IBM System x Servers
Technical Presentation

System x Technical Presentation

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Agenda

- **Introduction**

- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Innovation and Technical Leadership - The Server Portfolio

Autonomic Computing	**WorkLoad Mgr,Virtualization, Partitioning, Security, Systems Mgmt**
Series Unique Technologies	**z/OS, AIX 5L™, OS/400, Windows Operating System, FICON Express**
Shared Components	**BladeCenter, Linux, Processors, I/O Power, Hardware Console, Adapters, Switches, Power/Mechanical frames**

Customer value

- IBM's best technology
- Shared innovation
- Faster servers
- Improved availability
- Faster to market
- Investment leverage

Source: xSeries Linux Marketing Management & Strategy

System x Portfolio – Volume Servers

'The System x Portfolio is better suited to meet the demands of business performance computing'

- Introduction

•Market and Technology Trends

•IBM Systems Agenda

•Intel / AMD Portfolio

•Scale Up Solutions

•Scale Out Solutions

•Virtualisation

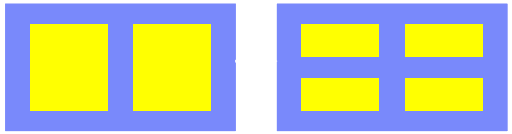
•Systems Management

•Futures

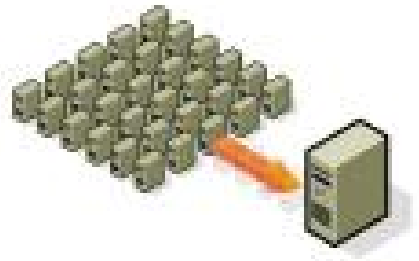
•Q & A

Technologies Trends Impacting x86 Architectures

- **Multi-core Processors Multiply**
  - **2 cores in 2005-6, 4 cores in 2006-7**
  - **New opportunities to advance application and solution architecture**



- **Virtualized computing will proliferate and move to mainstream solutions**
  - **Software licensing trends, increased AURs and industry analyst surveys indicate greater use of high volume servers as virtualization platforms**
  - **Virtualization solutions will enable customers to lower their total cost of operations by improving the utilization of their hardware and labor costs**

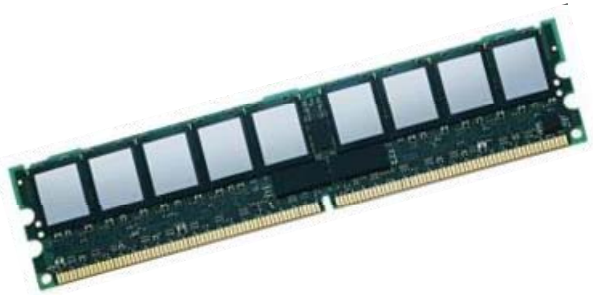


- **Power Management**
  - **Server power is approaching limits of thermal, acoustic, and power density**
  - **Active power management is key to managing future power**

Other Technology Trends

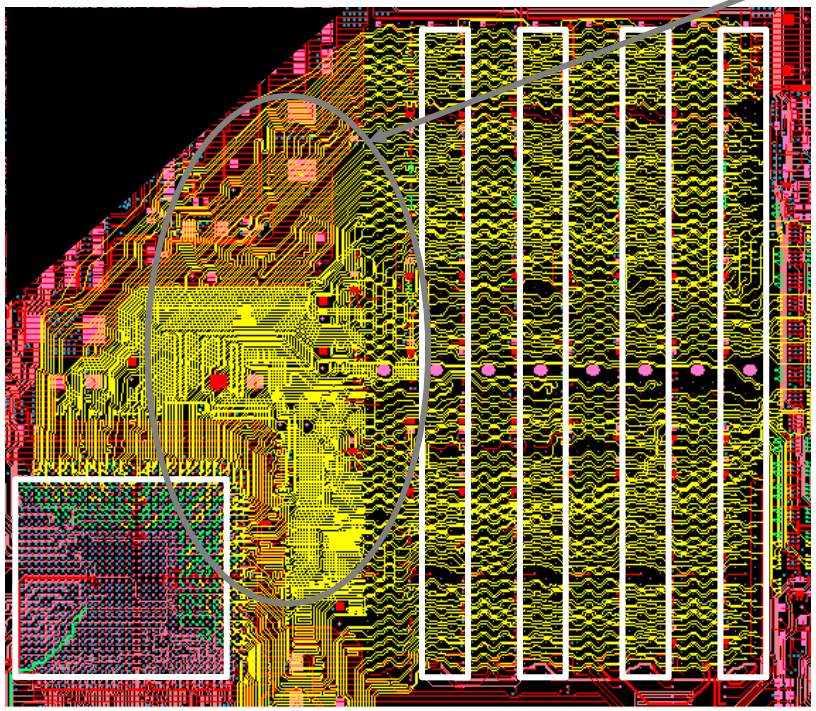
- RAID
  - Wide requirement for Standard RAID - top to bottom of portfolio
  - Solution requirements vary from very Basic to Fully Featured
- HDD
  - Serial Attached SCSI (SAS) replaces parallel SCS
  - Compatible with SATA - unifies drive attachment
  - 2.5-inch drives grow dramatically in 2006/2007

- Network Offload Technologies
  - Broadcom TOE or Intel IOAT
  - Offloads protocol processing from CPU to a separate engine, improves processor efficiency
- Fully Buffered DIMMS will become standard on two-socket systems
  - Faster speeds, higher peak bandwidth than DDR2
- PCI-Express
  - Adoption rate will increase in 2006-2007



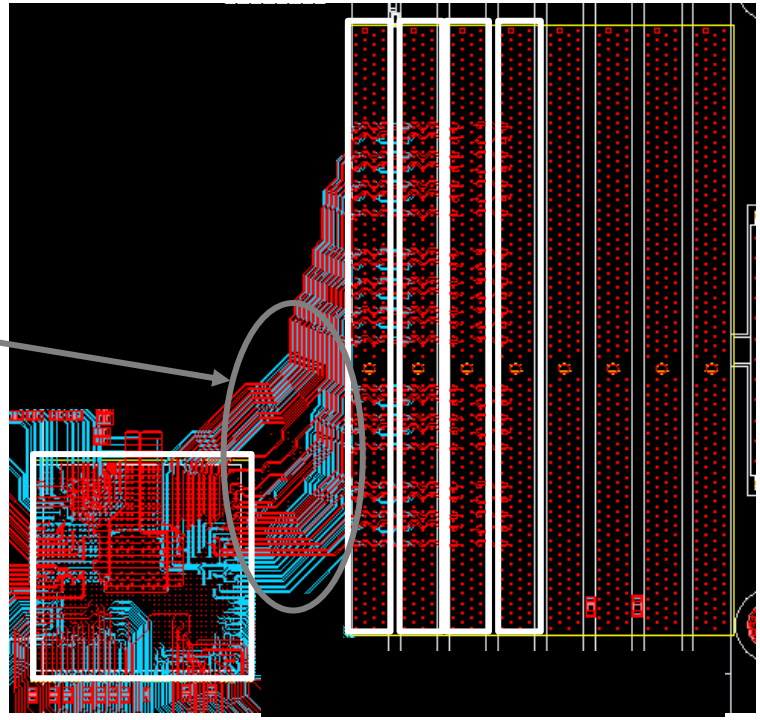
Routing Comparison

DDR2 Registered DIMMs:
1 Channel, 2 Routing Layers with 3rd layer required for power



Serpentine routing is complicated and uses up a lot of board area

FB-DIMMs:
2 Channels, 2 Routing Layers (includes power delivery)

