Configuring iSCSI Boot for EqualLogic SAN with Dell PowerEdge Servers and VMware ESXi 5.1

A Dell EqualLogic Deployment and Configuration Guide

Dell Storage Engineering
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Acknowledgements

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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 VMware® ESXi 5.1
- 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 1 Gigabit Ethernet (GbE) and 10GbE iSCSI boot from SAN environments with Dell EqualLogic storage arrays and supported network adapters

1 Introduction

This document provides instructions for configuring the Dell PowerEdge 12th Generation (12G) family of servers to boot VMware ESXi 5.1 from iSCSI SAN-based boot images residing on Dell EqualLogic PS Series arrays.

If you use boot from SAN, the benefits for your environment may include:

- Lower cost - Servers no longer require internal disks and can be denser and run cooler without internal storage.
- Easier server replacement - You can replace servers and have the new server point to the old boot location.
- Reduced footprint - Servers without local disks often take up less space.
- Simplified backup processes - You can back up the system boot images as part of the overall SAN backup procedures and use advanced array features such as snapshots on the boot image.
- Centralized management - Creating and managing the operating system image is easier and more efficient.
- Better reliability - You can access the boot disk through multiple paths, which prevents the disk from being a single point of failure.

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 ESXi 5.1, as well as general concepts around SAN storage and Ethernet networks.

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) 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
Operating system (OS)	VMware ESXi 5.1
Servers	Dell PowerEdge Servers (12G Family)
Network Adapters	Broadcom® NetXtreme® II 5720 1GbE Network Interface Controller (NIC) Broadcom NetXtreme II 57810 10GbE NIC Intel® 1GbE i350 Server Adapter Intel 10GbE x520 Server Adapter Intel 10GbE x540 Server Adapter
Storage Array	Dell EqualLogic 1GbE and 10GbE PS Series with firmware 6.0.1 or higher

1.3 Terminology

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

Arrays – Refers to iSCSI EqualLogic PS Series storage arrays

iSCSI Qualified Name (IQN) – This is a naming format that is 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)

Storage Area Network (SAN) –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.

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 3.1.
2. Configure the Server and Network adapter(s) on the server to support boot from iSCSI targets in Section 3.2 and Section 3.3.
3. Install the OS onto the iSCSI target volume that was prepared for boot in Section 4.
4. Configure redundant boot paths and multi-path I/O for the boot volumes and any additional SAN volumes in Section 5.

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 B.
   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 3.2 for more information.

   b. Record 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. The Rapid EqualLogic Configuration Portal, which provides general guidelines for configuring an EqualLogic SAN network, is available at http://en.community.dell.com/techcenter/storage/w/wiki/3615.rapid-equallogic-configuration-portal-by-sis.aspx
   b. The Switch Configuration Guides, which provide information for configuring network switches, are available 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 https://eqlsupport.dell.com/ (login required).

2.2 Additional considerations

Note the following additional considerations:

1. Do not configure the first physical NIC, as determined by the system BIOS, to boot from the iSCSI SAN. This causes ESXi 5.1 installation failure because ESXi claims the first NIC it discovers as vmk0 and uses it for the management network.
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.
4. To keep SAN boot volume traffic isolated, Dell recommends using one set of NICs to connect to the SAN ESXi boot volume and another to connect to the SAN data volume.

3 Configuring boot from SAN

3.1 Configuring the iSCSI target

To boot from an iSCSI SAN there must be a target volume created on the storage array dedicated to the boot partition of the server operating system. This target volume must be accessible by the storage host initiator.

On Dell EqualLogic PS Series storage array groups the boot from SAN volume can be created from within Group Manager.

1. Create an iSCSI volume.
2. Grant access to the volume from the ESXi 5.1 storage initiator using IP address range, IQN name, or CHAP authentication.
3. Record the iSCSI volume IQN name and CHAP authentication details if applicable.

To simplify deployment and management, Dell recommends using IQN name authentication to connect to a boot from SAN Volume. CHAP authentication may still be used for additional data volumes.

3.2 Configuring the iSCSI initiator

The next step is to configure the different NICs to act as an iSCSI initiator and connect to the newly created EqualLogic PS Series volume.

1. Boot the host server.
2. Press [**F10**] to enter the Dell Lifecycle Controller Unified Server Configurator (USC).
3. When the main Lifecycle Controller page appears, select **System Setup**, **Advanced Hardware Configuration**, and then **Device Settings**.

3.2.1 Configuring Broadcom 5720 and Broadcom 57810 NICs

Do not configure the first physical NIC, as determined by the system BIOS, to boot from the iSCSI SAN. This causes ESXi 5.1 installation failure because ESXi claims the first NIC it discovers as vmk0 and uses it for the management network.

The following section provides instructions for configuring the Broadcom BCM5720 and Broadcom 57810 network adapter as the iSCSI initiator. Figure 1 shows a BCM5720 NIC.

