IBM Systems & Technology Group

IBM BladeCenter

Unleash the power of your IT

Mike Easterly
Americas BladeCenter Product Manager

January 8, 2007

STG skills mastery
skills for success

Agenda

The smarter choice - BladeCenter

Complete Portfolio Review

- With New Product Overview

Power Cooling Leadership

IBM BladeCenter simply the logical choice

Reason 1: IBM BladeCenter requires less power and cooling

TCO dropping energy efficiency

Reason 2: IBM's Intelligent Fabric Architecture offers more bandwidth and adaptability

Extract the most from your applications

Reason 3: IBM offers more flexibility and choice in creating a customized infrastructure and industry solutions

Harness the innovative power of the industry

Reason 4: IBM believes preserving system investment with compatible chassis is an important objective

Preserve investment and speed adoption

In the Race to be the Best we lead

2002	2003	2004	2005	2006
	Took #1 Share #1 with Integrated Fibre	Two chassis one architecture #1 with Integrated IB	Power/cooling Dominance #1 in Industry cooperation #1 in 4Gb full fabric 500K+ blades	Three chassis still one architecture #1 in high speed - 10Gb uplink & 4X IB #1 in 8 core processing
Launch BC Intel Blade Integrated Ethernet Calli. Vector Cooling Management Module	2Gb Fibre	BladeCenter T PowerPC blade 1X InfiniBand Myrinet	Open Spec PowerExecutive AMD Blade 4Gb Fibre	Cell Blade Blade.org BladeCenter H 10G Fabrics Quad Core 4X InfiniBand AMM

Now it's the time to widen the lead

IBM

#1 with 10Gb Fabrics

I/O leadership

High speed NGN chassis

IBM

Powerful new ways to reduce TCO

Simplified management

IBM

New uses for time tested technology

Right sized solutions for the SBM

Complete I/O control

IBM

The Continued building on a simply smarter architecture

2007

Launch I/O bridges

Virtual Fabric Architecture

10Gb full fabric

BCHT

True transparent switching

Hosting workstations with BladeCenter

SMB chassis

SMB focus blades

B.A.M.

5 year anniversary of an idea that changed IT

Five Years of Durable Infrastructure

Foundation for Success

BladeCenter

- Announced in 2002 with Gb Ethernet support
- 2Gb Fibre Channel support in 2003
- 1X InfiniBand support in 2004
- 4Gb Fibre Channel support in 2005
- 5 generations of Intel Xeon processors including latest Quad Core
- 2 generations of PowerPC processors
- 2 generations of AMD processors
- Cell Processor in 2006, more in 2007
- 10Gb uplink enablement in 2006
- Advanced Management Module in 2006

Entering Year

Compatibility is the foundation for smarter IT

BladeCenter H

The Foundation is Solid - Build Better IT Now

One year ago we introduced BladeCenter H

- 10X the I/O performance
- 2X the I/O connectivity
- 2X the I/O capacity
- Built-in hardware based I/O virtualization
- Open Management Module

Today we further unleash the power of BladeCenter H

- Fastest I/O throughput available
- Doubling of the ports per blade
- Leadership in concurrent fabric support
- Simplify everything with a complete I/O virtualization solution
- Smartest power management solution available

Introducing Virtual Fabric Architecture

- In 2006 we delivered impressive advances in processor technology
  - Dual core AMD Rev F
  - Dual and Quad Core Intel Xeon
  - The eight processing core Cell
  - Dual core PowerPC

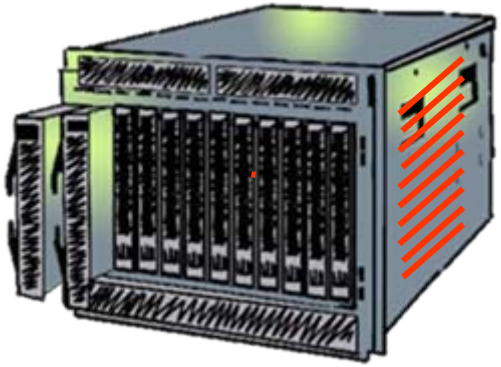
2006 was the year of the processor

- These processors allow us to do things with dual socket x86 servers not possible just one year ago
  - HPC applications
  - IPTV and Web 2.0
  - Virtualization
- A smarter I/O architecture is needed to provide these new applications the horsepower they need to excel
  - More fabrics into each blade
  - Faster fabrics to the blade and chassis
  - Better way to deploy and manage I/O
  - Better availability

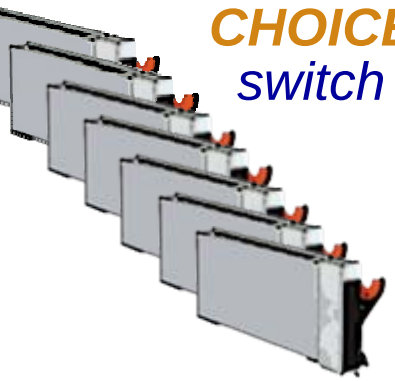
2007 is the year of I/O Advancement

Virtual Fabric Architecture - unleash your solution

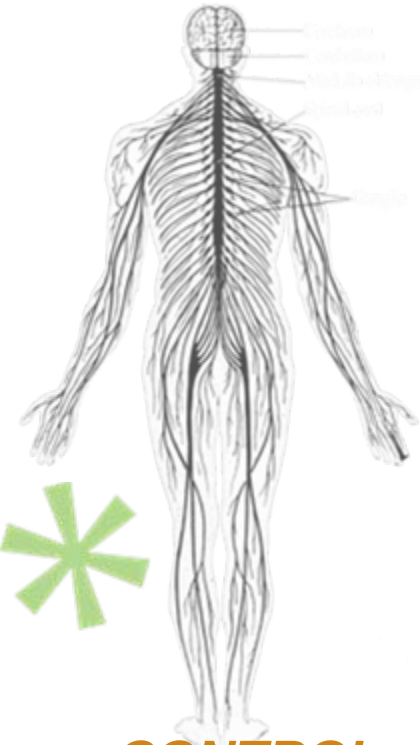
The ABCs of smarter I/O architecture



More **BANDWIDTH** – 43% more chassis bandwidth than HP



CHOICE- twice HP's switch ecosystem



CONTROL- open, multi-vendor, powerful virtualization

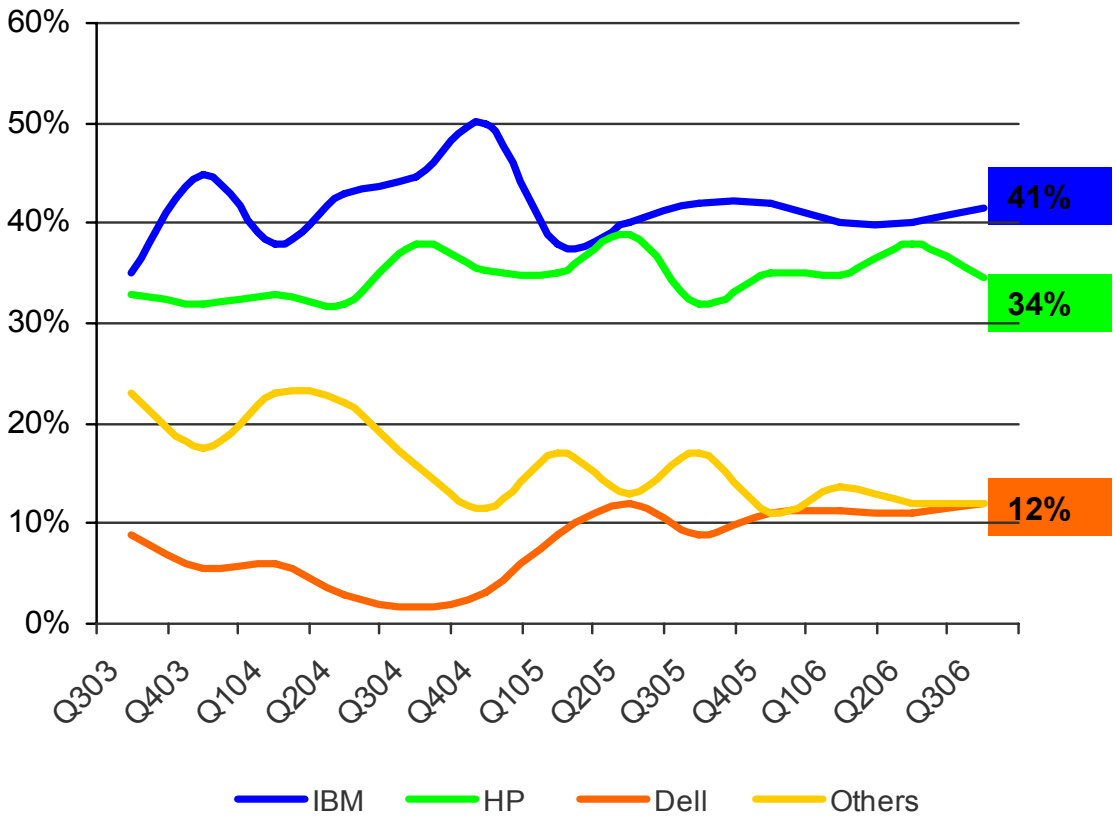
Complete end to end **AVAILABILITY** unlike HP

Redundant connectors

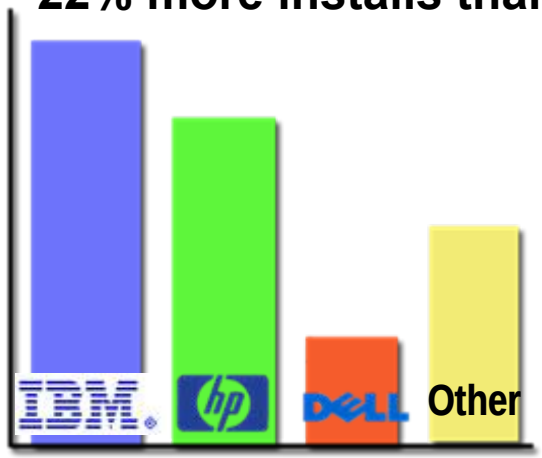
Twice the high speed switch **CONNECTIVITY** than HP

IBM Leadership in Blades

#1 for 13 consecutive quarters



22% more installs than HP



- Dell and HP rack clients converting to smarter IT with BladeCenter
- HP no track record of success in Blades
- Blades simply do not fit Dell's 'ship it quick' model

Source: IDC Quarterly Server Tracker, 11/2006

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IBM BladeCenter
Portfolio Review

Section content
Chassis update
Blade update
Expansion Blades
Networking - Ethernet, InfiniBand
Virtualizing I/O
Storage - Fibre, iSCSI,

January 8, 2007

Blades are not just about servers

Application | Environment/Performance | Data Center

Microsoft redhat
HS21 2-way Xeon
Novell. vmware
AMD Opteron L21
SOLARIS suse
AMD Opteron L41
AIX L
JS21 PowerPC

IBM + Partners

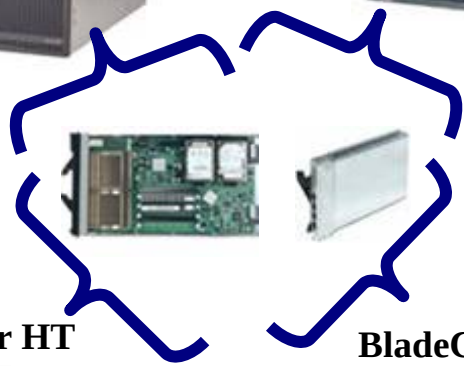
BladeCenter T

BladeCenter HT

BladeCenter

BladeCenter H

IBM



BROCADE
Myricom
Cisco Systems
QLOGIC
NORTEL NETWORKS

IBM + Partners

BladeCenter delivers a single IT building block

Building Choice – IBM Chassis Portfolio

2002-2008

BladeCenter

- 7U design
- Up to 14 blade bays
- Highest density up to 84
- Lowest cost
- Lowest Power
- Support 10GB Uplinks
- Support 4GB FC

