



# **Choosing the Right Switch Modules for the Power Based Blade Environment**

December 2010

Trina Bunting  
Power Systems Advanced Technical Skills  
Mark E. Johnson  
Storage Field Technical Sales Specialist  
Tom Junkin  
Power Systems Techline

© Copyright IBM Corporation, 2010

## Revision History

## Special Thanks

A special thanks to Kenneth Corkins and James Lenaburg from ATS System x team and Power Based Blade Development team for your input!

### Notices:

This paper is intended to provide information regarding Choosing the Right Switch Module for the POWER processor-based blade environment. It discusses findings based on configurations that were created and tested under laboratory conditions. These findings may not be realized in all customer environments, and implementation in such environments may require additional steps, configurations, and performance analysis. The information herein is provided “AS IS” with no warranties, express or implied. This information does not constitute a specification or form part of the warranty for any IBM or non-IBM products.

Information in this document was developed in conjunction with the use of the equipment specified, and is limited in application to those specific hardware and software products and levels.

The information contained in this document has not been submitted to any formal IBM test and is distributed **as is**. The use of this information or the implementation of these techniques is a customer responsibility and depends on the customer’s ability to evaluate and integrate them into the customer’s operational environment. While each item may have been reviewed by IBM for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environment do so at their own risk.

IBM may not officially support techniques mentioned in this document. For questions regarding officially supported techniques, please refer to the product documentation, announcement letters, or contact the IBM Support Line at 1-800-IBM-SERV. This document makes reference to vendor-acquired applications or utilities. It is the customer’s responsibility to obtain licenses of these utilities prior to their usage.

® Copyright International Business Machines Corporation 2010. All rights reserved. U.S. Government Users Restricted Rights

-Use, duplication, or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

# Table of Contents

I	Introduction	4
II.	Power Based Blade Overview	4
	A. POWER7 Based Blades	4
	B. POWER6 Based Blades	5
	C. Supported Expansion Card Options	7
III.	IBM BladeCenter Chassis Overview	9
	A. Power Based Blade Chassis Compatibility	11
IV.	I/O Connectivity – Blades, Switches, Chassis	11
V.	I/O Module Overview	16
	A. Ethernet Modules	16
	B. Fibre Channel Modules	18
	C. Pass-thru Modules	19
	D. SAS Modules	19
	E. InfiniBand Modules	20
	F. High Speed Modules	21
	G. Multi-Switch Interconnect Modules	21
	H. Converged Fabric I/O Modules	23
VI.	Choosing the Right Switch Module	24
	A. Choosing Ethernet Switch Modules	24
	B. Choosing Ethernet Pass-thru Modules	27
	C. Choosing Fibre Channel Modules	28
	D. Choosing Fibre Channel Pass-thru Modules	31
	E. Choosing I/O Modules for N_Port ID Virtualization	31
	F. Choosing I/O Modules for Fibre Channel over Ethernet	32
VII.	Ordering the Power Based Blade Solution	34
	A. BladeCenter H Configuration Example	36
	B. BladeCenter S Configuration Example	43
VIII.	Notable Switch Limitations/Issues	46
	A. Ethernet Switch Modules	50
	B. Fibre Channel Switch Modules	51
	C. Troubleshooting Issues with Ethernet Switch Modules	51
	D. Troubleshooting Issues with Fibre Channel Switch Modules	52
IX.	References	53

# I. Introduction

This document discusses how to select the correct switch modules for the POWER7® POWER6® BladeCenter® environment. It provides an overview of the POWER7, POWER6 and POWER6+ Based Blades, BladeCenter Chassis and the supported I/O Modules in the BladeCenter Chassis environment. We will also review the configuration of the I/O Modules supported in the BladeCenter Chassis that are preparatory to the ordering of valid customer POWER6® Blade Center® solutions. For a complete list of all supported options by blade, chassis, or operating system the ServerProven web site will hold the most up to date information, as support for existing options can be added as new products are announced and released: <http://www-03.ibm.com/servers/eserver/serverproven/compat/us/eserver.html>.

## II. Power Based Blade Overview

Currently there are three POWER7-Based Blades and four POWER6-Based Blades available:

- BladeCenter PS700
- BladeCenter PS701
- BladeCenter PS702
- BladeCenter JS23/43
- BladeCenter JS12
- BladeCenter JS22

### A. POWER7-Based Blades:

The Power7-Based Blades are the latest line of Power based blades available. These blades consist of the following components:

#### **BladeCenter PS700**

The BladeCenter PS700 is a single-wide POWER7-Based Blade that supports native virtualization. The following features are supported on the PS700 (Model 8406-70Y):

- 4 Core, Single Socket, 3.0GHz Single wide blade
- 4MB L3 Cache per core
- 8GB to 64GB DDR3 1066 MHz memory (8 DIMMs)
- 0 – 2 SAS Hard Disk Drives
- One CIOv and one CFFh (PCIe Adapters)
- Integrated Dual Port 10/100/1000 Ethernet, SAS Controller and USB Ports
- Integrated System Management Processor for Light-Path Diagnostics

- Service Processor – Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI); LAN Console required for IBM i
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **BladeCenter PS701**

The BladeCenter PS701 is a single-wide POWER7-Based Blade that supports native virtualization. The following features are supported on the PS701 (Model 8406-71Y):

- 8 Cores Single Socket, 3.0 GHz Single Wide Blade
- 4 MB L3 Cache per core
- 8GB to 128GB DDR3 1006 MHz memory (16 DIMMs)
- 0 – 1 SAS Hard Disk Drive
- One CIOv and one CFFh (PCIe Adapters)
- Integrated Dual Port 10/100/1000 Ethernet, SAS Controller and USB Ports
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor – Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI); LAN Console required for IBM i
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **BladeCenter PS702**

The BladeCenter PS702 is a double-wide POWER7-Based Blade that supports native virtualization. It is the first dual bay, 16-way POWER7-Based Blade available. The following features are supported on the PS702 (Model 8406-71Y + FC 8385):

- 16 Core, Single Socket, 3.0 GHz Double Wide Blade
- 4 MB L3 Cache per core
- 8GB to 256GB DDR3 1006 MHz memory (32 DIMMs)
- 0 - 2 SAS Hard Disk Drive
- Two CIOv and Two CFFh (PCIe Adapters)
- Integrated Quad Port 10/100/1000 Ethernet, SAS Controller and USB Ports
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor – Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI); LAN Console required for IBM i
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **B. POWER6-Based Blades**

The POWER6-Based Blades consist of the following components:

## **BladeCenter JS23**

The BladeCenter JS23 is a single-wide POWER6+ Based Blade that supports native virtualization. The following features are supported on the JS23 (Model 7778-23X):

- 2-socket dual-core 4.2 GHz POWER6+ Processor
- 32 MB L3 Cache per chip
- From 4Gb to 64GB ECC 400MHz or 667MHz DDR2 Memory with 8 DIMM slots
- One 2.5” SFF SAS Hard Drive (73GB, 146GB or 300GB) or 69GB Solid State Drive (SSD)
- One PCIe (1Xe) and one PCIe high speed expansion card
- Integrated dual port 10/100/1000 Ethernet, SAS Controller, Video Controller (Keyboard, Video, Mouse) and USB
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor - Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI)
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **BladeCenter JS43**

The BladeCenter JS43 is a double-wide POWER6+ Based Blade that supports native virtualization. The following features are supported on the JS43 (Model 7778-23X, Feature Code 8446):

- 2-socket dual-core 4.2GHz POWER6+ Processor
- 32MB L3 Cache per chip
- Up to 128GB ECC 400MHz or 667MHz DDR2 Memory with 16 DIMM slots
- Up to two 2.5” SFF SAS Hard Drives (73GB, 146GB or 300GB) or 69GB Solid State Drive (SSD)
- Two PCIe (1Xe) and two PCIe high speed expansion cards
- Integrated dual port 10/100/1000 Ethernet, SAS Controller, Video Controller (Keyboard, Video, Mouse) and USB
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor - Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI)
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **BladeCenter JS12**

The BladeCenter JS12 is a single-wide POWER6-Based Blade that supports native virtualization. The following features are supported on the JS12 (Model 7998-60X):

- 2-socket single-core 3.8 GHz POWER6 processor
- 4MB L2 Cache per core
- Up to 64GB ECC 400MHz or 667MHz DDR2 Memory with 8 DIMM slots

- Up to two 2.5” SFF SAS Hard Drives (73GB, 146GB or 300GB)
- One PCI-X and one PCIe high speed expansion card
- Integrated dual port 10/100/1000 Ethernet, SAS Controller, Video Controller (Keyboard, Video, Mouse) and USB
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor - Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI)
- PowerVM, AIX, Linux, IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **BladeCenter JS22**

The BladeCenter JS22 is a single-wide POWER6-Based Blade that supports native virtualization. The following features are supported on the JS22 (Model 7998-61X):

- 2-socket dual-core: 4.0 GHz POWER6 processor
- L1 cache per core: 64 KB I-cache and 64 KB D-cache; L2 cache: 4MB per core
- Up to 32GB ECC 533MHz or 667MHz DDR2 Memory with 4 DIMM slots
- One 2.5” SFF SAS Hard Drive (73GB, 146GB or 30GB)
- One PCI-X and one PCIe high speed expansion card
- Integrated dual port 10/100/1000 Ethernet, SAS Controller, Video Controller (Keyboard, Video, Mouse) and USB
- Integrated System Management Processor for Light-Path Diagnostics
- Service Processor - Serial over LAN (SoL), Intelligent Platform Management Interface (IPMI)
- PowerVM, AIX, Linux and IBM i hosted by VIOS
- Support for IBM Systems Director and Cluster Systems Management

## **C. Supported Expansion Card Options**

The form factors supported on the POWER7 and POWER6 Based Blades are Combo I/O Vertical (CIOv), Combo Form Factor Vertical (CFFv) and Combo Form Factor Horizontal (CFFh). The CIOv expansion card provides an interconnect to the blades via the PCIe (1Xe) bus connector to the vertically oriented I/O Modules located in bays 3 and 4 of the BladeCenter chassis. The CFFv expansion card provides interconnect to blades via the PCI-X bus connector to the vertically oriented I/O Modules located in bays 3 and 4 of the BladeCenter chassis. The CFFh expansion card provides interconnect to blades via the PCIe bus connector to the horizontal high speed I/O Modules located in bays 7 - 10 of the BladeCenter H and BladeCenter HT chassis.

A single wide blade can have up to two expansion cards installed (CIOv and CFFh or CFFv and CFFh). A double wide blade can have up to four expansion cards installed on them (two CIOv and CFFh or CFFv and CFFh). The PS700, PS701, PS702, JS23 and JS43 blades support the CIOv and CFFh expansion cards. The JS12 and the JS22 support the CFFv and the CFFh

expansion cards. The diagram below illustrates the combination of the CFFv and CFFh and the CIOv and CFFh expansion cards.

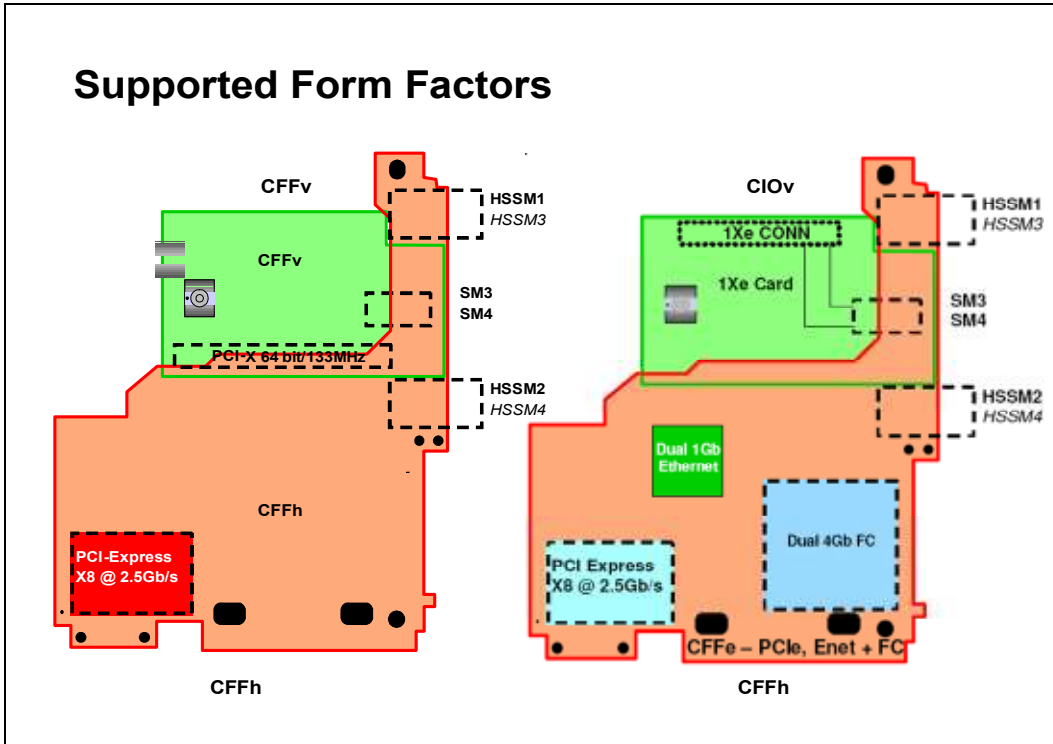


Figure 1 - Expansion Card Form Factors

The CIOv and CFFh or CFFv and CFFh expansion cards can be installed separately or together on the PS7XX and JS23/JS43 blades and the CFFv and CFFh cards can be installed separately or together on the JS12 and JS22 blades). When installing the CIOv and CFFh or CFFv and CFFh expansion cards on the blades, the CFFh expansion card should be installed last because it sits on top of the CIOv or CFFv expansion card.

All Blades in the chassis must use the same network protocol when said adapters' I/O will terminate to the same I/O Module bays. Therefore, if a CFFv or CIOv Fibre Channel card is chosen then the I/O Modules located in bays 3 and 4 of the chassis must have Fibre Channel Switch Modules. Not all of the blades in a chassis have to use a CIOv or CFFv expansion card, but, for planning purposes, it is important to be aware of the importance in matching up the types of I/O required by adapter, blade, I/O module, and chassis.

The following table lists the expansion cards currently supported on the Power based blades:



Feature Code / Part Number	Description	Form Factor	P	P	P	J	J	J	J	Operating System Support
			S 7 0 0	S 7 0 1	S 7 0 2	S 1 2 2	S 2 2 2	S 2 2 3	S 4 3 3	
8240 / 46M6140	Emulex 8Gb Fibre Channel Expansion Card	CIOv	y	y	y			y	y	AIX, Linux, IBM i hosted by VIOS
8241 / 46M6065	QLogic 4Gb Fibre Channel Expansion Card	CIOv	y	y	y			y	y	AIX, Linux, IBM i hosted by VIOS
8242 / 44X1945	QLogic 8Gb Fibre Channel Expansion Card	CIOv	y	y	y			y	y	AIX, Linux, IBM i hosted by VIOS
8246 / 43W4068	SAS Connectivity Expansion Card	CIOv	y	y	y			y	y	AIX, Linux, IBM i hosted by VIOS
8248 / 41Y8527	QLogic 4Gb Fibre Channel Expansion Card	CFFv				y	y			AIX 5L, Linux
8249 / 39Y9310	1Gb Ethernet Expansion Card	CFFv				y	y			AIX 5L, Linux
8250 / 39Y9190	SAS Expansion Card	CFFv				y	y			AIX, Linux, IBM i hosted by VIOS
8251 / 43W6859	Emulex 4Gb Fibre Channel Expansion Card	CFFv				y	y			AIX, Linux
8252 / 39Y9306	QLogic 4Gb Fibre Channel and Broadcom 1GB Ethernet Combo Expansion Card	CFFh	y	y	y	y	y	y	y	AIX, Linux, IBM i hosted by VIOS
8258 / 43W4423	4X InfiniBand DDR Expansion Card	CFFh	y	y	y	y	y	y	y	AIX, Linux
8271 / 44X1940	QLogic 8Gb Fibre Channel Expansion Card	CFFh	y	y	y	y	y	y	y	AIX, Linux, IBM i hosted by VIOS
8275 / 42C1830	QLogic 2-port 10Gb Converged Network Adapter (CNA) FCoE Expansion Card	CFFh				y	y	y	y	AIX, Linux, IBM i hosted by VIOS
8243 / 44W4474	1Gb Ethernet Expansion card	CIOv	y	y	y			y	y	AIX, Linux
8291 / 44W4479	2/4 Port Ethernet Expansion Card	CFFh	y	y	y	y	y			AIX, Linux
8297 / 32R1760	Cisco 4X InfiniBand Expansion Card	CFFh				y	y			Linux only
8298 / 43W4420	Voltaire 4x InfiniBand DDR Expansion Card	CFFh				y	y	y	y	VIO, Linux
32R1923	QLogic iSCSI Expansion Card	StFF				y	y			

**Table 1 – Blade Expansion Cards**

### III. IBM BladeCenter Chassis Overview

There are currently five BladeCenter chassis available, of which only four support the POWER7, POWER6 and POWER6+ Based Blades:

- IBM BladeCenter E provides the greatest density and common fabric support and is the lowest entry cost option.
- IBM BladeCenter H delivers high performance, extreme reliability, and ultimate flexibility for the most demanding IT environments.
- IBM BladeCenter T model is designed specifically for telecommunications network infrastructures and other rugged environments (**not supported**).
- IBM BladeCenter HT models are designed for high-performance flexible telecommunications environments by supporting high-speed internet-working technologies such as 10G Ethernet.
- IBM BladeCenter S combines the power of blade servers with integrated storage, all in an easy-to-use package designed specifically for the office and distributed enterprise environment.