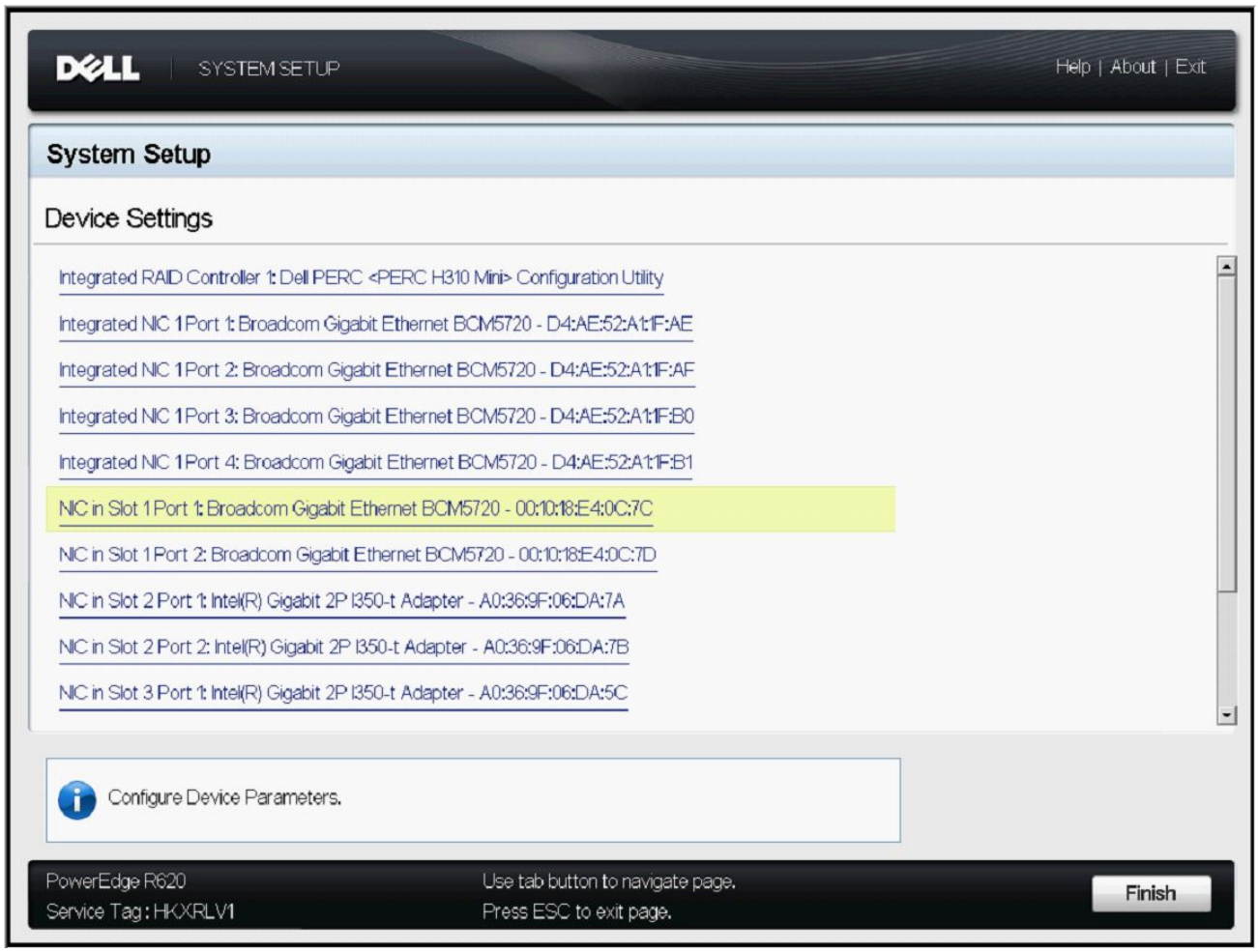

Figure 1 Device Settings menu

4. To use the Broadcom BCM5720, select **NC in Slot 1 Port 1: Broadcom Gigabit Ethernet BCM5720** in the **Device Settings** menu.

5. Select **MBA Configuration Menu.**

Figure 2 Broadcom BCM5720 MBA Configuration Menu

6. Set the **Legacy Boot Protocol** to **iSCSI**.
7. Select **Back** to return to the **Main Configuration Page**.

8. Select **iSCSI Boot Configuration Menu** and then **iSCSI General Parameters**.

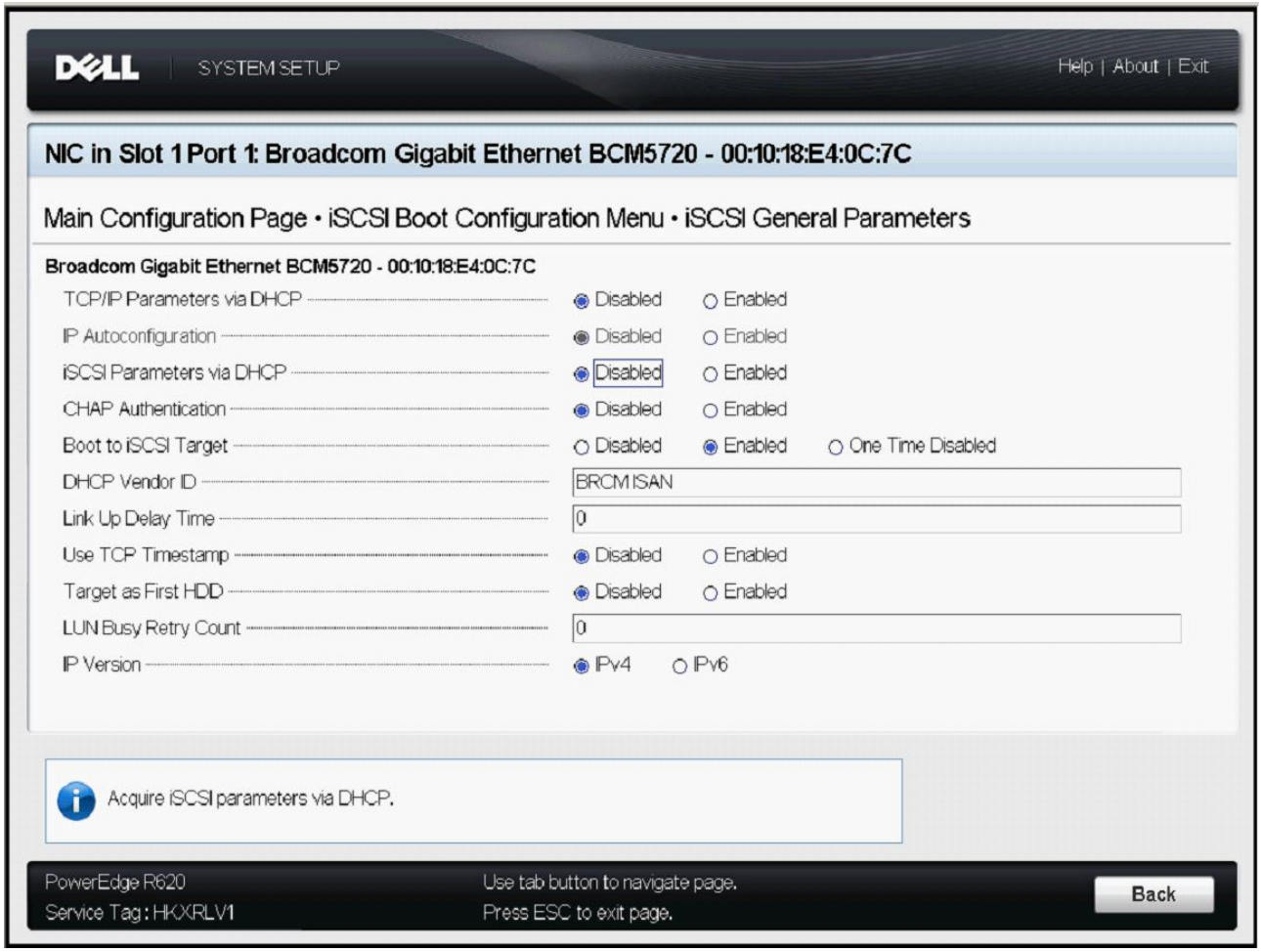

Figure 3 Broadcom BCM5720 iSCSI General Parameters

9. To use a static IP address, set the **TCP/IP parameters via DHCP** and **iSCSI Parameters via DHCP** to **Disabled**. To use CHAP authentication, set **CHAP Authentication** to **Enabled**.
10. Return to the **iSCSI Boot Configuration Menu**.

11. Select **iSCSI Initiator Parameters**.

Figure 4 Broadcom BCM5720 iSCSI Initiator Parameters

12. Set the initiator **IP Address**, **Subnet Mask**, and if required, the **Default Gateway**, **DNS**, **iSCSI Name**, **CHAP ID**, and **CHAP Secret**.
13. Exit to the **iSCSI Boot Configuration Menu**.

