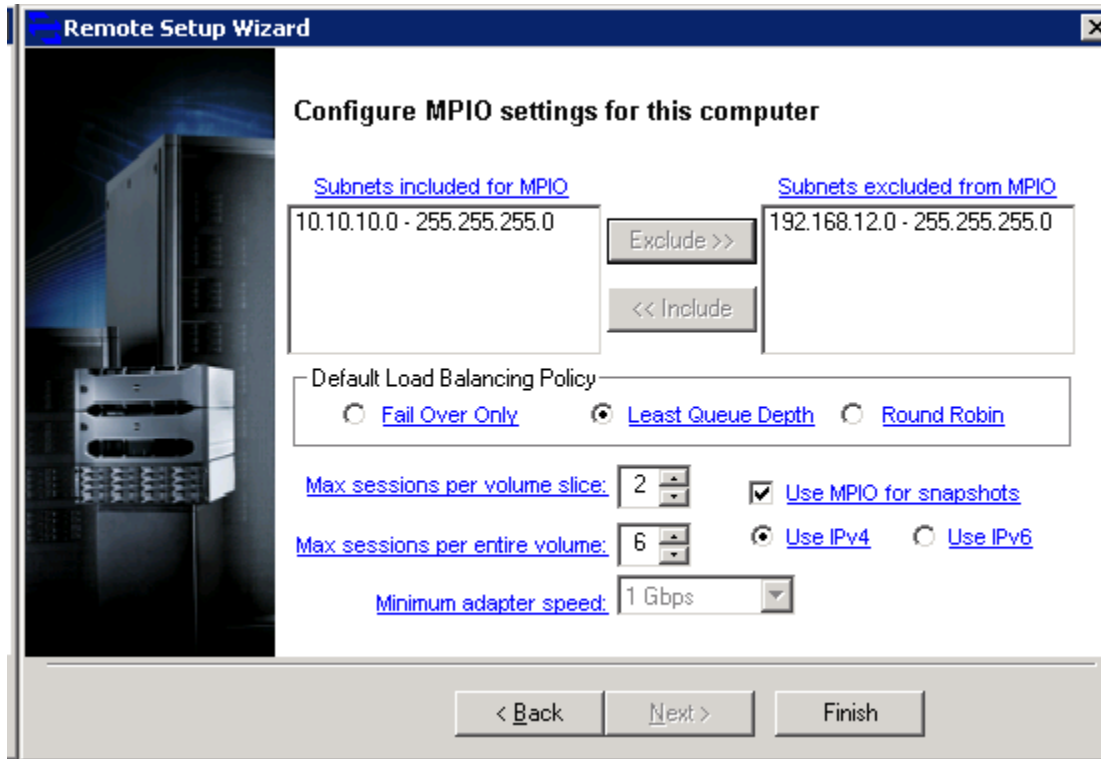


Figure 19 Configuring MPIO in Remote Setup Wizard

12. Reboot the system after installation. Click **YES** to reboot.

9.3 Configuring the Microsoft iSCSI initiator

By default, iSCSI boot from SAN may not reconnect on all paths after a failure on one of the NICs. For example, if one of the cable connections is disconnected and reconnected, the redundant iSCSI connection to the volume may not reconnect automatically. This section describes how to properly configure the Microsoft iSCSI initiator to automatically re-establish connections after a failure.

Configure the system using the following steps.

1. Open **iSCSI Initiator** from the start menu. Click on the **Discovery** tab -> **Discover Portal**. Enter the IP address or DSN name of the **EQL group** and enter 3260 as the port. Click **OK**.
2. Close the **iSCSI Initiator** menu by clicking **OK**.

3. **Optional:** If the Volume access is controlled by iSCSI Initiator name, then add the Microsoft iSCSI Initiator name in the **Access control record** for the volume with EqualLogic Group Manager using the following steps.
 - a. Open **iSCSI Initiator** and go to the **Configuration** tab. Record the Initiator Name, which is the Microsoft iSCSI initiator name.
 - b. Open **Group Manager** for the EqualLogic Arrays where the iSCSI Volume is located. Select the volume and go to the **Access** tab.
 - c. Click the **Add** button on the top right corner. In the **Create access control record** window, select **Limit access to iSCSI initiator name** and enter the **Microsoft iSCSI initiator name** from Step a.
 - d. Click **OK**. You will see the access created using the iSCSI initiator name.

9.4 Set Jumbo frames on Network adapters

Enable Jumbo frames on the network adapter ports. After configuring the jumbo frames, you may be prompted to reboot the system for the new settings to take effect.

The Jumbo frame settings can be done using specific configuration utilities for each adapter. For example, enabling Jumbo Frames with Broadcom adapters requires the Broadcom Advanced Configuration Suite (BACS) and Qlogic CNAs require the use of the Qlogic QConvergeConsole Management utility.

The following steps show the configuration for Intel Network adapters. The procedure may vary for other network adapters.

1. Go to **Server Manager** → **Diagnostics** → **Device Manager** → **Network adapters**
2. Select the network adapter used for iSCSI boot and double click it.
3. In the **Adapter Properties** window go to **Advanced** tab and choose **Jumbo Packets** in **Property**.
4. Change the value to **9014** or higher.
5. Click **OK** to save and close the **Adapter Properties** window.
6. Complete the same steps for any other adapters used for iSCSI boot from SAN.
7. Reboot the system for these settings to take effect.



10 Recovery from degraded network interface

When the host system is booted with a single active link to the boot volume (degraded boot), reestablishing the failed connection does not create redundant connections to the boot volume. To regain the redundant connection you must either reboot the host system or configure the IP address manually in the OS.