2004-2008

BladeCenter T

- 8U design
- Up to 8 blade bays
- AC or DC models
- NEBS Compliant
- Rugged
- Support 10GB Uplinks
- Support 4GB FC
- Ideal for Telco, Military and dirty floor

2006-2009+

BladeCenter H

- 9U design
- Up to 14 blade bays
- Extreme performance
- Up to 10GB midplane
- I/O flexibility up to 8 switch bays
- Support 30mm blades with up to 8 ports
- Support 10GB Ethernet
- Support 4x InfiniBand

2Q2007-2010+

BladeCenter HT

- 12U design
- Up to 12 blade bays
- AC or DC models
- NEBS Compliant
- Rugged
- Extreme performance
- Up to 10GB midplane
- I/O flexibility
- Support 10GB Ethernet
- Support 4x InfiniBand
- Telco/Military/dirty floor

One family, many applications, many environments, long term investment protection - our form factor will stay the same

BladeCenter (8677)
Extreme density for today's technologies

- Ability to support up to 84 blades per 42U rack vs. 56
- Can support the following blades:
  - All HS21 (8853) models
  - All LS21/LS41 – Ideally 68W
- Up to 4Gb fabric
  - Up to 4 switches
- Redundant ports on each Blade
- Redundant path midplane
- Built on the open aMM
- Supported by the complete BladeCenter ecosystem
- Best power and cooling efficiency
- Lowest priced chassis

14 Blades packaged in 7U

Today's fabric support + high speed

No single point of failure

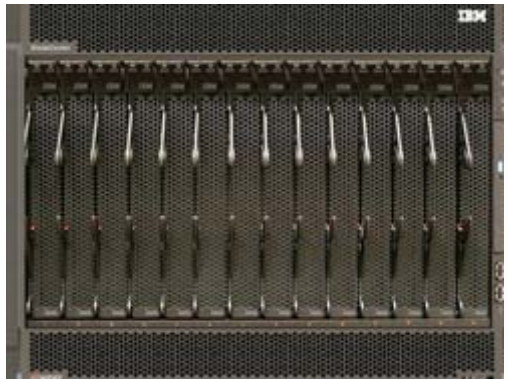
Advanced Management Module

Designed for 2007+ processor support

BladeCenter H

High performance and New Features but Fully Compatible

- Up to a 10X bandwidth
- 2x the ports to each Blade
- Built on the open AMM
- Completely compatible with all existing blades and switches
- I/O flexibility with 8 switch bays & two additional bays
- Supported by the complete BladeCenter ecosystem
- Power and cooling efficiency
- Future-proof
  - I/O
  - Power
  - Cooling
  - Built in I/O Virtualization



14 Blades packaged in 9U

All of today's fabric support + high speed

No single point of failure

New Advanced Management Module

Designed for 2007+ processor support

BladeCenter T

High performance and New Features but Fully Compatible

- Ability to support up to 40 blades per 42U rack vs. 36
- Can support blades the following blades:
  - All HS21 (8853) models
  - All LS21/LS41 – Ideally 68W
- Up to 4Gb fabric
  - Up to 4 switches
- Redundant ports on each Blade
- Redundant path midplane
- Built on the open aMM
- Supported by the complete BladeCenter ecosystem
- Best power and cooling efficiency
- Lowest priced chassis

8 blades in 8U chassis

Full Telco Specs

Manufacturing Dirty Floor environments

Ideal for ruggedized environments

No single point of failure

IBM BladeCenter HT

Next Gen performance for Next Gen Networks

- **Increased Performance and Scalability**
  - **12U Rack Mount, 12 Blades**
  - **High Speed Fabric support – up to 4x10G per blade server**
  - **Supports BC traditional fabrics**
- **Telco Ready**
  - **DC and AC Power configurations**
  - **NEBS Level 3 (Class A) / ETSI Compliant**
  - **Cable Management trays**
- **Rugged**
  - **Front-to-rear cooling supporting temperatures of up to 50C**
  - **Air filtration**
- **Supports BladeCenter ecosystem**
- **Improved Serviceability**
  - **Front access for blades, switches mgmt, media ports**

Merging the enterprise and the core network

Industry standard, time to market technology

Cutting edge I/O and processor performance

Telco + Military, medical, government, long life, extended operation range

What is Inside - Server Blades

Flexibility, Choice, Continued Support

HS21 2-way Intel

Features:

Intel Xeon™ EM64T dual- and **quad-core**

2 socket, dual core

Expandable to 32GB memory

10G capable

Supports Windows, Linux, Solaris, Netware, VMWare

Target Apps:

32 & 64-bit

Edge & core network applications

Enterprise workloads

Database & ERP

LS20/21/41 AMD

Features:

AMD Opteron™ Processors

Integrated Memory Controller

Delivers true SNP scalability

- LS20: 2 socket, Rev E
- LS21: 2 socket, Rev F
- LS41: 4 socket, Rev F

10G capable

Supports Windows, Linux, Solaris, Netware, VMWare

Target Apps:

32 & 64-bit

HPC and BPC

Memory intensive

JS20/21 PowerPC

Features:

Dual PowerPC™ 970 processors

64-bit performance at IA32 price

Performance for VMX deep computing clusters

NEBS3/ETSI capable

Supports Linux and AIX

10G capable

Target Apps:

32 & 64-bit

Telco

HPC

Web Serving

QS20 Cell BE

Features:

Dual Cell BE processors

Nine cores per processor

Extreme performance for highly parallel applications

Support 1G Enet and IB

Supports Open Source Linux

Target Apps:

Digital media

Medical imaging

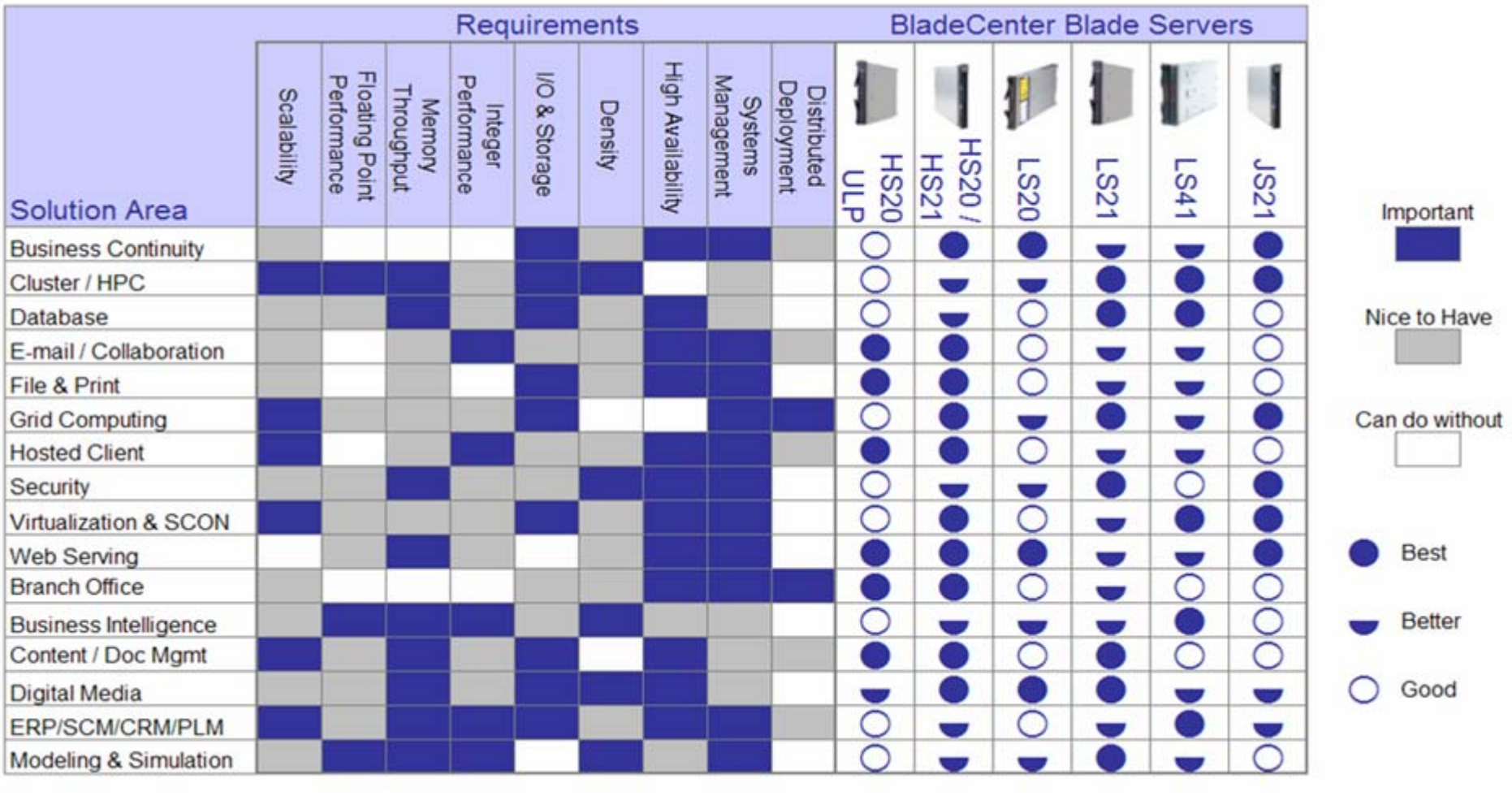
Communications

Other parallel, high bandwidth applications

Common Chassis and Infrastructure

The Right Tools for the Job

Flexibility to Cover Your Business Needs



Addressing IT Challenges Head On

Reduce Costs, Improve Business Continuity & Responsiveness

More Performance Less Space

- Fast Applications
- More Users
- Low Power consumption
- Easy to cool servers
- Dense Data Centers

Energy Efficient Performance

More Technology Fewer Risks

- Advanced Technology
- Compatible Designs
- High Data Integrity
- Investment protection
- Reliable Uptime

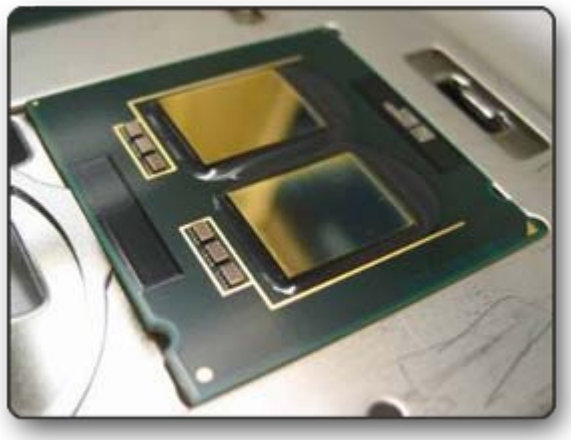
Stable and Reliable

Doing More With Less

- Boost Utilization
- Reduce Costs
- Improve Flexibility
- Performance Headroom
- Software Compatibility

Built for Virtualization

Affordable Technology



65nm manufacturing

Dual-Die implementation

Quad-Core Performance Dual-Core Prices

CPU price[1]	Dual-Core	Quad-Core
$1172		X5355*
$851	5160	E5345
$690	5150	E5335
$455	5140	E5320
$316	5130	E5310
$256	5120	
$209	5110	
$177	5050	

Affordable, Available, Advanced Technology

* Future Offering in BladeCenter Portfolio ** Source: Intel projections

[1] Source: Intel. Pricing reflects 1k unit price to OEMs on December 10, 2006

Expect Performance

Estimates for the HS21 Xtended

Solid performance benchmarks from Intel Xeon 5100 along with significant improvements in Quad core Intel Xeon 5300