The BladeCenter chassis can have Intel, AMD and Power Based Blades installed at the same time, as well as have different types of I/O Modules i.e. Fibre Channel, Ethernet, SAS or InfiniBand. The Management Module (MM), Advanced Management Module (AMM), Blowers and Power Modules are hot swappable. The BladeCenter H and BladeCenter HT have high-speed I/O Module bays offering 10Gb bandwidth. The following table compares the features available for only the BladeCenter Chassis' that support POWER7 and POWER6-Based Blades (BladeCenter T chassis is not included):

Features	BladeCenter E (M/T 8678)	BladeCenter H (M/T 8852)	BladeCenter HT (M/T 8740 -DC) (M/T 8750 -AC)	BladeCenter S (M/T 8886)
Chassis height	7U / 12.0" (305mm)	9U / 15.75" (400mm)	12U / 21.0" (/528mm)	7U / 12.0" 306.3mm)
Chassis depth	28 " (711mm)	28.0" (711mm)	27.8" (706.0 mm)	28.9" (733.4mm)
Max number of blade servers	14	14	12	6
Max number of I/O Modules (Switch, and bridge)	4	10 (4 x high speed, 4 x standard, 2 x bridge)	8 (4 x high speed, 4 x standard or 2 x bridge)	4
Power supply size (standard)	2320 Watts AC	2900 Watts AC	2535W DC (60A) 3160 DC (75A) 2800 Watts AC	950W/1450W AC auto-sensing
Number of Power Supplies (standard/ maximum)	2/ 4	2/ 4	2/ 4	2/ 4
Number of Blowers (standard/ maximum)	2/ 2	2/ 2	4/ 4	4/ 4
DVD/CD drives standard	1x DVD-ROM (in Media Tray)	1x DVD-ROM (in Media Tray)	None	1x DVD-ROM (in Media Tray)

Table 2 – BladeCenter Chassis Features

**Note:** If you remove an I/O Module that is being used you **may** or may not lose connectivity, depending on a number of factors, such as the use of redundant pathing software for I/O interfaces and whether or not, where available, I/O Module redundancy/failover features have

been properly configured. Removing a blower or power module may cause errors to appear on the AMM log but connectivity should not be lost.

It is important to note that only the BladeCenter H and BladeCenter S are orderable via the Advanced Administration System (AAS) channel. For more information on the BladeCenter Chassis refer to the BladeCenter Products and Technology Guide Redbook at <http://www.redbooks.ibm.com/redbooks/pdfs/sg247523.pdf>.

## A. POWER Based Blade Chassis Compatibility

IBM Support for specific blades by chassis is made from a general standpoint based on the potential power utilization of fully configured blades, dependant on amount of memory, number and type of adapters, as well as the wattage of specific models of CPUs when a chassis is fully populated with a specific blade configuration. To ensure your blade configuration does not exceed the power modules in the chassis, it is recommended that you use the IBM BladeCenter and System x Power Configurator from the System x and BladeCenter Configuration tools web page at <http://www-03.ibm.com/systems/x/hardware/configtools.html>.

If you are considering adding specific blade configurations to an existing chassis, please check with your IBM Field Technical Sales Specialist (FTSS), Advanced Technical Skills (ATS) team or IBM Business Partner Sales Engineer for assistance in determining whether or not specific configurations are supported by IBM.

The following table outlines which Power Based Blades are supported in the BladeCenter chassis:

Chassis	PS700	PS701	PS702	JS23	JS43	JS12	JS22
BladeCenter E	No	No	No	No	No	Yes	No
BladeCenter E Refresh	Yes	No	No	No	No	Yes	No
BladeCenter H	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BladeCenter HT	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BladeCenter S	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Table 3 – Blade support by chassis**

**Note:** Power based blades running IBM i hosted by VIOS, are only supported in the BladeCenter H and BladeCenter S chassis.

## IV. I/O Connectivity – Blades, Switches, Chassis

The Power based blades can have up to either six or eight I/O paths on a single wide blade server. The blade must support the CFFh expansion card and it must be installed in a

BladeCenter H or BladeCenter HT chassis to achieve all possible I/O paths. The CFFh adapter can either be a 2-port high speed adapter, such as 10Gb Ethernet or a Converged Network Adapter (CNA), or the CFFh can be a combo card, providing 4 x 1Gb Ethernet ports or 2 x 1Gb Ethernet and 2 x 4 or 8Gb Fibre Channel. The Multi-Switch Interconnect Module (MSIM) is required in the BladeCenter H and a MSIM-HT is required in the BladeCenter HT, to convert the four high speed switch bays to support 1Gb Ethernet and 4Gb/8Gb Fibre Channel switches. The following is an example of a configuration on a single wide blade in which the connections are as follows:

- The blade server has two integrated Gigabit Ethernet ports that connect to I/O Module located in bays 1 and 2 of the chassis
- The blade server can have a CIOv expansion card (BladeCenter PS700, PS701, PS702 and JS23/43 only) or a CFFv expansion card (BladeCenter JS12/JS22 only) installed that connects to I/O Module located in bays 3 and 4 of the chassis
- The blade server also has a CFFh expansion card installed that connects to I/O Module located in bays 7 – 10 of the chassis (BladeCenter H and BladeCenter HT)

The ports on the CFFh combo (4-port) card connect to switch modules that are housed in an MSIM (or MSIM-HT). One MSIM (or MSIM-HT) can be installed in bays 7 and 8 and a second MSIM (MSIM-HT) can be installed in bays 9 and 10. Each MSIM (or MSIM-HT) can have an Ethernet Switch Module (ESM) installed in the left I/O slot (an Ethernet Switch Module can also be installed in the right I/O slot of the MSIM/MSIM-HT) and either an Ethernet Switch Module or a Fibre Channel Switch Module (FCSM) installed in the right I/O slot. The CFFh expansion card can also connect to a high speed switch modules located in bays 7, 8, 9 and 10 of the chassis.

A single-wide Power based blade (PS700, PS701, JS23, JS12, JS22) has two integrated 10/100/1000 Ethernet ports which are hard wired to bays 1 and 2 of the chassis. A PS702 and JS43 (double-wide) blades can have a total of four integrated 10/100/1000 Ethernet ports. A single-wide or double-wide blade can have a CIOv or CFFv and CFFh expansion card installed on the blade. The double-wide blades can have a CIOv and a CFFh expansion cards installed on the PS701 and JS23 base as well as a CIOv and CFFv expansion cards installed on the expansion unit.

The following diagram shows the I/O options on the blade server attached through the BladeCenter H midplane to the various switch modules in the chassis. The on-board Ethernet ports are attached to the Ethernet modules in I/O bays 1 and 2. An optional CIOv adapter can be installed on the blade. The two ports from the CIOv adapter are connected to the I/O modules in Bays 3 and 4. Up to four ports of high-speed connectivity options can also be added to the BladeCenter H chassis. To attach to switches in bays 7, 8, 9 and 10, a CFFh card must be installed on the blade server. Bridge modules can be used with certain high-speed switch modules. The bridge modules do not directly attach to ports on the blade server, but rather attach through the high-speed switch modules.

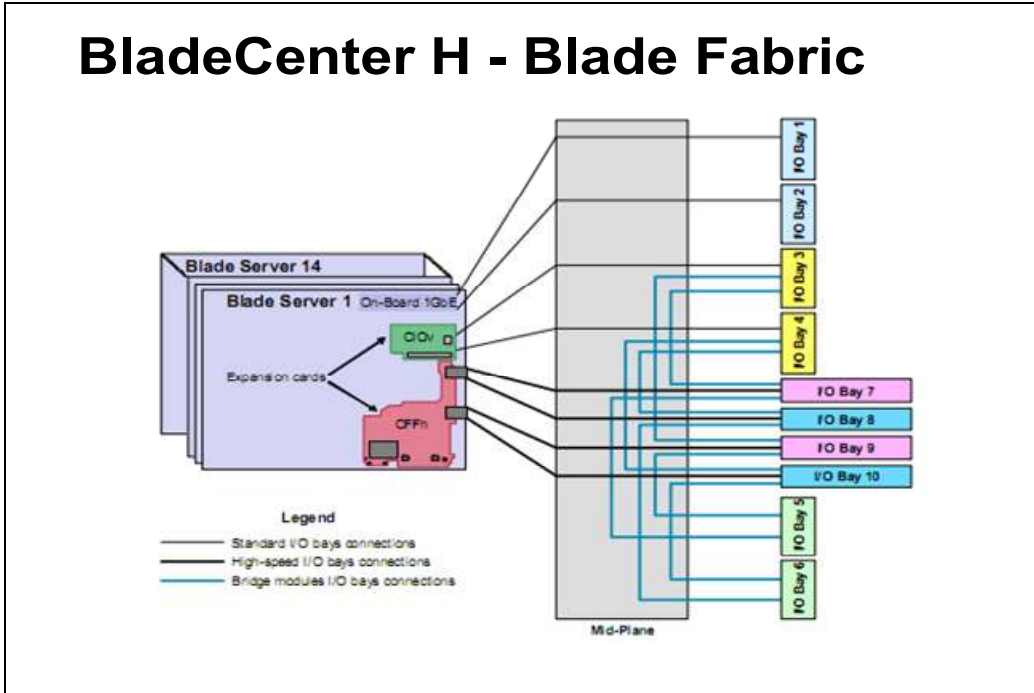


Figure 2 – Physical view of fabrics in the BladeCenter H Chassis

The BladeCenter chassis can have multiple I/O Modules installed which corresponds with the integrated Ethernet ports and the expansion cards install on the blades. The following diagram shows the expansion card and I/O Module options available, as well as the I/O bays corresponding blade server port connections in the BladeCenter E Refresh Chassis:

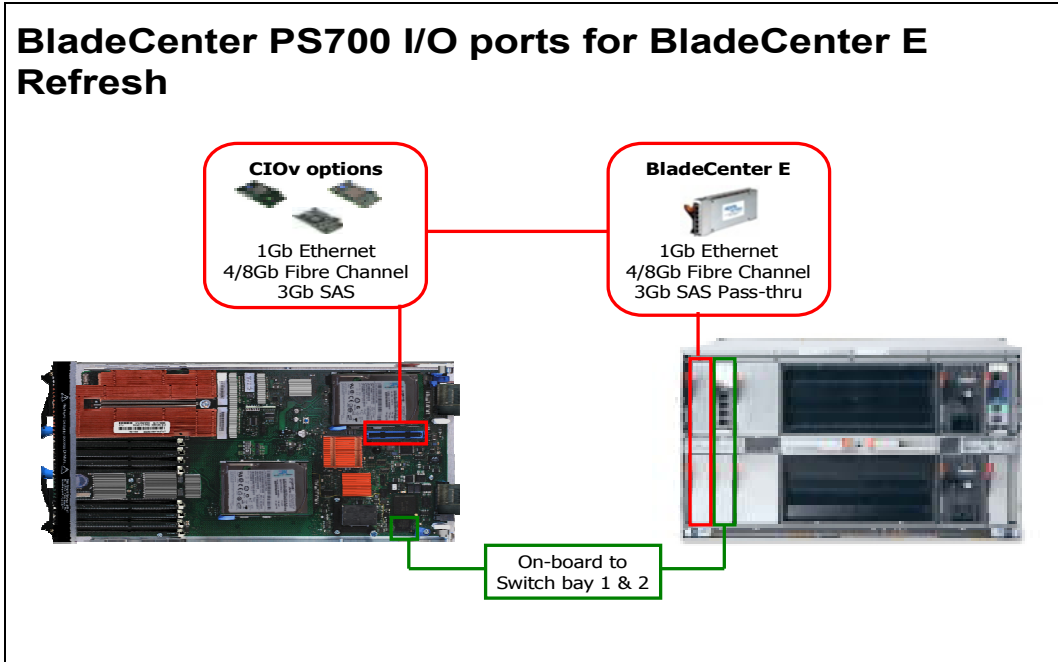


Figure 3 – BladeCenter E Refresh Chassis I/O Support/adaptor interconnect

The following diagram shows the expansion card and I/O Module options available, as well as the I/O bays corresponding blade server port connections in the BladeCenter H Chassis:

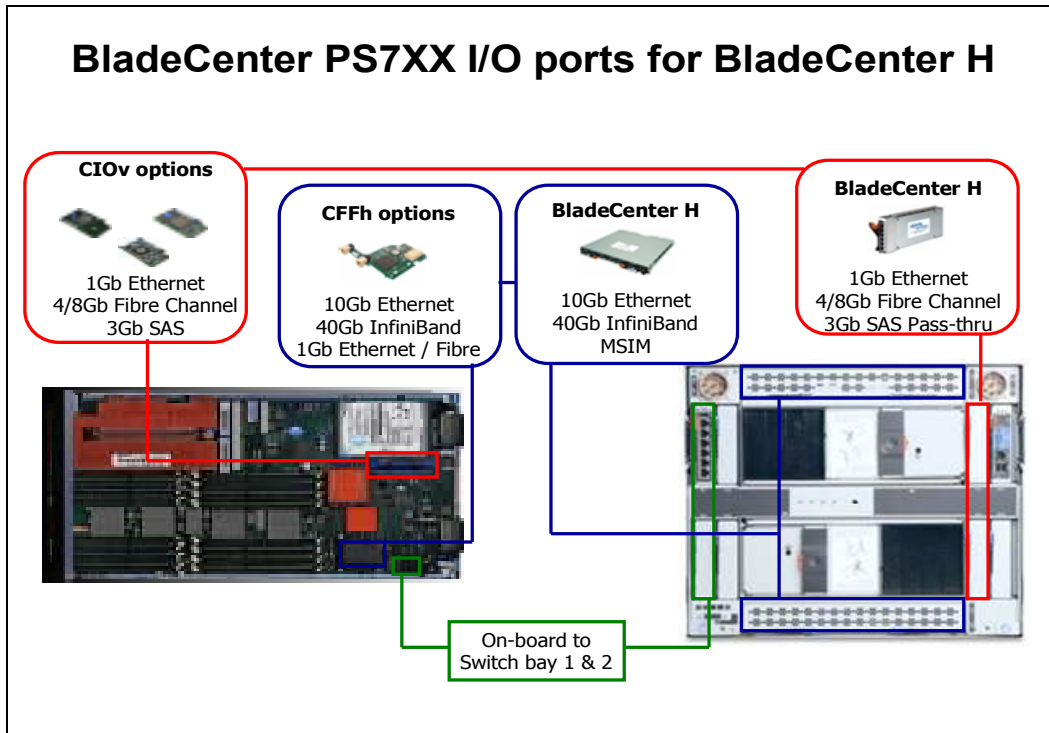


Figure 4 – BladeCenter H Chassis I/O Support/adaptor interconnect

The following diagram shows the expansion card and I/O Module options available, as well as the I/O bays corresponding blade server port connections in the BladeCenter HT Chassis:

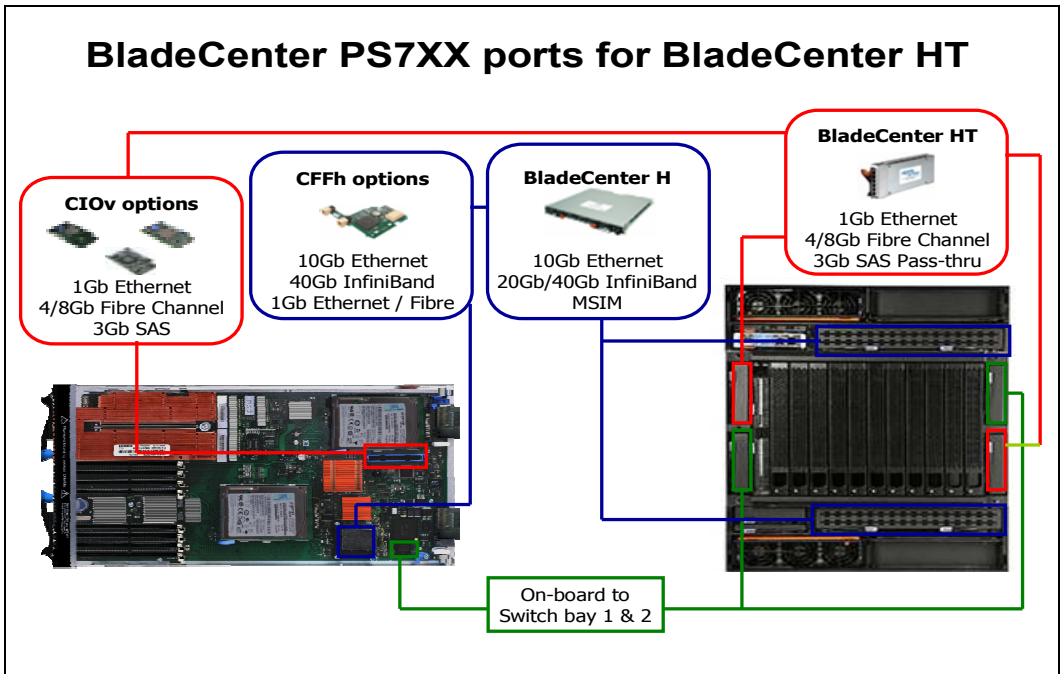


Figure 5 – BladeCenter HT Chassis I/O Support/adaptor interconnect

The following diagram shows the expansion card and I/O Module options available, as well as the I/O bays corresponding blade server port connections in the BladeCenter S Chassis:

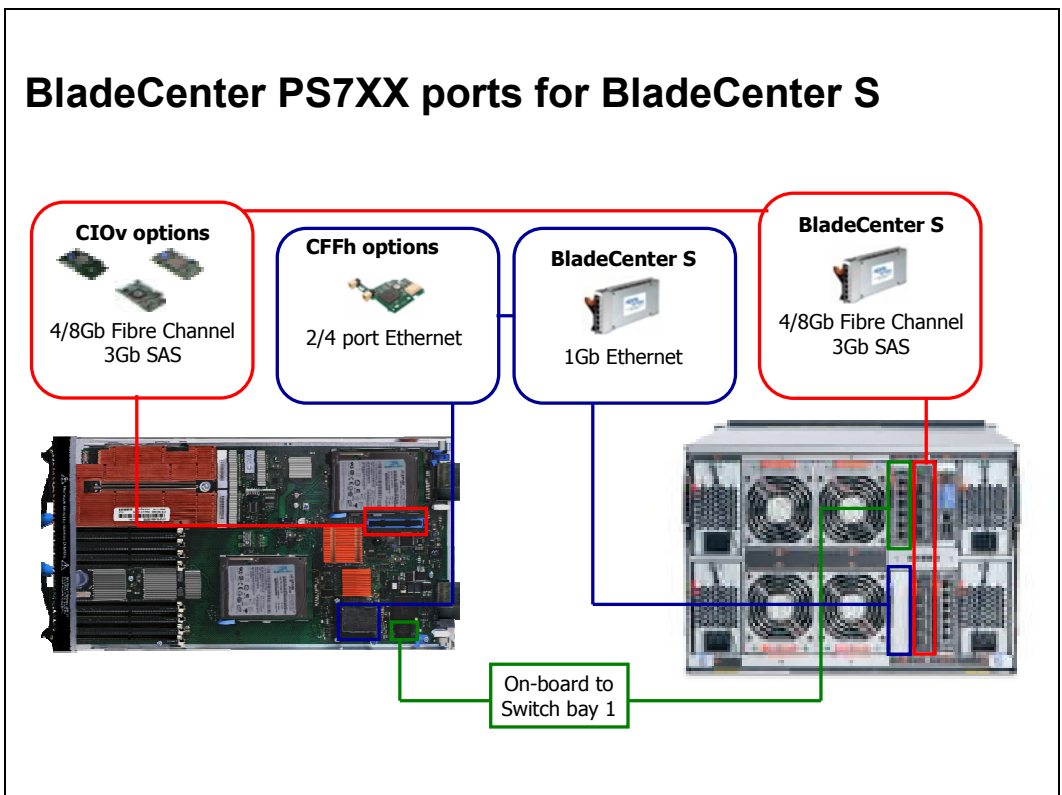


Figure 6 – BladeCenter S Chassis I/O Support/adaptor interconnect

## V. I/O Module Overview

There are several different types of I/O modules by various vendors supported in the BladeCenter chassis including:

- Ethernet Modules
- Fibre Channel Modules
- Pass-thru Modules
- SAS Modules
- InfiniBand Modules
- High Speed Modules
- Multi-Switch Interconnect Modules
- Converged Fabric I/O Modules

It is important to ensure the I/O module you are proposing is supported in the BladeCenter chassis the customer will be using, since not all I/O modules are supported in all of the BladeCenter chassis. An expansion card is required on the Power Based Blades to connect to the I/O Modules in bays 3 through 10 of the BladeCenter chassis, while the I/O Modules located in bays 1 and 2 of the chassis must support Ethernet traffic, being tied directly to the dual onboard 10/100/1000Mbit Ethernet on each blade's planar. For more information on I/O module and adapter support, refer to the BladeCenter Interoperability Guide from the System x and BladeCenter Configuration tools web page at <http://www-03.ibm.com/systems/x/hardware/configtools.html>.

**Note: The feature codes listed for the I/O Modules throughout this document applies to the BladeCenter H or BladeCenter S Chassis. If a feature code is not listed for a particular I/O Module then the module may not be orderable via the AAS channel and must be ordered via the System x channel.**

### A. Ethernet Modules

There are several types of Ethernet Switch Modules available from various vendors including Blade Network Technology® (BNT), Cisco Systems, Inc.® and QLogic Corporation® that are support in the BladeCenter Chassis. The following table lists the supported Ethernet I/O Modules for the Power Based Blades:

Part Number	Feature Code	I/O Module	Number x type of external ports	Network Layers
32R1859	3211	BNT Layer 2-7 Gb Ethernet Switch Module	4 x Gigabit Ethernet	Layer 2/7
32R1860	3212	BNT Layer 2/3 Copper Gb Ethernet Switch Module	6 x Gigabit Ethernet	Layer 2/3
32R1861	3213	BNT Layer 2/3 Fibre Gb Ethernet Switch Module	6 x Gigabit Ethernet	Layer 2/3
39Y9324	3220	Server Connectivity Module	6 x Gigabit Ethernet	Layer 2
41Y8522	3171	Cisco Catalyst Switch Module 3110X	1 x 10Gb Ethernet	Layers 2/3



Part Number	Feature Code	I/O Module	Number x type of external ports	Network Layers
			2 x StackWise Plus	
41Y8523	3173	Cisco Catalyst Switch Module 3110G	4 x Gigabit Ethernet, 2 x StackWise Plus	Layers 2/3
43W4395	3174	Cisco Catalyst Switch Module 3012	4 x Gigabit Ethernet	Layer 2/3
44W4404	1590	BNT 1/10Gb Uplink Ethernet Switch Module	3 x 10 Gigabit Ethernet 6 x Gigabit Ethernet	Layer 2/3
46C7191	3248	BNT Virtual Fabric 10Gb Ethernet Switch Module	10 x 10 Gigabit Ethernet, 1 x 1 Gigabit Ethernet	Layer 2/3
46M6071	2241	Cisco Nexus 4001i Switch Module	6 x 10 Gb Ethernet 1 x Gigabit Ethernet	Layer 2
44W4483		Intelligent Copper Pass-thru Module	14	NA
46M6181	5412	10Gb Ethernet Pass-thru Module	14	NA

**Table 4 – Support Ethernet Switch Modules**

**Note:** 10Gb ports on the BNT 1/10Gb Uplink Ethernet Switch Module and the BNT Virtual Fabric 10Gb Ethernet Switch Module can be used as stacking ports. Cisco 3110G and 3110X switches have dedicated StackWise Plus ports.

A basic explanation of the different layers supported by different switches is given below. Ensuring that a switch provides the functionality most appropriate is important to ensure that it will provide for the needs of the customer's environment. Generally, an Ethernet switch that supports Layers 2 and 3 will suffice for most customers, although some customers will benefit greatly from the features offered in Layers 4-7.

Layer 2 support means that the Ethernet switch can provide basic connectivity. The switch is capable of dealing with frame headers that contain physical addresses such as MAC addresses. For example, to forward network traffic based on a table of MAC addresses, or to distribute traffic across several physical links to form one logical higher-bandwidth link.

Layer 3 processing means that the switch can provide advanced connectivity. The switch is capable of dealing with packet headers that contain logical addresses such as IP addresses. For example, to forward traffic based on an IP routing table, to build such tables dynamically using routing protocols, or to control access to parts of the network by filtering traffic based on IP addresses. Many customers prefer edge switches that have L3 functionality, as they can integrate with their existing fabric more seamlessly than L2 alone or switches which contain only portions of the L3 functionality.

If the switch supports layers above 3, such as a Layer 7 switch, the switch is able to inspect packet contents (such as TCP ports or even application protocols such as FTP, HTTP, etc.), and not simply the headers. This enables implementation of advanced features such as server load balancing and application availability.

## B. Fibre Channel Modules

Fibre Channel is the most popular medium for connecting servers to storage for a number of reasons, including speed, distance capabilities, and wide adoption by the industry. There are many storage and switching options from vendors, and customers who have large Fibre Channel storage environments deployed will most commonly have core switches, often called Directors, that smaller edge switches connect to in order to provide greater manageability and resilience in larger Enterprise environments. The Fibre Channel SAN switches available for the IBM BladeCenters are the same type of edge switches commonly offered by SAN vendors, just in a different form factor to integrate into the BladeCenter chassis.

The following table lists the supported Fibre Channel I/O Modules by various vendors such as Brocade®, Cisco Systems, QLogic Corporation, for Power based blades in the BladeCenter Chassis for SAN connectivity:

Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface bandwidth
32R1812	3206	Brocade 20-port 4Gb SAN	6	1, 2, 4Gbps
32R1813	3207	Brocade 10-port 4Gb SAN	6	1, 2, 4Gbps
42C1828		Brocade Enterprise 20-port 8Gb SAN Switch with software	6	4 or 8 Gbps
44X1920	5869	Brocade 20-port 8Gb SAN	6	4 or 8Gbps
Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface bandwidth
44X1921	5045	Brocade 10-port 8Gb SAN	6	4 or 8Gbps
39Y9280	3242	Cisco Systems 20-port 4Gb FC	6	1, 2, or 4Gbps
39Y9284	3241	Cisco Systems 10-port 4Gb FC	6	1, 2, or 4Gbps
43W6725	3244	QLogic 20-port 4Gb SAN	6	1, 2, or 4Gbps
43W6724	3243	QLogic 10-port 4Gb SAN	6	1, 2, or 4Gbps
44X1905	3284	QLogic 20-port 8Gb SAN	6	2, 4, or 8Gbps for 8Gb SFP + transceivers and 1, 2, or 4Gbps for 4Gb SFP transceivers at 8Gbps max
43W6723	3245	QLogic 4Gb Intelligent Pass-thru Module	6	1, 2, or 4Gbps
44X1907	5449	QLogic 8Gb Intelligent Pass-thru Module	6	2, 4 or 8Gbps for 8Gb SFP + transceivers and 1, 2, or 4Gbps for 4Gb transceivers at 8Gbps max

**Table 5 – Supported Fibre Channel Switch Modules**

For more information refer to the Introduction to Storage Area Networks Redbook at <http://www.redbooks.ibm.com/abstracts/sg245470.html>.

## C. Pass-thru Modules

Pass-thru modules provide direct connections from internal blade ports to the external infrastructure devices, such as network or storage switches. The pass-thru modules are not assigned an IP address, nor do they have any management capabilities. The pass-thru modules offer a degree of flexibility that customers sometimes require, which cannot be obtained through the integration of full fabric switches in the BladeCenter chassis. One benefit of pass-thru modules in SANs is that a pass-thru module will not require a Domain ID, which a full switch would.

The following table lists the Pass-thru Modules currently supported in the BladeCenter chassis:

Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface Bandwidth
43W6723	3245	QLogic 4Gb Intelligent Pass-thru Module	6	1, 2 or 4Gbps
44X1907	5449	QLogic 8Gb Intelligent Pass-thru Module	6	2, 4 or 8Gbps for 8Gb SFP + transceivers and 1, 2, or 4Gbps for 4Gb SFP transceivers
44W4483		Intelligent Copper Pass-thru Module	14	NA
46M6181	5412	10Gb Ethernet Pass-thru Module	14	10Gb

**Table 6 - Supported Pass-thru Modules**

**Note:** While the Brocade FCSMs are not, strictly speaking, pass-thru modules, they have a mode known as Access Gateway (AG), and, when in this mode, act as a “pass-thru” device.

## D. SAS Modules

The SAS storage options can be an effective way for customers to address inexpensive storage requirements when higher levels of availability, performance, customization, and sharing of storage are not the most critical factors in a storage solution. The SAS Modules also allow the blades to connect to the integrated storage in the 6-Disk Storage Modules of the BladeCenter S Chassis, in addition to external storage.

The SAS RAID Controller Module, designed specifically for the BladeCenter S chassis, acts as a RAID controller module for the Blades in the S chassis, allowing the 12 drives in the two 6-Disk Storage Modules to be divided below the array level, and divided as the administrator desires between the 6 Blade servers in the BladeCenter S chassis. With the SAS RAID Controller Module the exact amount of storage needed by a blade can be assigned to it, instead of assigning storage by array, regardless of the size of the array, or storage requirements of the server. For full details of configuration support with the SAD RAID Controller Module, please reference the

current BladeCenter Interoperability Guide, as posted to the System x and BladeCenter Configuration Tools web page at: <http://www-03.ibm.com/systems/x/hardware/configtools.html>.

The following table lists the SAS Modules supported in the vertical I/O Module bays of the BladeCenter chassis:

Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface Bandwidth
39Y9195	3267	SAS Connectivity Module	4	12 Gbps
43W3584	3734	BladeCenter S SAS RAID Controller Module	4	12 Gbps

**Table 7 – SAS Modules**

**Note:** The SAS RAID Controller Module is only supported in the BladeCenter S Chassis and this module does not support connectivity to DS3200.

## E. InfiniBand Modules

InfiniBand is a strong technology that offers quality of service, low latency, and scalability. InfiniBand is typically used in high performance computing environments. If your customer has very high throughput and low latency requirements, InfiniBand can be an excellent solution. It is very important, though, to ensure that the operating system supports the InfiniBand features that are of interest, as not all features are supported in all operating systems. There has been a great deal more standardization around InfiniBand, and the Quad Data Rate (QDR) Host Channel Adapter (HCAs) supported by IBM Blades offer amazing performance possibilities for interested customers.

The BladeCenter H and BladeCenter HT chassis are capable of supporting InfiniBand Bridge Modules within the chassis, which then separates traffic into Ethernet and Fibre Channel storage connections. These modules are designed for connecting with the slower 4X InfiniBand vertical switch modules, as opposed to the 12X High Speed InfiniBand switches that can occupy switch bays 7-8 and 9-10 in the BladeCenter H and HT.

The following table lists the InfiniBand Modules currently supported in the High Speed bays of the BladeCenter H and BladeCenter HT chassis:

Part Number	Feature Code	I/O Module	Number External Ports	External Port Interface Bandwidth
46M6005	3204	Voltaire 40Gb InfiniBand Switch Module	16 4x QDR	10, 20 or 40Gbps

**Table 8 – Supported InfiniBand Module**

## F. High Speed Modules

High Speed switch modules provide the blade servers with up to 10Gb of bandwidth speed or more in the BladeCenter H and BladeCenter HT chassis. The 10Gb Ethernet environment can be effectively utilized for low latency compute needs as well as the ability to divide a 10Gb interface among multiple partitions to meet the needs of a compute environment that is more thoroughly compartmentalized through virtualization. While InfiniBand can provide speeds higher than Ethernet currently, it is often not as seamless a choice for high bandwidth environments due to the lack of industry adoption as compared to 10Gb Ethernet. There are a variety of high speed modules available including Ethernet and InfiniBand.

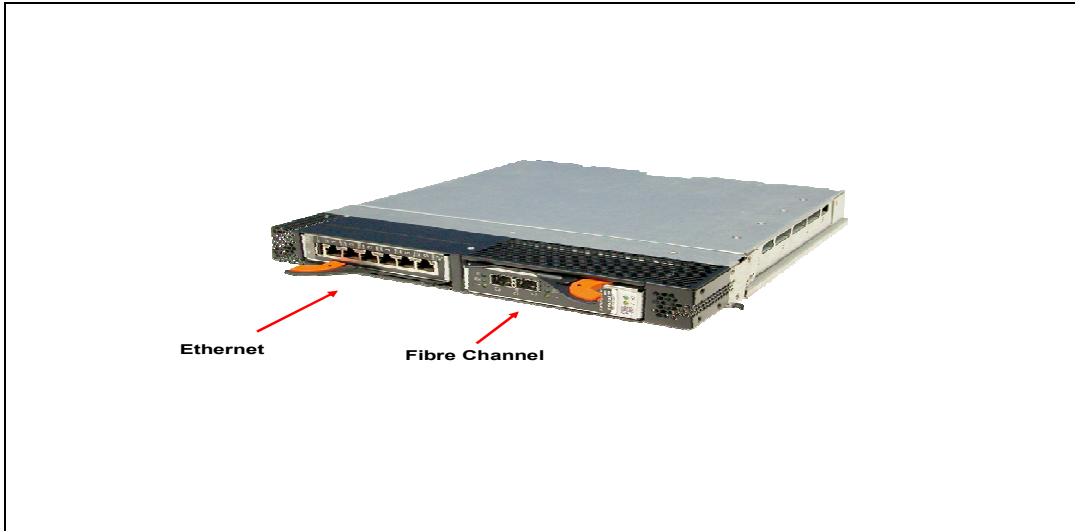
The following table lists the High Speed Switch Modules currently supported bays 7-10 of the BladeCenter H and BladeCenter HT chassis:

Part Number	Feature Code	Description
46M6181	5412	10Gb Ethernet Pass-thru Module
46C7191	3248	BNT Virtual Fabric 10Gb Ethernet Switch Module
46M6005	3204	Voltaire 40Gb InfiniBand Switch Module
46M6071	2241	Cisco Nexus 4001i Switch Module
46M6172	3268	QLogic Virtual Fabric Extension Module

Table 9 – High Speed Switch Modules

## G. Multi-Switch Interconnect Module

The Multi-Switch Interconnect Module (MSIM) is a switch module container that is installed in the high speed I/O Module bays (7-8 and 9-10) of the chassis. The MSIM provides space for two supported switch modules, in each MSIM. By using MSIMs, instead of high speed switch modules, a blade that takes one slot in a chassis is able to utilize the high speed mid-planes for multiple I/O interfaces, instead of a single interface per Blade. This is what enables a blade server to have up to eight I/O connections. The MSIM is supported in the BladeCenter H and the MSIM-HT is supported in the BladeCenter HT chassis. The MSIM offers a path to increasing bandwidth by increasing the number of I/O paths from an individual blade by utilizing the high speed I/O paths in the BladeCenter chassis for slower speed I/O connections, such as 1Gb Ethernet and 4Gb or 8Gb Fibre Channel storage. Due to the increased bandwidth capabilities of these high speed I/O paths, 4 port adapters, all Ethernet or a mixture of Ethernet and Fibre Channel for storage can connect to legacy switch modules in the MSIM utilizing the high speed I/O bays in the chassis.



**Figure 7 - Multi-Switch Interconnect Module**

**Note:** The use of an MSIM or MSIM-HT requires all four power modules to be installed in the BladeCenter H or BladeCenter HT Chassis.