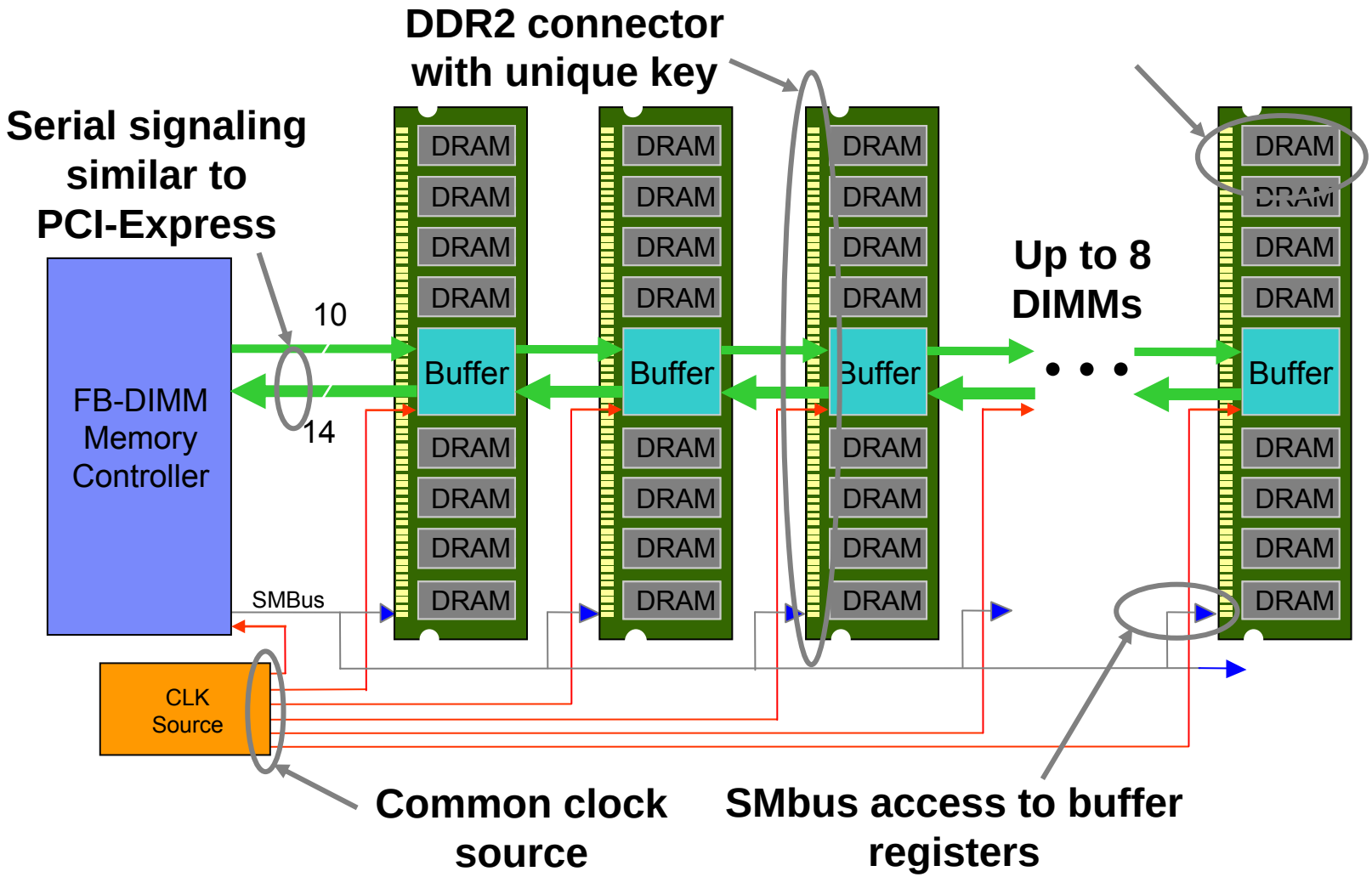


Fewer signals and relaxed trace length matching minimizes board area

FB-DIMM: Fewer Layers, Less Routing Area

Source: Intel Enterprise Architecture Group

FB-DIMM Interconnect



Agenda

- Introduction
- Market and Technology Trends
- **IBM Systems Agenda**
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Customer Business Challenges

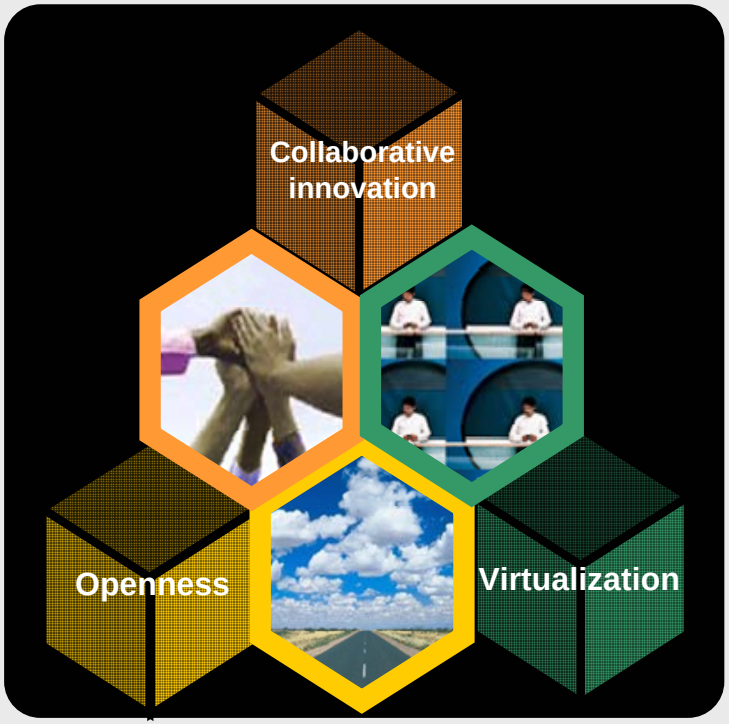
- **Business Responsiveness: Instant 24 x 7 Data Access**
  - Business demands drive the need for more applications, more performance, and more interoperability…….on the same budget!
  - Data must be available when and where users demand
- **Rapid Technology Change increases architecture risk**
  - Technology is moving at breakneck speed
    - Dual Core, Quad core
    - Memory density doubling every 18-24 months
  - Investment protection demands implementing the right technology at the right time
- **Extreme Data/IT Growth drives complexity and availability**
  - More data drives more robust data protection and SAN optimization
  - Data must be reliable and available to multiple applications
- **Data Center Robustness**
  - Power and cooling demands are reaching their highest point
  - Infrastructure complexity driven by complex and distributed heterogeneous architecture

The IBM Systems Agenda

IBM's strategic commitment for delivering innovative technology and skills for business advantage

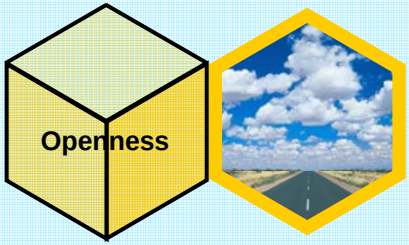
IBM Systems Agenda fundamental design principles

Technology innovation

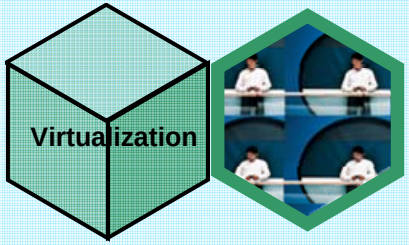


IBM Systems Agenda

Working with clients and industry partners, IBM provides end-to-end support to design, build and implement business solutions that can drive innovation and help transform your business.



IBM is committed to sharing technology with the industry and providing the industry's richest portfolio of interoperable server and storage systems.



Optimize IT operations and dynamically respond to the priorities of the business by managing the IT environment more efficiently with proven IBM virtualization capabilities.