14. Select **iSCSI First Target Parameters**.

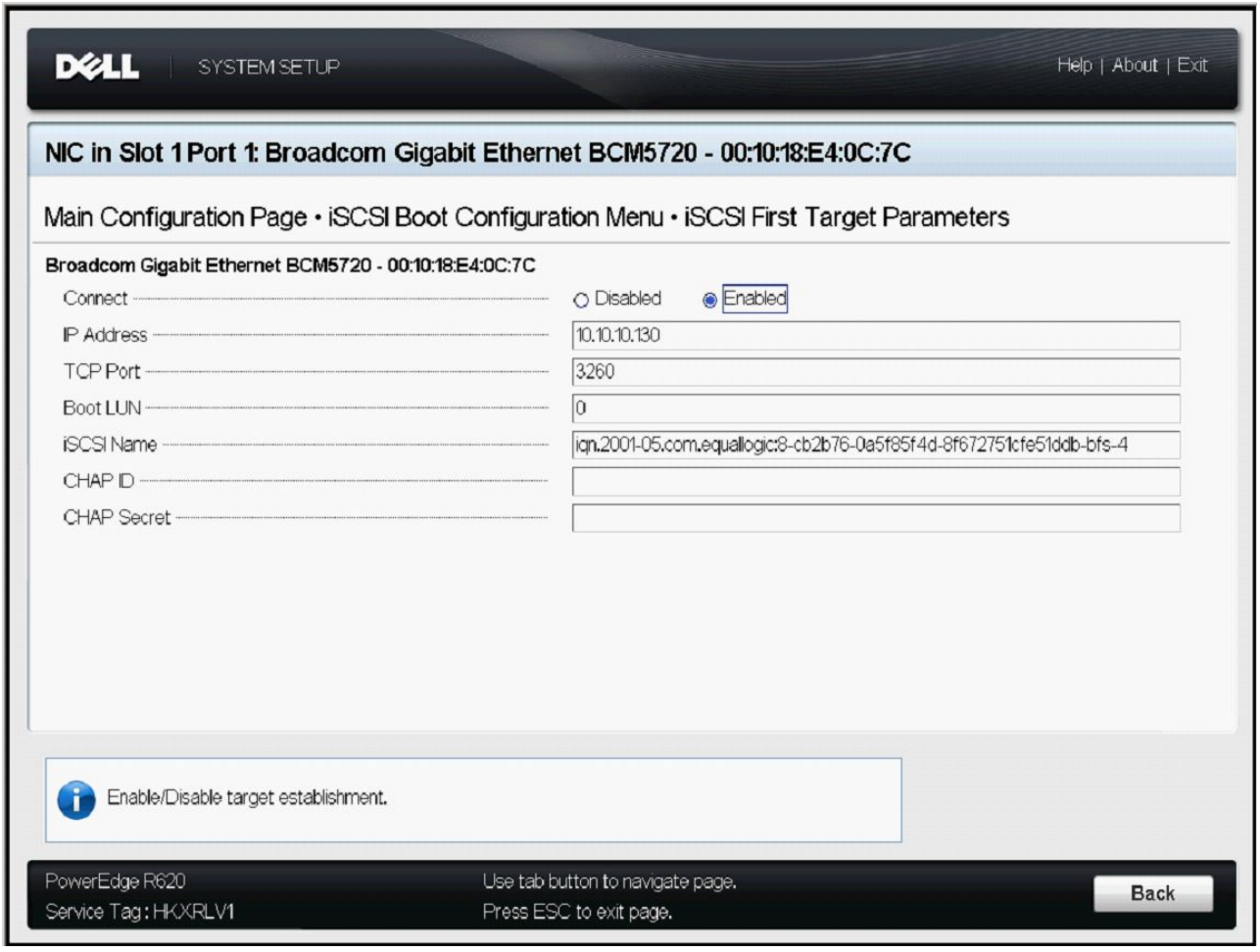

Figure 5 Broadcom BCM5720 iSCSI First Target Parameters

15. Set **Connect** to **Enabled**.
16. Set **IP Address** to the IP address of the EqualLogic Group hosting the iSCSI volume to be used for booting from SAN.
17. Set **iSCSI Name** to the iSCSI IQN of the volume (as recorded in Section 3.1).
18. Set the **CHAP ID** and **CHAP Secret** if using CHAP authentication.
19. Press [**Esc**] until prompted to save, and then save the adapter settings.

The previous steps configure a single connection to the iSCSI SAN bootable volume. However it is recommended to configure a secondary connection to satisfy the high availability requirement. To create the secondary connection, use the following instructions:

20. Write down the MAC address of the NIC port that will be used as Secondary Initiator Device.
21. At the Primary iSCSI device's iSCSI Boot Configuration Menu, click on **Secondary Device**. See Figure 6.