The following table lists the part numbers and feature codes for the Multi-Switch Interconnect Modules supported in the high speed switch modules in BladeCenter H and BladeCenter HT chassis:

Part Number	Future Code	Description
39Y9314	3239	Multi-Switch Interconnect Module
44R5913		Multi-Switch Interconnect Module for BladeCenter HT

**Table 10 – Multi-Switch Interconnect Modules**

It is important to note that all of the BladeCenter I/O Modules are not supported in the MSIM and MSIM-HT. For more information on the supported I/O Modules in the MSIM or MSIM-HT, refer to the IBM BladeCenter Products and Technology Redbook at <http://www.redbooks.ibm.com/abstracts/sg247523.html>. The following table lists the I/O Modules currently supported in the MSIM:

Part Number	Feature Code	I/O Module	Left Slot Ethernet	Right Slot Ethernet or Fibre Channel
<b>Ethernet</b>				
41Y8523	3173	Cisco Catalyst Switch Module 3110G	Yes	Yes
41Y8522	3171	Cisco Catalyst Switch Module 3110X	Yes	Yes
43W4395	3174	Cisco Catalyst Switch Module 3012	Yes	Yes
39Y9324	3220	Server Connectivity Module	Yes	Yes
32R1860	3212	BNT L2/3 Copper Gb Ethernet Switch	Yes	Yes
32R1861		BNT L2/3 Fiber Gb Ethernet Switch	Yes	Yes
44W4404	1590	BNT 1/10 Gb Uplink ESM	Yes	Yes
<b>Fibre Channel</b>				

Part Number	Feature Code	I/O Module	Left Slot Ethernet	Right Slot Ethernet or Fibre Channel
32R1812	3206	Brocade 20-port 4Gb SAN Switch	No	Yes
32R1813	3207	Brocade 10-port 4Gb SAN Switch	No	Yes
44X1920	5869	Brocade 20-port 8Gb SAN Switch	No	Yes
42C1828		Brocade Enterprise 20-port switch with software	No	Yes
44X1921	5045	Brocade 20-port 8Gb SAN Switch	No	Yes
39Y9280	3242	Cisco Systems 4Gb 20-port Fibre Channel Switch	No	Yes
39Y9284	3241	Cisco Systems 4Gb 10-port Fibre Channel Switch	No	Yes
26R0881	3244	QLogic 20-port 4Gb Fibre Channel Switch	No	Yes
43W6725		QLogic 20-port 4Gb SAN Switch Module	No	Yes
43W6724	3243	QLogic 10-port 4Gb SAN Switch Module	No	Yes
43W6723	3245	QLogic 4Gb Intelligent Pass-thru Module	No	Yes
44X1905	3284	QLogic 20-port 8Gb SAN Switch Module	No	Yes
<b>Pass-thru Modules</b>				
44x1907	5449	QLogic 8Gb Intelligent Pass-thru Module	No	Yes
44W4483		Intelligent Copper Pass-thru Module	Yes	Yes
43W6723	3245	QLogic 4Gb Intelligent Pass-thru Module	No	Yes
44X1907		QLogic 8Gb Intelligent Pass-thru Module	No	Yes

**Table 11 – I/O Modules supported in the Multi-switch Interconnect Module**

Support for a specific switch module in the right slot of the MSIM is dependent on a multiport CFFh expansion card on the blades in that chassis which is capable of connecting with that switch. For example, the 2/4 Port Ethernet Adapter (PN# 44W4479 / FC 8291) would require a supported Ethernet switch in both MSIM slots, not simply the left slot, while QLogic Ethernet and 4Gb Fibre Channel Expansion Card (PN# 39Y9306 / FC 8252) would require a supported Ethernet switch in the left slot of the MSIM and a supported Fibre Channel SAN switch in the right slot of the MSIM. Therefore, consideration should be made, when implementing a chassis and Blades as to what type(s) of I/O connectivity is desired. Often, customers have need of different types of I/O solutions, and a simple way to resolve this heterogeneous need is to create the chassis around I/O solutions. For more information on the Multi-Switch Interconnect Module for the IBM BladeCenter refer to <http://www.redbooks.ibm.com/abstracts/tips0711.html>.

## H. Converged Fabric I/O Modules

Converged I/O Modules are used in a Fibre Channel over Ethernet (FCoE) solution which allows you to send Fibre Channel packets over an Ethernet pipe thereby consolidating LAN, SAN and IPC traffic. This solution requires a converged network adapter (QLogic 10GB CNA Adapter), supported BladeCenter I/O Modules and Top of Rack switches. Some of the benefits of FCoE include lower cost, lower latency, lower power and ease of management. The following table lists the supported I/O Modules for FCoE:

Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface Bandwidth
46M6181	5412	10Gb Ethernet Pass-thru Module	14	10Gb

Part Number	Feature Code	I/O Module	Number of External Ports	External Port Interface Bandwidth
46C7191	3248	BNT Virtual Fabric 10GB Switch	10 x 10Gb Ethernet, 1 x 10Gb Ethernet for Management, 1 x RS-232 for Management	10Gb SFP+ (1/10Gb )
46M6071	2241	Cisco Nexus 4001i Switch	6 x 10Gb Ethernet, 1 x 1 Gb for management, 1 x RS-232 for Management	NA
46M6172	3268	QLogic Virtual Fabric Extension Module	6	2, 4,8Gb

**Table 12 – Supported FCoE I/O Modules**

## VI. Choosing the right Switch Module

There are several variables involved in choosing the right switch module or pass-thru module for your customer's environment including cost, vendor loyalty, features and functions. It is recommend to ultimately allow the customer to decide which switch module will work best in their environment however, IBM is often expected to make recommendations to the customer.

**Note: The feature codes listed for the I/O Modules throughout this document applies to the BladeCenter H or BladeCenter S Chassis only. If a feature code is not listed for a particular I/O Module then the module may not be orderable via the AAS channel and must be ordered via the System x channel.**

### A. Choosing Ethernet Switch Modules

The following factors should be considered when choosing an Ethernet Switch Module:

- Cost
- Vendor preference/Loyalty
- Switch Modules
  - Features/Functions (i.e. L2 only or L2/L3, or even L4-7 load balancing)
  - Migration path options (1G needed today, 10G needed in the future)
  - Manageability (GUI tools, CLI options, Management software)
  - Uplink and downlink speed (1Gb verses 10Gb)
  - Performance (number of uplinks/overall bandwidth/latency)
  - Environment support (i.e. not all switches supported in BC-D)
  - Cisco preference does not always mandate a Cisco implementation
    - BNT switches come with support for a Cisco-like CLI, allowing Cisco trained network administrators to work easily and comfortably with BNT switches using commands familiar to them from Cisco switches
    - BNT switches come with full L3 functionality enabled, not requiring additional licenses for advanced L3 functions



- BNT provide a BladeCenter chassis form factor switch that offers L7 functionality, which yields superior performance in some environments
- Power/cooling requirements
  - Some BladeCenter switches use more power than others – which can add up in large data centers

To understand which Ethernet switch is most appropriate for a customer’s needs, it is often helpful to first think about what the customer wants to do with the blades and I/O in the BladeCenter chassis. For example, considering if the customer needs a link speed of 1Gb or 10Gb, can be an easier part of this decision process. When considering 10Gb, remember that there are switch options that include 10Gb to the blade, as well as switches that use 10Gb uplinks to the external network, but 1Gb from the switch down to the blade. It is also important to consider the Open Systems Interconnections (OSI) layers involved in Ethernet switching. Would your customer benefit from application level load balancing or merely switch level failover or neither?

The following table compares the features and functions of Ethernet I/O Modules available from Cisco Systems:

Description	Cisco 3012	Cisco 3110G	Cisco 3110X	Cisco Nexus 4001i
Part Number	43W4395	41Y8522	41Y8522	46M6071
Feature Code	3174	3173	3171	2241
<b>Ethernet Ports</b>				
Number of external Ports	4	4	1	7
Speed of external ports, Mbps	10/100/ 1Gb	10/100/ 1Gb	10Gb	6x 1Gb/10Gb, 1x 1Gb
Dedicated stacking ports	No	2x StackWise Plus, 32Gb	2x StackWise Plus, 32Gb	No
Number of internal ports	14	14	14	14
Speed of internal ports	1000	1000	1000	1000/ 10000
<b>Switch Features</b>				
Number of VLANs supported	1005	1005	1005	512
Basic L3 Routing	Yes	Yes	Yes	Yes
Advanced L3 Routing	No	Via license	Via license	No
Managed Switch	Yes	Yes	Yes	Yes
Layer 2 Switching	Yes	Yes	Yes	Yes
Non-blocking architecture	Yes	Yes	Yes	Yes
802.1Q VLAN Tagging	Yes	Yes	Yes	Yes
Link Aggregation	Yes	Yes	Yes	Yes
Switch Stacking	No	Yes	Yes	No
Jumbo Frames	Yes	Yes	Yes	Yes
Server Load Balancing	No	No	No	No
Spanning Tree Protocol	Yes	Yes	Yes	Yes
Trunk failover (link state tracking)	Yes	Yes	Yes	Yes
Serial over LAN	Yes	Yes	Yes	Yes

**Table 13 – Cisco Systems Ethernet Modules functionality comparison**

The following table compares the features and functions of Ethernet I/O Modules available from IBM and BNT:

Description	IBM SCM	BNT L2/3 Copper GbE	BNT L2/3 Fibre GbE	BNT L2/7 GbE	BNT 1/10Gb Uplink	BNT Virtual Fabric 10Gb
Part Number	39Y9324	32R1860	32R1861	32R1859	44W4404	46C7191
Feature Code	3220	3212	3213	3211	1590	3248
<b>Ethernet Ports</b>						
Number of external Ports	6	6	6	4	9	11
Speed of external ports, Mbps	10/100/1Gb	10/100/1Gb	10/100/1Gb	10/100/1Gb	3x 10Gb, 6x 10/100/1Gb	10x 1Gb/ 10Gb, 1x 1Gb
Dedicated stacking ports	None	None	None	None	None	None
Number of internal ports	14	14	14	14	14	14
Speed of internal ports	1000	1000	1000	1000	1000	1000/ 10000
<b>Switch Features</b>						
Number of VLANs supported	256	1024	1024	1024	1024	1024
Basic L3 Routing	No	Yes	Yes	Yes	Yes	Yes
Advanced L3 Routing	No	Yes	Yes	Yes	Yes	Yes
Managed Switch	Yes	Yes	Yes	Yes	Yes	Yes
Layer 2 Switching	Yes	Yes	Yes	Yes	Yes	Yes
Non-blocking architecture	Yes	Yes	Yes	Yes	Yes	Yes
802.1Q VLAN Tagging	Yes <sup>1</sup>	Yes	Yes	Yes	Yes	Yes
Link Aggregation	Yes	Yes	Yes	Yes	Yes	Yes
Switch Stacking	No	No	No	No	Yes	Yes
Jumbo Frames	Yes	Yes	Yes	Yes	Yes	Yes
Server Load Balancing	No	No	No	Yes	No	No
Spanning Tree Protocol <sup>2</sup>	No	Yes	Yes	Yes	Yes	Yes
Trunk failover (link state tracking)	Yes	Yes	Yes	Yes	Yes	Yes
Serial over LAN	Yes	Yes	Yes	Yes	Yes	Yes

**Table 14 – IBM and BNT Ethernet Modules functionality comparison**

**Note 1:** The software features and functions supported by the switch module depend on the firmware release that is loaded onto it. For example, old firmware supports 128 active VLANs only, while the newer version can support up to 1024 VLANs.

**Note 2:** Supported on external ports only.

### BNT/Cisco Ethernet Switches

The default configuration on all of the BNT and Cisco Ethernet Switch Modules will support SoL therefore no additional configuration is required to enable SoL. For more advanced configuration options, to understand the full configuration options, and to determine the optimal design for a specific network environment, refer to the Reference section of this document for the appropriate link.

### Stackable Ethernet Switches

The Cisco 3110X Switch Module, Cisco 3110G switch module, BNT 1/10Gb switch module and the BNT 10-Port 10Gb switch module can be configured in a stacked configuration. Cisco supports up to nine physical switches in a stack, and BNT supports up to eight physical switches in a stack. When stacking Cisco switches, dedicated stacking ports on the Cisco switch are used with Cisco StackWise Plus cables. When stacking BNT switches, standard 10Gb cabling and

transceivers are used to connect the switches utilizing 1 or 2 of the 10Gb uplink ports on the switches.

## B. Choosing Ethernet Pass-thru Modules

If the customer does not need the full functionality of an Ethernet Switch then a pass-thru module may meet their requirements. Although the cost of a pass-thru module may often be cheaper than a switch, this solution may cost the customer more in the end because of the increased number of core switch ports required to support the overall blade environment and the cabling complexity. Deciding which pass-thru module to use is dependant on the customer's requirements. For example, if the customer's requirement is 10GB then the 10GB Pass-thru Module should be considered.

### Intelligent Copper Pass-thru Module

The Intelligent Copper Pass-thru Module (ICPM) provides Ethernet connectivity and can be used in place of Ethernet Switch Modules. The ICPM provides an unconfigured network connection that enables the blade to connect to an existing network infrastructure. The ICPM provides a single connection from each blade to one RJ-45 connector, which can go directly to an external switch or patch panel from each of the 14 blades in the chassis. This I/O module can be plugged into bay 1 and 2 of the chassis and it supports SoL. As the name implies, there is slightly more than pure signal passing occurring with the ICPM, and as such it could be described as being between a dumb pass-thru device, and a full switch. Unlike the other I/O devices supported by different BladeCenter chassis, the ICPM is not a non-blocking device. So, care should be taken before opting to use it simply because of its low price, as performance could be an issue in many customer environments.

### 10Gb Ethernet Pass-thru Module

The 10Gb Ethernet Pass-thru Module provides end-to-end non-blocking 10Gb speed within the chassis. This device supports both Ethernet and Converged Enhanced Ethernet packets, which allow clients to connect to an FCoE capable top-of-rack switch. The 10Gb Ethernet Pass-thru Module is plugged into the High Speed Switch bay slots of the chassis. The following table compares the features and functions of the Ethernet Pass-thru Modules available:

Description	QLogic Intelligent Copper Pass-thru Module	10Gb Ethernet Pass-thru Module
Part Number	44W4483	46M6181
Feature Code		5412
Number of external Ports	14 RJ-45 copper	14
Speed of external ports, Mbps	100/1000 Mbps	10Gb
Dedicated stacking ports	No	No
Number of internal ports	14	14
Speed of internal ports	1Gb	10Gb
Serial over LAN	Yes	No

**Table 15 – Cisco Systems Ethernet Modules functionality comparison**

## C. Choosing Fibre Channel Switch Modules

Choosing the best Fibre Channel Switch Module for a customer is similar to choosing the best Ethernet switch. Consider the customer's current Fibre Channel switch environment, if any, as well as what direction they might need to grow toward from a feature function standpoint, not just what features and functions they need for this specific project. This approach allows you to help the customer make a fabric decision that will benefit them in the long run.

When deciding which switch module to choose, the customer's existing fabric most commonly determines what Fibre Channel Switch you should be proposing. The following factors should be considered:

- QLogic – QLogic Switch Modules or QLogic Intelligent Pass-thru Module (IPM)
- Brocade Fabric – Fabric Switch Modules or QLogic IPMs (ask about secure fabric requirements)
- McData Fabric – QLogic IPM if they are staying with McData core and not moving to Brocade

**Note:** If the customer does not care about McData Mode (most McData installations are running in Open mode, NOT McData Mode). Ask about Secure Fabric requirements. Brocade's direction is to move McData customers to Brocade Cores.

- Cisco Fabric – Cisco MDS Switch Module or QLogic IPM
- Whether or not a customer's storage administrators are attempting to limit domain proliferation
- Whether or not the Fibre Channel I/O Module that is deployed be connected directly to a storage device, or if it will be attached to an existing SAN fabric

For other fabrics engage the storage team to propose displacing the customer's existing SAN infrastructure, possibly using Brocade switches in Access Gateway mode during transition to Brocade fabric. Alternatively, propose QLogic IPM as it is the MOST compatible with SAN Vendors and has a good Interoperability Guide with multiple switch vendors (<http://qa.qlogic.com/Interoperability/Pages/default.aspx>). If customers are attempting to connect a storage device directly to the Fibre Channel I/O module in their BladeCenter chassis, a full fabric switch such as Brocade, Cisco and QLogic must be utilized.

When choosing a Fibre Channel Module, it is also important to determine if a 10-port or 20-port license is required. A 10-port license can be updated to a 20-port license for a fee using an activation key which is tied to the serial number of the switch.