	Intel Xeon 5100 Series				Intel Xeon 5300 Series			
	Freq	Int rate	Fp rate	Tpc-c	Freq	Int rate	Fp rate	Tpc-c
Bin+1					2.66/1333	**198**	**101**	**234**
Bin	3.00/1333	**120.0**	**80.7**	**155.0**	2.33/1333	**183**	**96.7**	**230**
Bin-1	2.66/1333	**107.9**	**76.5**	**150.8**	1.86/1066	**147**	**78**	**205.5**
Bin-2	2.33/1333	**95.8**	**72.0**	**144.6**	1.60/1066	**131**	**74.8**	**201.1**
Bin-3	2.00/1333	**83.6**	**67.4**	**137.1**				
Bin-4	1.87/1066	**80.2**	**60.7**	**125.4**				
Bin-5	1.60/1066	**71.6**	**57.7**	**118.4**				

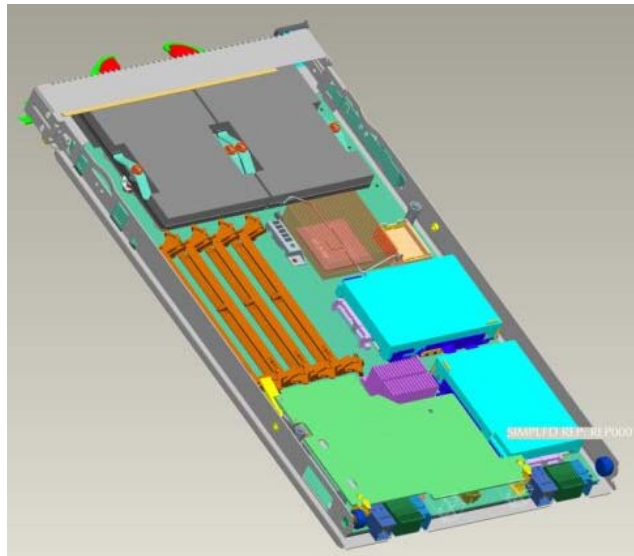
This sort of performance increase combined with relatively small power increase deliver on the promise of better performance from each kW provided to the rack

Intel is delivering leadership across most every application/ benchmark with the combination of Intel Xeon 5100 and Intel Xeon 5300

BladeCenter HS21 Single Wide

Maximum Density and Functionality for Most Applications

- The 30MM High Density Offering
  - 4 FB DIMMs (up to 16GB of memory per blade)
  - 2 Non Hot Swap SAS HDD
  - 2 NICs - Broadcom 5708S (TOE enabled)
  - 2 I/O connectors – CFF cards allow up to 2x the ports per blade
- Types of processors – Support in all IBM chassis at full density
  - Intel Xeon 5100 – Dual Core
    - 1.60-2.66Ghz @ 65W and 3.0Ghz @ 80W
  - LV Intel Xeon Dual Core - best for power constrained customers
    - 40W 2.33Ghz or 35W 2.13Ghz (NEBs)
  - Intel Xeon 5300 – Quad Core
    - 1.66-1.86Ghz 1066MHz
    - 2.0-2.33GHz 1333MHz GA 2/23
- Exp – Memory & I/O, Storage & I/O or PCI Exp Module



Two Drives - up to 292GB
Up to 8 ports/blade Std.
Industry leading expansion

BladeCenter Driving Efficiency

Leadership Performance Per Watt

The alternatives	Power/ Blade	SpecINT rate	Int/Watt	SpecFP rate	FP/Watt
IBM HS20 3.8Ghz 2MB L2 cache	**340W**	**43.1**	**.127**	**33.7**	**.099**
IBM HS20 2.0GHz ULP	**180W**	**57.9***	**.322**	**30.9***	**.172**
IBM HS21 2.66Ghz 4MB L2 (65W DC)	260W	109	.42	76.5	.29
IBM HS21 3.00Ghz 4MB L2 (80W DC)	305W	119	.39	80.7	.26
IBM HS21 2.33Ghz Quad Core (80W)	305W	183	.59	96.7	.32
IBM HS21 2.66Ghz Quad Core (120W)	400W	198	.48	101	.25
HP BL35p 2.2Ghz DC Opteron (68W)	**270W**	**66.8**	**.247**	**55.3**	**.205**
HP BL25p 2.4Ghz DC Opteron (95W)	**400W**	**73.6**	**.184**	**74.6**	**.187**
Dell PowerEdge 1855 2.8GHz DC Xeon	**500W**	**58.9**	**.118**	**N**	**N/A**
IBM LS21 2.6Ghz Rev F dual core Opteron	240W	81	.34	89.1	.37
HP DL360Gx 3.0Ghz 4MB L2 (DC) 1U	**435W**	**119**	**.087**	**32.9**	**.067**

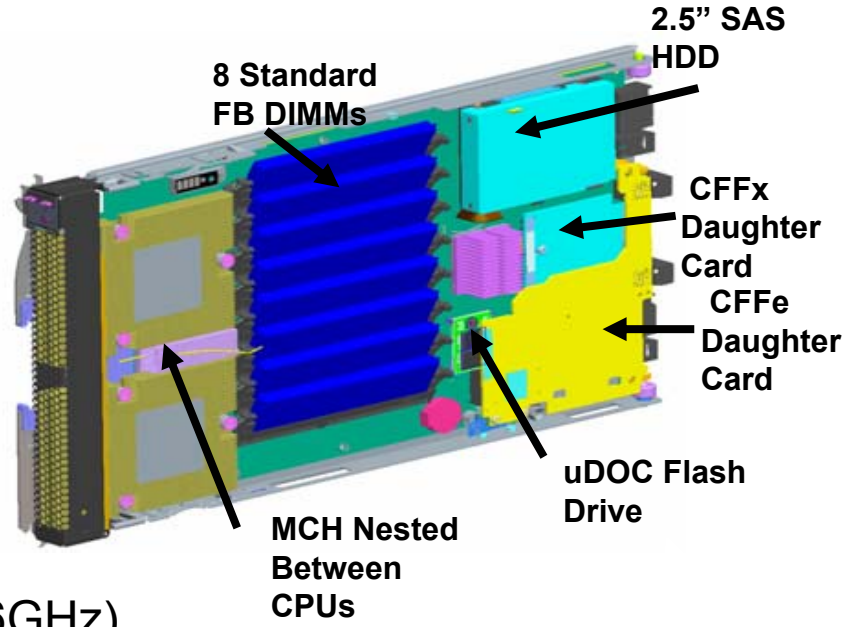
The fastest processor is not always the right choice in a power constrained environment

- Look to performance efficiency rather than raw leadership performance for best utilization of scarce data center resources
- 2.66GHz 65W WC easily beats the 3.00Ghz 80W part in delivering most performance/kW
- 2.33GHz 80W Quad Core beats the faster 2.66GHz 120W part in al benchmarks for perf/watt

BladeCenter HS21 XM (extended memory)

Maximum Density and Exceptional Performance

- The Base HS21 XM
  - 8 FB DIMMs (up to 32GB per blade)
  - Non Hot Swap SAS HDD (36/73/146GB)
  - 2 NICs - Broadcom 5708S (TOE enabled)
  - 2 I/O connectors - CFF cards allow up to 2x the ports per blade
  - Diskless ready
    - iSCSI and SAN boot for all OS
    - Support IBM Modular Flash Device 4GB at launch, 8GB mid 2007)
  - Two types of processors
    - 65W Intel Xeon 5100 Dual core (1.6-2.66GHz)
      - Supported in all chassis
    - 80W Intel Xeon 5160 (3.0Ghz) Dual core & Intel Xeon 5300 Quad core (1.6-2.33GHz)
      - Supported in BCH (BC1 8677 is TBD)
  - Supports PEU2 and SIO Expansion Units



Start shipping end Feb
Ideal for boot from ….
Exceptional performance

Why Flash Now?

- Flash ready for prime time
  - Prices falling 50% annually; with capacity doubling every 9 months
  - The consumer market will drive even greater innovation
- 24/7 reliability and availability thanks to read/write leveling
- Extremely low power consumption – cost savings
- Small foot print
- Ability to replace 2 HDDs with a single flash device
  - Potentially reduced cost
  - Some might consider for less expensive scratch disk
  - Most Linux OS images are will fit 4GB
- Proven technology from IBM's Telecom experience
  - NEBS Level 3 compliant for ultra rugged application

Why not to RAID 1

Buy two HDDs

Utilize 5-10% of the total capacity

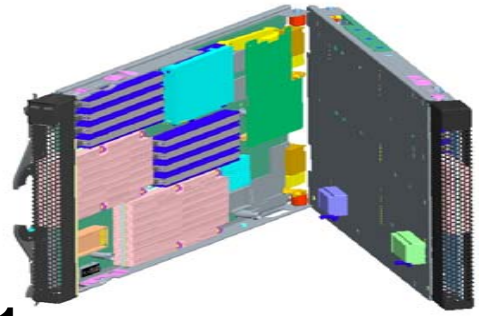
Consume 20-30W of power

Maintain 1000s of high failure parts

LS21/LS41 Product Overview

2- and 4-socket AMD dual core processor blade servers for front and mid tier applications requiring high performance, enterprise-class availability and game changing flexibility.

2.8GHz - Feb
8GB Kits - Feb



LS41

Base LS21

- 8 DIMMs (32GB max)
- Fixed SAS HDD (36/73/146GB)
- 2 NICs - Broadcom 5708S (TOE)
- 2 I/O connectors - CFF cards allow up to 2x the ports per blade
- All Processors supported in all chassis
  - 68W AMD Opteron 2000
  - 95W AMD Opteron 2000 best w/ BCH
- Supports
  - SIO Expansion Unit
  - PEU 2b soon

Base LS41

- 2-socket or 4-socket (Sell 4-socket)
- 16 DIMMs (64GB max)
- Two SAS HDD (36/73/146GB) RAID 1
- 4 NICs - Broadcom 5708S (2 TOE)
- 3 I/O connectors (CFF)
- All Processors supported in all chassis
  - 68W AMD Opteron 2000
  - 95W AMD Opteron 2000 best w/ BCH
- Supports
  - SIO Expansion Unit
  - PEU 2b soon

None x86 Blades

The following blades are not focused on by the System x team.

JS21

- Ideal for 64-bit UNIX® HPC
- Support IBM AIX 5L™ & Linux
- 2-socket single or dual core PowerPC
- 4 DIMMs (16GB max)
- Two SAS HDD (36/73/146GB) RAID 1
- 4 NICs - Broadcom 5708S (2 TOE)
- 3 I/O connectors (CFF)
- Compatible with all IBM chassis
- Advanced POWER™ Virtualization and AltiVec™ SIMD acceleration

Contact: Bruce Wellington/Somers/IBM

QS20

- Ideal workloads -image processing, signal processing and graphics rendering applications
- Two 3.2 GHz Cell BE processors
- 1 GB XDRAM (512 MB per processor)
- 410 GFLOPS peak performance
- Blade-mounted 40 GB IDE hard disk drive
- Dual 1Gb Ethernet controllers
- Connectivity to Ethernet or InfiniBand

Contact: Steve Monti/Raleigh/IBM

Expanding the Reach of BladeCenter
More and Smarter I/O Options

- **Blades are no longer limited to specific solutions due to limited expansion**
  - More I/O content via Expansion Options turn a blade into a 2U competitor
- **IBM allows clients the expend the capability of our base blades**
  - Memory and I/O Expansion - more ports, more memory
    - Supported on HS21 8853 models only
    - 4x1Gb Ethernet, 8 DIMMs and up to 2 I/O expansions
  - Storage and I/O Expansion - more ports, RAID5, more disk capacity
    - Up to three I/O expansions
    - RAID 5 across 3-5 drives with 256MB cache
  - PCI Expansion Unit - supporting legacy PCI-X cards on a blade
    - Provides two 64-bit/100MHz PCI-X slots