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- **Intel / AMD Portfolio**
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Product Line-up for Q4 2006

Highly Scalable

System x3950

System x3950-E

Rack Optimised

System x 3755

xSeries 306m

System x3650 - T

System x3650

System x3850

System x 3455

System x3550

System x x3655

System x x3655

Universal

xSeries 100

xSeries 206m

System x3400

System x3500

System x3800

IBM BladeCenter H

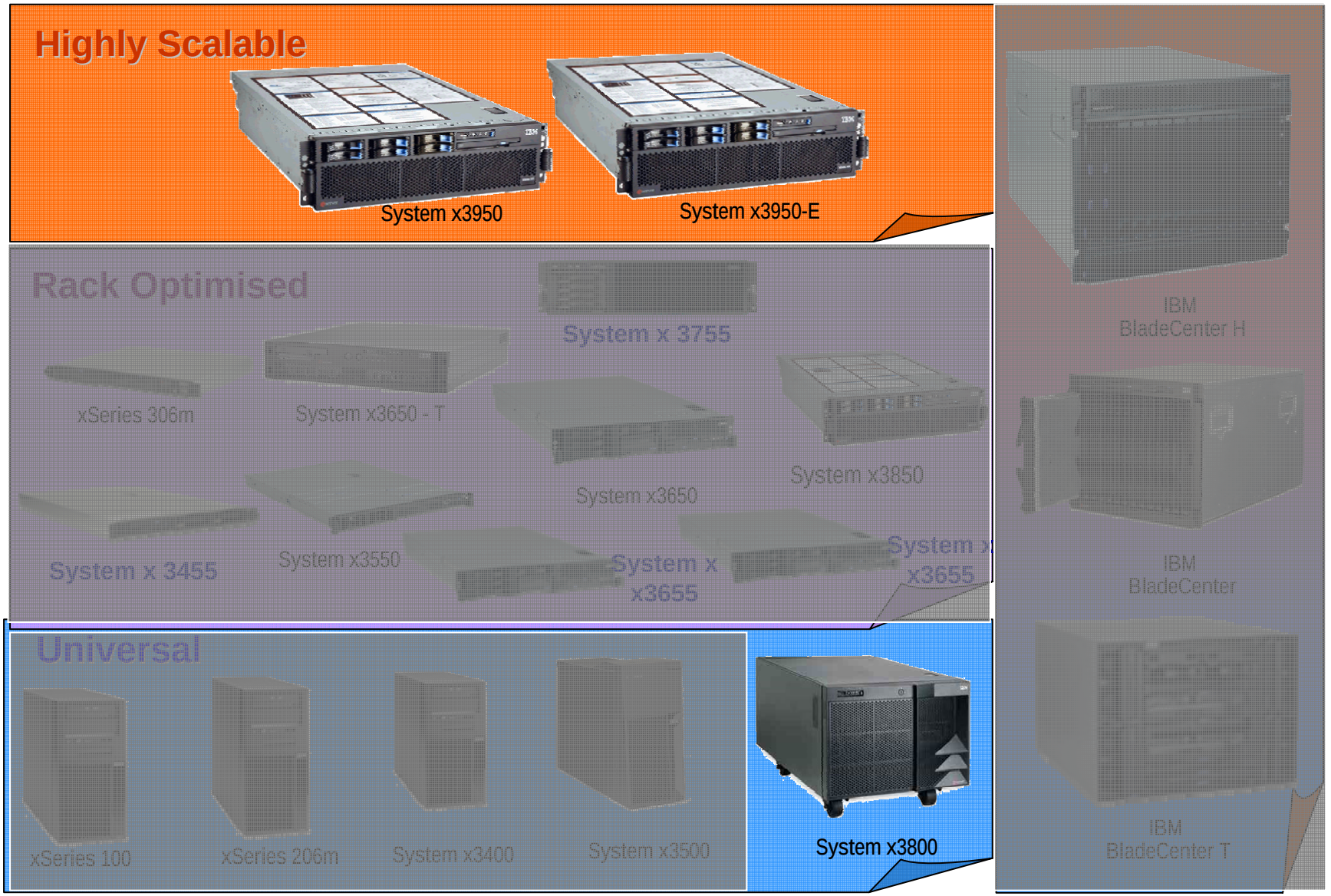
IBM BladeCenter

IBM BladeCenter T

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- **Scale Up Solutions**
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Product Line-up for Q4 2006



IBM defines High-end Industry-Standard Servers

1st Generation: 2001

- x360: 6-month time to market advantage, Most rack dense 4w (3U) ever introduced
- x440: 12-month TTM, Most rack dense 8w (4U), Most successfully benchmarked server in history (35 #1's)
- XpandOnDemand Scalability up to 16-way plus Remote I/O
- Industry-first High Availability Technologies: Active Memory & Memory ProteXion
- Leadership Virtualization for Server Consolidation

2nd Generation: 2003

- x365: Leadership density (3U) with 4X storage capacity & advanced EXA features
- x445: the fastest industry-standard server in history, 20 more #1 benchmarks (little competition to compare)
- x455: Unleashing EXA on Itanium2 for pure 64-bit
- XpandOnDemand Scalability up to 32-way plus Remote I/O
- 9 Consecutive Quarters (3Q02) as #1 8-way database server in the Industry

3rd Generation: 2005

- System x3850: Leadership 4-socket performance, First-to-market with 64-bit Xeon MP
- System 3950 32-socket – 64way flagship optimized for scalability & virtualization with up to 125% higher performance
- System 3800: Extending EXA to the 4-way Tower space with maximum storage for SMB
- Attacking application-serving tier with 64-bit performance + 32-bit compatibility + dual-core capability

Changing industry-standard servers with eServer X3

The IBM eServer X3 Architecture delivers tangible customer benefits for the long term

Technology does matter

- IBM Innovation lowers TCO
- #1 Price-performance: 4/8/16/32w
- Leadership in 64-bit Extensions

IBM is committed to product development

- Over $100M invested in EXA
- We are committed to EM64T

IBM is the leader in scalable systems for a reason!

- #1 in 8-way+ servers for scale-up
- #1 in Blade Servers for scale-out

Increase your opportunities for growth

- 2003: Dell forced to exit 8-way market
- 2005: HP forced to exit 8-way market
- Unisys struggles for market traction with its ES7000

Reduce your risk by investing in the right long-term strategy

- HP is ‘dazed & confused’ about its 64-bit strategy
- Intel partners with IBM to compete against Opteron

Reduce costs by leveraging the leading solution for scalable SMP & SCON

- 8way-16way: keystone to server consolidation
- 8-way-32-way: pay-as-you-grow without penalty

eServer X3: Third-generation Enterprise X-Architecture

Mainframe-inspired innovation that delivers break-through performance, mission-critical availability, and unmatched modular scalability to become *the leading x86 64-bit solution architecture for commercial enterprise applications*, virtualization, and web services.

Performance

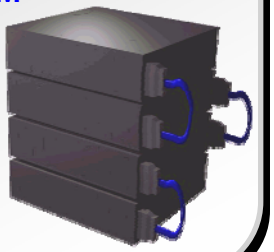
- #1 x86 4w, 8w, 16w, 32w Performance
- 32-bit/64-bit x86 compatibility
- Reduced latencies of 3G Chipset
- XceL4v™ Dynamic Server Cache
- PCI-X2, SAS, DDR2 Memory
- Optimized for Windows & Linux and the application-serving tier

High Availability

- 3G Active Memory
- OS-independent Mirroring
- Chipkill & Mem ProteXion
- Hot-swap & Hot-add in all major subsystems
- Reliability of Intel Xeon MP Front-side bus architecture

