Dense computing and redundant storage consolidation
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IBM*@*server*™* BladeCenter
Remote SAN Boot for HS20 (8678/8832) and HS40 (8839)

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Acknowledgements

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1.0 Overview

Remote boot or "root boot" is the name used when referring to a server configuration where the Server's operating system is installed on a logical drive (LUN) that is not resident locally to the Server chassis. This document will describe in details the process that you must go through to setup a remote boot for IBM eServer BladeCenter Servers using a logical drive from Fibre Channel Storage Array.

This process is intended for a configuration of a Blade Center directly connected to the Storage Array using Fibre Channel (FC) cables (Figure 1) If the Blade Server is connected to the Storage Array via FC switches (Figure 2), please reference the IBM eServer BladeCenter Interoperability guide first for instructions to correctly integrate the BladeCenter into an existing FC switched fabric. Upon following these preliminary tasks, you will be able to use the information in this document to set up remote boot.
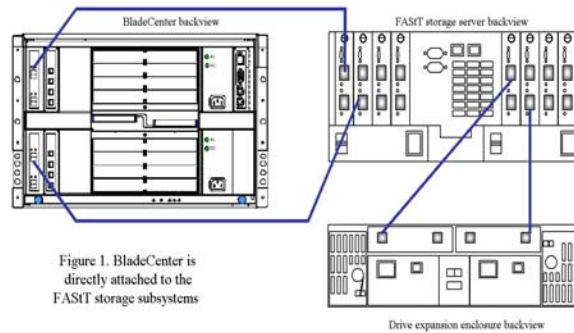
Figure 1.- BladeCenter in Direct-attach SAN environment
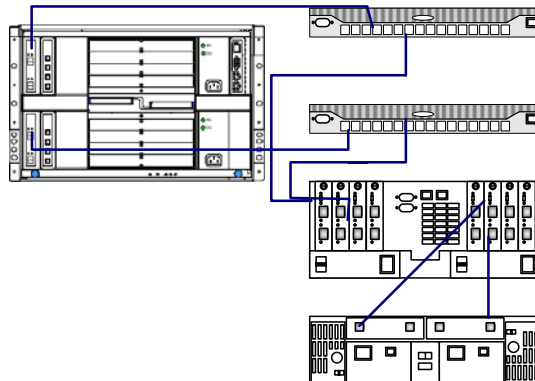
Figure 2.- BladeCenter in Fabric-attach SAN environment

2.0 Change Notification

Change Revision	Description	Date
1.0	Initial Release.	12/2003
2. 0	-Addition of Windows 2003 Standard Edition, Enterprise Edition, and Web Edition Operating System versions. -Removal of requirement to use I/O Stream-guard in remote boot. -Addition of HS40 and OPM support. -Addition of Brocade SAN Switch Module support.	07/2004

3.0   Using this document

This document will demonstrate to the Storage Administrator audience how to prepare, configure, and boot the IBM eServer BladeCenter using IBM Fibre Channel based storage solutions. The initial view of this document describes how to configure the Blade Center Fibre Channel I/O expansion adapter, provides a brief overview of the BladeCenter I/O module subsystem, and detailed steps for configuring Remote boot. Additionally, this document describes 'how to' and best practices for configuring the Fibre Channel capable I/O Modules using DS4000 disk systems series (formerly FAStT) and ESS ESS Storage platforms. I would like to point out that this document was not intended for use in configuring Clustered Hosts for Remote boot.

4.0　Preparation Checklist

As a preparation procedure, ensure that you either have access or have researched the following areas before proceeding to configuration.

Fibre Channel I/O expansion adapter

- ✓ Review the Blade Center Fibre Channel I/O Adapter Installation & User's guide.
- ✓ Refer to the Storage vendor's preferred setting for assigning the Boot LUN. In most cases, this will be LUN 0 (zero).
- ✓ Ensure that the Fibre Channel I/O Adapter has the latest supported BIOS. This is located at: www.ibm.com/support

Fibre Channel Switch Module

- ✓ Review the appropriate Switch Module installation & User's guide.
- ✓ For the Optical Pass-thru module, ensure that the OPM (break-out) cable is using the correct mapping to identify the Blade that you intend to configure for remote booting.
- ✓ Review the Blade Center's Fibre Channel switch Interoperability Guide.
- ✓ Backup the switch fabric configuration to a file.
- ✓ Record the IP Addresses of the BladeCenter Fibre Channel Switch module.

Remote Management workstation for configuring remotely

- ✓ Configure a Remote Management workstation which can be used to access the Fibre Channel switch module via an IP address. This is a system with the IBM DS4000 Storage Manager installed also and can be used to manage the storage.

- ✓ Install the IBM SAN Utility switch management application on the Remote Management workstation to have a graphical interface for managing the Fibre Channel Switch module. This workstation should be running the latest Java Utility when configured with a Microsoft Windows Operating system.

DS4000 Storage

- ✓ Reference the most current DS4000 Readme files, Installation and User's guides to ensure that you are comfortable with the configuration to follow. Otherwise, contact your local Blade Center support representative.

- ✓ Install the host management software on the Remote Management workstation.

- ✓ Obtain the IP Addresses of the DS4000 Storage subsystem.

- ✓ Obtain the necessary Storage Partitioning Premium Feature if required.

- ✓ Ensure that the DS4000 Storage server and drives are cabled in accordance with the DS4000 cabling guide.

ESS Storage
- ✓ Reference the most current ESS Readme, Installation and User's guides to ensure that you are comfortable with the configuration to follow.

- ✓ Reference the ESS Specialist Online Help for using ESS Specialist. Otherwise, contact your local Blade Center or Storage support representative.

5.0   About the BladeCenter I/O Subsystem

The IBM eServer BladeCenter is capable of containing up to fourteen processor blades for the Enterprise chassis and eight for the Telco chassis, two management modules, and four total I/O modules. Based on the current blade design, only Ethernet[1] (ENET) or Optical Pass-thru (OPM) I/O modules can be inserted into Bays 1 & 2. Any type of defined switch module, for example the Ethernet Switch Modules, Fibre Channel and Optical-Pass-Thru, can be inserted into Bays 3 & 4. However, for the purpose of this document, the I/O module will either be a Fibre Channel switch or Optical Pass-Thru module used in Slots 3 or 4. The corresponding blade server I/O expansion card must match with the I/O module protocol type. For example, the Fibre Channel daughter-card supports the Fibre protocol and only the OPM or Fibre Channel switch module is supported. On a BladeCenter chassis, the four switch bays are numbered from a rear view perspective as shown in below in Figure 3.
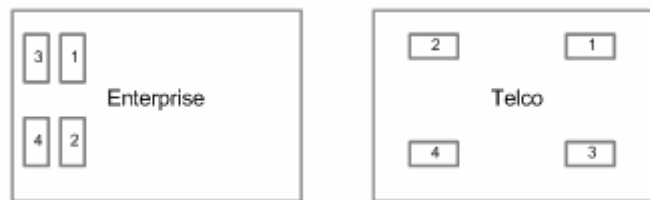

Figure 3.   Enterprise and Telco Blade Chassis Rear view (I/O subsystem)

[1] Ethernet will be abbreviated as ENET in the rest of this document.

6.0 Preparing the BladeCenter Server I/O Expansion card for Remote Boot

The HS20 and HS40 Server Blades have the capabilities of using the [2]Fibre Channel I/O Expansion card that is designed with dual-channels. When the Blades using I/O expansion cards are inserted into the BladeCenter's chassis they interface with a mid-plane which provides connectivity to I/O modules 3 and 4 in the rear of the chassis.

The diagram in Figure 4 depicts placement of the I/O expansion card on the Server blade. For a more detailed overview of the I/O expansion card, you should refer to the Installation and User's guides.

Note:	The following I/O Expansion card options are supported for Remote booting using the HSXX Blade versions: 13N2203 and 48P7061.
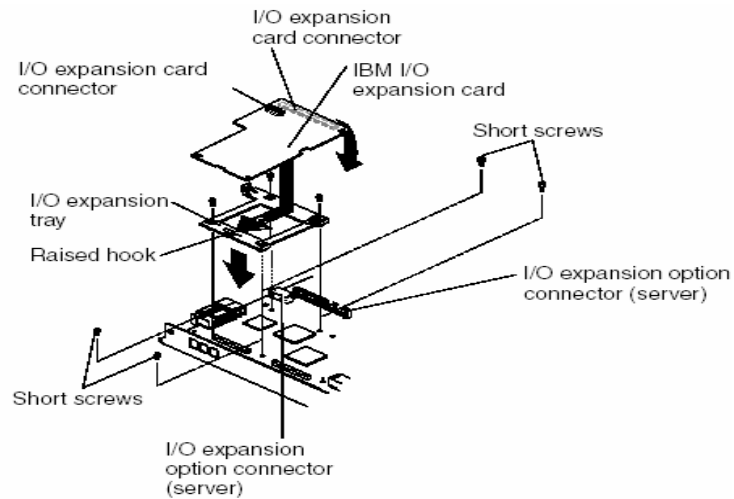
Figure 4. -HS20 Blade I/O Expansion card layout

This section is intended to provide a description and steps for preparing the HS20 and HS40 Blade Servers with and I/O expansion card in preparation to Remote Boot from Fibre Channel Storage.