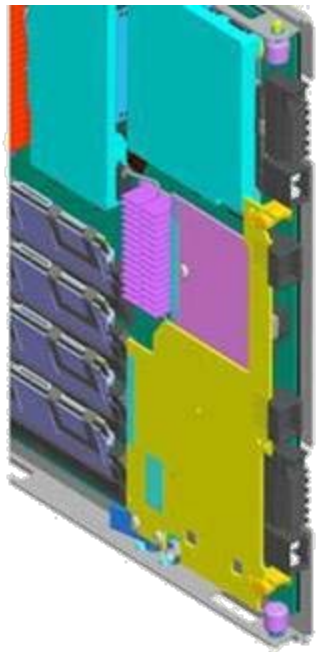
Storage and I/O Expansion Unit

Breakthrough CONNECTIVITY

MSIM - The Evolution of I/O Connectivity

- **Virtualization, multi-core, and clustering are all driving additional port requirements per blade**
- **BladeCenter H has inherent hardware capability for eight I/O paths per blade**
- **Multi-Switch Interconnect Module provides a means for exploiting existing 8 paths to each blade (HS21, LS21, JS21)**
  - **Up to 12 ports for the LS41**
- **MSIM fits into the high speed switch slots in BladeCenter H**
- **Supports standard BladeCenter switch portfolio**

Availability: March 2007



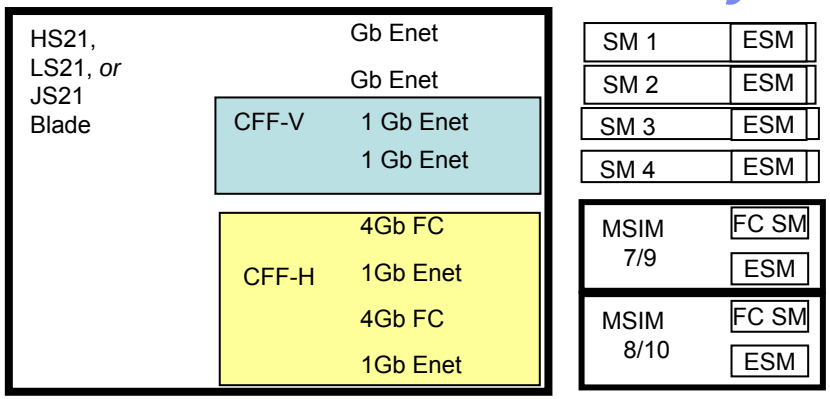
Dual 4G Fibre Channel HCA

Dual Fibre Channel/Ethernet Expansion Card

Breakthrough CONNECTIVITY

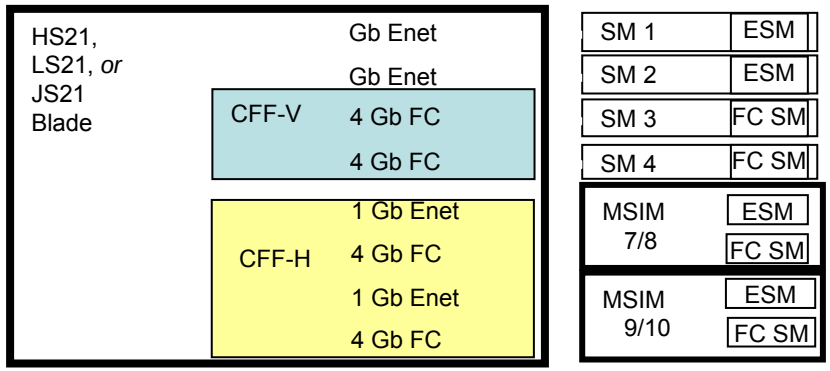
MSIM - The Evolution of I/O Connectivity

6 1G Ethernet
2 4G Fibre Channel



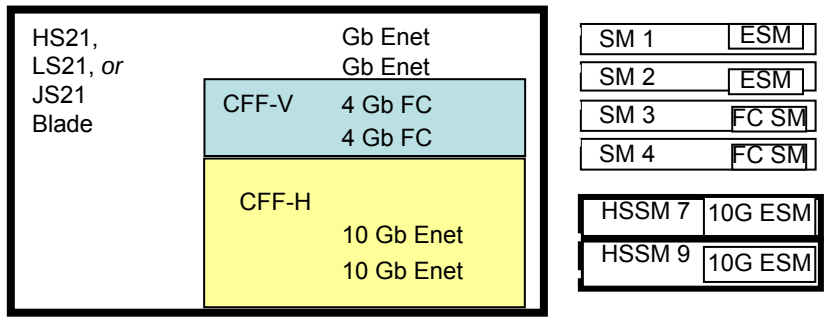
Base NICs
(1) 39Y9310 Gb Enet CFFV
(1) 39Y9306 Combo CFFH

4 1G Ethernet
4 4G Fibre Channel



Base NICs
(1) 41Y8527 4Gb FC CFFV
(1) 39Y9306 Combo CFFH

2 1G Ethernet
2 4G Fibre Channel
2 10G Ethernet Channel



Base NICs
(1) 41Y8527 4Gb FC CFFV
(1) 39Y9271 10Gb Enet CFFH

Blade.org and openness

Harnessing the power of the industry

The clear leader in customer choice - integrate your current standard into BladeCenter

- **Choice**
  - More I/O options
  - More Ethernet Switch options
  - More Fibre Switch options
  - More InfiniBand options
  - Myrinet
  - Pass through capability
- **Your trusted partners inside BladeCenter**
  - Manage integrated components the same as external components

BladeCenter - Ethernet Switching

Expanding the Ecosystem with Partnership

Server Connectivity Module for IBM BladeCenter

- Supplier: IBM
- Ideal for SMB
- Alternative for Pass Thru
- Simplified Configuration
- Avail: Now

List Price:

$999

Nortel Layer 2/3 Gb Ethernet Switch Modules

- Supplier: Nortel
- OS: AOS
- 6-port copper/fiber
- Layer 2 Switching
- Multiple STP
- Layer 3 Routing
- Avail: Now

List Price:

$1,899 (Cu)

$3,999 (fiber w/SFPs)

Cisco Systems ® Intelligent Gb Ethernet Switch Module

- Supplier: Cisco
- OS: IOS
- Layer 2 Switching
- Layer 3/4 services
- Avail: Now

List Price:

$4,999 (Cu)

$4,999 (Fiber w/o SFPs)

Nortel ® L2-7 GbE Switch Module

- Supplier: Nortel
- Layer 2 - 7
- OS: AOS
- Load Balancing
- Routing / Switching
- Advanced Filtering
- Content Intelligence
- Avail: Now

List Price:

$8,999

Nortel® L2/3 10GbE Uplink Switch Module

- Supplier: Nortel
- OS: AOS
- Layer 2 Switching
- Multiple STP
- Layer 3 Routing
- (1) 10 Gb MM Fiber Ports
- (2) 10 Gb Copper Ports
- Avail: Now

List Price:

$4,999

(excluding XFP)

SR XFP: $1399

LR XFP: $2199

BladeCenter - High Speed Switching

Expanding the Ecosystem with Partnership

Feb 2007

- Supplier: Nortel
- OS: AOS
- 6-port 10Gb full fabric
- NetXEN 10Gb I/O adapter

Nortel® 10GbE Switch Module

- Two 4X and Two 12X IB ports
- Enterprise virtualization with VFrame

Cisco Systems® 4X InfiniBand Switch Module

- Non Blocking
- Full 4X Bandwidth
- Double wide switch
- Perfect for large clusters

Voltaire ® 4X InfiniBand Pass Through Module

10Gb Performance

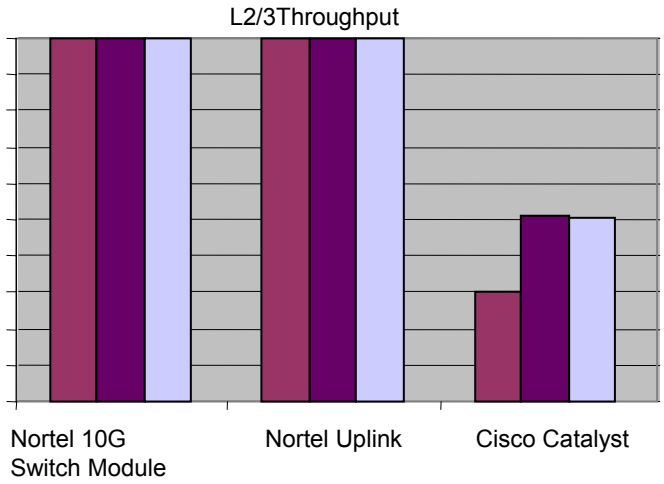
Performance Gains in Latency and Throughput

10Gb Throughput

(higher is better)

64 512 1518

Packet Size (Bytes)

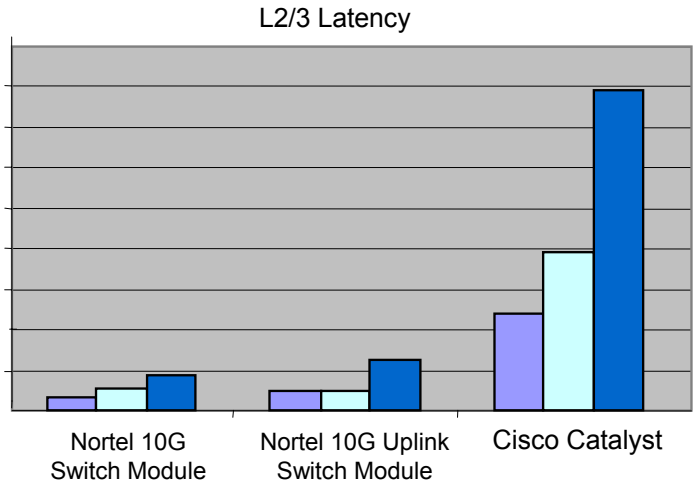


10Gb Latency

(lower is better)

64 512 1518

Packet Size (Bytes)



*"Consolidating the network intelligence inside a multi-layer switching and routing module that could be plugged into a blade server chassis is the **logical next step in realizing the promise of blade servers** towards consolidating network resources."*

- Tolly Report

More than twice the throughput at less than a fifth of the latency of standard networking equipment

All latency numbers in this chart include latency of test tool (traffic generator). The Tolly Group audited these results on 10/20/06

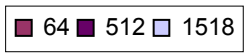
10Gb Performance

Performance Gains in Latency and Throughput

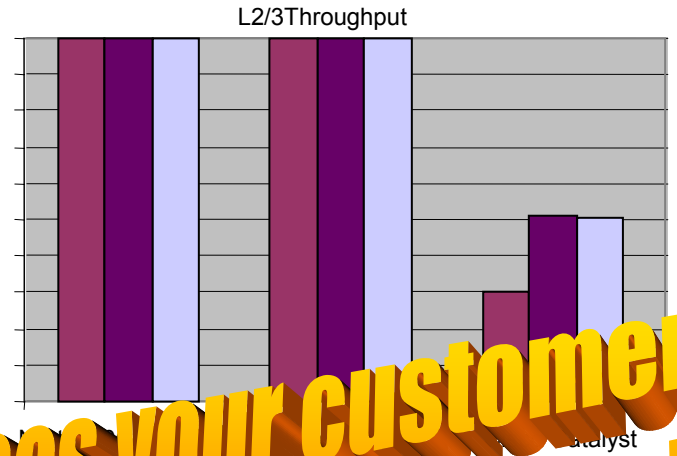
THE TOLLY GROUP

10Gb Throughput

(higher is better)



Packet Size (Bytes)



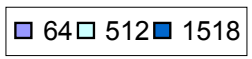
Does your customer utilize 4-6 uplinks per switch today?