Scalability

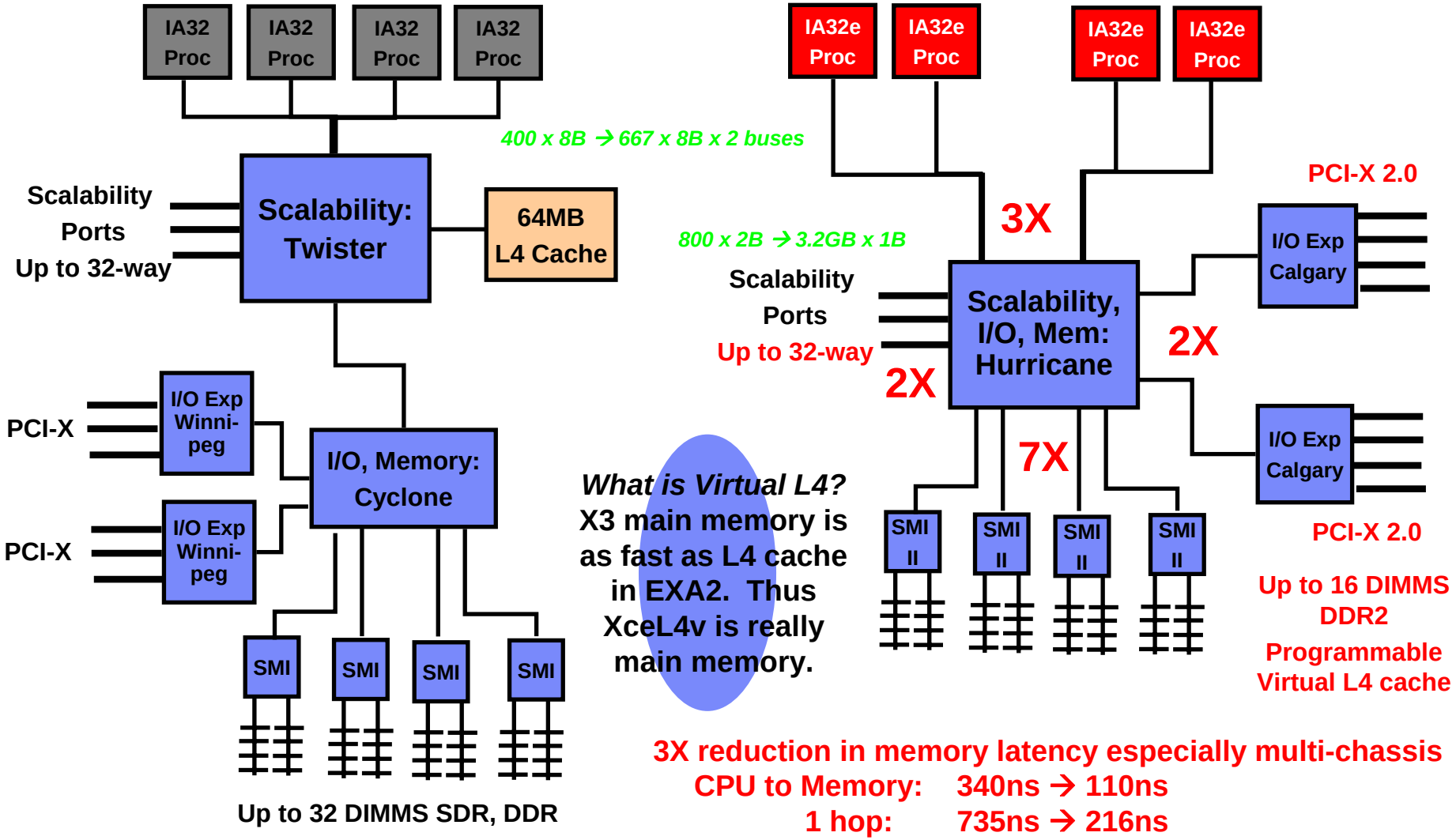
- Improved pay-as-you-grow with more granularity in CPU, I/O, RAM
- 2-32-sockets, Up to 512GB Memory, Dual-core Capable
- Flexibility with MXE scalability or x460 partitioning
- Optimized for Windows & Linux and the database-serving tier



Manageability

- Integrated hardware & remote mgmt software
- Integrated hardware-based security (TPM)
- Comprehensive alerting with PFA and Light Path Diagnostics
- Multi-chassis partitioning

EXA2 vs. EXA3: Fatter pipes & lower latencies



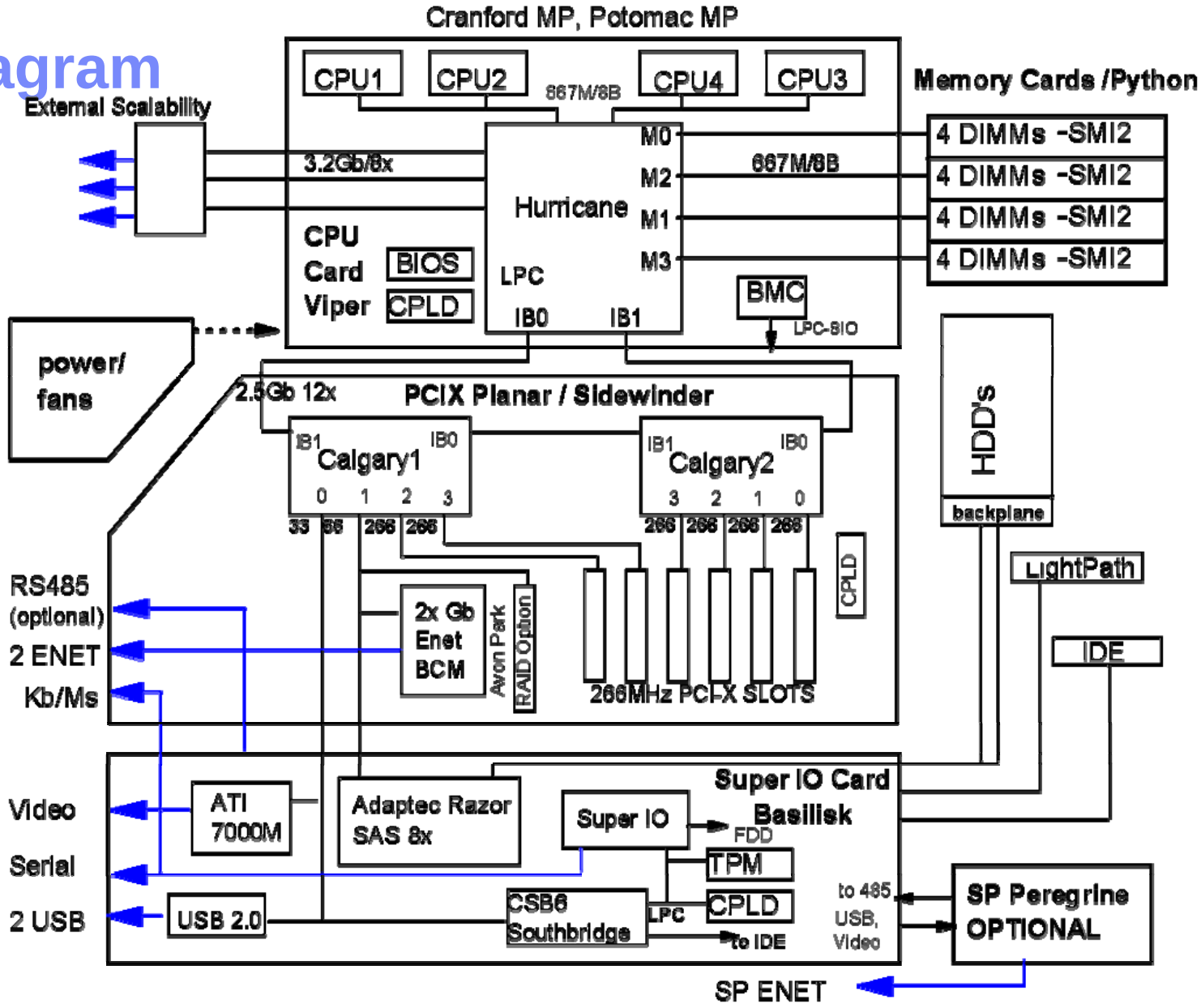
3X reduction in memory latency especially multi-chassis