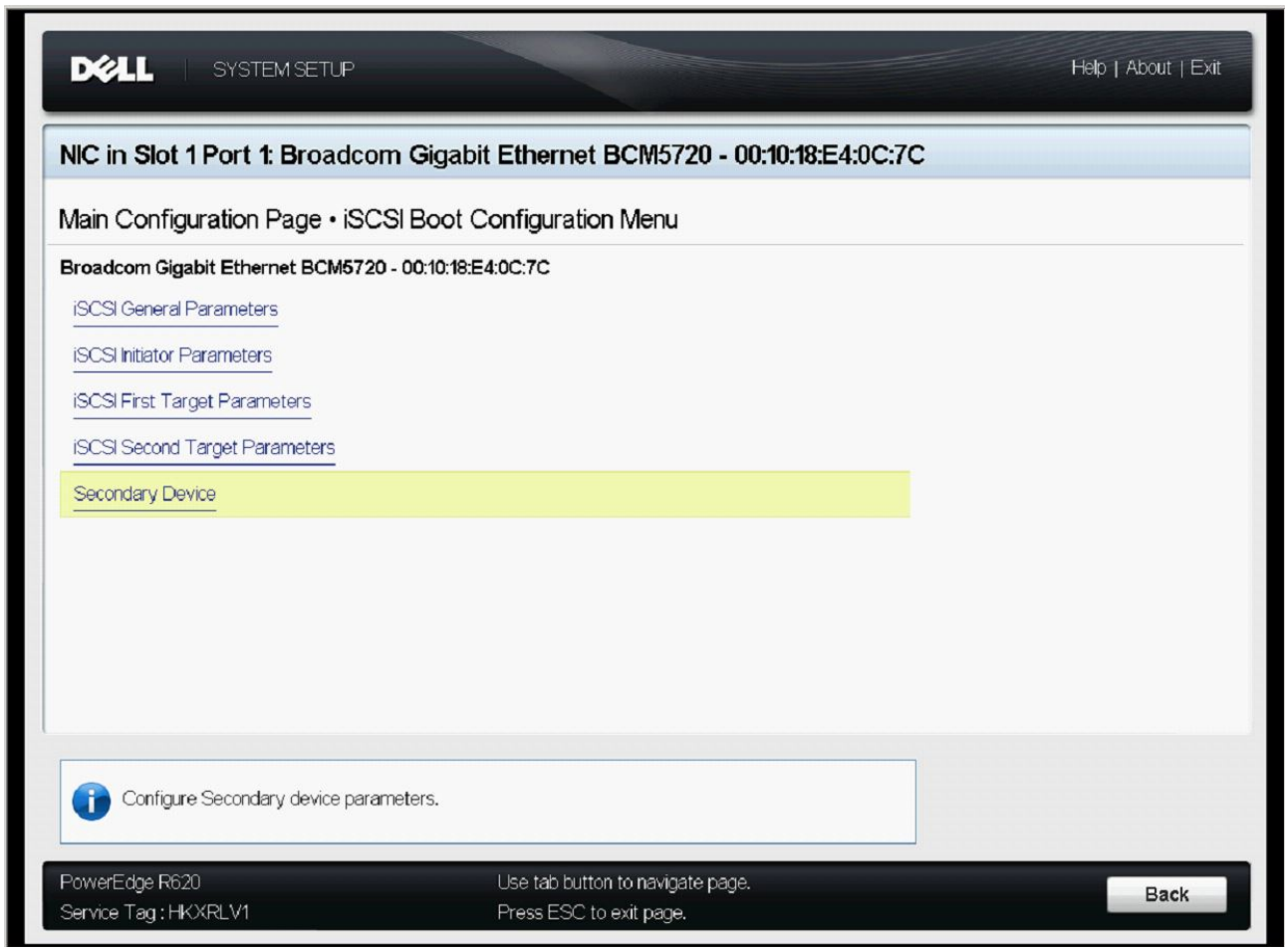

Figure 6 BCM5720 Secondary iSCSI Device

22. Enter the Secondary iSCSI Device MAC address.

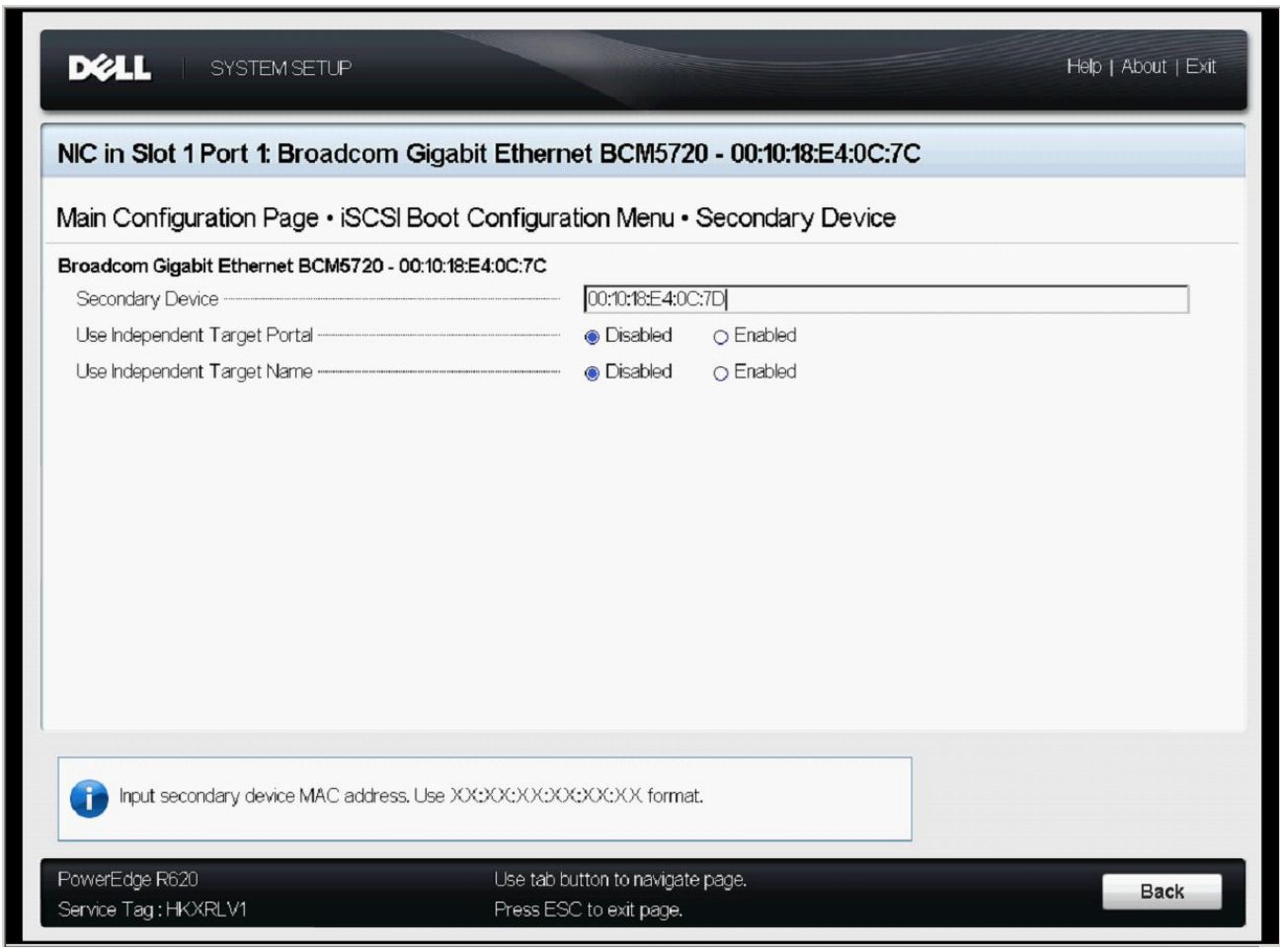

Figure 7 BCM5720 Secondary iSCSI Device Setting

23. Press [**Esc**] until the Main Page is displayed. Save changes.
24. Press [**Esc**] and choose to reboot, and then proceed to Section 3.3.

3.2.2 Configuring the Intel i350-t, Intel x520, and Intel x540 NICs

Do not configure the first physical NIC, as determined by the system BIOS, to boot from the iSCSI SAN. This causes ESXi 5.1 installation failure because ESXi claims the first NIC it discovers as vmk0 and uses it for the management network.

The following section provides instructions for configuring Intel i350-t, x520, and x540 network adapters as the iSCSI initiator. This example shows the i350-t NIC.

1. From the Device Settings menu, select **NIC in Slot X Port 1: Intel(R) Gigabit 2P I350-t Adapter**.
2. Return to the Main Configuration Page.
3. Select **NIC Configuration**.
4. Set **Legacy Boot Protocol** to **iSCSI Primary**, and return to the Main Configuration Page.
5. Select **iSCSI Configuration** and then **iSCSI General Parameters**.