*"Consolidating the network intelligence inside a multi-layer switching and routing module that could be [illegible] into a [illegible] chassis is the **logical next step in realizing the [illegible] in blade servers** [illegible] consolidating network resources."*

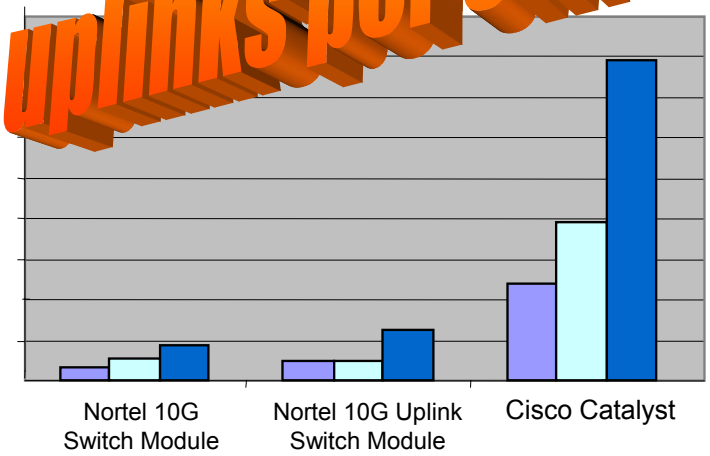
- Tolly Report

10Gb Latency

(lower is better)



Packet Size (Bytes)



More than twice the throughput at less than a fifth of the latency of standard networking equipment

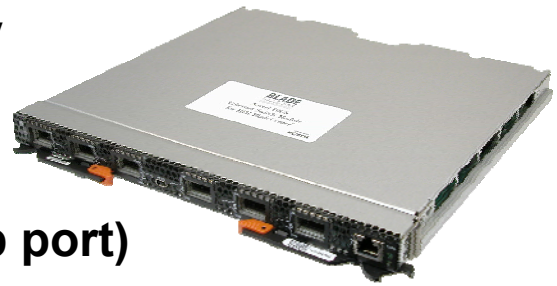
TOLLY Up to Spec CERTIFIED

All latency numbers in this chart include latency of test tool (traffic generator). The Tolly Group audited these results on 10/20/06

IBM BladeCenter 10G Ethernet Portfolio

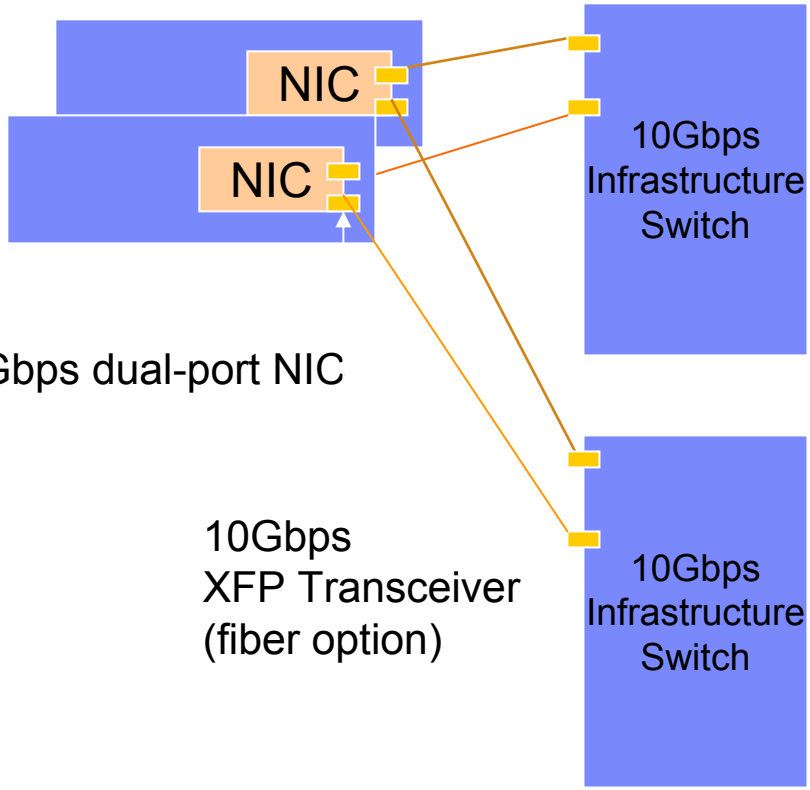
Accelerate your application with 10Gb Ethernet

- **Nortel® L2/3 10GbE Uplink Switch Module**
  - **14 x 1Gb ports interfacing to blades**
  - **3 x 10G ports (one fiber, 2 copper) to network**
  - **Copper Cables: Two special cable options provide dual path 10G connections between chassis (P/Ns 32R1937, 32R1941)**
  - **xFPs: Short and Long Range options**
  - **Available now for all IBM BladeCenters**
- **Nortel 10G Ethernet Switch Module** – Available Feb 2007
  - **Jointly developed 10Gb Ethernet solution for BCH**
  - **(14) 10Gb ports interfacing to blades (with expansion card)**
  - **(6) 10Gb XFP connections to network**
  - **First blade vendor to market with full 10Gb capability**
  - **Performance and price/performance leadership**
    - **NetXen I/O Adapter web price $899**
    - **Nortel Switch web price $9,799 (<$500 per 10Gb port)**



Economics of 10Gb Ethernet Connectivity

Rack Solution



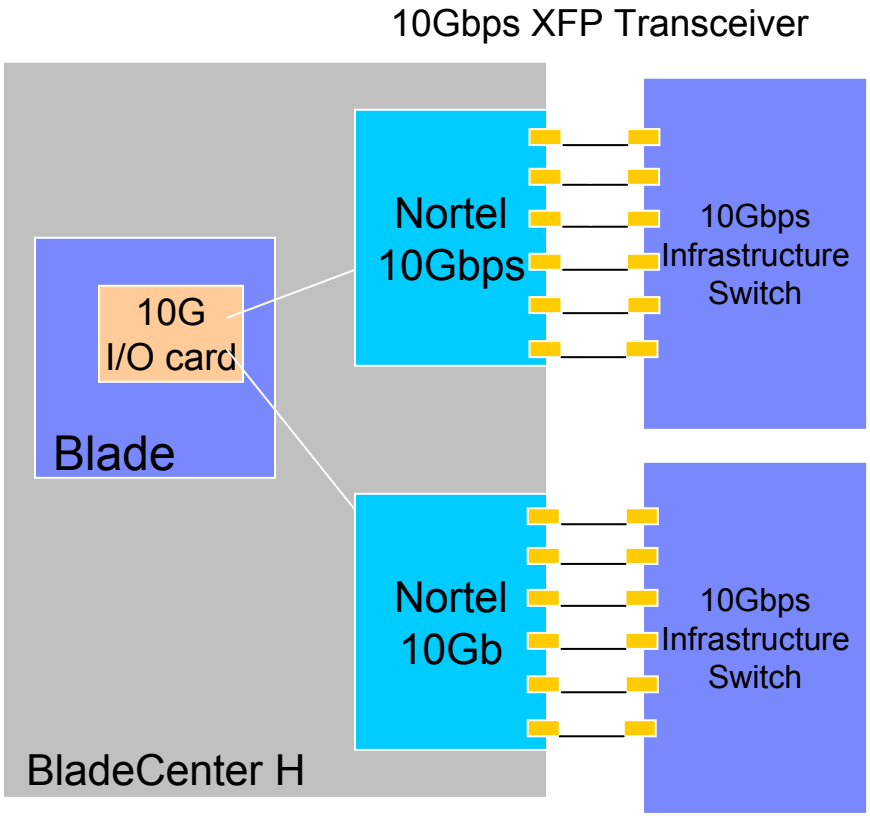
NICs:	$1500 - $3000
Switch ports:	$800-$5000
XFPs:	$1200-$4000

14 Server
Rack Connectivity Cost

NICs:	$1500 * 28	$42,000
28 Fiber Cables:	$ 150 * 28	$4,200
XFPs:	$1200 * 56	$67,200
External Switch Ports:	$ 800 * 28	$22,400
Total		$135,800

Economics of 10Gb Ethernet Connectivity

BladeCenter H Solution



Dual Port Exp Card:	$899
Switch ports:	$490
XFPs:	$1200

14 Server Rack Connectivity Cost

NICs:	$1500 * 28	$42,000
28 Fiber Cables:	$ 150 * 28	$4,200
XFPs:	$1200 * 56	$67,200
External Switch Ports:	$ 800 * 28	$22,400
Total		$135,800

14 Server BladeCenter Connectivity Cost

Dual Port Exp:	$899 * 14	$12,586
Fiber Cables:	$150 * 0	$ 0
XFPs:	$1200 * 12	$ 14,400
Nortel 10Gb Switch Module:	$ 490 * 40	$19,600
Total		$46,586

>65% Savings to Deploy 10G Ethernet in Blades vs Racks

InfiniBand Switch Modules

InfiniBand - High Performance and Enterprise Virtualization

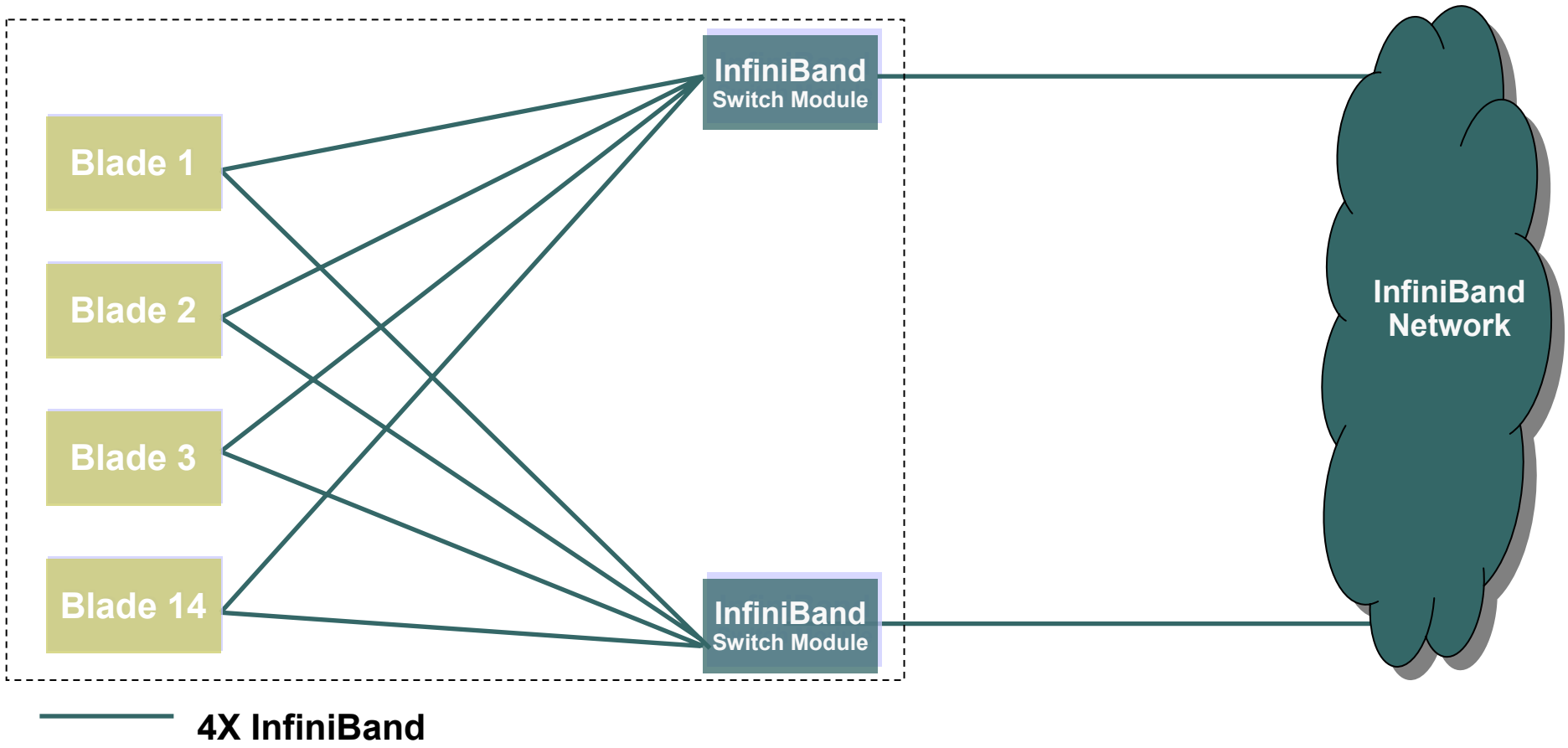
- **4X (10Gb) InfiniBand switch solution developed IBM & Cisco**
  - Providing dual 4X connectivity to the blade
  - 80Gb of bandwidth to each switch
  - Virtualized I/O via VFrame (Cisco) software