### 10-port License version

- 10 physical ports on the switch
  - Enables 7 internal ports – connects 7 blades
  - Enables 3 external ports or ISL connections, connection to storage devices, etc.
  - Configurable to whichever 7 internal ports you wish to enable, which can be a great cost savings for chassis that might only ever have 7 SAN attached blades but which

need to be installed in specific blade server bays and still offer the option of full 20 port enablement in the future

20-port License version

- 20 physical ports on the switch
  - Enables 14 internal ports – connects 14 blades
  - Enables 6 external ports

**Note:** The Activation Key assigned to a particular switch by serial number cannot be used on a different switch.

There are several different Fibre Channel Switch Modules from different vendors supporting different advanced functions, many of which are unique to the switch vendor. The following table compares the features and functions supported by the Brocade Fibre Channel Switch Modules:

Description	Brocade 20-port 4Gb SAN	Brocade 10-port 4Gb SAN	Brocade Enterprise 20-port 8Gb with software	Brocade 20-port 8Gb SAN	Brocade 10-port 8Gb SAN
Part Number	32R1812	32R1813	42C1828	441X920	441X921
Feature Code	3206	3207		5869	5045
Active Ext Ports	6	3	6	6	3
Active ports to blade slots	14	7	14	14	7
Link Speed all the way through	2, 4Gb	2, 4Gb	2, 4, 8Gb	2, 4, 8Gb	2, 4, 8Gb
Managed Switch	Yes	Yes	Yes	Yes	Yes
External Ports- F_ports, FL_ports, E_ports	Yes	Yes	Yes	Yes	Yes
Internal Ports - F_ports 2 or 4Gbps	Yes	Yes	Yes	Yes	Yes

**Table 16 – Brocade Fibre Channel Switch Functionality**

It is important to note the Brocade 10 port switches have Dynamic Ports on Demand (DPOD) so you can vary the number of internal/external ports. The following table compares the features and functions supported by QLogic and Cisco Systems Fibre Channel Switch Modules:

Description	QLogic 20-port 4Gb SAN	QLogic 10-port 4Gb SAN	QLogic 20-port 8Gb SAN	Cisco 20-port 4Gb SAN	Cisco 10-port 4Gb SAN
Part Number	43W6725	43W6724	44X1907	39Y9280	441X921
Feature Code	3244	3243	3284	3242	5045
Active Ext Ports	6	6	6	6	3
Active ports to blade slots	14	14	14	14	7
Link Speed all the way through	1, 2, 4Gb	1, 2, 4Gb	2, 4, 8Gb	1, 2, 4Gb	1, 2, 4,Gb
Managed Switch	Yes	Yes		Yes	Yes
External Ports- F_ports, FL	Yes	Yes	Yes	Yes	Yes

Description	QLogic 20-port 4Gb SAN	QLogic 10-port 4Gb SAN	QLogic 20-port 8Gb SAN	Cisco 20-port 4Gb SAN	Cisco 10-port 4Gb SAN
ports, E_ports					
Internal Ports – F_ports 2 or 4 Gbps	Yes	Yes	Yes	Yes	Yes

**Table 17 – Fibre Channel Switch Functionality**

### Brocade Fibre Channel Switch Modules

Brocade offers a new 8Gb 20-port Enterprise, 20-port and 10-port SAN Switch as well as a 4Gb 20-port and 10-port SAN switch. These switches allow the integration of the Brocade fabric into the BladeCenter architecture. These SAN fabric switches deliver the advanced Brocade functions, performance, manageability, scalability and security required by the most demanding storage area networks (SANs). The integration of SAN switching capabilities increases SAN manageability and reduces complexity.

For existing Brocade customers, or those intending to migrate to a Brocade fabric, even though the initial cost of the Brocade switch is typically higher, this can be a better option due to simplicity.

### Cisco Systems Fibre Channel Switch Modules

Cisco Systems 4Gb Fibre Channel Switch Modules provide high-performance end-to-end SAN solutions using Fibre Channel technology. These modules allow seamless integration of IBM BladeCenter into existing Cisco SANs, and have functions equivalent to the Cisco MDS 9124 switch. As of Cisco MDS SAN-OS Release 3.1 (1), On-Demand Port Activation (ODPA) licensing is used for the 10-port Cisco switch. ODPA automatically enables switch ports as they are connected to either blade servers (any seven of 14 internal ports can be enabled), or external devices (first three ports can be enabled consequently), and up to ten ports can be active at the same time. It is possible to make ports ineligible to get the license, or move licenses among ports.

### QLogic Fibre Channel Switch Modules

The QLogic 4Gb 20-port Fibre Channel switch enables high-performing end-to-end SAN solutions using Fibre Channel technology. These standards-based switches provide interoperability with FC-SW-2-compliant SANs. SAN fabric switch modules deliver the advanced functions, performance, manageability, and scalability required by the most demanding SANs. The QLogic 20-port 4Gb Fibre Channel SAN Switch Module and QLogic 10-port 4Gb SAN Switch Module enable high performance SAN solutions and allow BladeCenter integration with any open standard-based storage area networks utilizing full fabric switching functionality.

For the QLogic 10-Port 4Gb SAN Switch Module, the default port license assignments are 1 through 7 for internal ports (the first seven blade bays), and 0, 15, and 16 for external ports (the first three external ports). Port license assignments can be changed to other available internal ports (8 through 14) or external ports (17, 18, or 19) by using the QLogic management tools. A 20-port license can be ordered and applied via firmware.

## D. Choosing Fibre Channel Pass-thru Modules

The QLogic Intelligent Pass-thru Module (IPM) can be used in place of Fibre Channel Switch Modules. The IPM Module provides a fully interoperable solution for seamless integration of the Fibre Channel initiators to an existing fabric. Instead of simply passing a signal from a Fibre Channel HBA to a switch, the IPM utilizes industry-standard NPIV technology to provide a cost-effective connectivity solution for the IBM BladeCenter. The IPM is ideal for those customers with existing SANs that want to integrate BladeCenter cost-effectively; and without disruption to their existing SAN. The IPM provides additional functionality via a software upgrade option to a QLogic open-standard full-fabric functionality utilizing the full-fabric mode. The real value of the QLogic Intelligent Pass-Thru Modules, whether 4Gb or 8Gb, is that they integrate seamlessly into an NPIV capable fabric devices, allow connectivity without spawning new Fibre Channel domains, and do so at a cost that is far less than a full fabric switch.

The limitation of either model of Intelligent Pass-thru Module is that they require connectivity to a full fabric switch, and cannot be used to connect blade HBAs directly to a storage device. Most customers SANs today are Brocade, Cisco, McDATA (now part of Brocade), or QLogic, and their SAN environments involve some sort of core fabric switches, or what are commonly called directors. The following table lists the supported Fibre Channel Pass-thru Modules:

Description	QLogic 4Gb Intelligent Pass-thru Module	QLogic 8Gb Intelligent Pass-thru Module
Part Number	43W6725	43W6724
Feature Code	3244	3243
Active Ext Ports	6	6
Active ports to blade slots	14	14
Link Speed all the way through	1, 2, 4Gb	2, 4, 8Gb
Managed Switch	Yes	Yes
Ext Ports- F_ports, FL ports, E_ports	Yes	Yes
Int Ports – F_ports 2/4 Gbps	Yes	Yes
Convert to Full Fabric Switch	No	No

Table 18 – Fibre Channel Pass-thru Modules Functionality

## E. Choosing I/O Modules for N\_Port ID Virtualization

The following expansion cards and Switch Modules are currently supported for NPIV on the PS7XX and JSXX blades running AIX, Linux or IBM i hosted by VIOS:

<b>NPIV Compatibility Matrix</b>	<b>QLogic 8Gb CIOv</b>	<b>QLogic 8Gb CFFh</b>	<b>Emulex 8Gb CIOv</b>
	Requires firmware version 5.02.01 or later	Requires firmware version 5.02.01 or later	Will Require firmware update; check Emulex site
<b>QLogic 4Gb Switch Module</b> Requires firmware version	AIX - No IBM i - No Linux - No	AIX - No IBM i - No Linux - No	AIX - No IBM i - No Linux - No

<b>NPIV Compatibility Matrix</b>	<b>QLogic 8Gb CIOv</b>	<b>QLogic 8Gb CFFh</b>	<b>Emulex 8Gb CIOv</b>
6.5.0.22.00 or later	Requires firmware version 5.02.01 or later	Requires firmware version 5.02.01 or later	Will Require firmware update; check Emulex site
<b>QLogic 8Gb Switch Module</b> Requires firmware version 7.10.1.04 or later	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>	<i>AIX - No</i> <i>IBM i - No</i> <i>Linux - No</i>
<b>Brocade 4Gb Switch Module</b>	<i>AIX - No</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - No</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>
<b>Brocade 8Gb Switch Module</b>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - Yes</i>
<b>Cisco 4Gb Switch Module</b>	<i>AIX - Yes</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - Yes</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - Yes</i> <i>IBM i - Yes</i> <i>Linux - No</i>
<b>QLogic Intelligent Pass-thru Module</b>	<i>AIX - Yes</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - Yes</i> <i>IBM i - No</i> <i>Linux - No</i>	<i>AIX - No</i> <i>IBM i - No</i> <i>Linux - No</i>

Table 19 – NPIV support

**Note: For more information on the I/O Modules and expansion cards supported for NPIV refer to the BladeCenter Interoperability Guide from the System x and BladeCenter Configuration tools web page, which lists all of the nuances and requirements for configuring NPIV on Power based blades**

<http://www-947.ibm.com/support/entry/portal/docdisplay?brand=5000020&Indocid=MIGR-5073016>.

If your customer already has one of the adapters or switches listed in the above table and they plan to implement NPIV please refer to the BladeCenter Interoperability Guide to ensure the operating system level the customer is running is supported. If this is a new configuration then the SAN Switch Module the customer chose will most likely depend on their existing fabric.

One advantage of utilizing NPIV with IBM BladeCenter SAN switches is that it allows SAN switches from Brocade and Cisco, as well as Qlogic to be utilized as SAN pass-thru devices. Brocade refers to this mode as Access Gateway, while Cisco documentation will just discuss setting ports for N-port ID Virtualization or NPIV. By doing this, instead of simply purchasing the Qlogic Intelligent Pass-Thru Module, customers could more seamlessly upgrade chassis SAN switches from a pass-thru “mode” to a full fabric switch with a setting change; currently requires rebooting the BladeCenter switch.

## F. Choosing I/O Modules for Fibre Channel over Ethernet

The Power based blades support Fibre Channel over Ethernet (FCoE) using the Converged Network CNA Adapter and supported I/O Modules. The CNA card can also be used for 10Gb



Ethernet support with the BNT Virtual Fabric 10Gb Ethernet Switch Module. The CNA adapters support VIOS 2.1.3.0 or later, AIX 5.3 TL 12 and AIX 6.1 TL 5 or later. The table below list the expansion card and I/O Modules currently supported in an FCoE environment for Power based blades:

Blade Converged Network Adapter	BladeCenter Switch Module	FCoE Top of Rack Switch
QLogic 10Gb CNA Adapter	10Gb Ethernet Pass-Thru Module	IBM Converged Switch B32 (Brocade 8000)
QLogic 10Gb CNA Adapter	10Gb Ethernet Pass-Thru Module	Cisco 5010/5020
QLogic 10Gb CNA Adapter	BNT Virtual Fabric 10Gb Switch Module	TOR with NIC Traffic only
QLogic 10Gb CNA Adapter	BNT Virtual Fabric 10Gb Ethernet Switch Module + QLogic Virtual Fabric Extension Module	TOR not required, supports Brocade Fabrics

**Table 20– Fibre Channel over Ethernet Support**

**Note: For more information on the supported expansion cards and I/O Modules supported for FCoE refer to the BladeCenter Interoperability Guide, which lists all the nuances and requirements for FCoE <http://www-947.ibm.com/support/entry/portal/docdisplay?brand=5000020&lnocid=MIGR-5073016>.**

#### BNT Virtual Fabric 10Gb Ethernet Switch

The BNT Virtual Fabric 10Gb Ethernet Switch Module offers the most bandwidth of any blade switch and represents the perfect migration platform for clients who are still at 1Gb outside the chassis by seamlessly integrating in the existing 1Gb infrastructure. This is the first 10Gb switch for the BladeCenter that supports converged networking. If you have a chassis with multiple servers, some operating at 1Gb, some at 10Gb, and some transmitting converged packets, this single switch can handle all these workloads and can connect to a 1Gb infrastructure or a 10Gb infrastructure or both.

#### QLogic Virtual Fabric Extension Module

The QLogic Virtual Fabric Extension (VFE) Module is a bridge module for Native Fibre Channel SANs and 10Gb Converged Enhanced Ethernet networks. The VFE is installed in bays 3 and 5 and bays 4 and 6 of the chassis. The VFE module must be connected to the BNT Virtual Fabric 10Gb Switch Module and the CNA 10Gb adapter must be installed on the blade. The VFE Module offers six ports of 8Gb Fibre Channel connectivity.

#### Cisco Nexus 4001i

The Cisco Nexus 4001i Switch Module provides high-performance, scale-out, virtualized, and non-virtualized x86 computing architectures. It is a line rate, extremely low-latency, non-blocking, Layer 2, 10Gb Ethernet switch that is fully compliant with Fibre Channel over Ethernet (FCoE) and IEEE Data Center Bridging standards. This switch is supported in the BladeCenter H and BladeCenter HT chassis and is installed in bays 7-10.

### Cisco Nexus 5000

The Cisco Nexus 5010 for IBM System Storage™ and Cisco Nexus 5020 for IBM System Storage FCoE switches help reduce costs through data center infrastructure simplification. The Cisco Nexus 5010 provides eight 1, 10Gb Ethernet and twelve 10Gb Ethernet fixed ports with one expansion module slot. The Cisco Nexus 5020 provides sixteen 1Gb, 10Gb Ethernet and twenty-four 10Gb Ethernet fixed ports with two expansion module slots. The Cisco 5000 switches are part of the storage portfolio and are not sold via the AAS channel or the System x ordering channel.

### IBM Converged B32 Switch

The Converged B32 (Brocade 8000) is a 1U top-of-rack Layer 2 FCoE switch with 24 10Gb Ethernet ports for LAN connections and 8 8Gb Fibre Channel ports for SAN connections. This switch provides advanced Fibre Channel services, supports Ethernet as well as Converged Enhanced Ethernet (CEE) and is managed by Brocade Data Center Fabric Manager (DCFM). The B32 Switch is a part of the storage portfolio and is not sold via the AAS channel or the System x ordering channel.

### 10Gb Pass-thru Module

The BNT 10Gb Pass-thru Module provides Ethernet connectivity and it can be used in a FCoE Solution. The BNT Pass-thru module allows you to connect to an FCoE capable top-of-rack switch and is installed in Bays 7-10 of the BladeCenter H and BladeCenter HT chassis.

## VII. Ordering the Power Based Blade Solution

While you can order the various Power based blades singly and separately, the chassis itself needs to be ordered with at least one blade integrated in the chassis. Power based blades and associated chassis are ordered through via AAS. The BladeCenter H and the BladeCenter S Chassis are orderable via AAS. The other chassis are orderable via System x ordering channel. Although most of the I/O Modules are orderable via AAS, some are not. The table below lists the I/O Modules and the Accessories currently orderable through AAS for the BladeCenter H Chassis:

<b>7989-BladeCenter H Switch Modules</b>		
<b>Part Number</b>	<b>Feature Codes</b>	<b>Description</b>
44W4404	1590	BNT 1/10 Gb Uplink Ethernet Switch
46M6071	2241	Cisco Nexus 4001I Switch Module
41Y8522	3171	Cisco Catalyst Ethernet Switch Module – 3110X
41Y8523	3173	Cisco Catalyst Ethernet Switch Module – 3110G
43W4395	3174	Cisco Catalyst Ethernet Switch Module – 3012
46M6005	3204	Voltaire 40GB InfiniBand Switch Module
32R1860	3212	BNT Network Layer 2/3 Copper Gigabit Switch Module
39Y9280	3242	Cisco Systems 4Gb 20-port Fibre Channel Switch Module
46C7191	3248	BNT 10-port Ethernet Switch Module
39Y9195	3267	SAS Connectivity Module

46M6172	3268	QLogic Virtual Fabric Extension Module
44X1905	3284	QLogic 20-port 8Gb SAN Switch Module
44X1921	5045	Brocade 10-port 8Gb SAN Switch Module
46M6181	5412	10Gb Ethernet Pass-thru Module
44X1920	5869	Brocade 20-port 8Gb SAN Switch Module
<b>Accessories</b>		
	2242	Software Upgrade License for Cisco Nexus 4001I
	3175	IP Services S/W Upgrade License for Cisco Catalyst 3220
	3177	Brocade ISL Trunking for IBM BladeCenter
	3188	Brocade 4Gb Fabric Watch for IBM BladeCenter
	3238	IBM Short Wave SFP Module, 4Gb
	3260	1M SAS 4-Channel Cable
	3261	Cisco Systems 4Gb Short-wave Length SFP Module
	3266	3M SAS 4-Channel Cable
	3282	IBM 10Gb Ethernet 850 nm Fibre SFP+ Transceiver
	3286	8Gb SFP+ Short Wave Optic Transceiver
	4380	LC-LC Fibre Channel Cable, 5-Meter
	4385	LC-LC Fibre Channel Cable, 25-Meter
	4941	IBM BladeCenter Open Fabric Manager
	4942	IBM BladeCenter Open Fabric Manager Advanced Upgrade
	4943	IBM BladeCenter Open Fabric Manager Advanced Upgrade for IBM Director
	5358	Brocade 8Gb SFP+ Short-wave Optic Transceiver

**Table 21 – Orderable features for BladeCenter H Chassis**

The table below lists the I/O Modules and Accessories currently orderable through AAS for the BladeCenter S Chassis:

<b>7779-BladeCenter S</b>		
<b>Switch Modules</b>		
<b>Part Number</b>	<b>Feature Codes</b>	<b>Description</b>
4W4404	1590	BNT 1/10 Gb Uplink Ethernet Switch
43W4395	3174	Cisco Catalyst Ethernet Switch Module – 3012
32R1860	3212	BNT Network Layer 2/3 Copper Gigabit Switch Module
39Y9195	3267	SAS Connectivity Module
44X1905	3284	QLogic 20-port 8Gb SAN Switch Module
43W3584	3734	SAS RAID Controller Switch Module
<b>Accessories</b>		
	3238	IBM Short Wave SFP Module, 4Gb
	3260	1M SAS 4-Channel Cable
	3266	3M SAS 4-Channel Cable
	3282	IBM 10Gb Ethernet 850 nm Fibre SFP+ Transceiver
	3286	8Gb SFP+ Short Wave Optic Transceiver
	4380	LC-LC Fibre Channel Cable, 5-Meter
	4385	LC-LC Fibre Channel Cable, 25-Meter
	4941	IBM BladeCenter Open Fabric Manager
	4942	IBM BladeCenter Open Fabric Manager Advanced Upgrade
	4943	IBM BladeCenter Open Fabric Manager Advanced Upgrade for IBM Director

**Table 22 – Orderable features for BladeCenter S Chassis**

The following is intended to guide you in preparing valid orders for the AAS system and a few alternatives through the High Volume Easily Configured (HVEC) system used for ordering Modular (System x) products.