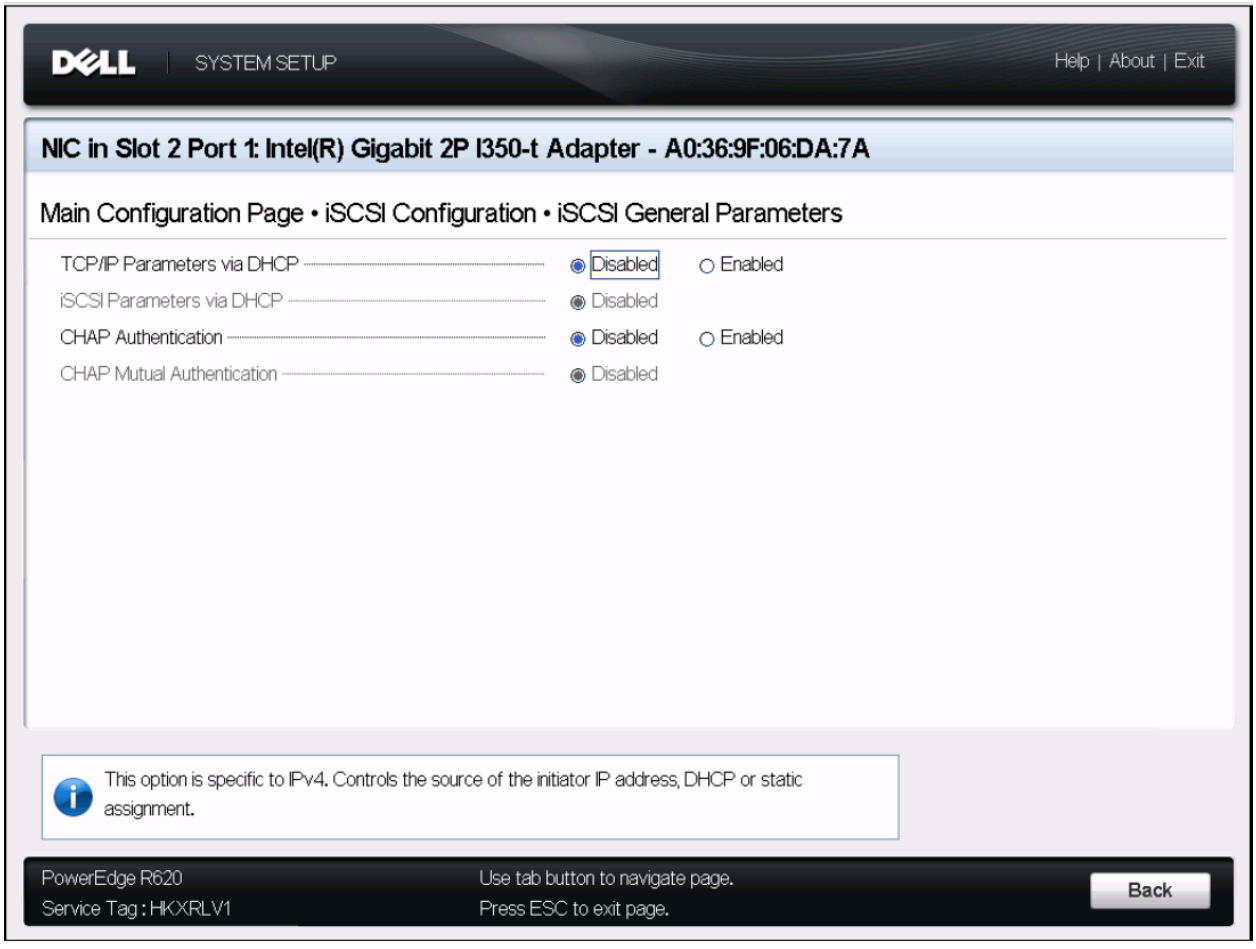

Figure 8 Intel i350-t iSCSI General Parameters

6. If a static IP address is being used, set **TCP/IP Parameters via DHCP** to **Disabled**.
7. If using CHAP authentication, set **CHAP Authentication** to **Enabled**.

8. Return to **iSCSI Configuration**.
9. Select **iSCSI Initiator Parameters**.

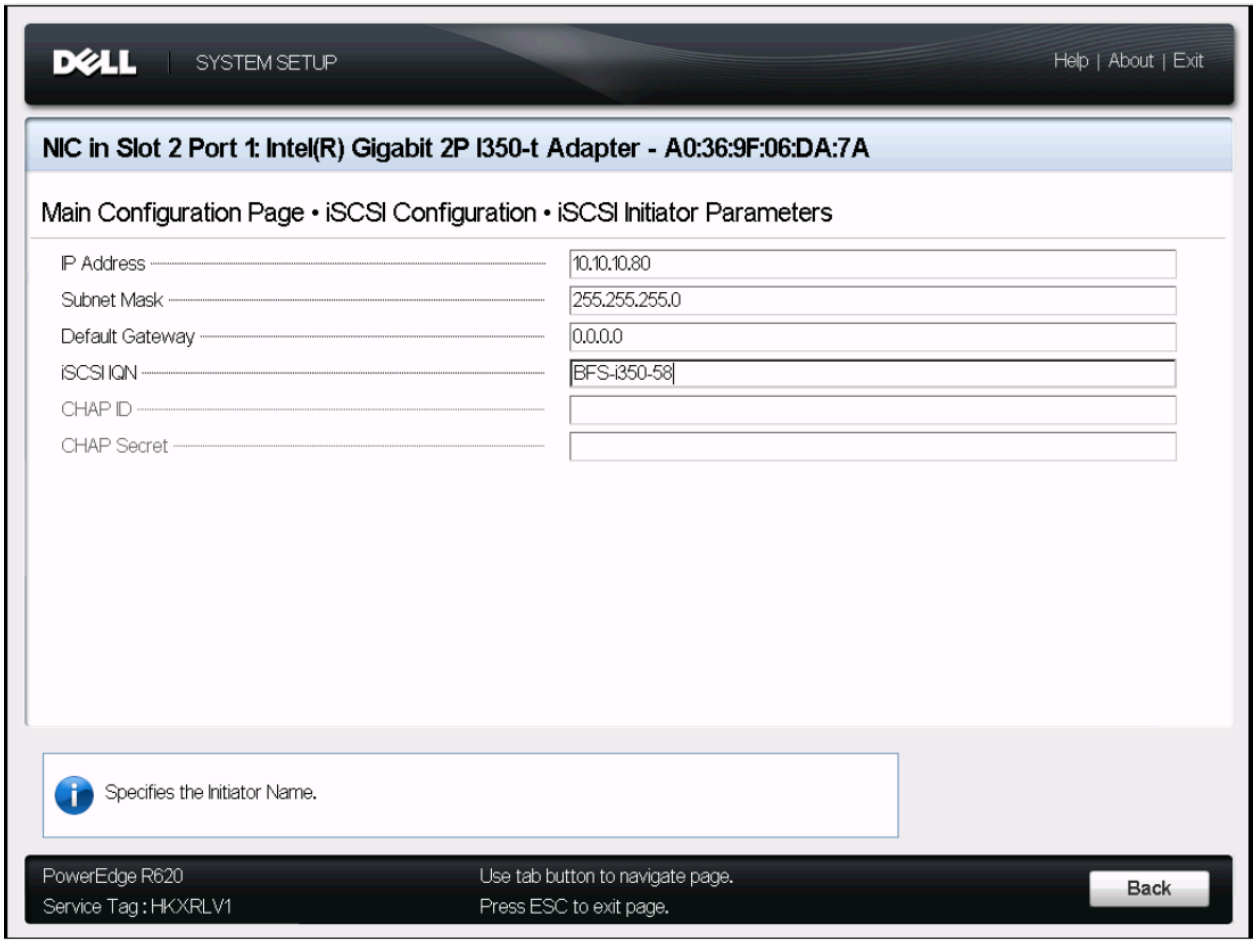

Figure 9 Intel i350-t iSCSI Initiator Parameters

10. Set the initiator **IP Address**, **Subnet Mask**, and if required, **Default Gateway**, **iSCSI IQN**, **CHAP ID**, and **CHAP Secret**.
11. Return to **iSCSI Configuration**.