- **QLogic 4x InfiniBand Bridges**
  - Ethernet Bridge Module - 6 external 10/100/1000 Mbps RJ-45 Ethernet ports to external network
  - Fibre Channel Bridge Module - 6 1/2/4 Gbps SFP-based FC ports to external SAN network
  - Each bridge - 2 internal 4x ports to InfiniBand Switch

- **4X InfiniBand solution developed by IBM and Voltaire**
  - Providing dual 4X connections, non blocking to the blade
  - Up to 280Gb of pass through interconnect to the chassis
  - Enabled via Blade.org partnership and IBM1350 Cluster

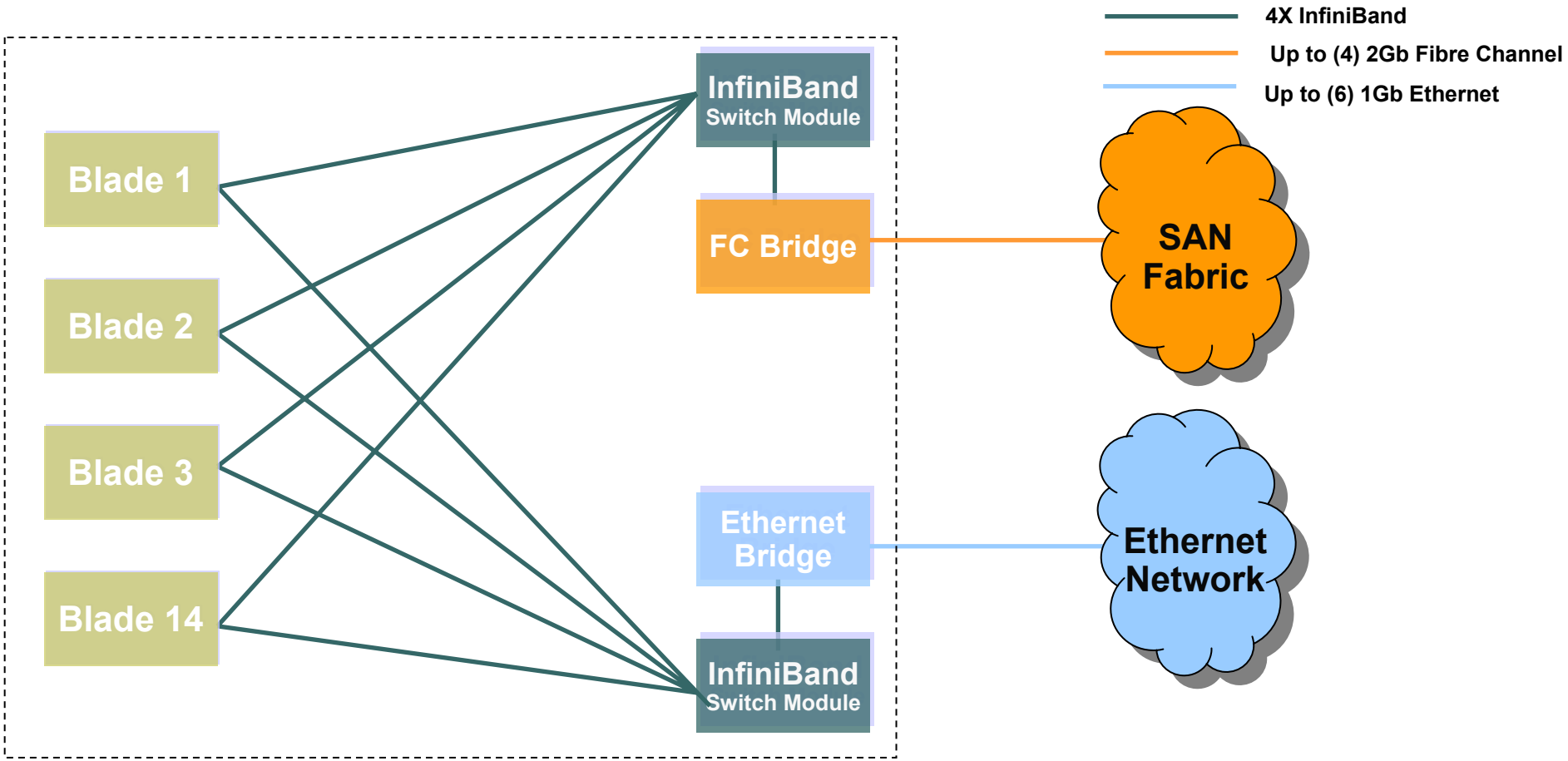
BladeCenter H Leading the High Speed Evolution

BladeCenter H InfiniBand Connectivity



IBM implementation using only one adapter slot leaving more I/O connection

BladeCenter H InfiniBand Connectivity



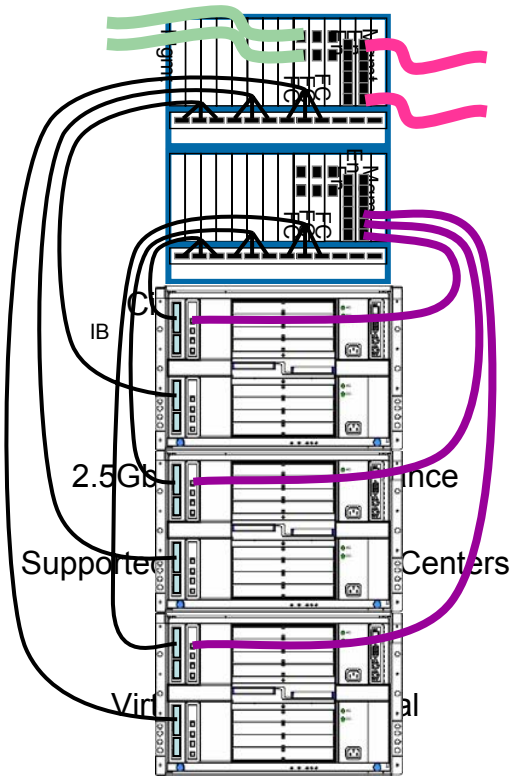
IBM can also allow customers to not have to build external InfiniBand infrastructure. Also can connect chassis using InfiniBand.

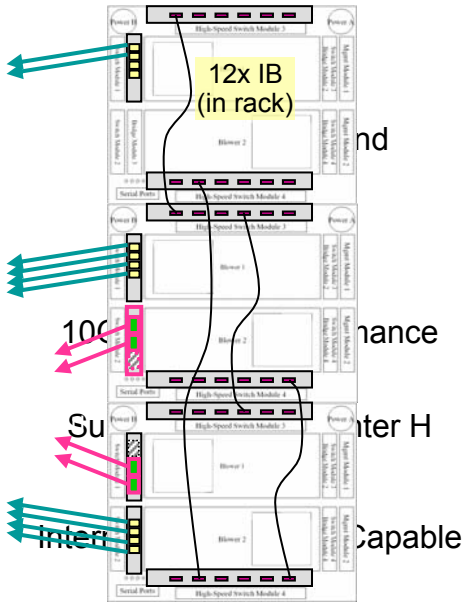
InfiniBand in the enterprise data center

High Performance and Enterprise Virtualization

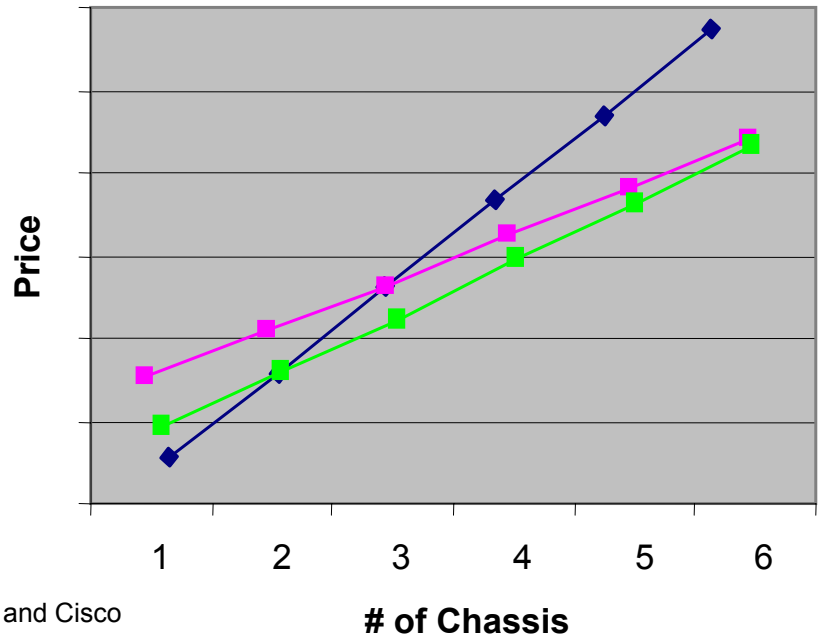
Partnering to drive InfiniBand adoption

- Reduce Data Center Complexity
- High Performance Compute
- Enterprise I/O Virtualization





The economics of going virtual



Source: IBM and Cisco

Standard BladeCenter Ethernet (1G) + Fiber Channel (4G) Interconnects

InfiniBand (10G) with External Bridges

InfiniBand (10G) with Internal Bridges

"With its ability to unify and minimize the compute fabric in the datacenter, InfiniBand enables a cleaner connection to the communications and storage fabric, reducing complexity and cost, while increasing performance."

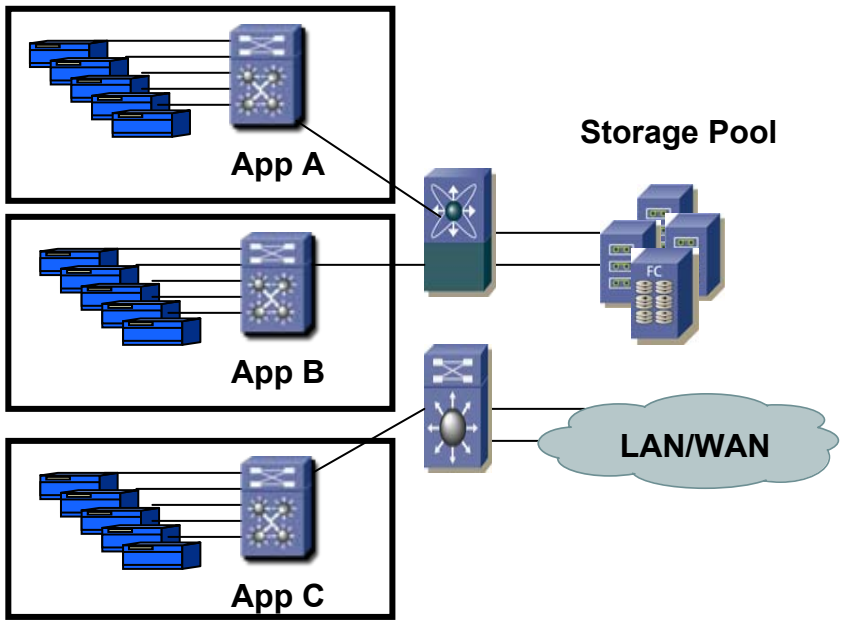
- Lucinda Borovick IDC

Integration of InfiniBand Bridges into the chassis lowers the cost of I/O Virtualization