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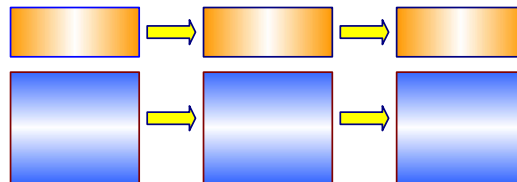
[2] Although the HS40 has dual I/O expansion card slots, only one is presently supported in the Remote boot scenario.

6.1 Install the FC I/O Expansion Card

1. Ensure that the HS20 or HS40 Blades are powered-off.
2. Remove the FC I/O Expansion Card from the static-protective package.
3. Slide the narrow end of the FC I/O Expansion Card into the raised hook on the tray.
4. Align the FC I/O Expansion Card connectors with the network-interface option connector and the PCI-X expansion slot. **(For HS40 Blades record whether you are using Slot 0 or Slot 1).**
5. Gently press the card into the connectors.
6. Lower the cover so that the slots at the rear slide down onto the pins at the rear of the blade server.

Important: The blade server cannot be inserted into the BladeCenter unit until the cover is installed and closed. Do not attempt to override this protection.

The following illustration (Figure 5) shows how to install an I/O expansion card on the blade server. The same procedure is used to install an expansion card in either I/O expansion card location; however, the illustration shows installing an expansion card only in I/O expansion card location 2.
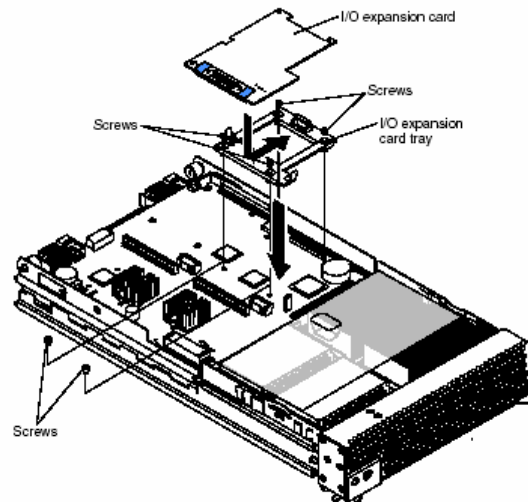
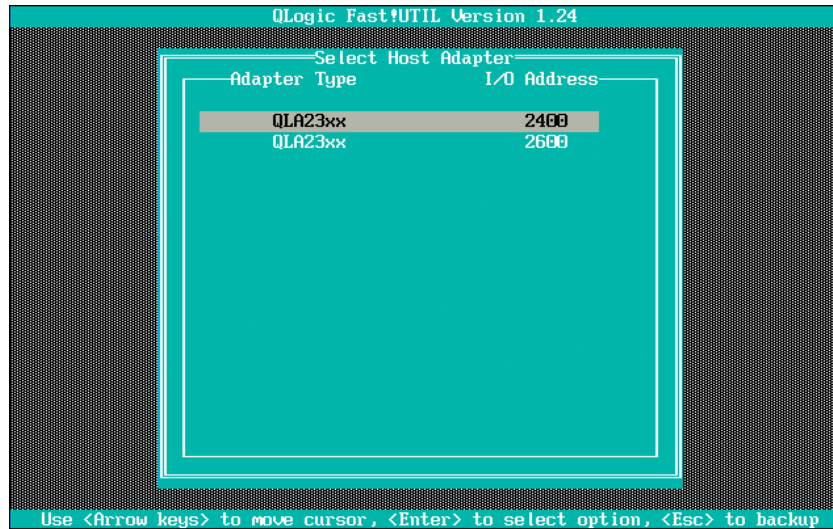Important: If you are installing only one I/O expansion card in your blade server, it must be installed in I/O expansion card location 2.

Figure 5. -HS40 Blade FC I/O Expansion card layout

6.2 Record Host Adapter Port Name

1. Boot the HS20 or HS40 Blade Server.
2. Press *Ctrl+Q* to enter the BIOS configuration utility as depicted in the illustration below.

3. Select the 1st Host adapter port as shown in Figure 6 by pressing *Enter*.


```
                    QLogic Fast!UTIL Version 1.24

                        ┌──────Select Host Adapter──────┐
                        │ Adapter Type        I/O Address│
                        │                                │
                        │   QLA23xx              2400    │
                        │   QLA23xx              2600    │
                        │                                │
                        │                                │
                        └────────────────────────────────┘

     Use <Arrow keys> to move cursor, <Enter> to select option, <Esc> to backup
```

Figure 6. - Fibre Channel I/O Expansion card ports

Note: The upper port correlates to the top Fibre Channel I/O Module (Slot 3) of the BladeCenter chassis.

4. Select *Configuration Settings → Host Adapter Settings*.
5. Record the Adapter Port Name (World-Wide Port Name) of this Host adapter channel. You will need this when configuring Storage Partitioning/provisioning and to zone the Fibre Channel expansion card port
6. Press the *Esc* key.
7. Select the menu item, *Select Host adapter*.
8. Select the 2nd Host Adapter port and press Enter.
9. Obtain the Adapter Port Name of the adapter and record it.
10. Press *Escape* to exit the Fast!Util program after you have recorded the Adapter Port Name for both adapters.
11. Power down the Blade server.

Record the adapter World-Wide Name port information below:

Slot	World-Wide Name:	I/O Address:
Slot 3		
Slot 4		

6.3 Update the Blade Server BIOS (if necessary)

1. The Blade Server BIOS can be updated using the Update Xpress CD available from http://www.ibm.com/support. This will also mentioned again in Section 8.3.

## 7.0 Configuring Fibre Channel Storage arrays (Single-path only)

Up to this point, the Storage Administrator has configured the Blade Server and recorded the necessary information for configuring the FC I/O Expansion card. This section describes attaching the IBM eServer BladeCenter into a SAN and configuring a single path to Remote boot from DS4000 or ESS storage array.
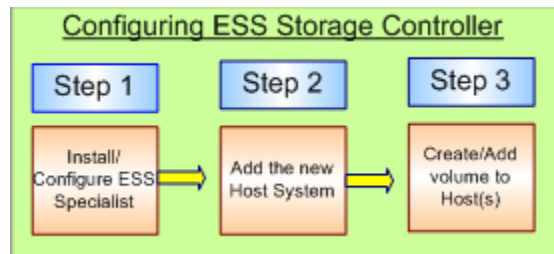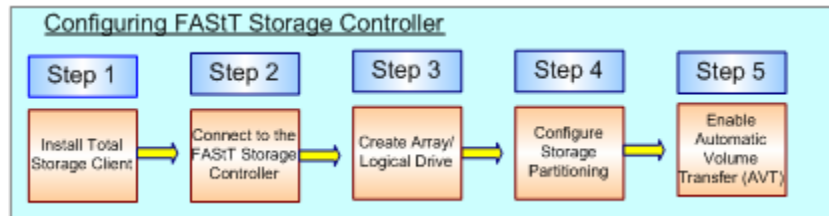
7.1 Configuring DS4000 Storage for Remote boot

Note: The following steps will be performed from a Remote workstation that has the DS4000 Total Storage Manager client installed. You should consult the DS4000 documentation for additional guidance.

1. Install the IBM DS4000 Storage Manager Client on the designated Remote workstation.
2. Launch the IBM DS4000 Storage Manager Client using the *Start → Programs → IBM Storage Management Client* Windows menu.
3. Using the Storage Management application, connect to the Storage subsystem that you intend to manage and configure for Remote booting.
4. Once you have selected the applicable Storage subsystem, proceed to Creating logical drives and arrays.
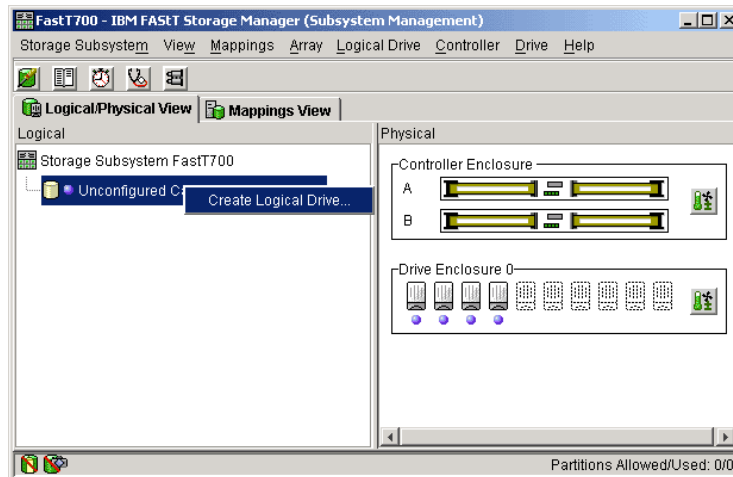
Figure 7. - Storage Manager client management screen.

5. Proceed to configure Storage partitioning by performing the steps below.

Note: You should review your DS4000 publications will provide more in-depth illustrations on Storage Partitioning.