## **Exceptions to the Order Process**

The solutions described below are currently orderable through the AAS ordering system. There may be circumstances where your solution will require a switch module that is not currently available as a configuration option for the Power based blades and chassis in the eConfig tool. This is not a support issue but is an order channel issue.

As an example you may have a request for 10Gb Ethernet, or Fiber Ethernet switches or a specific brand of Fibre Channel Switches that are not currently shown as available options in eConfig. In most cases these options are still available through the Modular Systems order process (HVEC). Please check with your Power Systems Technical Support specialist to see if these options are available.

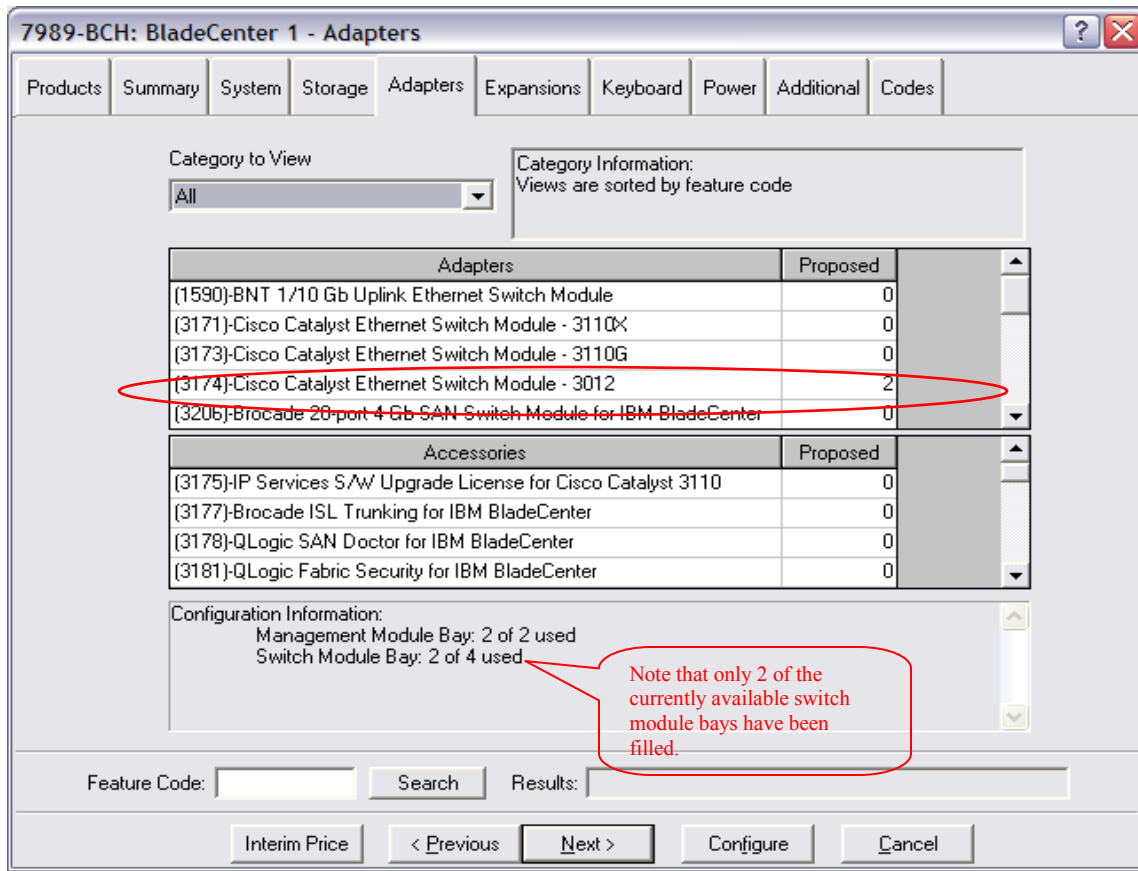
### **A. BladeCenter H Configuration Example**

What follows are various solutions chosen to show specific options in configuring blades and chassis using the IBM Configurator for e-business. This assumes you are already familiar with using the eConfig tool and basic blade and chassis attributes. We will look at several solutions for blades and chassis that require different switch considerations.

**Solution A: Switch Basics** - The first solution is six (6) PS700 Express Blades in a BladeCenter H Chassis. The blades will have only the integrated dual ported Ethernet adapter. This solution is intended to show the basic blade configuration and corresponding chassis Ethernet switches which will allow both Ethernet ports on the blades to connect to the network. After configuring the blades you'll know immediately that you have only two Ethernet ports to activate on each of the 6 blades. Thus you need two Ethernet switches in the chassis. By looking at Figure 2 in Section IV earlier you will have seen that the integrated Ethernet adapter ports are hard wired to connect with switches in the BladeCenter H chassis module bays 1 and 2.

**Note:** In the BladeCenter S chassis, both of the integrated Ethernet ports are wired to the switch module in Bay 1. We will show this in a later solution.

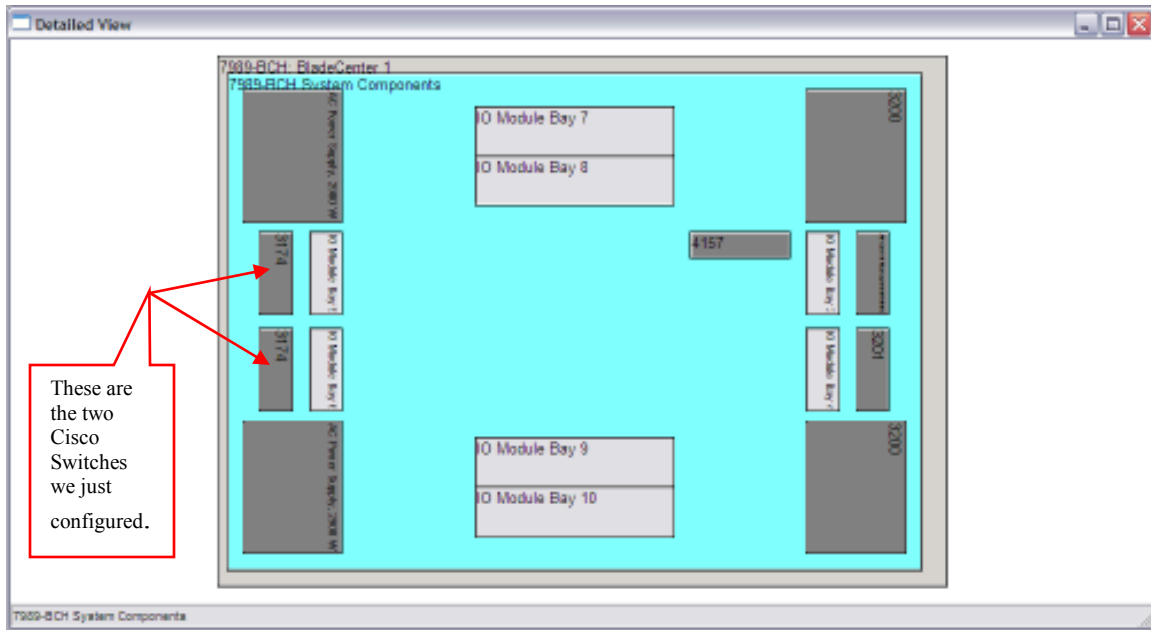
Your eConfig switch selection would look like the following:



**Figure 8**

We chose the Cisco Catalyst switches here instead of the default BNT switch but it could have been any 2 of the available Ethernet switches.

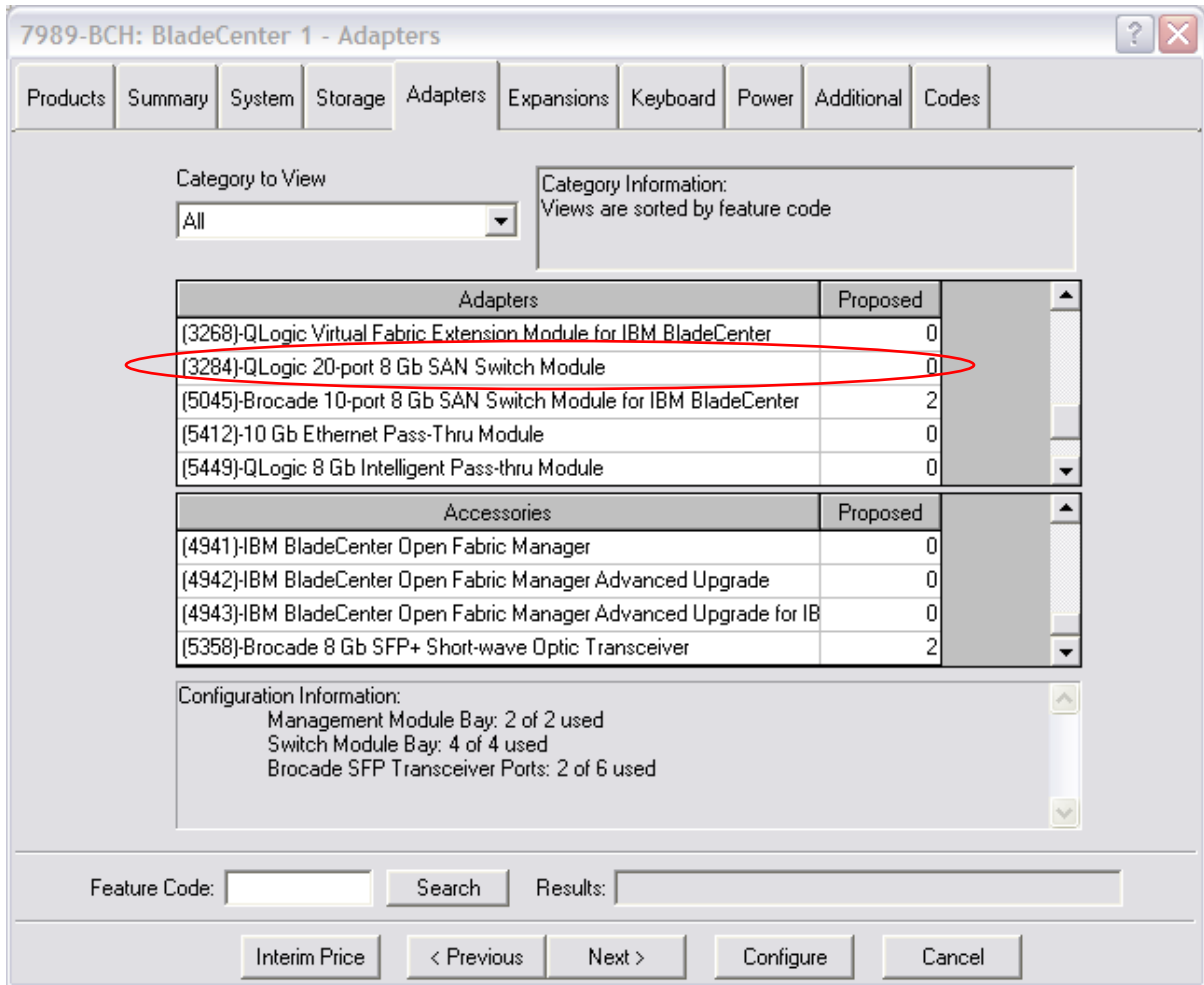
The block diagram from eConfig (Figure 9) shows you that it placed these two switches in the appropriate switch bays that are connected to the integrated Ethernet ports on the blades.



**Figure 9**

**Solution B: Adding SAN Switches** - This builds on the first solution adds SAN connectivity using a dual ported fiber channel adapter in all 6 of the blades and adds the corresponding fiber channel switches to the chassis. We will use SAN boot here with no disk drives on the blades. We have two CIOv options for dual port 8Gb Fiber Channel adapter options (QLogic feature code 8242 and Emulex feature code 8240). We also have CFFh adapter options that we will look at in a later solution.

For this solution we've chosen to select the QLogic 8Gb 2 port Fiber Channel expansion card for our 6 BladeCenter PS700 blades. Figure 10 below shows the adapter selection in eConfig.



**Figure 10**

With the addition of the Fiber Channel adapters we now have 6 PS700 blades with 2 ports of Ethernet and 2 ports of Fiber Channel. Following with our basic principle of a switch for each active port we now need to add the corresponding switches to our chassis.

We have both Brocade and QLogic switch modules as options. In this case we have chosen the Brocade 10-port 8Gb SAN Switch module. Here is an instance where the number of blades is important. The 10-ports supply 7 internal port connections (for up to 7 blades) and 3 external connections to the SAN device. So with our six (6) BladeCenter PS700 blades we can use this switch option and configure 2 of them since we still want to activate both of the fiber channel ports now configured on each blade. Figure 12 below shows the selection of our switch option along with our previously selected Ethernet switch selections from the previous solution.

7989-BCH: BladeCenter 1 - Adapters

Products Summary System Storage Adapters Expansions Keyboard Power Additional Codes

Category to View: All

Category Information: Views are sorted by feature code

Adapters	Proposed
(3268)-QLogic Virtual Fabric Extension Module for IBM BladeCenter	0
(3284)-QLogic 20-port 8 Gb SAN Switch Module	0
(5045)-Brocade 10-port 8 Gb SAN Switch Module for IBM BladeCenter	2
(5412)-10 Gb Ethernet Pass-Thru Module	0
(5449)-QLogic 8 Gb Intelligent Pass-thru Module	0

Accessories	Proposed
(4941)-IBM BladeCenter Open Fabric Manager	0
(4942)-IBM BladeCenter Open Fabric Manager Advanced Upgrade	0
(4943)-IBM BladeCenter Open Fabric Manager Advanced Upgrade for IB	0
(5358)-Brocade 8 Gb SFP+ Short-wave Optic Transceiver	2

Configuration Information:  
 Management Module Bay: 2 of 2 used  
 Switch Module Bay: 4 of 4 used  
 Brocade SFP Transceiver Ports: 2 of 6 used

Feature Code:  Search Results:

Interim Price < Previous Next > Configure Cancel

Figure 11

**Note:** We have not added more than the default number of Small Form Factor Pluggable Module ports that enable the physical cable connections to your SAN storage device. The number of SFP Module ports you select will be dependent on the number of cable connections available on the storage device. The image below is shown just to familiarize you with what a SFP Module looks like. The module plugs into one of the external ports on the switch.



Figure 12 - SFP Module



The system diagram (Figure 13) below from eConfig shows that the additional switch modules have been placed in switch bays 3 and 4 which is appropriate for CIOv adapter connections.

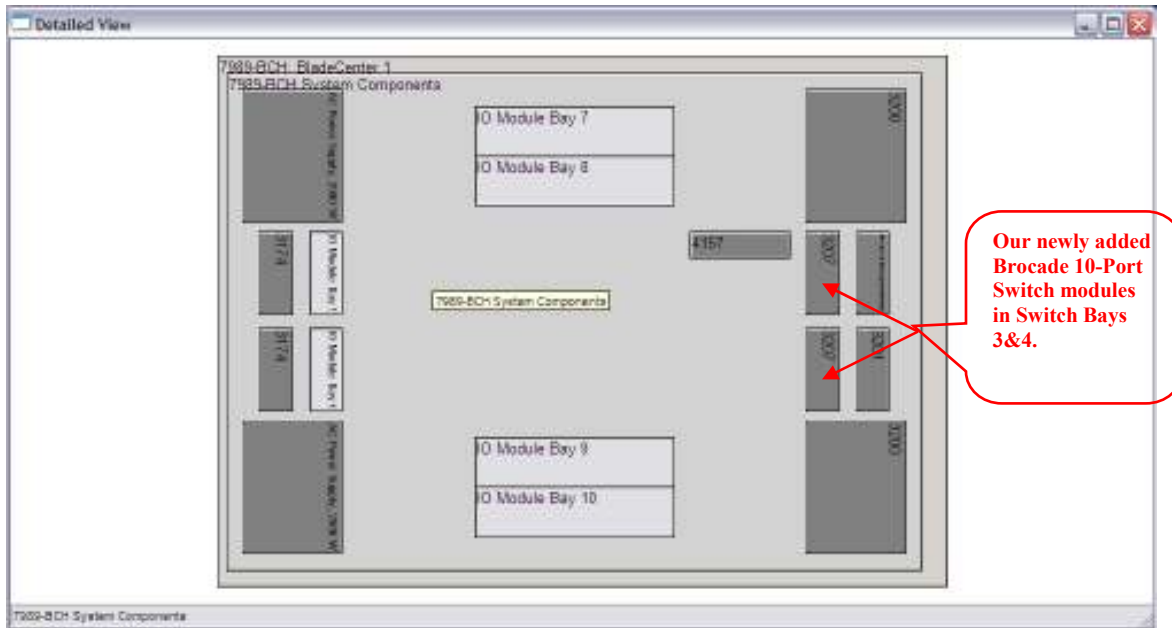
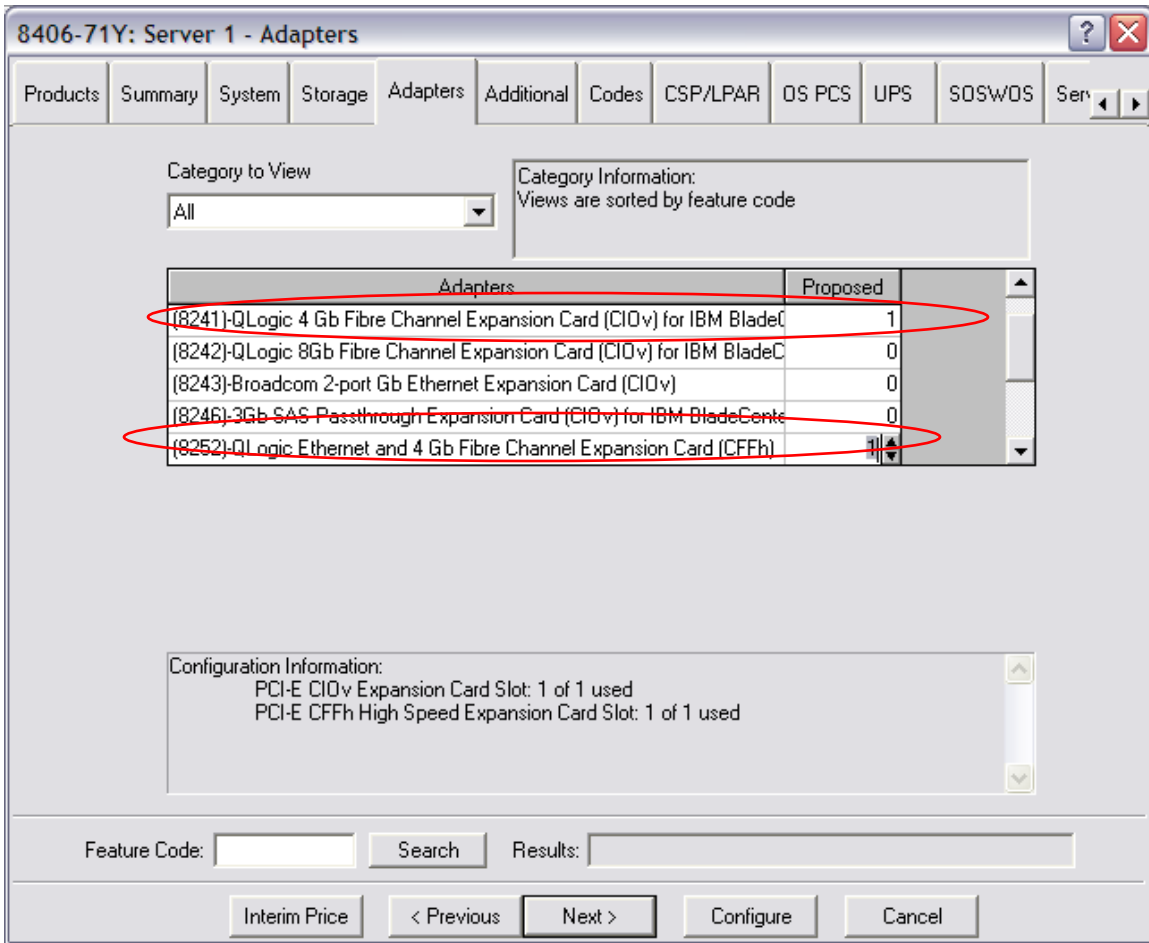