CPU to Memory:	340ns → 110ns
1 hop:	735ns → 216ns
2 hop:	940ns → 324ns

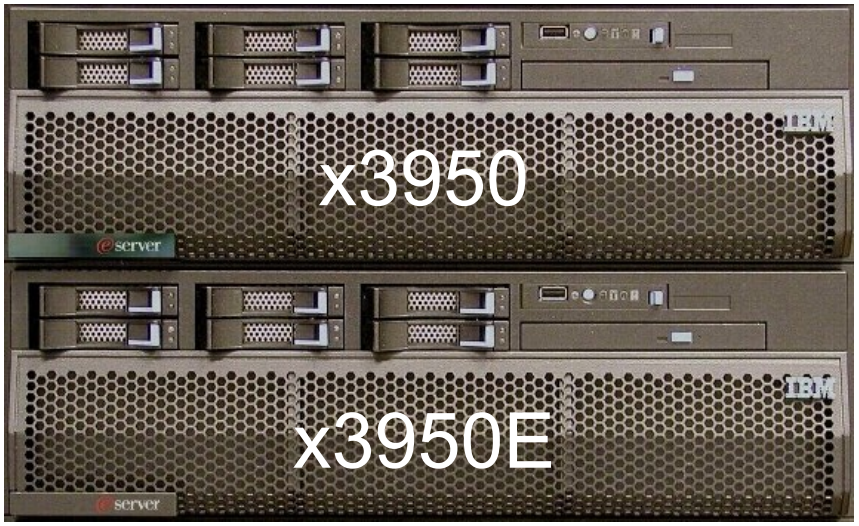
Block Diagram

CPU Power

Gallatin: 90W
Cranford: 110W
Potomac: 129W
Paxville: 165W
Tulsa: 180W



Third-Generation Enterprise X-Architecture

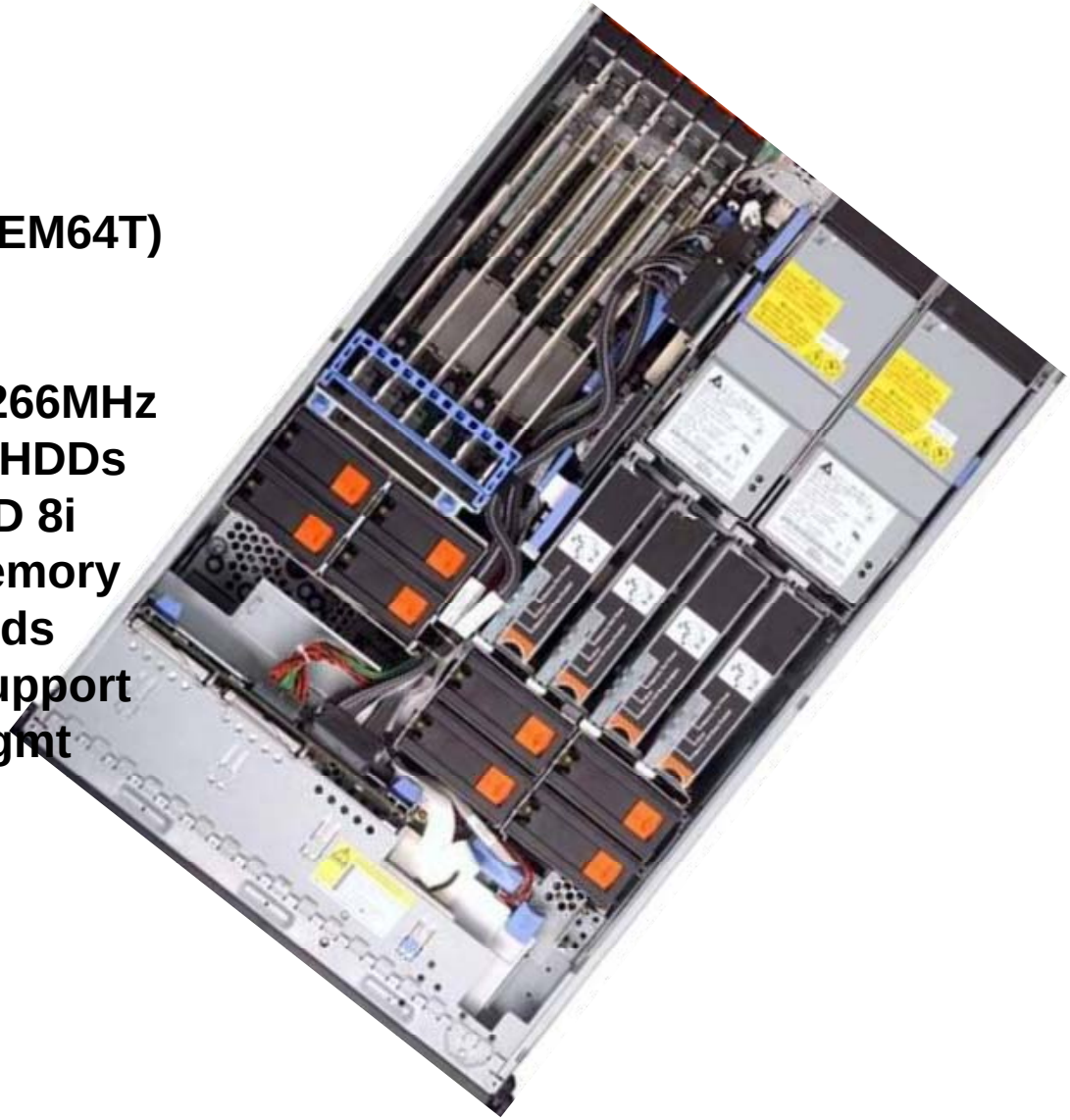


Common Elements:

Shared Planar Boards, Dual-core Ready
Xeon MP EM64T: 64-bit Extensions
Active Memory™: Faster DDR2
XceL4v™ Server Accelerator Cache
PCI-X 2.0 (Future PCI-E 4X/8X)
XA-64e™ 3rd Gen Chipset
Integrated SAS with optional RAID5
Remote Supervisor Adapter II Slimline

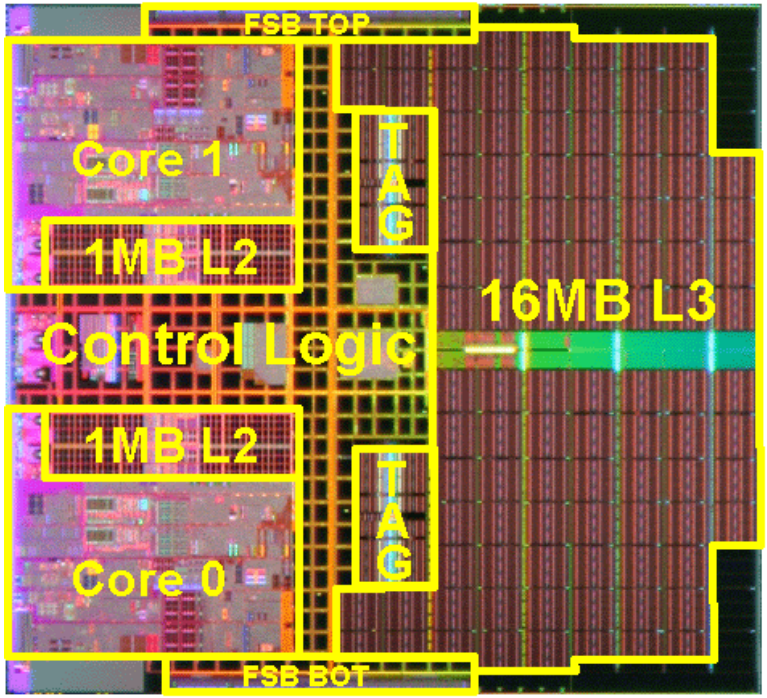
System x3950, x3950-E & x3850 Common Mechanical

- 3U rack-optimized chassis
- 4-socket Intel 64-bit Xeon MP (EM64T)
- XA-64e 3rd generation chipset
- 256MB XceL4v per 4 CPUs
- 6 available PCI-X2 slots up to 266MHz
- 6 available 2.5” SAS hot-swap HDDs
- Optional RAID5 with ServeRAID 8i
- Up to 16 DIMMs: 64GB max memory
- Up to four 4-DIMM memory cards
- DDR2-based Active Memory support
- RSAII standard for systems mgmt
- Two 1300W power supplies



Intel Tulsa processor – Dual Core Processors

- Dual cores, 4 threads / socket
- Front side bus remains at 667MHz
- 4 Core speeds: 2.5GHz, 3.0GHz, 3.16GHz, 3.3GHz
- Varied L3 cache sizes
  - 2.5GHz – 4MB L3 cache
  - 3.0GHz – 4MB L3 cache
  - 3.16GHz – 8MB L3 cache
  - 3.3GHz – 16MB L3 cache
- L3 cache is shared between cores
- 1MB of L2 cache / core - 2MB total
- Two power envelopes
  - 2.5GHz & 3.0GHz use 95 Watts
  - 3.16GHz and 3.3GHz use 150 Watts