Breakthrough CONTROL

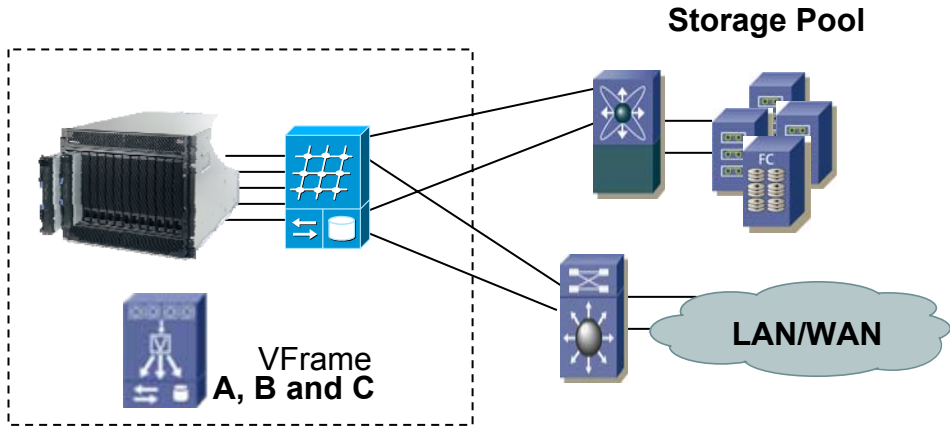
IBM BladeCenter I/O Virtualization with InfiniBand and Cisco VFrame

Fixed Data Center



- One to one ratio of servers to apps
- Majority of server under-utilized
- No flexibility to reallocate server power
- Over provisioning of back-up servers

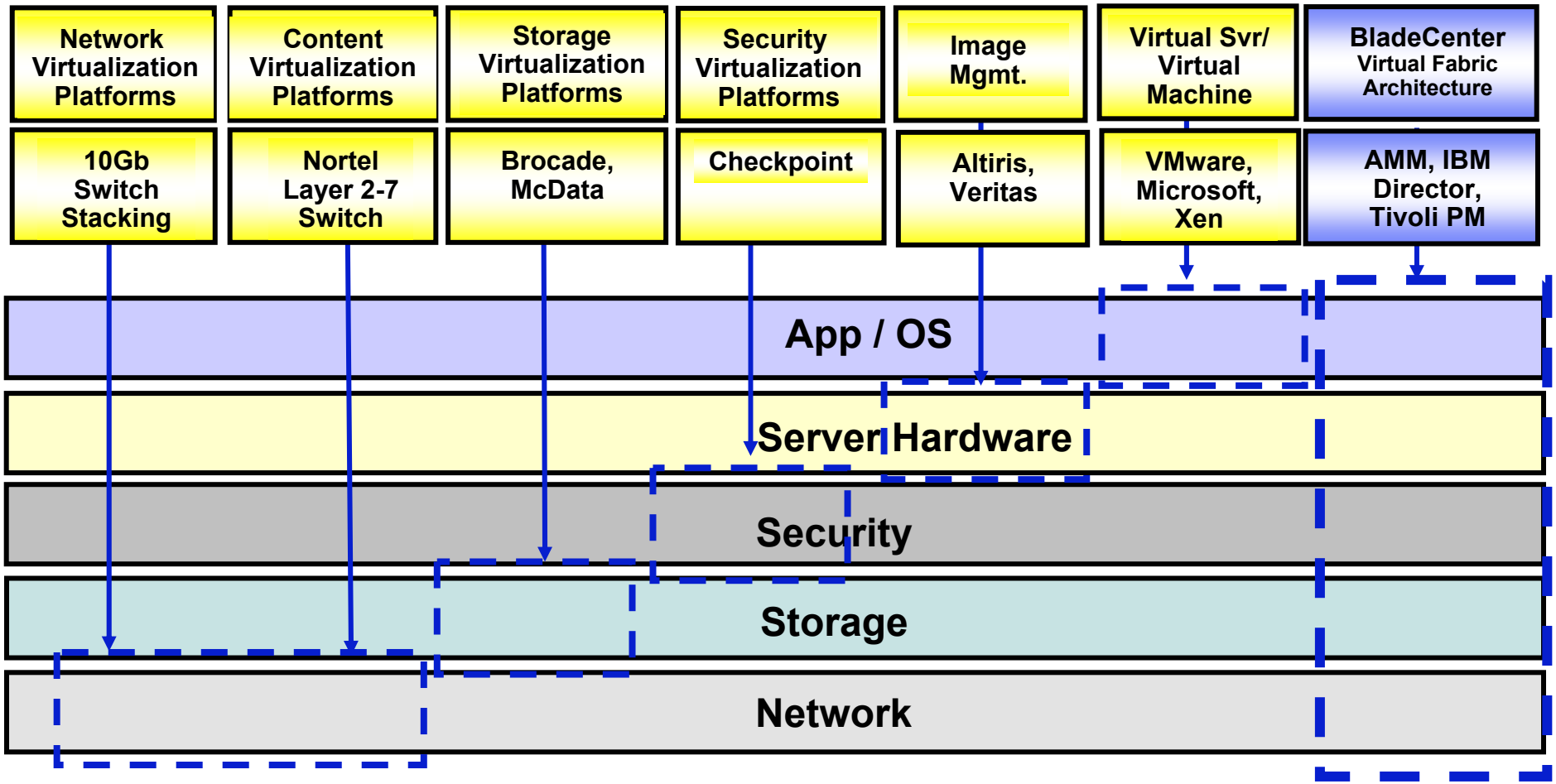
Virtualized Data Center



- Scalable, unified server I/O
- Utility pools across multiple applications
- Dynamically maps servers to LUNs
- Adds and removes services based upon utilization and high availability needs
- External interfaces for policy rule imports
- Eliminates local disk requirements

BladeCenter - Complete Approach

Infrastructure/Fabric/OS/Application Virtualized



Enabling Not Inventing the Roadmap for Success

What is Inside BladeCenter - SAN Switching

Expanding the Ecosystem with Partnership

NEW!

IBM eServer BladeCenter Optical Pass-thru Module

- Provides unblocked optical connection
- Up to 14-optical connections to external SAN (requires breakout cable option)

List Price $4509

QLogic™ 6-port Fibre Channel Switch Module

- Equivalent to SANbox 5200
- 6-1/2/4Gb Auto sensing external ports
- 10 and 20 port versions

List Price 10-port $8999 20-port $13999

McDATA® 6-port Fibre Channel Switch Module

Equivalent functionality to McDATA Sphereon 4500

- 6-1/2/4 Gb Auto sensing external ports
- 10 and 20 port versions

List Price 10-port $10999 20-port $15999

Brocade® 4Gb SAN Switch Module

- Equivalent to Silkworm 3900
- 6-1/2/4 Gb Auto sensing external ports
- 10 and 20 port versions

List Price 10-port $8999 20-port $14999

Cisco® Enterprise SAN Switch Module

- Managed by MDS9000
- 6-1/2/4 Gb Auto sensing external ports
- Supports Cisco SANoS
- Long and short wave SFPs
- 10 and 20 port versions

Q1 2007 availability

List Price 10-port $8999 20-port $14999

BladeCenter Delivers Cisco Systems MDS

First to Market Functionality

- Cisco Systems® MDS 9000 series Fabric Switches and Directors
- Port Channels, VSANs, Non-disruptive code upgrade, “on-demand” port activation
- Enhanced Security:RADIUS/TACACS+
- Interfaces
  - Wire-speed throughput
  - 6 4Gbps External Fibre Channel (Fiber) interfaces
  - 14 1/2/4Gbps Internal interfaces to blades
- Management / Monitoring
  - Cisco IOS Command Line Interface
  - SNMP - Management Information Base (MIB) based applications
  - Management and Power through Management Module
  - Console Port on faceplate

Want to Go Diskless - Simply and Affordably?

iSCSI Boot Solutions in BladeCenter Provide the Solution

iSCSI is SCSI over Ethernet

- Builds on stable a familiar Ethernet standards
- Creates a SAN at a reduced acquisition cost
- Provides the block transfer capability of FC SANs at NAS volume level prices
- Delivers a solution with no practical distance limitations
- Another option for running diskless blades
- Provides a high degree of Interoperability and uses lower cost Ethernet switches instead of Fibre Channel Switches
- OS Supported solutions for both Windows and Linux users

BladeCenter iSCSI Initiator (SW or HW)

Ethernet Switch Module

Gigabit Ethernet

DS300 or other iSCSI Target

IBM BladeCenter BladeBoot

The iSCSI low cost storage fabric - software and hardware

SOFTWARE INITIATOR ***List Price: Free of Charge***

- iSCSI handled by NIC on blade - no other hardware needed on the blade
  - Delivers a low-cost alternative to Fibre Channel Storage Area Networks
  - Allows blades to run diskless
  - Open. Co-developed with Microsoft – 1st to market SW-based iSCSI
  - Built into bios via firmware upgrade
  - No other Blade vendor offers a hardware-based iSCSI initiator integrated into chassis

iSCSI HBA (HARDWARE) ***Adapter List Price: $699***

- HBA pulls TCP/IP workload from the main processor increasing system performance in high utilization solutions
  - Provides a mid level performance fabric for off blade storage
  - Delivers a lower cost alternative to Fibre Channel Storage Area Networks
  - iSCSI Expansion Card delivers features comparable to the QLogic QMC 4052 HBA

Hardware or software - share common protocols

BladeCenter & Blade.Org

Enabling innovation

Accelerating **BladeCenter Platform based solutions to market**

Increasing the number **of BladeCenter Platform solutions**

Increasing end user confidence **in BladeCenter Platform solutions**

Breakthrough CONTROL

IBM BladeCenter and Tivoli Provisioning Manager

Management Module and IBM Director

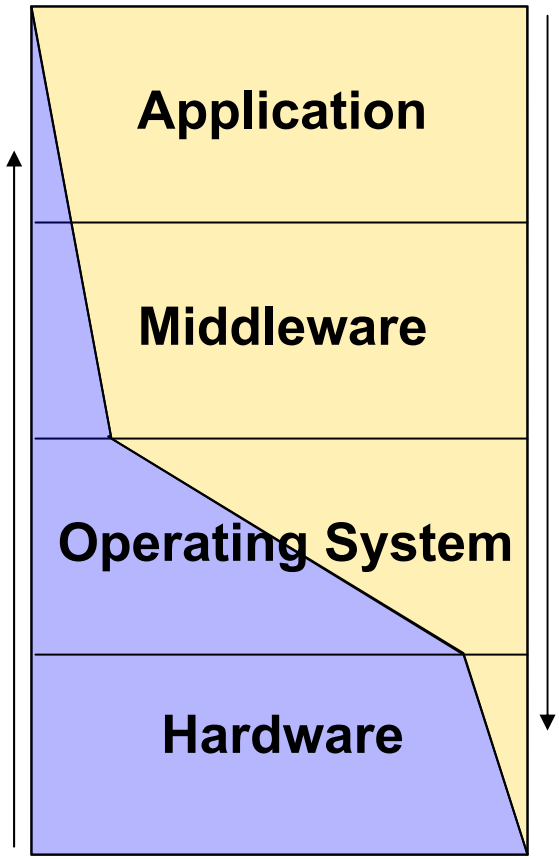
"Care and feeding" of the hardware

Detailed hardware inventory, alerts and tools for IBM Systems

Basic software distribution

Allows for upward integration into the TPM environment

Advanced, predictive server hardware management



Tivoli Provisioning Manager

Automated Provisioning

Compliance and Remediation

Advanced software distribution

Reporting

Discovery and Inventory

Patch Automation

Bare Metal Installation

Tivoli Sales Contact: **Barbara L. Korte**
bkorte@us.ibm.com

IBM Systems & Technology Group

IBM BladeCenter

Power and Cooling leadership

Section content

Designing energy efficient systems

PowerExecutive™ with the new capping function

Power testing IBM v HP

January 8, 2007

With IBM BladeCenter – less is more!