To reestablish the network interface, use the following steps:

1. Open **Control Panel** from the Start menu.
1. Click on **Network and Internet->Network and Sharing Center**.
2. Choose the network adapter used for the iSCSI network and double click it.
3. Select **Properties** on the **Network adapter Properties** window.
4. Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
5. In the **Internet Protocol Version 4 (TCP/IPv4) Properties** select the radio button for **Use the following IP address**.
6. Enter the IP address and Subnet mask details as needed. (These details should be the same as entered in Section 7 for the particular network adapter.)
7. Click **OK** and close the **Network Adapter Properties** window.
8. Do the same for all the other network adapters used for iSCSI boot.

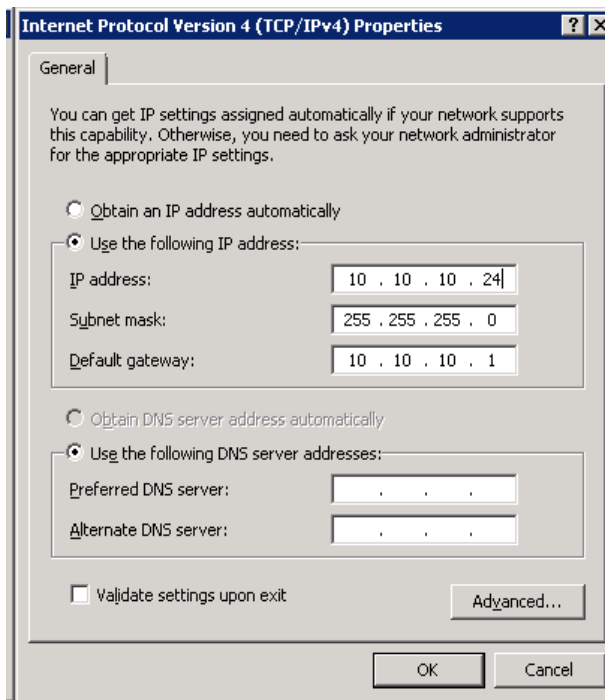


Figure 20 Internet Protocol Version 4 (TCP/IP 4) Properties window

11 Conclusions

Configuring a Windows 2008 R2 server to boot from an EqualLogic iSCSI SAN has several advantages for management of the server and network. It also provides high reliability for the IT environment. Using Boot from SAN is valuable in an IT environment for the following advantages:

- Quick and easy centralized backup
- Faster recovery in event of server failure
- Servers can be replaced, re-purposed, and added more quick and easily
- Lower operating cost by eliminating need for local hard disks on each server
- Simpler management for administrators

Using an external storage device to host server boot images helps with quick and easy centralized backups for the boot images. Data including boot information can be easily replicated which can make recovery in the event of server hardware failure faster. The boot images are securely stored on a storage platform independent of the servers, so it is easy to replace servers. Adding a new server with a replicated boot image is quick and easy because you only need to point the new server to a newly replicated or existing boot image.

Boot from iSCSI SAN gives higher reliability in terms of hardware failure, data loss, rapid disaster recovery, and easier centralized backup. Using iSCSI storage instead of local hard drives helps in efficient use of storage space because over-provisioning in terms of the internal storage of the server can be eliminated, which results in lower operating cost. SAN storage systems are generally more robust and reliable compared to hard-drives on individual servers.

Boot from iSCSI SAN enables simplified management for the administrator. Operating system patching and upgrades can be carried out with very little downtime. Upgraded operating system images can be prepared and cloned on the storage device and individual servers can be pointed to new boot images and rebooted with very little downtime. Boot images can be cloned and used to test upgrades, service packs, and other patches without disturbing a production environment.

Boot from iSCSI SAN provides great benefits and offers opportunities to make administrative tasks simpler. By following the best practices outlined in this whitepaper, server and storage administrators can improve the operational efficiency and productivity in their IT environment.



A Configuration worksheet

You can use the following worksheet to capture configuration information for your boot from iSCSI SAN environment.

Note: Always use fully-qualified IQN format: <iqn><yyy-mm>.com.<company name>:<server name>. Example: iqn.1984-04.com.dell:server-name.
For more information, see RFC3720 and RFC3721 at <http://rfc.net/>.

Dell PowerEdge Server (Host/Initiator)	
Primary Boot NIC	Secondary Boot NIC (optional)
IQN:	IQN (Optional: if different from Primary NIC):
IP Address:	IP Address:
Subnet Mask:	Subnet Mask:
Gateway:	Gateway:
Slot Location:	Slot Location:
Dell EqualLogic Storage (Target)	
IQN:	
iSCSI Port: (default 3260)	
EqualLogic Group IP address:	



Additional resources

Support.dell.com is focused on meeting your needs with proven services and support.

DellTechCenter (<http://delltechcenter.com>) is an IT Community where you can connect with Dell Customers and Dell employees for the purpose of sharing knowledge, best practices, and information about Dell products and your installations.

Microsoft MSDN article "*Microsoft iSCSI Boot Step-by-Step Guide*":

- [http://technet.microsoft.com/en-us/library/ee619733\(v=ws.10\).aspx](http://technet.microsoft.com/en-us/library/ee619733(v=ws.10).aspx)

Referenced or recommended Dell publications:

- Dell EqualLogic PS Series Network Performance Guidelines:
<http://www.equallogic.com/resourcecenter/assetview.aspx?id=5229>

For EqualLogic best practices white papers, reference architectures, and sizing guidelines for enterprise applications and SANs, refer to Storage Infrastructure and Solutions Team Publications at:

- <http://dell.to/sM4hJT>





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