6. Under the *Mappings View* tab, you should create a host group, host, and assign host ports.

    a.   Select *Mappings → Define Host Group*.

    b.   Click on the Host group; select *Mappings → Define→ Host*.

    c.   Click on the Host that was created in the previous step; select *Mappings → Define→ Host-ports*. Each Host should initially have a single host-port assigned. Otherwise, the host will have dual-path access assigned. The host port is the Adapter WWPN that you recorded while configuring the FC I/O Expansion card. The host type for each of these host-port types will be Windows® Non-clustered by default and should be changed to correspond to the Operating system type that you will be installing.

       Note: Automatic Volume Transfer (AVT) is used to perform Controller level LUN transitioning. For the Linux host-type, this is already enabled. However, as described later in this document, AVT should be enabled for Windows.
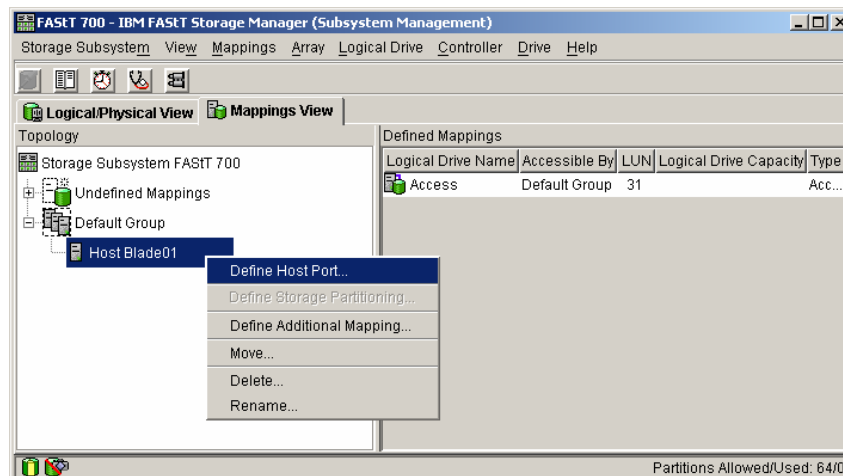
Figure 8. -Configuring Host groups and defining Host ports

7. Right click on the host created in Step 6b and assign the intended boot Logical Drive, *as LUN 0,* to the Host that was also created previously.

8. Remove the Access Logical Drive from the **Host group** created in Step 6a. (Note: This LUN is added automatically to the host group when the first LUN is mapped to it. Review the figure below to compare with your configuration.
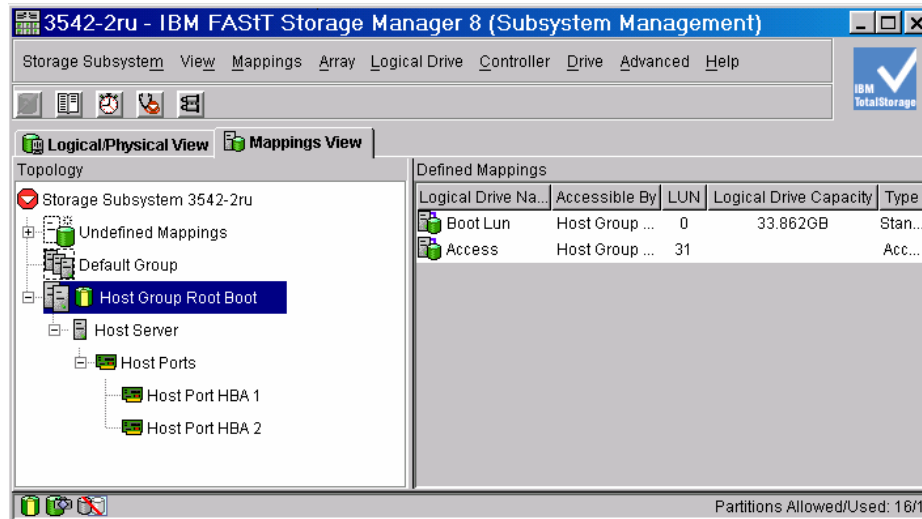
Figure 9. – DS4000 Host-port mapping

9. Enable AVT on the DS4000 storage controller using the following script sample.

Note: AVT is intended to be used in situations that utilize redundant paths to the Storage controller. The script can be found in your DS4000 CD-pack or on at http://www.ibm.com/support. This procedure is also mentioned in the *Configuring for Redundancy* section and can be performed at either point. Additional documentation can also be found in the Storage Management Client Online Help or Installation and User's guide. The Enable AVT script is typically provided in a *.scr* file and is only intended to be performed by a seasoned Storage Administrator.

7.2   *Configuring ESS Storage for Remote boot*

1. Configure the ESS using the ESS Specialist.
    -Storage Allocation
    -Open Systems
    -Modify Host Systems.

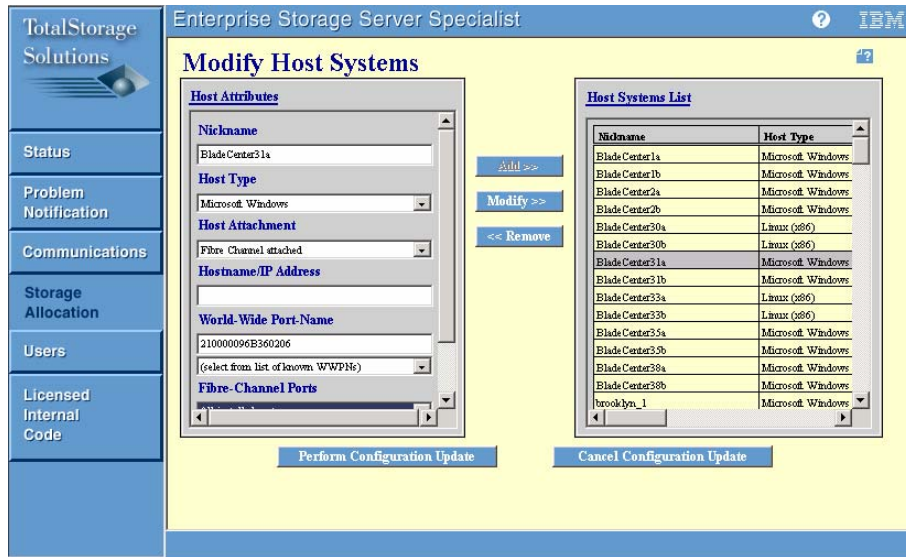2. Enter the information in the text fields of the Modify Host System

Figure 10. - ESS Host Port mapping using ESS Specialist

3. Add the Host Attributes to the Host Systems List and Perform Configuration Update.

4. After the Configuration Update you will be brought to the Open Systems Storage Window, Add
    Volumes to the Host.   Select the *Add volumes*.
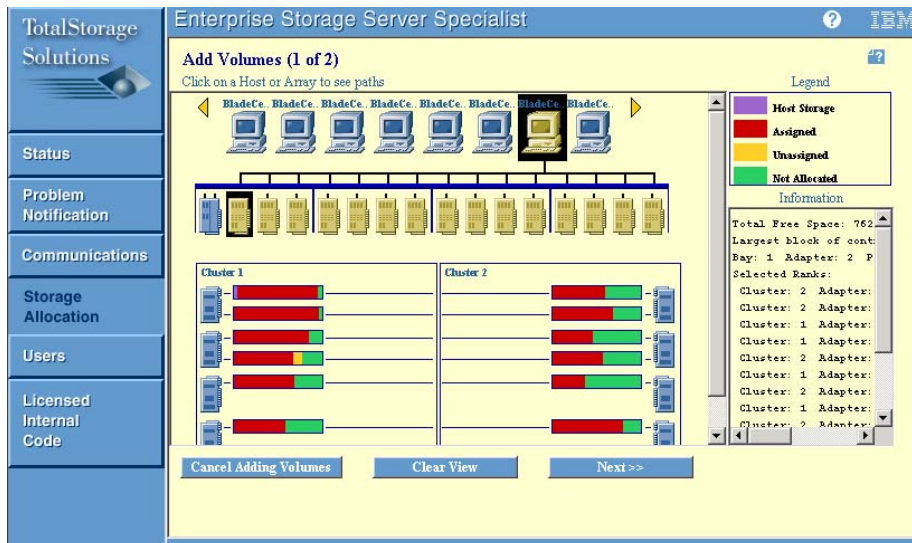
Figure 11.   – ESS volume assignment using ESS Specialist

5. Click on your Host (Host Nickname), and select clusters (Green) from Cluster 1 and/or Cluster 2,
    then select *Next*.
Note on Adding Volumes: You will want to add (1) 5 GB LUN, for Operating Systems Purposes.
Additional volumes can be added after the installation of the OS. Perform the Configuration Update.
Only one volume should be assigned to the Host until the installation of the Operating System is
completed.