Figure 13

**Solution C: Fully Occupied Switch Bays** - This solution jumps to fourteen (14) PS701 blades in a BLADECENTER H chassis where the blades are fully populated with adapters to provide 4 Ethernet ports and 4 fiber channel ports. The chassis will be fully populated with corresponding switches to support the number of blade ports required.

In this exercise the PS701 has a wider array of expansion card options for fiber channel connectivity to the SAN. The options are now either CFFh or CIOv adapters from Emulex or QLogic. In this example to provide 4 Ethernet ports and 4 Fiber Channel ports we will configure along with the integrated Ethernet (2 ports) on the PS701, a QLogic 8Gb 2-port Fibre Channel Expansion (CIOv) card and a QLogic Ethernet and 4Gb Fibre Channel expansion (CFFh) card. This last expansion card provides 2 ports for Ethernet (hard wired to switch bays 7 & 9) and 2 ports for Fibre Channel (hard wired to switch bays 8 & 10).

Figure 14 below shows the selection of blade adapter cards for this solution.



**Figure 14**

In the chassis we will select 4 of the Cisco Ethernet Switches you saw in the earlier solutions and 4 of the Brocade 20-port 4Gb SAN Switch Modules to cover the number of blade ports we have already defined and the total number of blades (14). Again, the integrated Ethernet ports (2) are connecting to switches in bays 1 and 2 of the chassis. The (2) ports on QLogic CIOv card are connecting to switches in bays 3 & 4 and the (4) ports supplied by the QLogic CFFh card are connecting to switches in bays 7 through 10 of the chassis. To house these last 4 switches we will need (2) of the Multi-Switch Interconnect Modules (feature code 3239). Figure 15 below shows the placement of the switches we have selected.

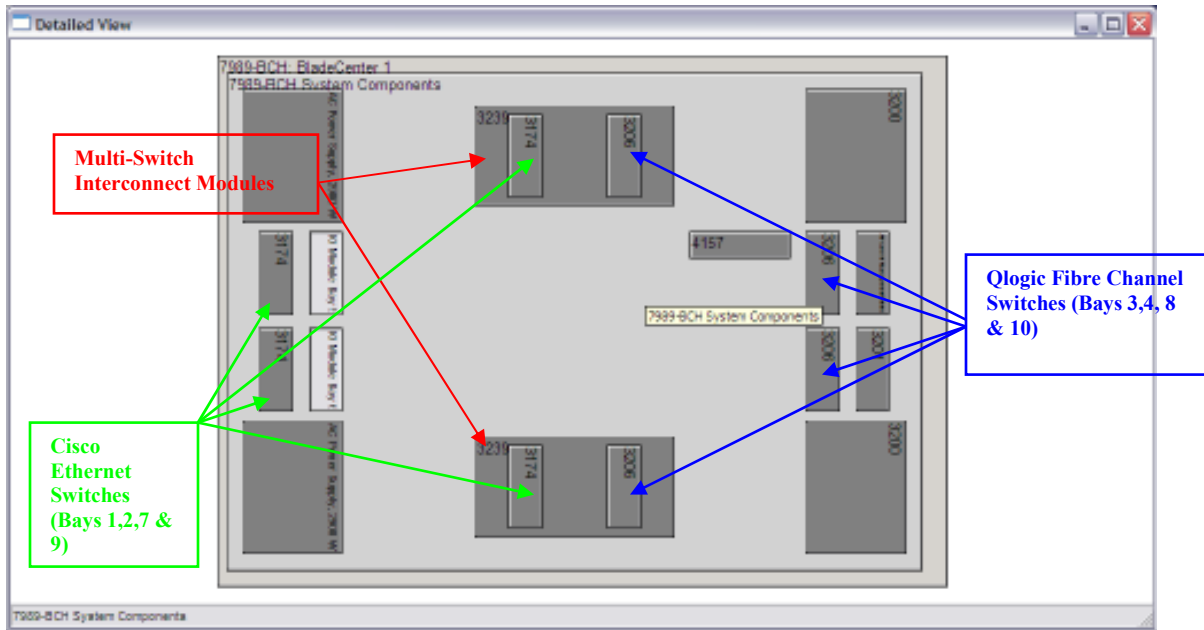
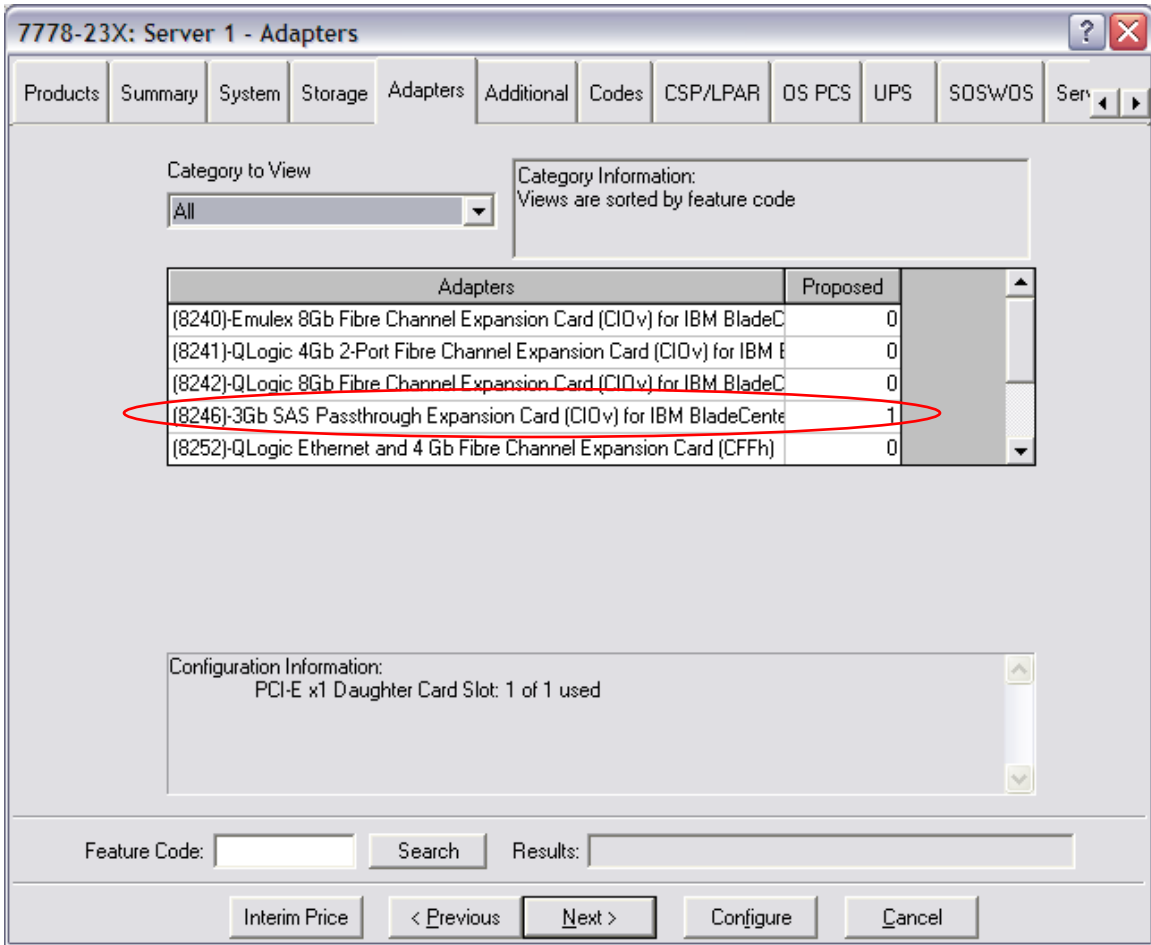


Figure 15

## B. BladeCenter S Configuration Example

**Solution D: The BladeCenter S Chassis** - This solution uses six (6) BladeCenter JS23 blades in a BladeCenter S. The intent here is to show the connectivity to an Ethernet network and to 12 internal disk drives in the BladeCenter S chassis using SAS blade adapters and SAS disk controllers in the chassis. Unlike the BladeCenter H chassis, in the BladeCenter S chassis, all of the integrated Ethernet ports from the blades are hardwired to the Ethernet switch in switch module bay 1. (See Figure 7 in Section IV). So, for the integrated Ethernet ports our rule of thumb changes in the BladeCenter S chassis. We only need the one switch to activate both ports.

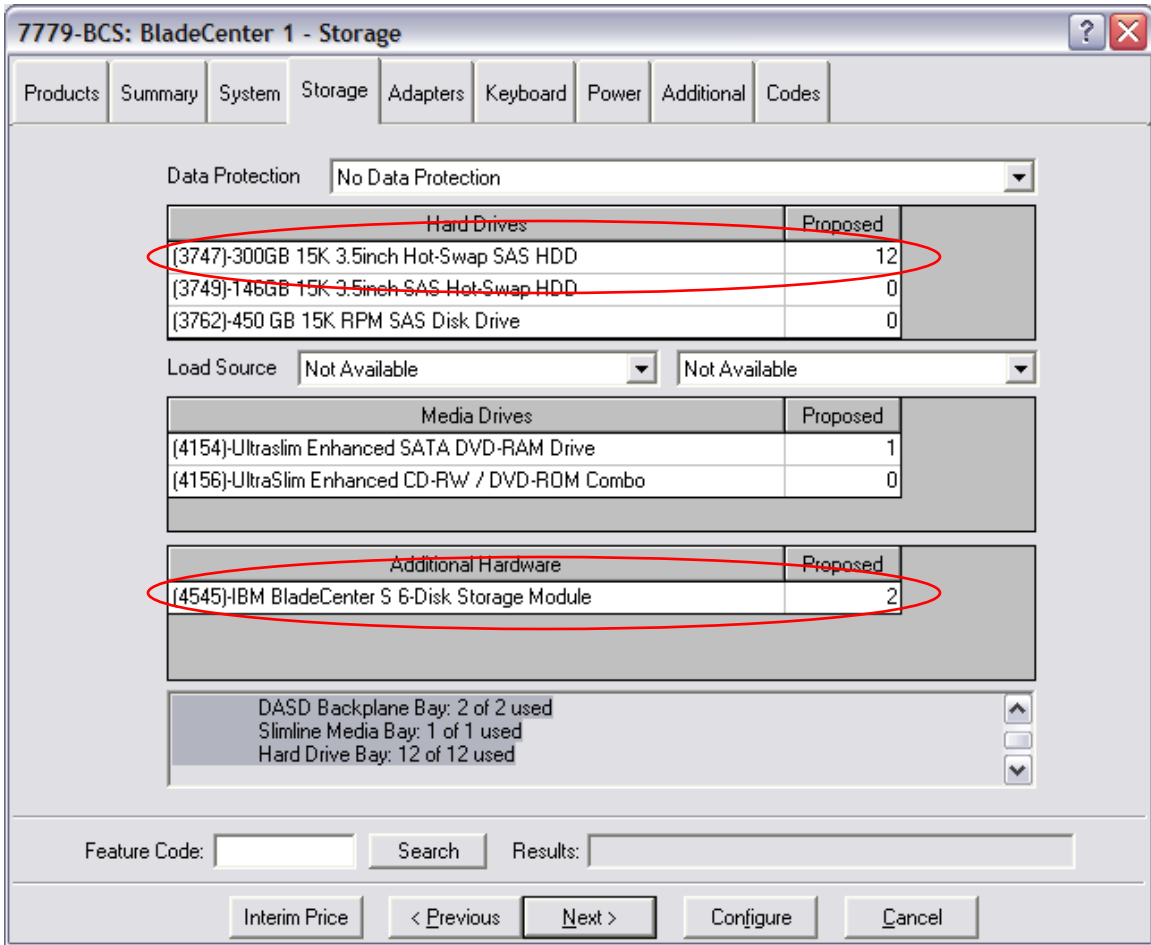
For this exercise we will configure (6) BladeCenter JS23 (the max the BladeCenter S will house). These blades will have one internal disk drive and the SAS adapter card (CIOv) feature 8246 needed to connect to the SAS controllers in the BladeCenter S. They will use only their integrated Ethernet ports for network connectivity. Figure 16 below shows the selection of the SAS adapter in eConfig.



**Figure 16**

With your 6 blades configured you now need to configure your BladeCenter S chassis. The important elements here are the Ethernet switch, the internal disk drives and the SAS controllers needed to provide the disk interface between your blade SAS card and the disk drives.

For the Storage Modules, we have chosen 12 of the 300GB disk drives (6 in each of the 2 storage modules). Figure 17 below shows those selections.



**Figure 17**

Next we configure the 2 SAS RAID Controller Switch Modules that provides the interface between your blade SAS adapter and the disk storage modules. So we have selected quantity 2 of feature code 3734. These will occupy switch bays 3 & 4 of the chassis.

Lastly select the Ethernet switch of your choice. This will be placed in switch module bay 1 and service both of the integrated Ethernet ports on your blades. We've selected the BNT Networks switch (feature code 3212). It also happens to be the default.

Your resulting chassis diagram for this solution will appear as follows in Figure 18:

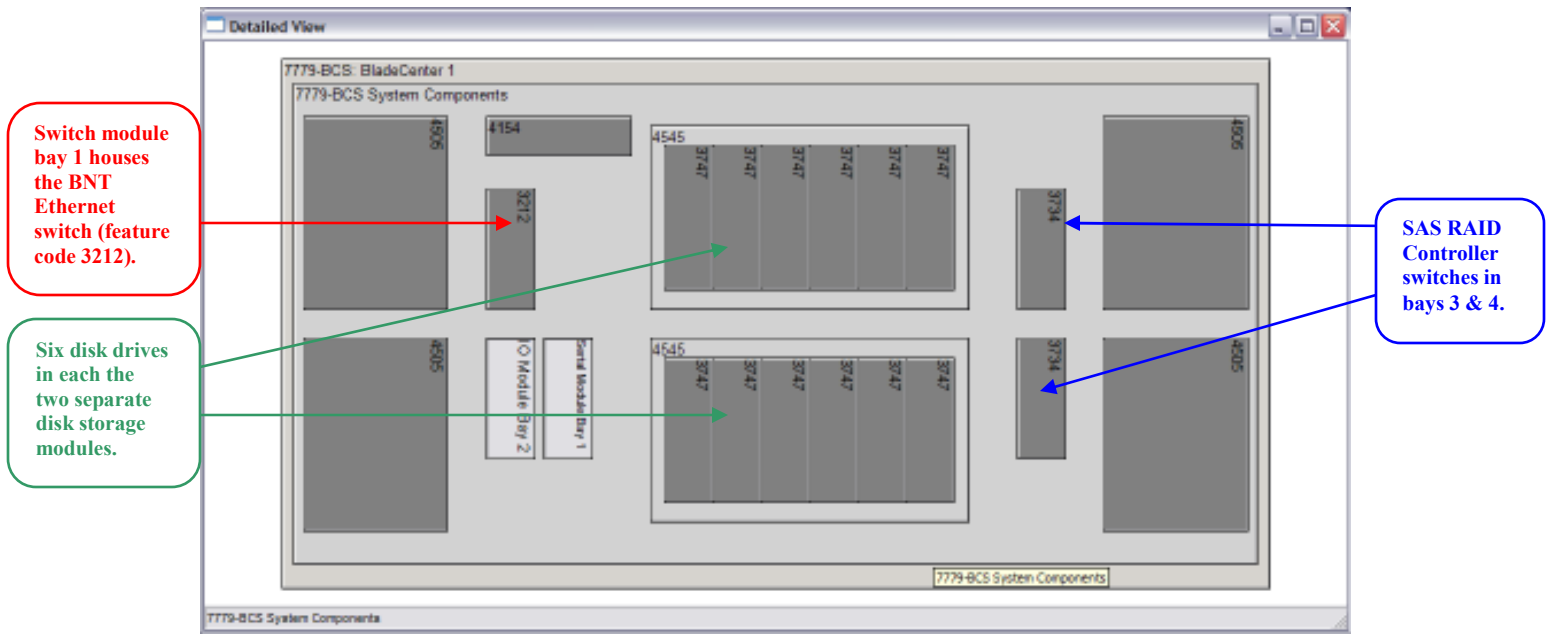


Figure 18

## VIII. Notable Switch Limitations/Issues

The following section describes **some of the known switch limitations/issues affecting the Power based blades**. The information in this section may not include every possible switch configuration issue for Power based blades therefore Retain Tips, PMRs and documentation (ie Redbooks) should be referenced for setup configuration guidance. This section also provides basic information on how to troubleshoot Ethernet and Fibre Channel I/O I/O Modules in the BladeCenter chassis. It is important to note that ALL of the I/O Modules must be initially configured from the AMM (external ports enabled, IP address assigned depending on the I/O Module, etc.). It is a Best Practice to ensure the latest level of firmware is installed on the Power Based Blades, expansion cards, the I/O Modules and the AMM.