12. Select **iSCSI Target Parameters**.

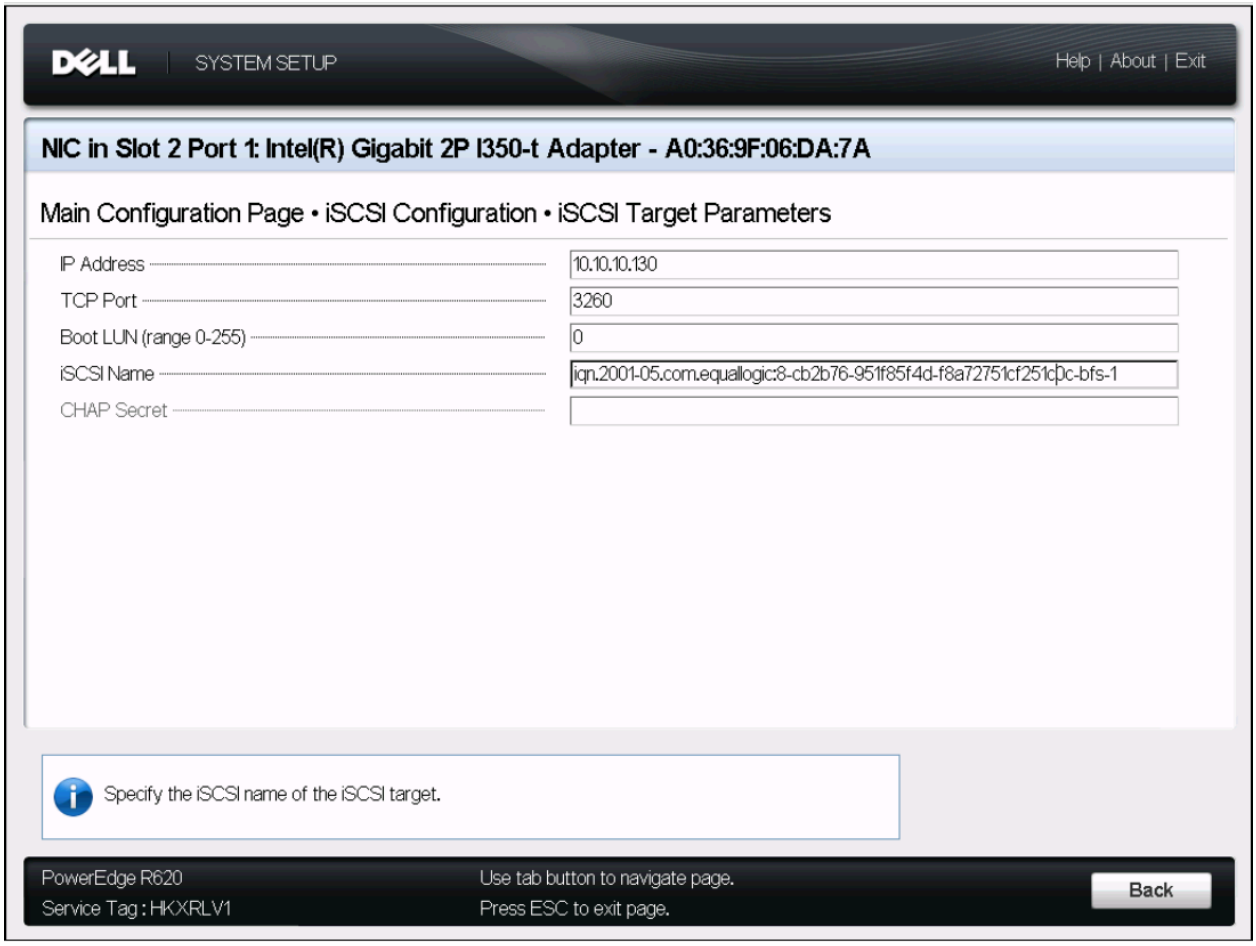

Figure 10 Intel i350-t iSCSI Target Parameters

13. Set IP Address to the IP address of the EqualLogic Group hosting the iSCSI volume to be used for booting from SAN.
14. Set iSCSI Name to the iSCSI IQN of the volume.
15. Set CHAP ID and CHAP Secret if using CHAP authentication.
16. Press [**Esc**] until prompted to save, and then save adapter settings.

The previous steps configure a single connection to the iSCSI SAN bootable volume. However it is recommended to configure a secondary connection to satisfy the high availability requirement. To create the secondary connection, use the following instructions:

17. Press [**Esc**] until the Device Settings page is displayed. Then, click on the NIC that is going to be configured as the Secondary iSCSI device.
18. Follow the same instructions as in Section 3.2.2, only changing step 4. Instead of **iSCSI Primary**, use **iSCSI Secondary**. See the following figure.

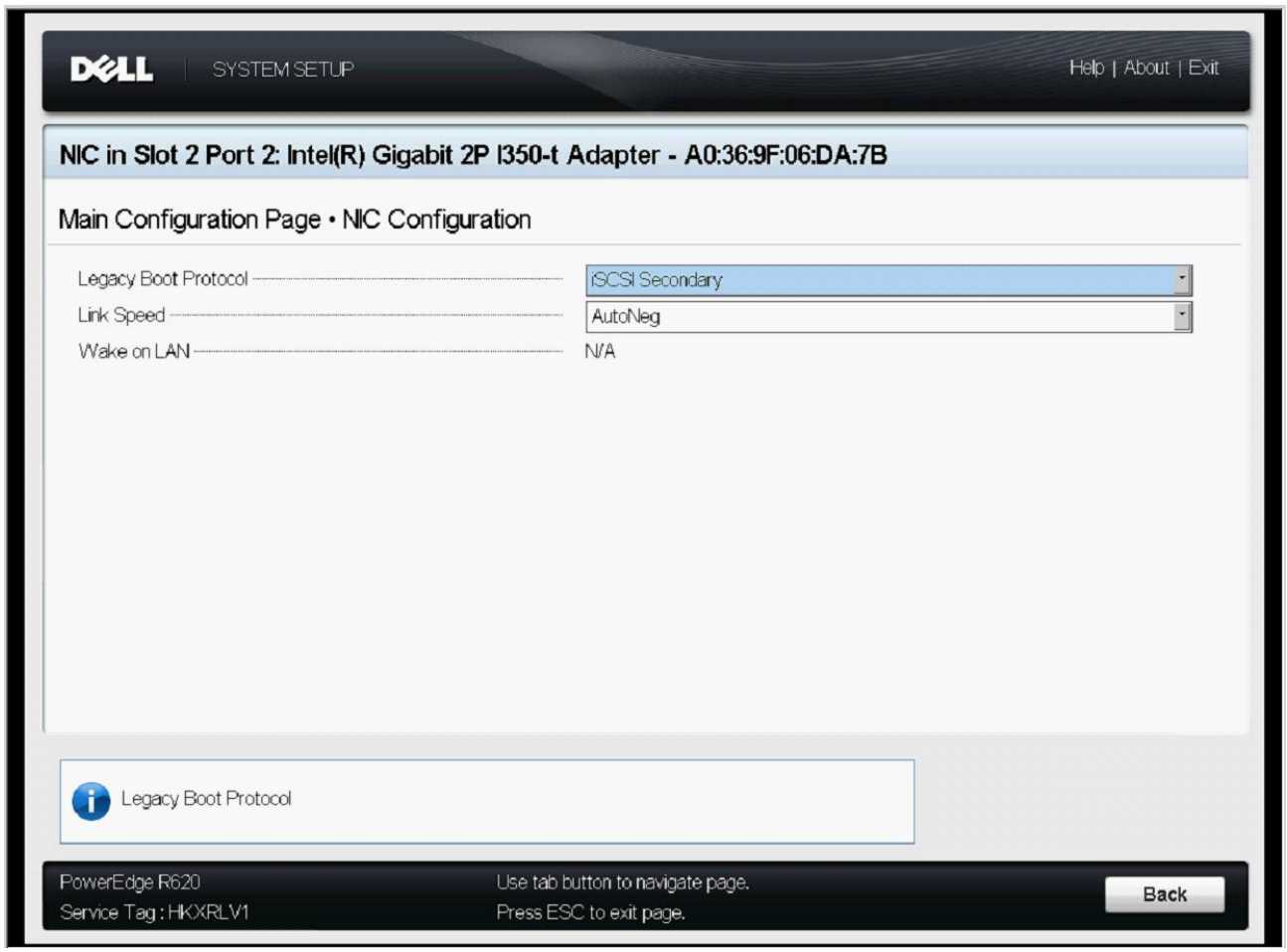

Figure 11 Intel i350-t Secondary iSCSI Device Setting

19. After the Secondary Device is configured and that set up has been saved, press [**Esc**] until the **Main Page** is displayed.
20. Press [**Esc**] and choose to reboot host so that newly configured iSCSI boot device will appear in the BIOS boot list.