Figure 12. – ESS volume creation using ESS Specialist

6. You will then see the (1) 5GB LUN that was created and it is assigned to the WWPN of the FC I/O Expansion card.

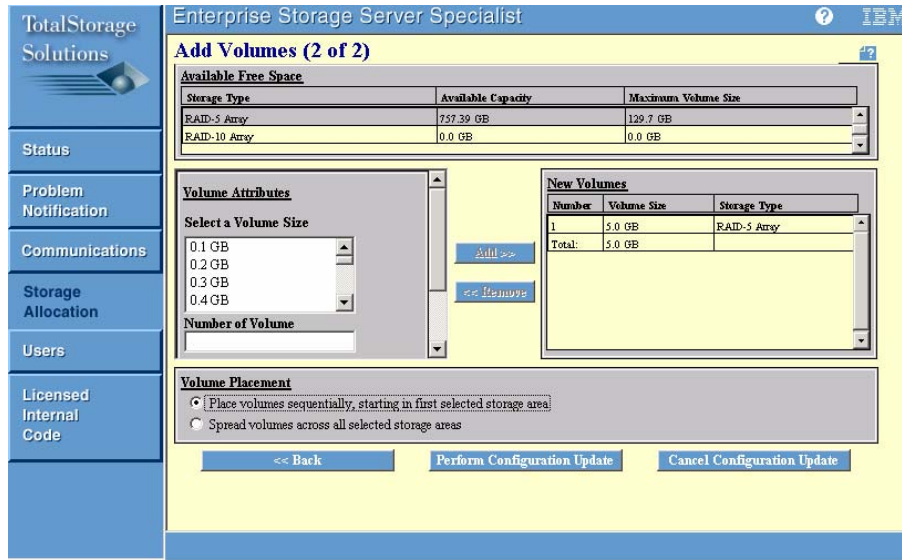## *8.0 Update the Server BIOS for HS20 and HS40*

1. Power on the HS20 or HS40 Blade server.

2. Enter the BIOS by pressing F1 and you will be directed to the Server's BIOS menu.

3. Confirm that the Blade server's BIOS and Diagnostics are at the latest level by reviewing the support website (www.ibm.com/support). Otherwise, update using the latest code levels found there.

8.1 Configure I/O Expansion card parameters

1. Boot the HS20 or HS40 Blade Server.
2. Press *Ctrl+Q* to enter the BIOS configuration utility as depicted in the illustration below.
3. Select the first Fibre Channel adapter port.

Note: The upper port correlates to the top Fibre Channel I/O Module (Slot 3) of the BladeCenter chassis and is assumed to be the path configured first in this document.

4. Select *Configuration Settings* → *Host Adapter Settings*.
5. Enable the Host adapter's BIOS by selecting Enable from the Host adapter BIOS parameter.

6. Press the *Esc* key once.

7. Select *Selectable Boot Settings* and enable the Selectable Boot.

8. Select the (*Primary) Boot Port Name, LUN* and press *Enter*.   This will bring you to the Select Fibre Channel Device screen.

9. Listed here you will find the Controller to which your HBA Adapter is connected on the DS4000 Storage or ESS Storage device. Select it and press the *Enter* key.

10. Your Selectable Boot Settings should now show the Controller Port Name, as shown Figure 13.
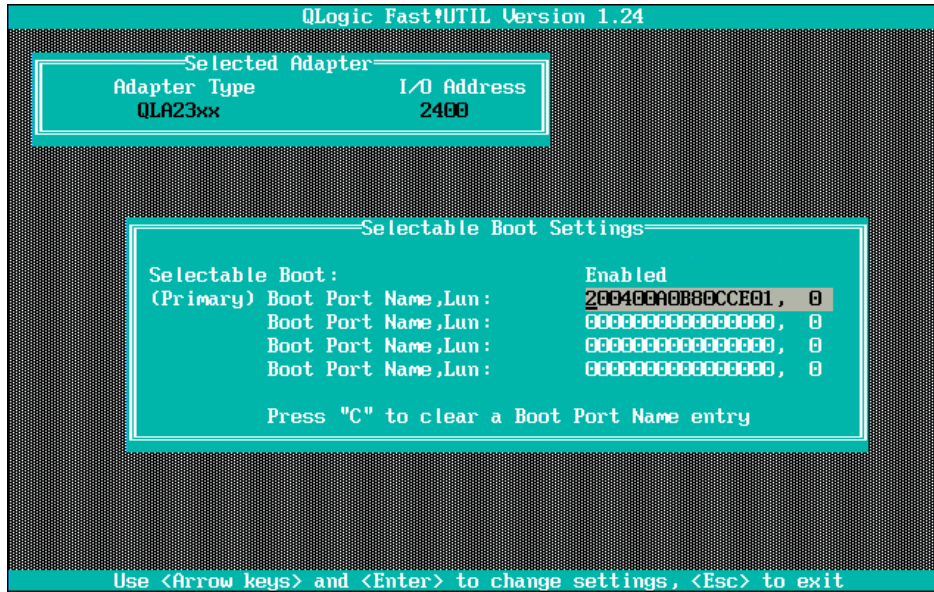
Figure 13 – HBA Boot device assignment mapping

8.2 Configuring the HS20 Blade Server BIOS

1. On Server boot, Select *F1* to enter the Server's BIOS. If your HS20 has the optional SCSI attachment, change the Plannar SCSI to Disabled.

Note:	Ensure that the *Daughter Card* parameter is Enabled.

2. Select the IDE Configuration Menu.
3. Disable the Primary IDE connection and Secondary IDE connection.
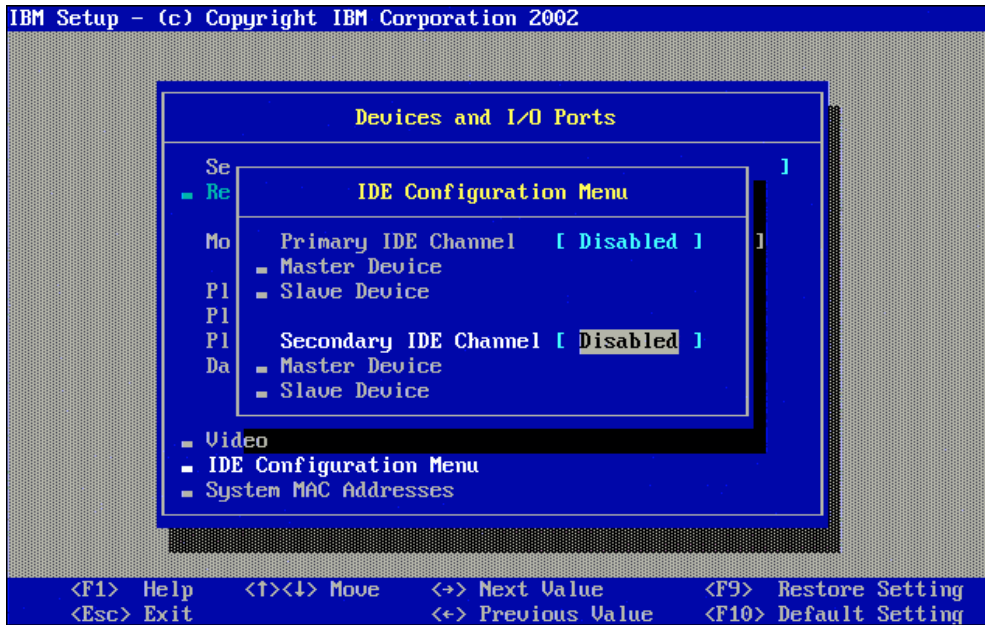
4. Ensure that these devices are listed in the following order as startup devices:

Device	Startup Order
CD-Rom	First Startup Device
Diskette Drive 0	Second Startup Device
Hard Disk 0	Third Startup Device
Network	Fourth Startup Device

5. Select Save Settings and then exit the BIOS configuration.

8.3 Configuring the HS40 Blade Server BIOS.

1. Ensure that the Media Tray and KVM Control is assigned to the HS40 that you are working with.
2. Ensure that these devices are listed in the following order as startup devices:

Device	Startup Order
USB Hotplug CDROM	First Boot Device
USB Hotplug FDD	Second Boot Device
HA 1 PortID 010000 1742 (Fibre Device)	Third Boot Device

3. Select the Third Startup Device and press `Enter`.
4. Select the Fibre Channel Daughter Card as the Third Startup Device. In the example shown in Figure 15, the Fibre Channel Daughter Card is HA 1 PortID 0100000 1742.

Note: The HS40 requires that you have the HBA port BIOS enabled before seeing Fibre Channel Daughter card as a Startup sequence option.
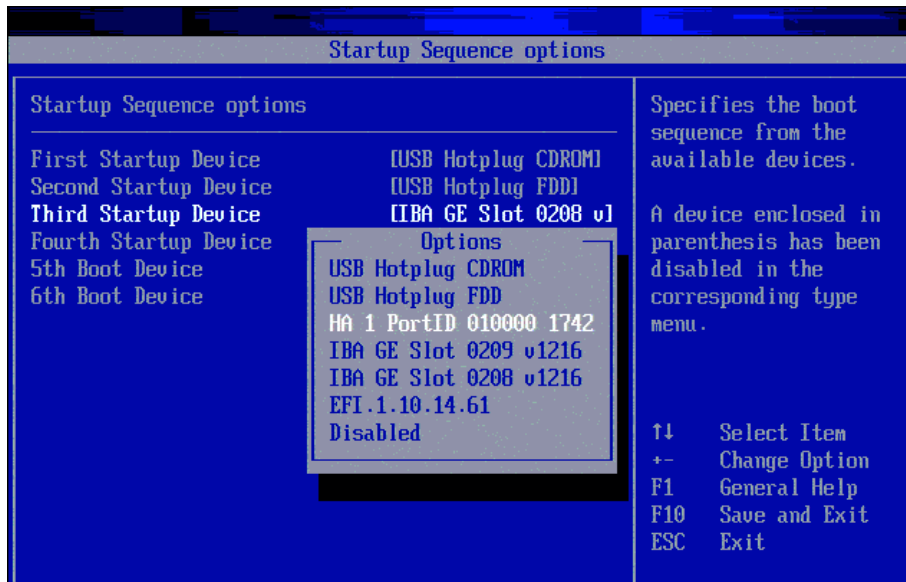
Figure 15. – HS40 Device Startup sequence

5. Select Save and exit the BIOS configuration.

9.0   Configuring IBM eServer BladeCenter Fibre Channel capable I/O Modules

This section describes I/O modules that support the Fibre Channel capable I/O expansion card. Therefore, I/O modules must reside in slots 3 or 4. The I/O modules are provided in two flavors; Fibre Channel Switches and Optical Pass-thru modules that can be used as interconnects to attach the Blade Center into an external SAN environment.