Note that the Tulsa processor requires a unique planer implementation so customer with pre-Tulsa systems will not be able to upgrade these systems with Tulsa processors.

x3950: Scalable Solutions & Applications

Database
SQL, DB2, Oracle

ERP/CRM/SCM
SAP, Siebel, i2

Server Consolidation
VMware ESX

Targeting the database-serving tier with the first mainstream 8-socket x86 server combining break-through 64-bit performance and high availability on the industry's most prevalent server instruction set architecture (x86 ISA).*

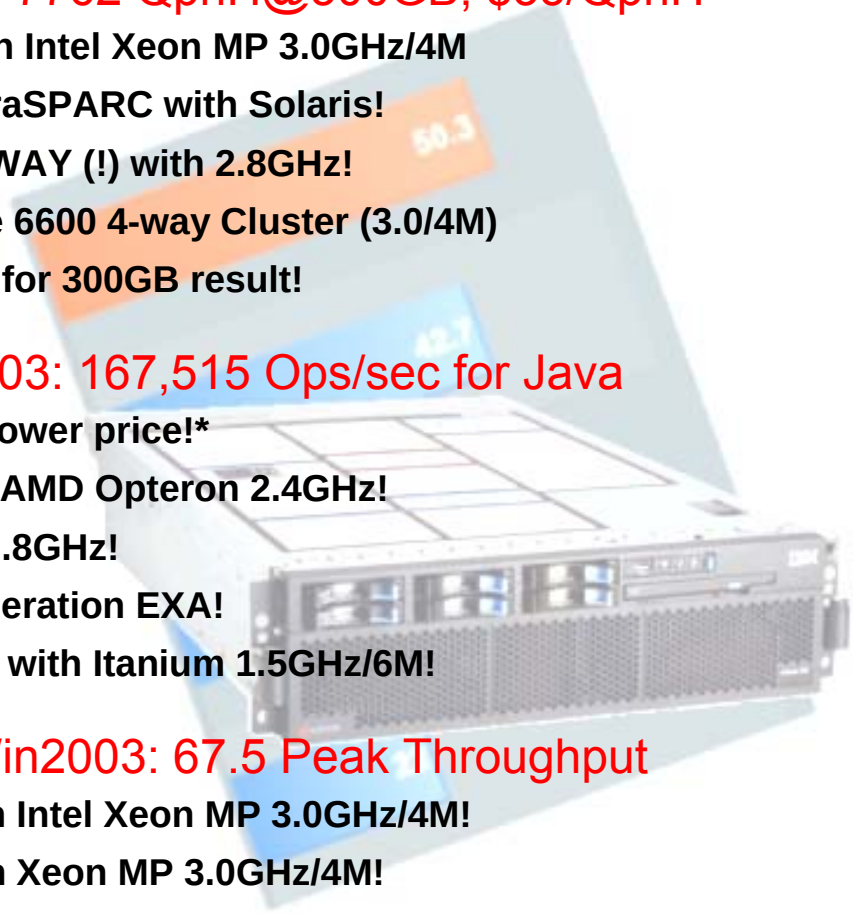
Application Flexibility + OS Flexibility

vmware Novell Microsoft redhat suse

*Source IDC: x86 servers outnumber by 10X all other server architectures combined, i.e. RISC/UNIX, SPARC, MIPS, et.al.

x3850 #1 Benchmarks with 64-bit Intel Xeon MP

- #1 TPC-H 32-bit 4-way with Win2003, DB2: 7731 QphH@300GB, $33/QphH
- #1 TPC-H 32-bit 4-way with SLES 9, DB2: 7762 QphH@300GB, $33/QphH
  - **51% greater than previous generation x365 with Intel Xeon MP 3.0GHz/4M**
  - **150% greater than the Sun Fire V440 4-way UltraSPARC with Solaris!**
  - **90% greater than the HP ProLiant DL760 G2 8-WAY (!) with 2.8GHz!**
  - **13% greater than the two-node Dell PowerEdge 6600 4-way Cluster (3.0/4M)**
  - **The Highest 4-way Server result ever achieved for 300GB result!**
- #1 SPECjbb2000 32-bit 4-way with Win2003: 167,515 Ops/sec for Java
  - **7% greater than Dell PowerEdge 6850 and 6% lower price!***
  - **55% greater than the Sun Fire V40z 4-way with AMD Opteron 2.4GHz!**
  - **30% greater than the IBM x445 8-WAY (!) with 2.8GHz!**
  - **128% greater than the IBM x360 4-way first-generation EXA!**
  - **43% greater than the HP Integrity rx5670 4-way with Itanium 1.5GHz/6M!**
- #1 SPECint_rate2000 32-bit 4-way with Win2003: 67.5 Peak Throughput
  - **18% greater than the Dell PowerEdge 6650 with Intel Xeon MP 3.0GHz/4M!**
  - **9% greater than the HP ProLiant DL580 G2 with Xeon MP 3.0GHz/4M!**
  - **3% greater than the Sun Fire V490 4-way with Solaris!**



*Configurations: 4w, 4GB, (1) 36GB 10K, RAID, 2 PS, DVD, 3yr NBD

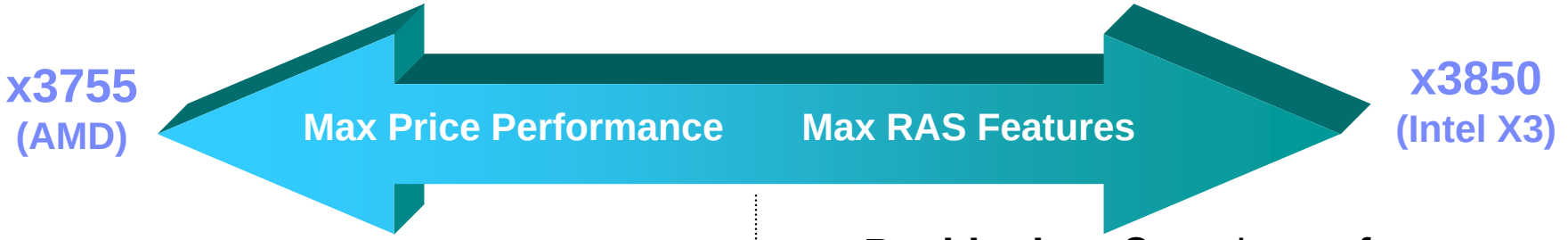
IBM System x3755

Ultimate HPC 4-socket Performance

- ***Superior performance for high performance computing applications***
  - ***Leadership Performance / Watt***
  - ***Leadership Price / Performance***
  - ***Flexible CPU configurations – supporting a 3 CPU config***
- ***Memory scalability and performance***
  - ***Largest, fastest memory capacity***
- ***Leadership I/O performance through unique HTx design***

Target apps: Scientific & Technical Computing, Financial Analysis

x3755 to x3850 Comparison



- **Positioning:** Superior performance for high performance computing
  - Lowest Cost 4-Socket
  - Superior Spec CPU Benchmarks
- **Target Applications**; Scientific computing, technical applications
- **Primary target Industries**; Petroleum, Life Sciences, Academia, National Labs

- **Positioning:** Superior performance for CPU-intensive enterprise applications
  - High RAS features
  - 99+ Benchmarks with EXA
- **Target Applications**; ERP, CRM, Midsize DB, Virtualization, Hosted Client
- **Primary target Industries**; Mid to Large enterprise, FSS, Insurance, Manufacturing

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- **Scale Out Solutions**
- Virtualisation
- Systems Management
- Futures
- Q & A