Keep in mind that while we will find new and therefore unknown issues from time to time, the vast majority of the issues we run into are likely to have been encountered by others, and therefore documented at [ibm.com](http://ibm.com) in the Troubleshooting section of the Support pages. The simplest path is often the best, and the simplest path in troubleshooting an issue with Blade I/O is to see if the issue is known and documented, or not. Any page at [ibm.com](http://ibm.com) will have the menus seen in the following screenshots. You can easily get to a list of known issues by choosing Troubleshoot from the Support & downloads menu at the top of the web page at [www.ibm.com](http://www.ibm.com).



Figure 19

Choose the type of product you want to find out more about, in this case BladeCenter, which includes all chassis and Blades from the drop down window labeled “Choose support type”, and click on the arrow to proceed to the next section.



Figure 20

Simply select one or more items, such as chassis and/or Blade models in column one. Keep in mind that when looking for information, such as Ethernet or Storage networking, you could be looking for adapter or Blade OS/FW oriented information, which would require that an appropriate Blade model is selected, or I/O module related information, which would require than an appropriate chassis be selected from this screen.



Figure 21

Select the radio button for “**Troubleshoot**”, if it is not preselected in column 2, and click on the link to see your results.

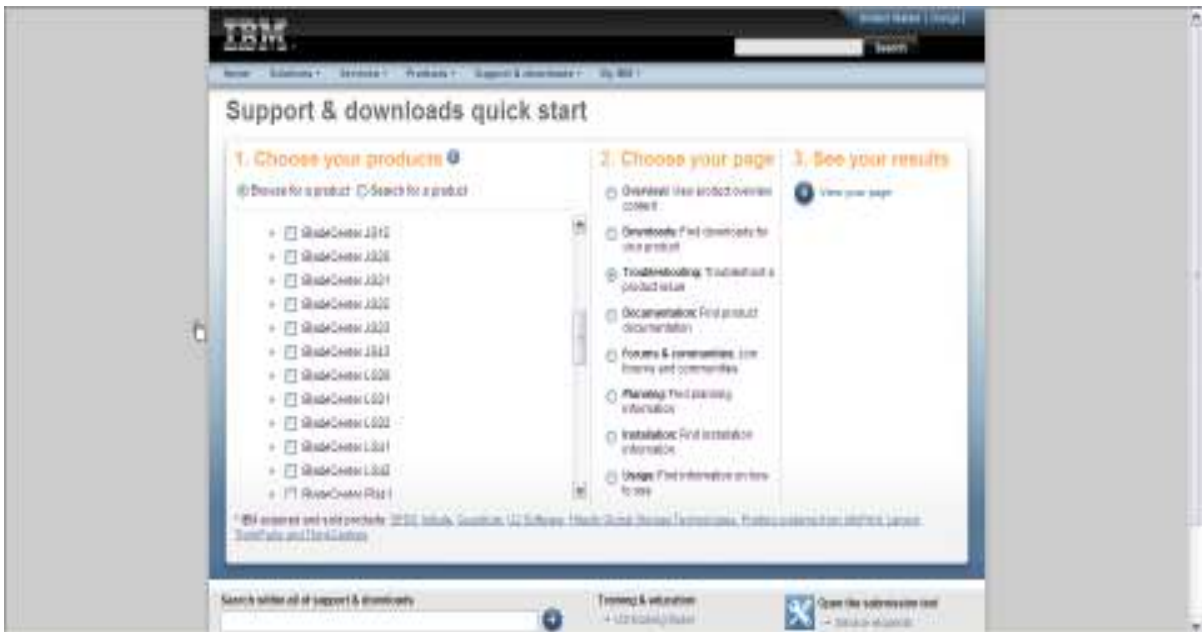


Figure 22

The Problem resolution box on the Troubleshooting page lists a few issues, but by selecting the “**More results link**” at the bottom of this box, you will get a listing of all known issues with a selected product. In this instance, the “**BladeCenter H**” is the only selected product.





Figure 23

You can then further narrow the results by Operating System as well as area of interest, such as networking if you are looking for information regarding known issues surrounding Ethernet products.

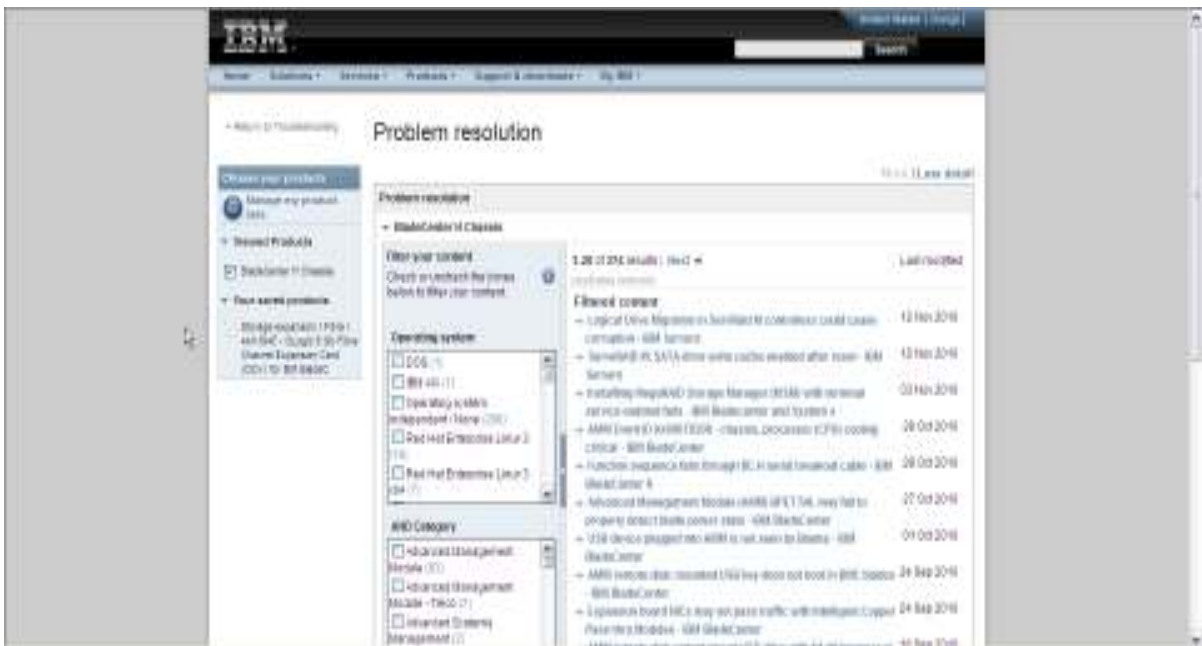


Figure 24

Simply by selecting “**Networking**” from the “**AND Category**” box, we’ve narrowed the possible number of known issues pertaining to the BladeCenter H chassis, or chassis components for the BladeCenter H chassis, from around 374 results, to just over 50.



Figure 25

## A. Ethernet Switch Modules

The following are some of the known Ethernet Switch Module issues:

### BNT/Cisco Stacked Ethernet Switches

Currently there is an issue with SoL on Power based blades with stacked switches when ent0 is used as part of EtherChannel (Link Aggregation only). Due to blade limitation, SoL is not available when ent0 is configured as part of a Link Aggregation.

### 10GB switches with a single 1GB uplink

It is important to remember that switches with 10Gb uplink(s) that have a single 1GB uplink port installed are capable of delivering more bandwidth from multiple blades than can be reliably sustained across a 1GB link to an external target. As a result, if proper application sizing is not done blades could send or receive more Ethernet I/O than the 1GB interface is capable of handling, which could result in packet loss. This should not be seen in environments where applications are not capable of generating more than a 1Gb link can reliably manage.

### Cisco 3110G, 3110X and 3012

With the 3110G, 3110X, and 3012 switches the blade onboard NIC and switch may not negotiate the link successfully. To resolve this configuration the command “speed non-negotiate” should

be added to the switch. This will force the link up when it detects a NIC present. This issue only affects the onboard NICs.

## B. Fibre Channel Switch Module issues

The following are some of the known Fibre Channel Module issues:

- When using the 4Gb switch module with the BladeCenter T chassis, the internal ports operate at 2Gbps and the external ports operate at 4Gbps
- When using the 4Gb switch module with the BladeCenter HT unit in standard I/O bays, the internal ports operate at 2Gbps and the external ports operate at 4Gbps
- When using the 4Gb switch module with the BladeCenter HT unit in MSIM-HT, the internal ports operate at 4Gbps and the external ports operate at 4Gbps
- Intelligent Pass-thru Modules cannot connect directly to storage
- The QLogic 8Gb Intelligent Pass-thru Module cannot be upgraded to a full switch

## C. Troubleshooting issues with Ethernet Switch Modules

The following are some of the things you can check to help you resolve issues with Ethernet Switch Modules:

- Ensure the External Ports for all of the I/O Modules have been enabled from the AMM to ensure connectivity outside of the Chassis
- Make sure you preserve the IP configuration on reset
- Ensure the downstream ports are not configured for EtherChannel when configuring NIB  
When configuring Link Aggregation ensure the downstream ports are configured for EtherChannel
- It is generally considered a best practice to put the AMM ports, as well as internal I/O Module ports designed for connectivity to the AMM through the I2C bus on the chassis mid-planes, on a different subnet and VLAN from the blade NICs and external, or uplink, ports on the Ethernet switches to avoid looping scenarios

The following table lists some helpful commands for Cisco and BNT switches:

Comment	Cisco IOS CLI	BNT AOS CLI	BNT AOS is CLI
Show running config	<i>show run</i>	<i>/cfg/dump</i>	<i>show run</i>
Dump of information for use by technical support teams	<i>show tech</i>	<i>/maint/tsdmp</i>	<i>show tech</i>
Show information on VLANs	<i>show vlan</i>	<i>/info/l2/vlan</i>	<i>show vlan</i>
Show status of all ports	<i>show int status</i>	<i>/info/link</i>	<i>show int link</i>
Show information about any aggregations	<i>show eth sum</i>	<i>/info/l2/trunk</i> <i>/info/l2/lacp/dump</i>	<i>show portchannel info</i> <i>show lacp info</i>

Comment	Cisco IOS CLI	BNT AOS CLI	BNT AOS is CLI
Show information about individual port status (example port 1)	<i>show int g1/0/1</i>	<i>/stats/port 1/if /stats/port 1/ether</i>	<i>show int port 1 interface-counters show int port 1 ethernet-counters</i>

**Table 23 – Fibre Channel Switch commands**

## D. Troubleshooting issues with Fibre Channel Switch Modules

The following are some of the things you can check to help you resolve issues with Fibre Channel Switch Modules:

- Ensure the External Ports for all of the I/O Modules have been enabled from the AMM to ensure connectivity outside of the Chassis
- To manage the Fibre Channel Switch Modules from the Switch make sure you “**Enable**” the “**External management over all ports**”. Also make sure you preserve the IP configuration on reset
- If the port on the blade does not become active ensure you are using a supported Fibre Channel Expansion Card
- If the port on the adapter is active but the storage is not accessible, ensure the zoning is configured properly
- If a port is still not available on a blade verify the license (ie if the blade is in Bay 8 verify you have a 20-port license instead of a 10-port license)
- For OS installation, you only want the server to see one path to the boot LUN

## IX. References

### **IBM Power Based Blade Wiki**

<https://www.ibm.com/developerworks/wikis/display/WikiPtype/POWER+Blades>

### **IBM BladeCenter PS700, PS701, and PS702 Technical Overview and Introduction -**

<http://www.redbooks.ibm.com/abstracts/redp4655.html?Open>

### **IBM BladeCenter JS12 and JS22 Implementation Guide -**

<http://www.redbooks.ibm.com/abstracts/sg247655.html>

### **IBM BladeCenter Products and Technology Guide -**

<http://www.redbooks.ibm.com/redpieces/pdfs/sg247523.pdf>

### **IBM ServerProven Support Website –**

<http://www-03.ibm.com/servers/eserver/serverproven/compat/us/eserver.html>

<https://www-03.ibm.com/servers/eserver/serverproven/compat/us/blade/8852.html>

### **Installation and User's Guide – IBM BladeCenter E –**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-45152>

### **(BladeCenter E) Hardware Maintenance Manual and Troubleshooting Guide –**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-50053>

### **Planning Guide - IBM BladeCenter S -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073632>

### **(BladeCenter S) Installation and User's Guide - IBM BladeCenter S –**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073635>

### **Installation and User's Guide - IBM BladeCenter H -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-63306>

### **(BladeCenter H) Problem Determination and Service Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-63570>

### **Installation and User's Guide - IBM BladeCenter HT -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5071317>

### **(BladeCenter HT) Problem Determination and Service Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5071591>

**BNT switch documentation -** <http://www.bladenetwork.net/IBM-BladeCenter-support.html>

**Forum for asking questions about BNT switches -** <http://www.bladeswitching.com>

### **BNT Layer 2-3 GbE Switch Module Installation Guide -**

[http://publib.boulder.ibm.com/infocenter/bladectr/documentation/index.jsp?topic=/com.ibm.bladecenter.io\\_32R1861.doc/io\\_c\\_esm\\_bnt\\_32R1861\\_product\\_page.html](http://publib.boulder.ibm.com/infocenter/bladectr/documentation/index.jsp?topic=/com.ibm.bladecenter.io_32R1861.doc/io_c_esm_bnt_32R1861_product_page.html)

### **BNT Layer 2-3 GbE Switch Module Application Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-58325>

### **SmartConnect User's Guide for BNT L2-3 GbESM -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5074970>

### **BNT Layer 2-7 GbE Switch Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-53065>

### **BNT Layer 2-7 GbE Switch Module Application Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-53098>

### **Nortel 10Gb Uplink Ethernet Switch Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-64158>

### **Nortel 10Gb Uplink Ethernet Switch Module Application Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-64687>

### **BNT 1/10Gb Uplink Ethernet Switch Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5076217>

**BNT 1/10Gb Uplink Ethernet Switch Module Application Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5076214>

**BNT 1/10Gb Uplink Ethernet Switch Module Command Reference -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5076525>

**10Gb Ethernet Pass-Thru Module**

<http://www.redbooks.ibm.com/abstracts/tips0715.html>

**BNT**

- **10-port 10Gb Ethernet Switch Module Installation Guide**

- **Application Guide**

- **Command Reference**

- **isCLI Reference**

- **BBI (Browser-based Interface) Quick Guide**

- **Release Notes**

- **End User License Agreement**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5080917>

**Cisco Catalyst Switch Module 3110 and 3012 System Message Guide**

**Cisco Catalyst Switch Module 3110 and 3012 Software Configuration Guide**

**Cisco Catalyst Switch Module 3110G, 3110X, and 3012 Hardware Installation Guide**

**Cisco Catalyst Switch Module 3110G, 3110X, and 3012 Getting Started Guide**

**Cisco Catalyst Switch Module 3110 and 3012 Command Reference**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5075938>

**IBM Server Connectivity Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-64155>

**IBM Server Connectivity Module User's Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-64190>

**Brocade 4 Gb SAN Switch Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-62707>

**QLogic 4 Gb Fibre Channel Switch Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-58197>

**QLogic 4 Gb Intelligent Pass-thru Module and 4 Gb SAN Switch Modules Getting Started Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5071313>

**QLogic 4 Gb Intelligent Pass-thru Module and 4 Gb SAN Switch Module for IBM Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5071303>

**QLogic 8 Gb Intelligent Pass-thru Module and 20-port 8 Gb SAN Switch Module Installation and User's Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5079302>

**SAS RAID Module Documentation**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5078491>

**Intelligent Copper Pass-thru Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5076328>

**Installation and User's Guide Multi-Switch Interconnect Module - IBM BladeCenter -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5070476>

**Multi-Switch Interconnect Module Installation Instructions - IBM BladeCenter HT -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073195>

**IBM BladeCenter Advanced Management Module Installation Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073392>

**IBM BladeCenter Advanced Management Module User's Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073887>

**Advanced Management Module Command Line Interface Reference Guide -**

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-54667>