The Fibre Channel switch module is designed to reduce the amount of cabling that is used to interface to the external SAN environment. The Fibre Channel switch module also has resident functionality of a traditional Fibre Channel switch.

The Optical Pass-thru module is designed to allow I/O expansion card break-out capabilities to an external SAN environment. Because the optical break-out provides a one-to-one (FC I/O expansion-to-external device) port correlation, it may become more feasible to utilize an intermediate switch device. This intermediate switch device allows cable extensibility and aggregates the flow of traffic to the Target device.
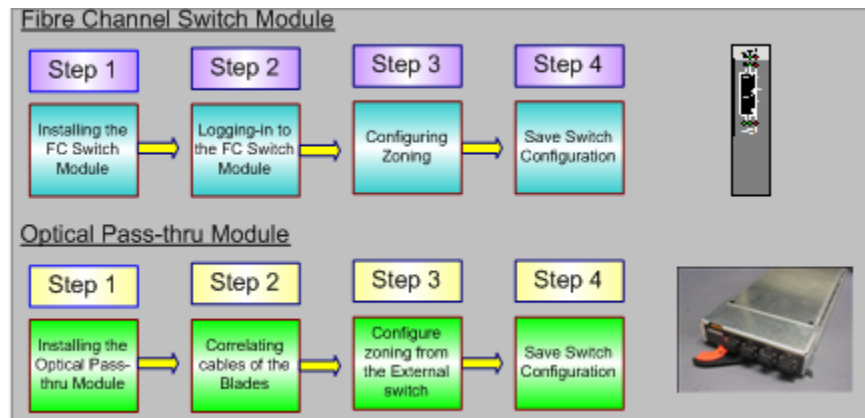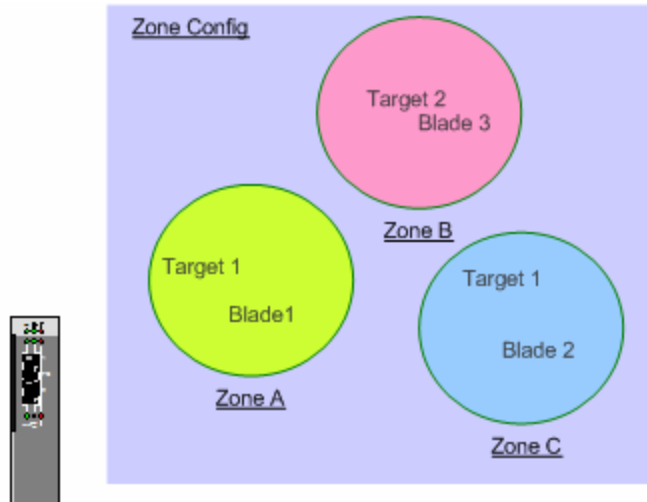

Figure 16. - Configuring Fibre I/O Modules

9.1   Configuring Fibre Channel Switch module for a Remote Boot environment

This configuration section does not assume that you are using a particular type of Fibre Channel switch module only that the switch module is a functional IBM eServer BladeCenter Fibre Channel capable switch module. This section describes two important concepts; Zoning and Interoperability. These should be considered when deploying BladeCenter in a Remote boot SAN environment while using Fibre Channel Switch Modules.

A. <u>Zoning</u>

Zoning is used to prevent propagation of state-change traffic to other Blades in the Fabric. It is recommended that each Blade that has I/O expansion cards resident be included in a separate zone. This is to prevent extraneous State-change traffic to other Blades that may be in operation. Although in most cases, this traffic is non-disruptive, it can have a slight performance impact on adjacent Blades in the fabric. Follow the zoning example provided in **Figure 18** to guide you through zoning setup for your configuration.

Figure 17. - Zoning Concept

Figure 18. - Zone Configuration steps using the Brocade SAN switch Module and 2-port FC switch Module

Note: These zoning steps must be repeated for each Fibre Channel Switch Module.

B. Interoperability

For SAN environments that operate on the premise of Open Fabrics, interoperability may be inherent. Open Fabrics are SANs where vendor neutral device integration is permissible. Interoperability is described as interconnecting two or more Switch Fabric devices of different vendor types.

When attaching the BladeCenter into any SAN environment, it is important to understand the SAN vendor of the devices that you are attaching to. Once this is determined, you should proceed to gathering appropriate documentation that will guide you in designing this interoperable SAN. For the purpose of

Remote booting, you should consult the Storage vendor to ensure that Interoperable Fabrics are supported. For best practices, before proceeding to integrate the BladeCenter into an existing Fabric, you should backup your switch configuration. Additionally, for BladeCenter Interoperability guidelines see the IBM eServer BladeCenter Fibre Channel Interoperability Guide, available at http://www.pc.ibm.com/support.

## *9.2 Configuring a Single Path to the Storage Server*

Note: Disable **Port 0** on one of the Switch Modules (Module 4). This step assumes that a path to your storage controller is attached to this port.

Disabling this Switch port only allows a single path to the storage controller.

Brocade Switch Module Commands	Qlogic Switch Module Commands
1. Start a telnet session to the switch 2. Login using 'USERID' 3. BSSM: > portDisable **0** 4. BSSM: > logout	1. Start a telnet session to the switch 2. FCSM: USERID> admin start 3. FCSM (admin): USERID> config edit 4. FSCM (admin-config): USERID> set config port **0** 5. set port **0** to offline 6. FSCM (admin-config): USERID> config save 7. FCSM (admin): USERID> config activate 8. FCSM (admin): USERID> admin end 9. FCSM (admin): USERID> logout

9.3 Configuring Optical Pass-thru module for a Remote Boot environment

The Optical Pass-thru module (OPM) provides 4-pair of fiber optic cable break-outs per single Optical transceiver. The OPM has 4 Optical transceivers numbered 1 thru 4 on the face of the OPM that allows communication to the device. Each cable correlates to a particular Blade slot. For example, break-out Cable extension 1 thru 4 of Optical transceiver port 1 correlates with the Blades in slot 1 thru 4.   The break-out cable extension 1 thru 4 of Optical transceiver port 2 correlates with Blades in slot 5 thru 8 and so on. Depending on whether the OPM is in slot 3 or 4 will determine whether you have connectivity to the upper or lower port of the I/O Expansion card.
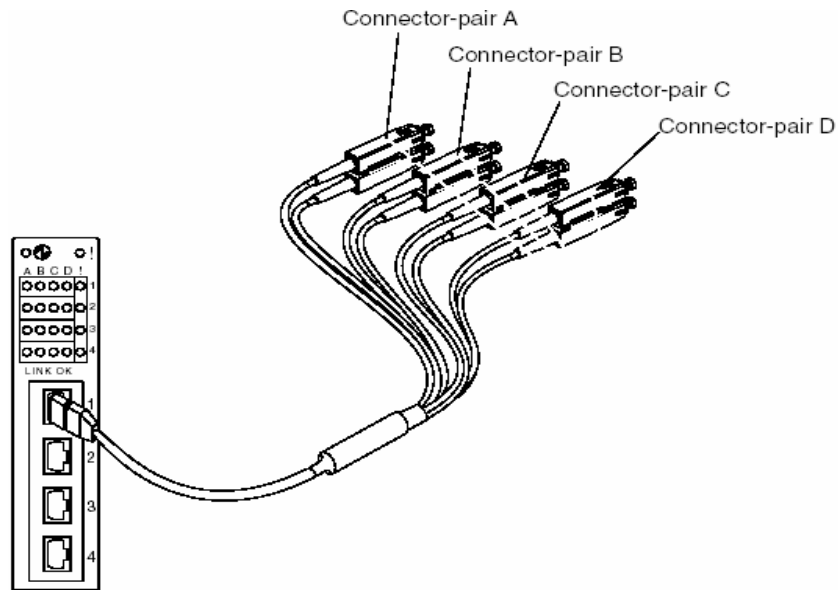
Figure 19. - Optical Pass-Thru Module and Break-out (SC-type) cable