Product Line-up for Q3 2006

Highly Scalable

System x3950

System x3950-E

Rack Optimised

System x 3755

xSeries 306m

System x3650 - T

System x3650

System x3850

System x 3455

System x3550

System x x3655

System x x3655

Universal

xSeries 100

xSeries 206m

System x3400

System x3500

System x3800

IBM BladeCenter H

IBM BladeCenter

IBM BladeCenter T

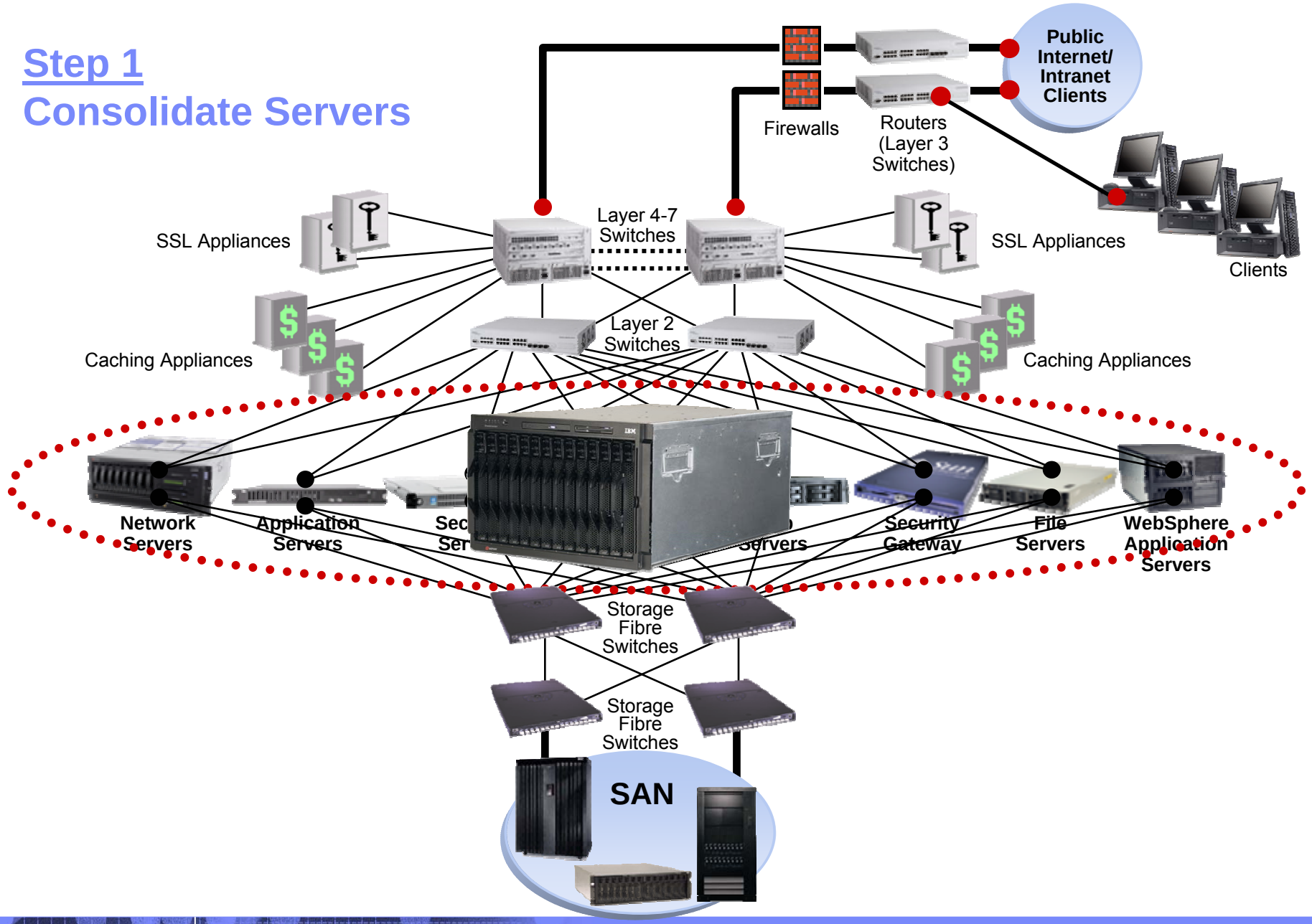
What problems should blades address?

A properly designed blade should

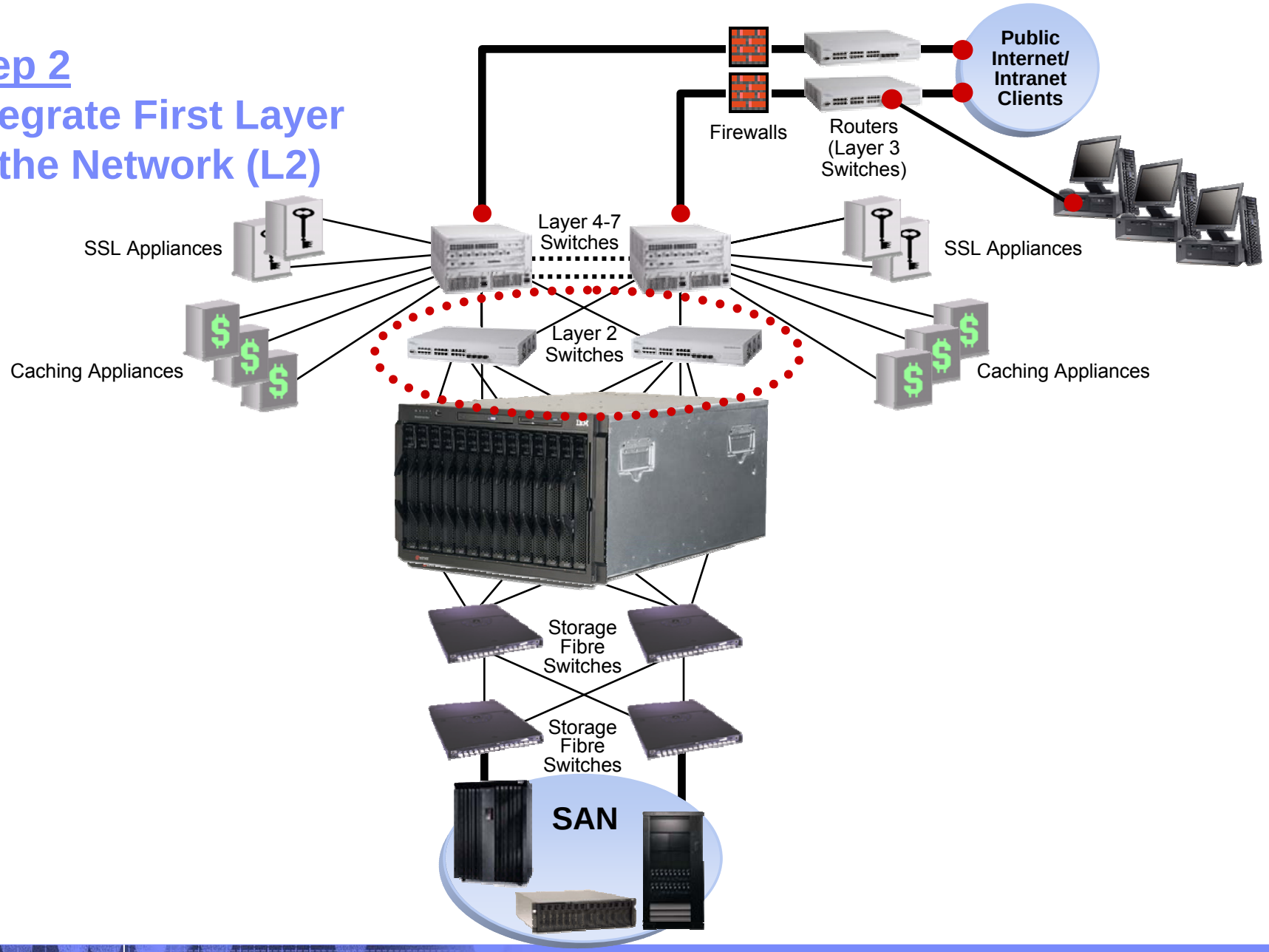
- **Reduce power consumption**
- **Be easier and less costly to cool (less heat and less air flow)**
- **Reduce weight over 1U/2U alternatives**
- **Drive out costs and reduce TCO**
- **Reduce points of failure and increase RAS (reliability, scalability, serviceability)**
- **Increase manageability**
- **Speed deployment**
- **Drive out cable complexity**
- **Be flexible enough to match current infrastructures and fabrics**
- **Be able to run all your applications and OS varieties not just Linux/Windows**
- **Reduce the ‘churn’ needed to bring on new technology**
- **Increase density**