3.3 Configuring the BIOS boot order

Before installing ESXi 5.1, the BIOS boot order should be changed so that the iSCSI volume is used when booting from the SAN.

1. Press [**F10**] to enter the Dell Lifecycle Controller **Unified Server Configurator (USC)**.
2. Select **System Setup**, and then **Advanced Hardware Configuration**.
3. Select **System BIOS**, **Boot Settings**, and then **BIOS Boot Settings**.

If you have a Broadcom 5720, or Broadcom 57810, continue in Section 3.3.1. If you have an Intel i350-t, Intel x520, or Intel x540 NIC, go to Section 3.3.2.

3.3.1 Configuring BIOS boot settings for Broadcom 5720, and Broadcom 57810 NICs

The following section provides instructions for configuring the Broadcom BCM5720 and Broadcom 57810 network adapters as the iSCSI initiator. The illustrated example shows a BCM5720 NIC.

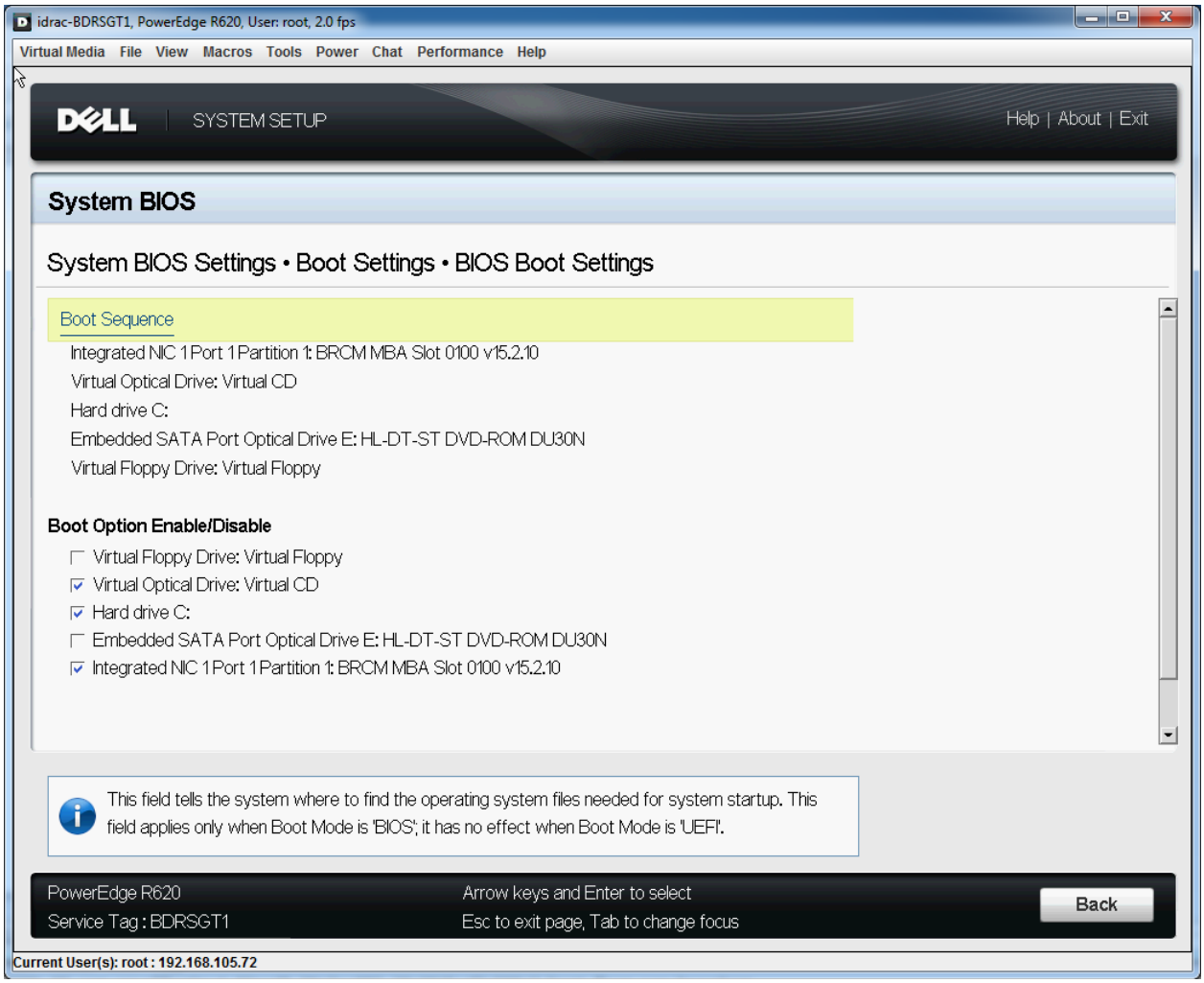

Figure 12 BIOS Boot Settings for Broadcom BCM5720

1. Select **Boot Sequence** and set **NIC 1 Port 1 Partition 1: BRCM MBA Slot 0100 v15.2.10** as the first boot device.
2. Set the second boot device as the device providing the installation media. For example, DVD, iDRAC virtual optical drive, or PXE-enabled NIC.
3. Press [**Esc**] until the System Setup Main Menu is reached. If prompted to save, choose to do so.

When using the Broadcom BCM5720 and Broadcom 57810 as the iSCSI initiator, it is necessary to disable the iSCSI boot for a single boot only. Otherwise, the BIOS will attempt to boot to the empty iSCSI target (which at this point has no operating system boot partition) and fail to boot to the ESXi 5.1 installation media. To disable the iSCSI boot for a single boot only, use the following steps:

4. Select **Device Settings**.
5. Select **NIC 1 Port 1: Broadcom Gigabit Ethernet BCM5720**.
6. Select **iSCSI Boot Configuration Menu**.

7. Select **iSCSI General Parameters**.
8. To prevent a failed boot to the empty iSCSI target volume, set **Boot to iSCSI Target** to **One Time Disabled**.
9. Return to the iSCSI Boot Configuration Menu.
10. Return to the Main Configuration Page.
11. Press [**Esc**] until the Device Settings, choosing to save the settings when prompted.
12. Press [**Esc**] until the USC Main Page is reached.
13. Make sure the ESXi 5.1 installation media is available in the device configured as the second BIOS boot device.
14. Press [**Esc**] and choose to reboot the host. The iSCSI initiator should connect to the iSCSI target prior to booting from the device providing the ESXi 5.1 installation media.

To install the ESXi 5.1 operating system, continue in Section 4.

3.3.2 Configuring BIOS boot settings for Intel i350-t, Intel x520, and Intel 540 NICs

The following section provides the steps for configuring the BIOS to iSCSI boot using the Intel i350-t, Intel x520, and Intel 540 network adapter. The figures show an Intel i350-t NIC.