Because the OPM serves as a physical extension of the FC I/O expansion card ports, there is not a concern for Interoperability or zoning on the OPM per se. The SAN Administrator should be mindful of cable management and port-count when designing a SAN using OPM.
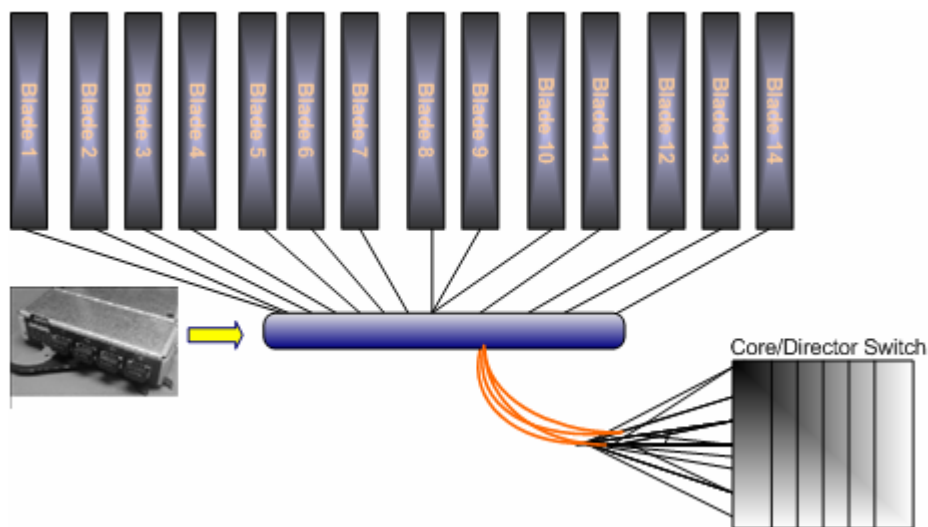
Figure 20. - SAN diagram using OPM

As depicted in the drawing above, the OPM is directly attached to the external switch. The external switch can be zoned as described in the zoning section of "Configuring Fibre Channel Switch module for Remote boot environment" section of this document. It is also recommended to consult the switch vendor's documentation to find out more about Zoning.

10.0 Installing the Windows Operating System

Now that you have configured the System BIOS, FC I/O Expansion card BIOS and Storage array you are ready to begin the installation of the Operating System. The following Operating Systems have been validated and are subjects of this document:

Operating System	Platform
Windows 2000	Server Enterprise Advanced Server
Windows 2003	Standard Server Web Edition Enterprise Edition

To install the Operating system, you will require a 3rd party device driver for the FC I/O Expansion card. This device driver can be downloaded from the following website: www.pc.ibm.com/support . This device driver package should be extracted to the root of the a:\ drive. Once this is done, you are ready to perform the installation using the steps below.

1. Begin the installation using the supported Windows CD-ROM.

2. During the installation process, when prompted, Press **F6** to install a 3rd party device driver

3. When prompted insert the Fibre Channel Daughter Card device driver diskette.

4. If Windows prompts you to use the driver included with Windows or the driver that you have specified, be certain to use the driver from the diskette, not the driver included with Windows.

5. Continue the Windows 2000/Windows 2003 installation until finished.

6. Install the recommended service packs and reboot.

7. **(For DS4000 only)** Install the relevant DS4000 host management software packages (You should refer to the DS4000 website for additional Installation and User's guide instructions):

    a. Total Storage Manager client

    b. Agent

    c. Utilities

Note: RDAC is not to be installed until the secondary path to the Storage has been configured and installed. Otherwise, you could experience a Blue-screen.

8. **(For ESS only)** Install SDD using the appropriate Windows installation package. However, you should reference the SDD User's guide for planning purposes.

9. Power down the Blade server and proceed to enable the second path as described in the Configuring for Redundancy section (Section 11) if you desire to have dual-paths to the Storage Controller.

10.1 Installing the Linux Operating System

Once you have configured the System BIOS, FC I/O Expansion card BIOS and Storage array you are ready to install Linux. The following Operating System[3] versions are subjects of this document.

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[3] The Linux OS installation steps only apply to Red Hat versions of Linux presently.

Operating System	Platform
Redhat Linux	Advanced Server 2.1
	Enterprise Linux 3.0

The Linux distribution typically has the FC I/O Expansion card source files. Therefore, you should proceed with installation and the KudZu application should detect the appropriate device driver for the boot device. To install Linux, proceed to the following steps:

1.   Insert the Installation CD-ROM.

2.   Proceed to the installation using the FC I/O Expansion card device driver that was detested.

3.   Install the latest Errata and reboot.

4.   **(For DS4000 only)** Install the relevant DS4000 host management software packages (You should refer to the DS4000 website for additional Installation and User's guide instructions):

   a.   Total Storage Manager client

   b.   Agent

   c.   Utilities

   d.   FAStT MSJ

Note: These steps do not support configuring using the Linux RDAC. FAStT MSJ is to be used to configure the Primary and Alternate paths to the Storage device.

5.   **(For ESS only)** Install the SDD multi-path device driver to ensure fail-over and load-balancing. However, you should refer to the SDD User's guide for planning purposes.

6.   Use FAStT MSJ to configure the primary path to your Fibre Channel Disk device. This is not applicable for ESS.

7.   Power down the Blade server and configure the second path.

11.0   Configuring for Redundancy

Up to this point of configuring Remote boot, these steps have assumed that you were using a single port of the FC I/O expansion card to perform the OS installation (configured through Port Disable on the switch).

This purpose of this was to prevent LUN contention during the OS installation. The next steps will discuss configuring the 2nd port of the FC I/O Expansion card to become useable in the event of a failure on the 1st port. This section will describe how to configure the second I/O expansion module and install multi-path software etc. This process is used for connecting the secondary path using Storage Partitioning for DS4000 or provisioning for ESS platforms.

11.1   DS4000

1.   Configure Host-port mapping using DS4000 Storage Manager Client as previously done in Section 7.1.

2.   Under the *Mappings View* tab, you should create a host group, host, and assign host ports.

   a.   Select *Mappings → Define Host Group*.

b. Click on the Host group; select **Mappings → Define → Host**.

c. Click on the Host that was created in the previous step; select **Mappings → Define → Host-ports**. Each Host should initially have a single host-port assigned. Otherwise, the host will have dual-path access assigned. The host port is the Adapter WWPN that you recorded while configuring the FC I/O Expansion card. The host type for each of these host-port types will be Windows® Non-clustered by default and should be changed to correspond to the Operating system type that you will be installing.

3. Enable AVT for the DS4000 Storage Controller using the following script sample. **Note: This should have been done while preparing the controller.**


```
Enabling AVT

Windows 2000 (Non-clustered)
// The following commands Enable AVT
// You must reboot the controllers for the NVSRAM settings to take affect
set controller [a] HostNVSRAMBYTE [2,0x24]=0x01;
set controller [b] HostNVSRAMBYTE [2,0x24]=0x01;
```

4. To enable the second path to the Storage controller:

    Note: Enable **Port 0** on the Switch Modules that was previously Disabled to allow only a single path.   This provides you with dual-paths to the storage controller.

Brocade Switch Module Commands	Qlogic Switch Module Commands
1. Start a telnet session to the switch 2. Login using 'USERID' 3. BSSM: >portEnable **0** 4. BSSM: > logout	1. Start a telnet session to the switch 2. FCSM: USERID> admin start 3. FCSM (admin): USERID> config edit 4. FSCM (admin-config): USERID> set config port **0** 5. set port **0** to online 6. FSCM (admin-config): USERID> config save 7. FCSM (admin): USERID> config activate 8. FCSM (admin): USERID> admin end 9. FCSM (admin): USERID> logout

Note: Steps 5 and 6 are not applicable for Linux.

5. Verify paths to the Target Storage device using the **SMdevices** command. If a primary and alternate path is not available, do not proceed to install RDAC. **(Not applicable for Linux Operating Systems)**

6. Install RDAC for failover capability and reboot the server as directed. **Note:** The RDAC application should be compatible with the Firmware that is being used on the Storage controller. You can confirm this by referring to the DS4000 RDAC and Firmware Readme files. **(Not applicable for Linux Operating Systems)**

7. Proceed to Configure the BIOS of the 2nd port for the Fibre Channel Daughter-card.

a. Boot the HS20 or HS40 Blade Server.

b. Press *Ctrl+Q* to enter the BIOS configuration utility as depicted in the illustration below.

c. Select the first Fibre Channel adapter port.

Note: The upper port correlates to the top Fibre Channel I/O Module (Slot 3) of the BladeCenter chassis and has already been configured during the Single-path configuration.

d. Select *Configuration Settings* → *Host Adapter Settings*.

e. Enable the Host adapter's BIOS by selecting Enable from the Host adapter BIOS parameter.

f. Press the *Esc* key once.

g. Select *Selectable Boot Settings* and enable the Selectable Boot.

h. Select the "*(Primary) Boot Port Name, LUN*" *parameter* and press *Enter*. This will bring you to the Select Fibre Channel Device screen.

i. Listed here you will find the Controller to which your HBA Adapter is connected on the DS4000 Storage Server. Select it and press the *Enter* key.

j. Your Selectable Boot Settings should now show the Controller Port Name, as shown Figure 21 below.