IBM BladeCenter H LS21	HP BladeSystem BL465c	IBM BladeCenter H HS21	HP BladeSystem BL460c
3 enclosures, 36 Opteron servers, 72 processors	**3 enclosures, 36 Opteron servers, 72 processors**	**3 enclosures, 36 Xeon servers, 72 processors**	**3 enclosures, 36 Xeon servers, 72 processors**
27U	**30U**	**27U**	**30U**
5,220W	**6,840W**	**9,360W**	**11,485W**
17,732 BTU	**23,324 BTU**	**31,917 BTU**	**39,160 BTU**
24% less power		**19% less power**	

Every kilowatt of power saved can save $2,000US on the electric bill

- **A small data center with 100 servers the 24% savings add up to over $60K US**

Lower power can also increase rack density

- **Cutting down the number of racks from 19 to 14 and the amount of floor space needed by 110ft^2**

Energy efficient system design + PowerExecutiveTM

- **Monitor power & enforce a power caps**
- **All hardware based, not OS independent**

Configuration notes: AMD both with pair of 2.4GHz RevF dual core processors, 16GB memory, dual Ethernet, one 36GB SAS HDDs. Intel both with pair of 2.66GHz dual core processors, 16GB memory, dual Ethernet, one 36GB SAS HDDs. Power figures based on testing performance 11/14/2006 - number quoted is average power difference idle through maximum utilization.

IBM BladeCenter – it pays to be efficient!

Costs	Item	500 IBM LS21 (2.4GHz)	500 HP BL465c (2.4GHz)
Annual	Power (based on $.1US/kwh)	$72,500	$95,000
	Cooling (based on 50% cooling to power input)	$36,250	$47,500
	Floor space (5KW racks)	$46,200 (308 ft^2)	$62,700 (418 ft^2)
One-time	Racks	$49,000 (14 racks)	$66,500 (19 racks)
Three-year		$513,850	$682,100

IBM BladeCenter

The more efficient choice for power and cooling

HP BladeSystem

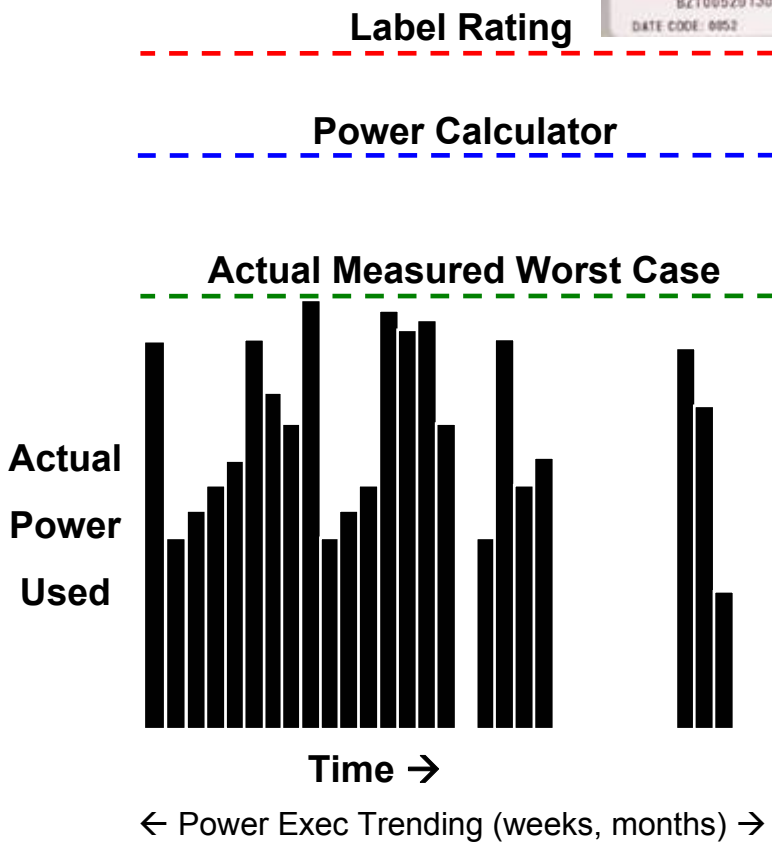
$168,250 in **additional cost** to power, cool, host HP solution **110 additional square feet** consumed in data center

Comparison of IBM LS21 and HP BL465c with same configuration. Cost of power assumed $.10US kwh. Racks of 5KW maximum, cost of rack based on $100/ft2 x 22ft2/rack. Rack cost $3500 with flat panel and KVM switch.

Plan correctly to save on infrastructure

Better information for upfront planning

- In the past the only way to size needed power was use of the label rating
  - Overestimates power needs
  - Causes excessive infrastructure costs
- The IBM Power calculator allows users to size their unique configurations power needs
  - Still builds in some excess
- PowerExecutive takes this to the next level by monitoring and tracking power over time
  - Make the smartest choices based on the best information
  - IBM unique function - included with every blade and System x



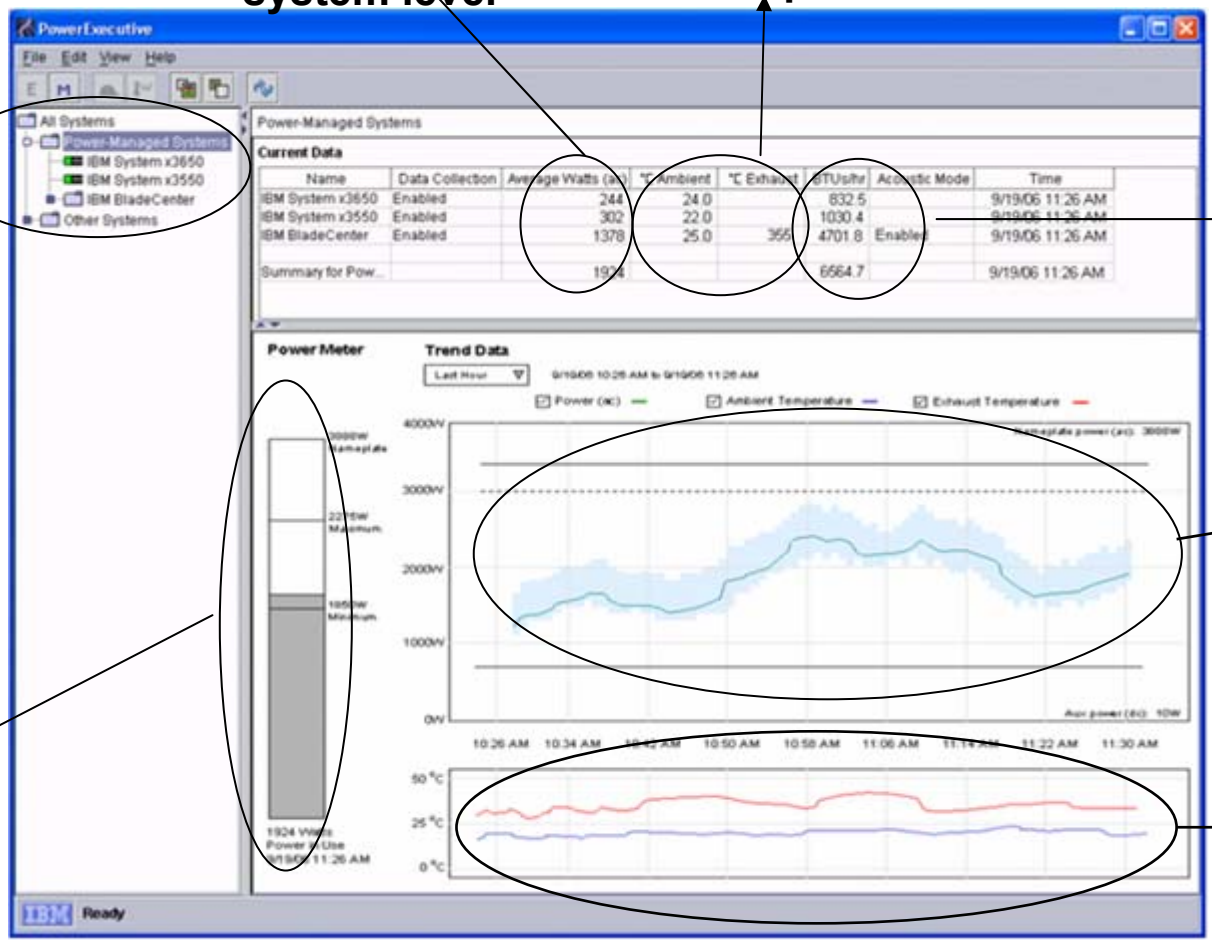
PowerExecutive™ in action

Manage Power at the rack and server level

Monitor:
- Power supply
- Blades
- I/O modules
- Mgmt module
- Blowers
- Media tray
- Midplane

Compare actual vs. name plate power at system level

View inlet and exhaust temperatures



Track heat emitted

Trend power use over time

Trend temperature over time

Compare rack actual power vs. Label Power

PowerExecutive™

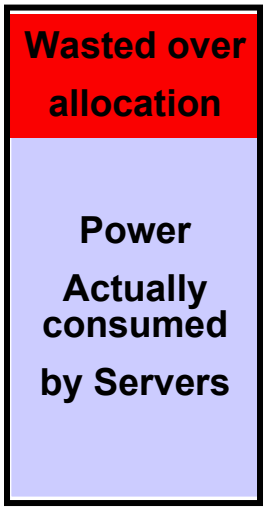
Cap and reclaim - the path the better power utilization

Simulation of typical rack power planning based on label power

Previously, this was was the only option within the rack for sizing/allocating

PowerExecutive allows customers to turn that wasted power into productivity

Allocation Model of Server

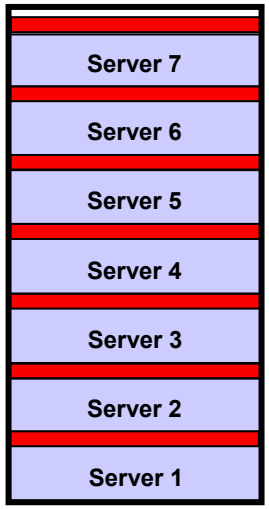


Power budget not converted into compute cycles

Power budget converted into compute cycles

Excess planned power for each server, this power adds up at the rack level

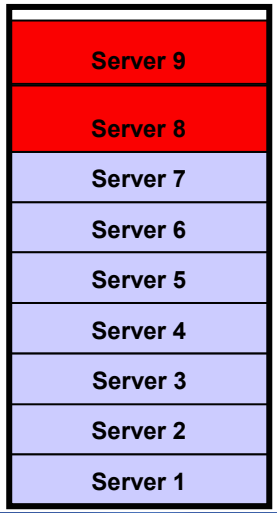
Allocation Before PowerExecutive



That wasted available power is now real power to turn on more servers

Allocation After PowerExecutive

+2 additional servers



Get More From Your Data Center
Seven steps to a more efficient solution

1. Pick the most power efficient server available - ***BladeCenter***
2. Maximize what ever envelope limits you (remember, it is not likely to be U space in the rack today) - ***BladeCenter***
   - Power
   - Cooling
   - Air flow
   - Weigh
3. Extract the most from each server - ***IBM Virtualization Leadership***
4. Plan smartly to optimize infrastructure - ***IBM Power Calculator***
5. Look to room level solutions as needed - ***IBM Rear Door Heat Exchanger***
6. Monitor, track, and control your power usage - ***Power Executive***
7. Prepare now for today and tomorrow - ***IBM Lab Offering Workshops***

धन्यवाद

Hindi

Спасибо

Russian

תודה רבה

Hebrew

Gracias

Spanish

Grazie

Italian

شكراً

Arabic

Thank You

English

Obrigado

Portuguese

多謝

Traditional Chinese

Merci

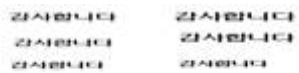
French

Danke

German

ありがとうございました

Japanese



Korean

多谢

Simplified Chinese

ขอบคุณ

Thai

நன்றி

Tamil

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