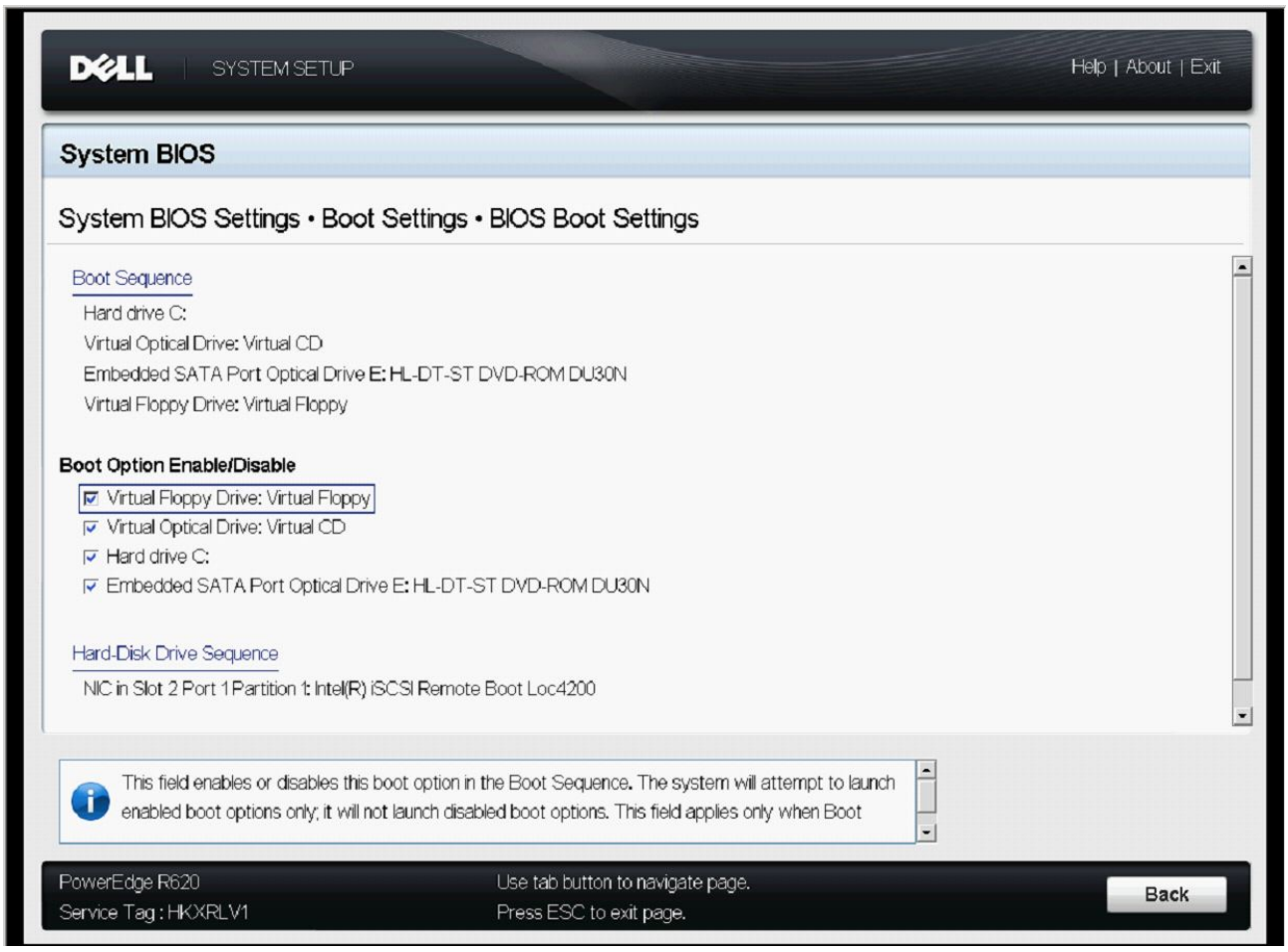

Figure 13 BIOS Boot Settings for Intel i350-t

1. Select **Hard-Disk Drive Sequence**.
2. Set **NIC in Slot X Port 1 Partition 1: Intel(R) iSCSI Remote Boot** ahead of the integrated storage controller.
3. Select **Boot Sequence**.
4. Set **Hard drive C:** as the first boot device.
5. Set the second boot device as the device providing the installation media. For example DVD, iDRAC virtual optical drive, or PXE-enabled NIC.
6. Press [**Esc**] until the **USC** is displayed.
7. Make sure the ESXi 5.1 installation media is available in the device configured as the second BIOS boot device.
8. Press [**Esc**] and choose to reboot the host. The iSCSI initiator should connect to the iSCSI target prior to booting from the device providing the ESXi 5.1 installation media.

4 Installing ESXi 5.1

Use the installation wizard to install ESXi 5.1. You will use the same steps to install ESXi 5.1 on a bootable iSCSI volume as when installing on local storage. One exception is that the attached iSCSI volume must be chosen as the storage device where the OS will be deployed, as illustrated in Figure 14.

Figure 14 ESXi 5.1 Installation

Note: In a diskless server, there will be no local storage and only the EqualLogic SAN volume will be displayed

5 Installing the Dell EqualLogic Multipathing Extension Module (MEM)

MEM is the Dell EqualLogic Multipathing Manager for ESXi 5.1. The paths that it manages are the paths connected to the non-bootable SAN volumes, not the ones connected to the iSCSI SAN bootable volume that were configured in Sections 3.

Dell recommends using one set of NICs to connect to the SAN ESXi boot volume and another to connect to the SAN data volume, MEM should be configured to use only the NICs connected to the non-bootable SAN volumes.

In a Boot from iSCSI SAN configuration, the MEM installation is a typical installation. For detailed information about how to install MEM, see the following guide:

http://en.community.dell.com/dell-groups/dtcmedia/m/mediagallery/20094619/download.aspx

6 Conclusion

Configuring a VMware ESXi 5.1 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 reasons:

- Quick and easy centralized backup
- Faster recovery in the 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 faster in the event of server hardware failure. 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 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. 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 details

Table 2 Component table

Component	Description
Operating system	ESXi 5.1 Update 1, Build # 1065491
Driver version	NIC driver versions are included in the Dell Customized ESXi Installation image (support.dell.com) After ESXi5.1 is installed, it is recommended to check for the latest driver version updates www.vmware.com/support .
NIC Firmware version	Broadcom 5720: v7.4.8, Broadcom 57810: v7.4.8, Intel i350-t: v1.5-6, Intel x520: v0x8000030d, Intel x540: v0x8000039c, QLogic 8262: v4.14.10,
Application	EqualLogic Group Manager, VMware vCenter Server, VMware vSphere Client
Server	Dell PowerEdge R620, 32 GB RAM, 2 x Xeon E5-2620 @ 2 GHz CPU, 2x SATA 250 GB internal HDDs
Storage	EqualLogic PS6110XV, EqualLogic PS6100XV, Storage Array Firmware version 6.0.2 (H2). Each array unit is equipped with 24 x SAS HDD, Seagate ST9145862SS, Revision HN63
Switches	Dell Force10 S60, firmware v8.3.3.8 Dell PowerConnect 8132F, firmware v5.0.1.3

B 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><yyyy-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/.

Table 3 Configuration worksheet

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:
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.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.

Referenced or recommended Dell publications:

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

Best practices when implementing VMware vSphere in a Dell EqualLogic PS Series SAN Environment

- http://en.community.dell.com/techcenter/extras/m/white_papers/20434601.aspx

Referenced or recommended VMware publications:

- VMware vSphere 5.1 Documentation Center: http://pubs.vmware.com/vsphere-51/index.jsp#com.vmware.vsphere.storage.doc/GUID-2A66A330-A9E5-460B-8982-54A1B1C38C02.html

- VMware ESXi 5.1 vSphere Storage Guide (Section 13) http://pubs.vmware.com/vsphere-51/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-51-storage-guide.pdf

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