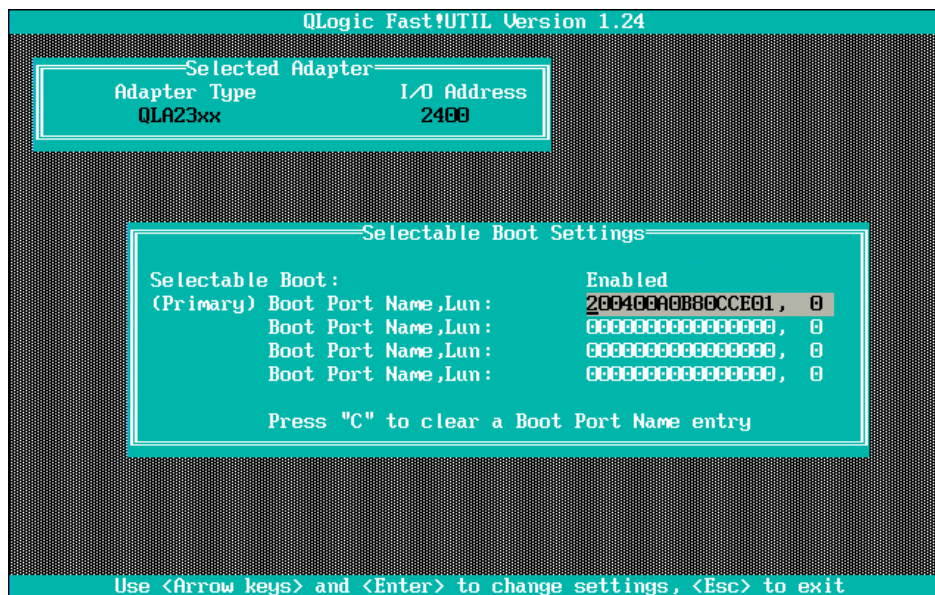k. Save your settings and Exit the FC Daughter-card BIOS.

Figure 21 – HBA Boot device assignment mapping

8. Reboot your system to the Operating System.

9. Run the **SMdevices** command from the command line to verify paths to the Target Storage device. If RDAC is properly installed, you will notice that the 2nd path to the LUN has been masked. (**Not applicable for Linux Operating Systems**)

Figure 22 Sample SMDevices Output

11.2 ESS

1. Using ESS Specialist, modify the Host System to include the 2nd HBA and Boot LUN.

2. Enter the information in the text fields for the 2nd port of the FC Host adapter and Boot LUN.

3. Save the configuration and proceed to enabling the path through the Switch Module.

4. To enable the Switch Module secondary path to the Storage controller:

   Note: Enable **Port 0** on the Switch Modules that was previously Disabled to allow only a single path.   This provides you with dual-paths to the storage controller.

Brocade Switch Module Commands	Qlogic Switch Module Commands
5. Start a telnet session to the switch 6. Login using 'USERID' 7. BSSM: >portEnable **0** 8. BSSM: > logout	10. Start a telnet session to the switch 11. FCSM: USERID> admin start 12. FCSM (admin): USERID> config edit 13. FSCM (admin-config): USERID> set config port **0** 14. set port **0** to online 15. FSCM (admin-config): USERID> config save 16. FCSM (admin): USERID> config activate 17. FCSM (admin): USERID> admin end 18. FCSM (admin): USERID> logout

5. Install the SDD multi-path device driver using the Linux RPM or Windows installation package.

   Note: You should reference the SDD User's to properly plan your installation.

6. Use the data path query device command to confirm that both daughter-card paths are able to see the Boot LUN and storage.

```
Subsystem Device Driver Management                                    _ □ ×
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\Program Files\IBM\Subsystem Device Driver>datapath query device

Total Devices : 5


DEV#:   0  DEVICE NAME: Disk6 Part0  TYPE: 2105F20    POLICY: OPTIMIZED
SERIAL: 628FCA47
========================================================================
Path#          Adapter/Hard Disk    State    Mode     Select      Errors
    0    Scsi Port2 Bus0/Disk6 Part0  OPEN   NORMAL    2533397          3
    1    Scsi Port3 Bus0/Disk6 Part0  OPEN   NORMAL    2549148          0

DEV#:   1  DEVICE NAME: Disk7 Part0  TYPE: 2105F20    POLICY: OPTIMIZED
SERIAL: 629FCA47
========================================================================
Path#          Adapter/Hard Disk    State    Mode     Select      Errors
    0    Scsi Port2 Bus0/Disk7 Part0  OPEN   NORMAL    2492024          3
    1    Scsi Port3 Bus0/Disk7 Part0  OPEN   NORMAL    2506264          0

DEV#:   2  DEVICE NAME: Disk8 Part0  TYPE: 2105F20    POLICY: OPTIMIZED
SERIAL: 62AFCA47
========================================================================
Path#          Adapter/Hard Disk    State    Mode     Select      Errors
    0    Scsi Port2 Bus0/Disk8 Part0  OPEN   NORMAL    2577910          3
    1    Scsi Port3 Bus0/Disk8 Part0  OPEN   NORMAL    2588413          0

DEV#:   3  DEVICE NAME: Disk9 Part0  TYPE: 2105F20    POLICY: OPTIMIZED
SERIAL: 62BFCA47
========================================================================
Path#          Adapter/Hard Disk    State    Mode     Select      Errors
    0    Scsi Port2 Bus0/Disk9 Part0  OPEN   NORMAL    2513811          3
    1    Scsi Port3 Bus0/Disk9 Part0  OPEN   NORMAL    2539580          0

DEV#:   4  DEVICE NAME: Disk10 Part0  TYPE: 2105F20   POLICY: OPTIMIZED
SERIAL: 62CFCA47
========================================================================
Path#          Adapter/Hard Disk    State    Mode     Select      Errors
    0    Scsi Port2 Bus0/Disk10 Part0  OPEN  NORMAL    2518656          3
    1    Scsi Port3 Bus0/Disk10 Part0  OPEN  NORMAL    2526513          0

C:\Program Files\IBM\Subsystem Device Driver>
```

Figure 23 –Output of SDD's *datapath query device* **command**

7. Once SDD is loaded and both paths to Storage are configured, you should verify paths using the **datapath query device** command. **Note:** See the SDD User Guide for more information.

```
Subsystem Device Driver Management                                    _ □ ×
C:\Program Files\IBM\Subsystem Device Driver>datapath query adapter

Active Adapters :2

Adpt#     Adapter Name    State     Mode      Select      Errors  Paths  Active
    0  Scsi Port2 Bus0   NORMAL   ACTIVE    12635798        15      5       5
    1  Scsi Port3 Bus0   NORMAL   ACTIVE    12709918         0      5       5

C:\Program Files\IBM\Subsystem Device Driver>_
```
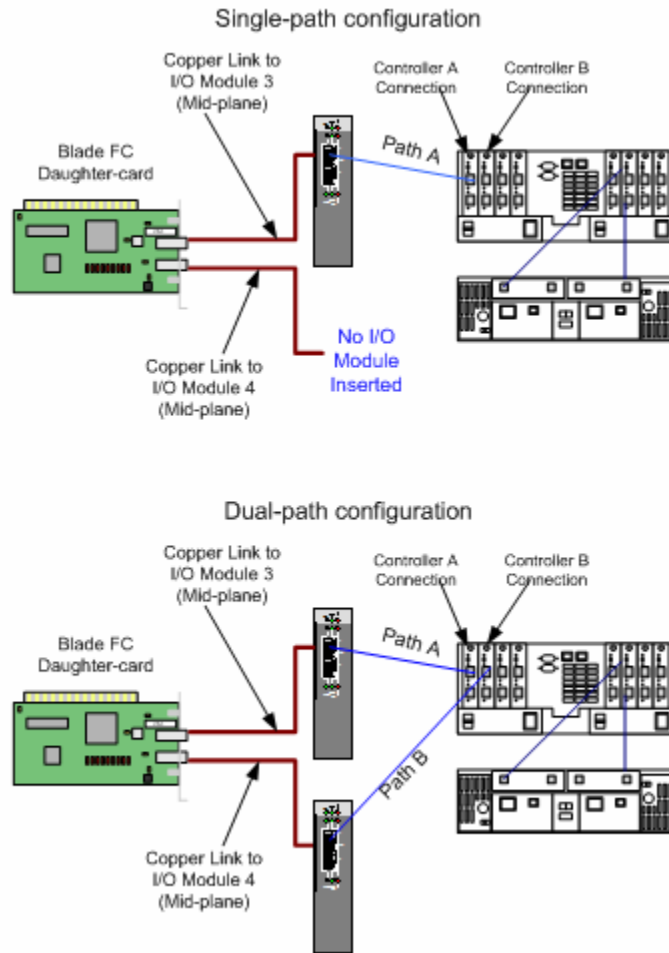
Figure 24- Output of SDD's *datapath query adapter* **command**

Appendix A: Single/Dual-path Concept Diagrams[4]

Single-path configuration

Dual-path configuration

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[4] **Note:** Other configurations can be used in combination with zoning. However, hardware and
software level zoning and provisioning should be carefully planned.

Appendix B: Modify initrd for SDD on Linux (RHEL 3)

- First, this assumes you have correctly configured your bootloader to boot from the SAN device single pathed. It is also assumed that the SDD rpm has been installed on the system. This procedure describes how to copy SDD files into the initial ramdisk (initrd) and edit the linuxrc script which is processed when the kernel mounts the initial ramdisk at boot time.

- You will need sufficient space in your /boot to contain considerably larger initrd files (eg: 32MB each). If there is not sufficient space in /boot the following steps can be performed in some other temporary directory. At the end simply copy the compressed initrd file (a few megabytes instead of 32MB) back into the /boot directory.

- The initrd usually must be enlarged to allow it to hold additional files amounting to roughly 4MB of space. To do this:

    o Make a backup of your of existing _initrd_file_:
      cd /boot
      cp _initrd_file_ _initrd_file.bak
    o Uncompress the image:
      zcat _initrd_file_.bak > _initrd_file_
    o Setup a loopback device for the image:
      losetup /dev/loop0 /path/to/your/_initrd_file_
    o Fix any errors that may exist on the filesystem:
      e2fsck -f /dev/loop0
      losetup -d /dev/loop0
    o The 'df /dev/loop0' command will tell you how large the initrd's filesystem is. If it is not 32MB or larger, or does not have much free space it needs enlarged (eg: to 32MB):
      dd if=/dev/zero of=_initrd_file_ seek=33554432 count=1 bs=1
      If the file is already 32MB or larger do not perform this step as it is unneeded and could corrupt the initial ramdisk filesystem. If the initrd is sufficiently large skip ahead to mounting the loopback device.
    o Setup a loopback device for the image:
      losetup /dev/loop0 /path/to/your/_initrd_file_
    o Another e2fsck here should show clean. If it doesn't, the 'dd' step was not performed correctly and corrupted the initrd. You will need to delete the loopback device ('losetup -d /dev/loop0) and start the procedure from the beginning.
    o Resize the filesystem (this will automatically expand it to use all available space, which is desirable):
      resize2fs /dev/loop0
      Mount the loopback device:
      mount /dev/loop0 /mnt/tmp

- The initrd filesystem is now 32MB in size and additional files can be added to it:
  cd /mnt/tmp

- If you haven't already added your hba driver to the initrd using the standard mk_initrd or mkinitrd process you can manually copy the module files for the hba driver as well as the scsi core and scsi disk drivers into the initrd filesystem and add the appropriate insmod command to the initrd's linuxrc script. However, this should have been done in the first step of configuring for single-path SAN booting and that step is a prerequisite for this procedure.

- You may also wish to add echo commands into the linuxrc after the hba load and mounting /proc in order to force adding luns through /proc/scsi/scsi if the device discovery is not happening correctly automatically.

- Create SDD's directories in the initrd:
  mkdir -p opt/IBMsdd/bin
  chmod -R 640 opt/IBMsdd/

- For SDD you will need to copy the following files to the initrd filesystem:
  - o /etc/vpath.conf   -> etc/
  - o /etc/group, passwd, nsswitch.conf   -> etc/
  - o /opt/IBMsdd/sdd-mod.o-CORRECT_VERSION -> lib/sdd-mod.o
  - o /opt/IBMsdd/bin/*   -> opt/IBMsdd/bin/
  - o /lib/libc.so.6   -> lib/
  - o /lib/ld-linux.so.2   -> lib/
  - o /lib/libacl.so.1   -> lib/
  - o /lib/libattr.so.1   -> lib/
  - o /lib/libdl.so.2   -> lib/
  - o /lib/libm.so.6   -> lib/
  - o /lib/libpthread.so.0   -> lib/
  - o /lib/libnss_files.so.2   -> lib/
  - o /lib/librt.so.1   -> lib/
  - o /bin/awk, chmod, chown, cp, date, grep, ls, mknod, mount, ps, rm, sed, sh, tar, umount -> bin
  - o /dev/sd[a-z], sd[a-z][a-z]   -> dev/ (ie: tar cps /dev/sd[a-z] /dev/sd[a-z][a-z]| tar xps)
  - o On RedHat you will additionally need:
    - ▪ /lib/libproc.so.2.0.7   -> lib/
    - ▪ /lib/libpcre.so.0   -> lib/
    - ▪ /lib/libtermcap.so.2   -> lib/
    - ▪ /bin/ash.static   -> bin/ash
  - o The etc/nsswitch.conf file must have its passwd and group entries changed to point to "files" instead of "compat".

- The following changes must be made to the initrd's linuxrc script:
  - o The following block of commands should be removed from the end the file:
    echo Creating block devices
    mkdevices /dev
    echo Creating root device
    mkroot dev /dev/root
    echo 0x0100 > /proc/sys/kernel/real-root-dev
    echo Mounting root filesystem
    mount -o defaults --ro -t ext2 /dev/root /sysroot
    pivot_root /sysroot /sysroot/initrd
    umount /initrd/proc
    Also the first line of the linuxrc script should be changed to invoke the "ash" shell instead of the "nash" shell.
  - o The /proc filesystem must be mounted for the SDD configuration, so if /proc is not already explicitly mounted in the linuxrc (or is subsequently unmounted) append a mount command:
    mount -n -tproc /proc /proc
  - o Append the following commands to the end of the linuxrc script to configure SDD:
    insmod /lib/sdd-mod.o
    /opt/IBMsdd/bin/cfgvpath
    Configuration information needs copied to the system's root filesystem so it must briefly be mounted. Eg, for an ext3 root filesytem on /dev/vpatha3:
    /bin/mount -o rw -t ext3   /dev/vpatha3 /sysroot
    or for a reiserfs root filesytem on /dev/vpatha3:
    /bin/mount -o rw -t reiserfs /dev/vpatha3 /sysroot

To copy the dynamically created device special files onto the system's root filesystem:
tar cps /dev/IBMsdd /dev/vpath* | (cd /sysroot && tar xps) /bin/umount /sysroot
The kernel needs told where its root filesystem will be. This is traditionally passed to the bootloader as a string (eg: /dev/vpatha3) and translated to a hexadecimal representation of the device's major and minor number. If the major and minor number are 254,3 then these are represented in hex as 0xFE03. The linuxrc simply passes the hexadecimal value into /proc:
echo 0xFE03 > /proc/sys/kernel/real-root-dev /bin/umount /proc

- Edit the system fstab, changing all the system mount points from LABEL and/or /dev/sd mount sources to their equivalent /dev/vpath. See comments below regarding the dangers of booting by label in a multipath configuration. Copy the system fstab to the initrd's etc/ directory.

- Unmount the image and remove the loopback binding:
umount /mnt/tmp
losetup -d /dev/loop0

- Compress the image:
gzip -9 _initrd_file_
mv _initrd_file_.gz _initrd_file_

- Append the following to your boot parameters (eg: in lilo.conf or grub.conf or menu.lst):
ramdisk_size=34000
If you created a larger initrd, make this large enough to cover the size.

For completeness your bootloader's append for the kernel's root parameter could be changed to the appropriate vpath device (eg: root=/dev/vpatha5), but the above steps override this value by passing the corresponding hex major,minor into /proc within the initrd's linuxrc script.

NOTE: Booting by LABEL risks that the first device found in the fabric with the correct label will be the wrong device or that it will be an sd single-path device instead of a vpath multipathed device. At this point the machine may be rebooted and should come up with it's root filesystem on a vpath device instead of an sdd device.

Appendix C: BladeCenter SAN Options Equipment List

Option Number	Description	Option Number	Description
13N2203	BladeCenter Fibre Channel Expansion Card	26K6477	Qlogic 6-port Enterprise Fibre Channel Switch Module (Qlogic SANBox 5200 Equivalent)
48P7061	BladeCenter Fibre Channel Expansion Card	48P7062	BladeCenter 2-port Fibre Channel Switch Module2 (Qlogic SB2- 16 Equivalent)
19K1271	Short-wave SFP Module	26K5601	Brocade Entry SAN Switch Module for IBM BladeCenter
19K1272	Long-wave SFP Module	90P0165	Brocade Enterprise SAN Switch Module for IBM BladeCenter
19K1247	1m LC-LC Fibre Channel Cable	02R9080	BladeCenter Optical Pass-thru Module
19K1248	5m LC-LC Fibre Channel Cable	26K5618	Brocade Entry Switch Full SAN Upgrade for IBM eServer BladeCenter
19K1249	25m LC-LC Fibre Channel Cable	26K5613	Brocade Extended Fabrics for IBM eServer BladeCenter
19K1250	LC-SC Fibre Channel Adapter Cable (Note: 1)	26K5605	Brocade Performance Bundle for IBM eServer BladeCenter
73P6033	BladeCenter Optical Pass-thru Module LC Cable	**Note:** You should contact the Field Sales Rep for other options that may have become available.	

Summary

This paper provides an overview for configuring the IBM BladeCenter to remote boot in the Linux and Windows operating environments. These steps are typically performed by seasoned Storage Administrators with requisite knowledge of the DS4000 (formerly FAStT) and ESS Storage products. However, this document has sought to provide guidance for the novice SAN Administrator to follow and successfully accomplish this task. One should keep in mind that this provides a general guideline for configuring remote boot and any effort to create a remote boot environment should be well planned.

Additional Information

For more information about blade server technology and benefits in general and BladeCenter specifically, read Why Blade Servers? and Slashing the costs of your IT Infrastructure, at http://www.ibm.com/pc/us/eserver/xseries/bladecenter/more_about.html.
Visit http://www.ibm.com/servers/eserver/blades (or call 1-888-SHOPIBM) for information about IBM eServer BladeCenter products and services, including part numbers and prices for servers, racks, storage units and other options.