Turning a 1U on its side is not going to sort out many of these issues

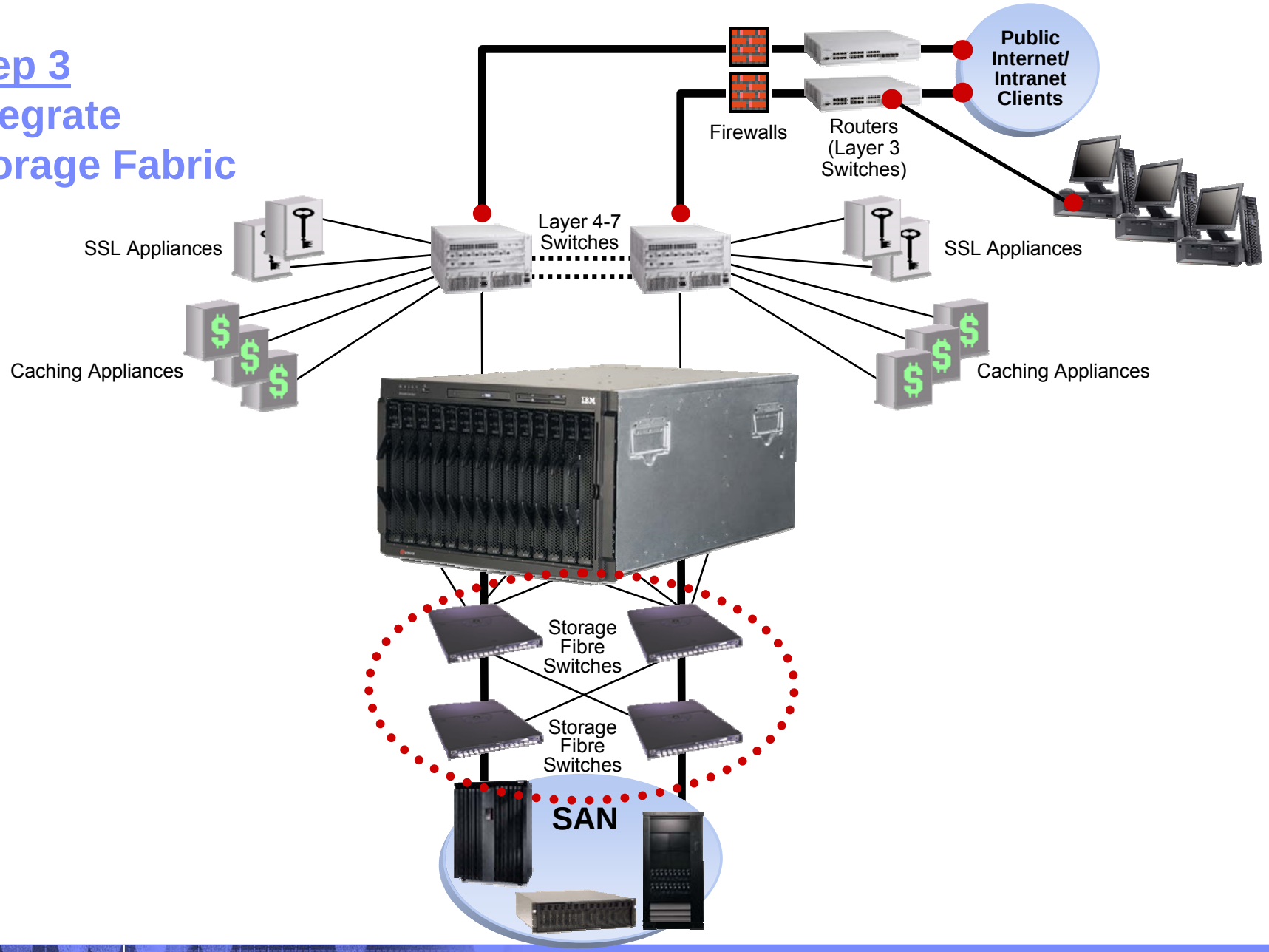
Step 1
Consolidate Servers



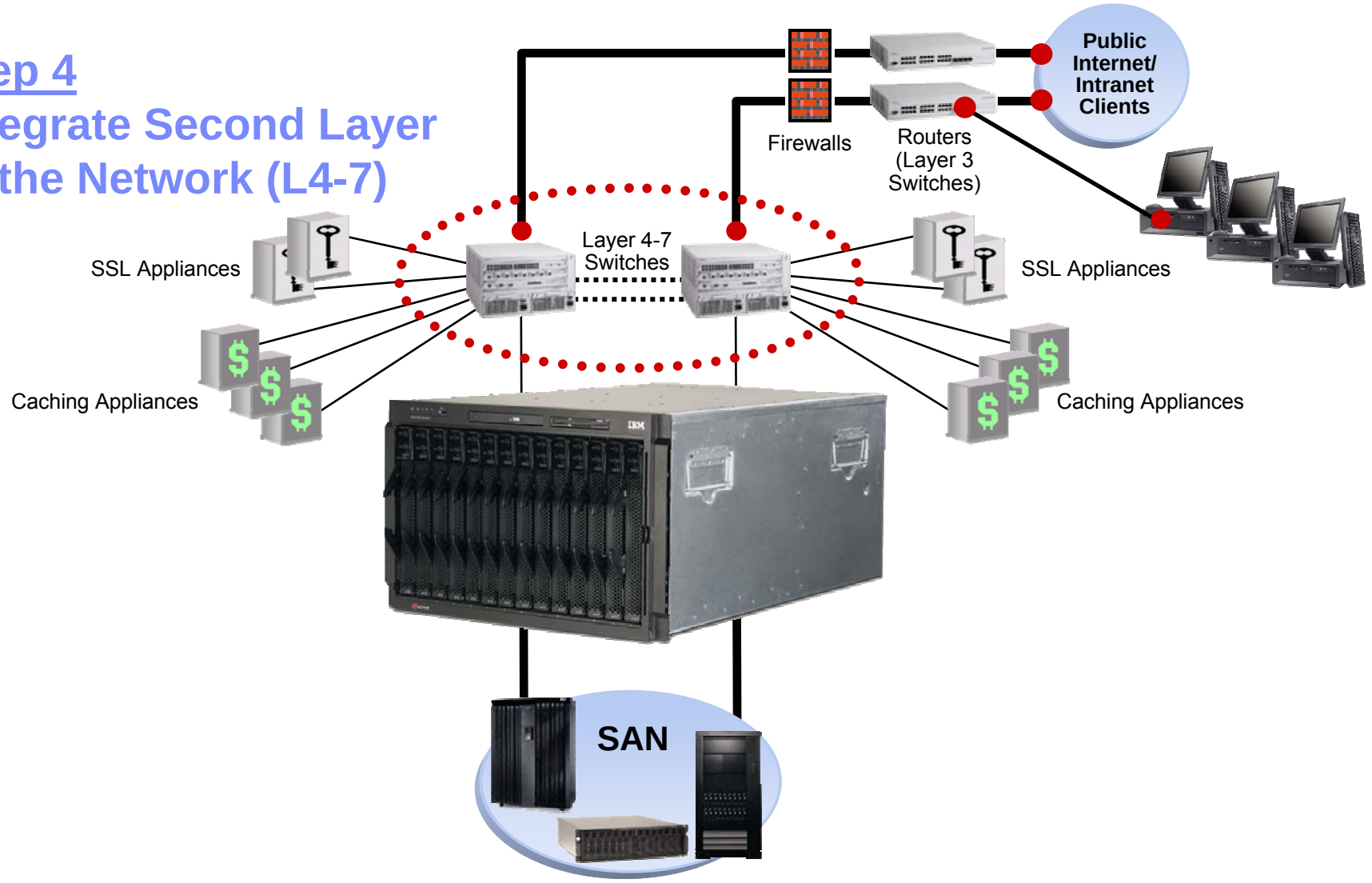
Step 2
Integrate First Layer of the Network (L2)



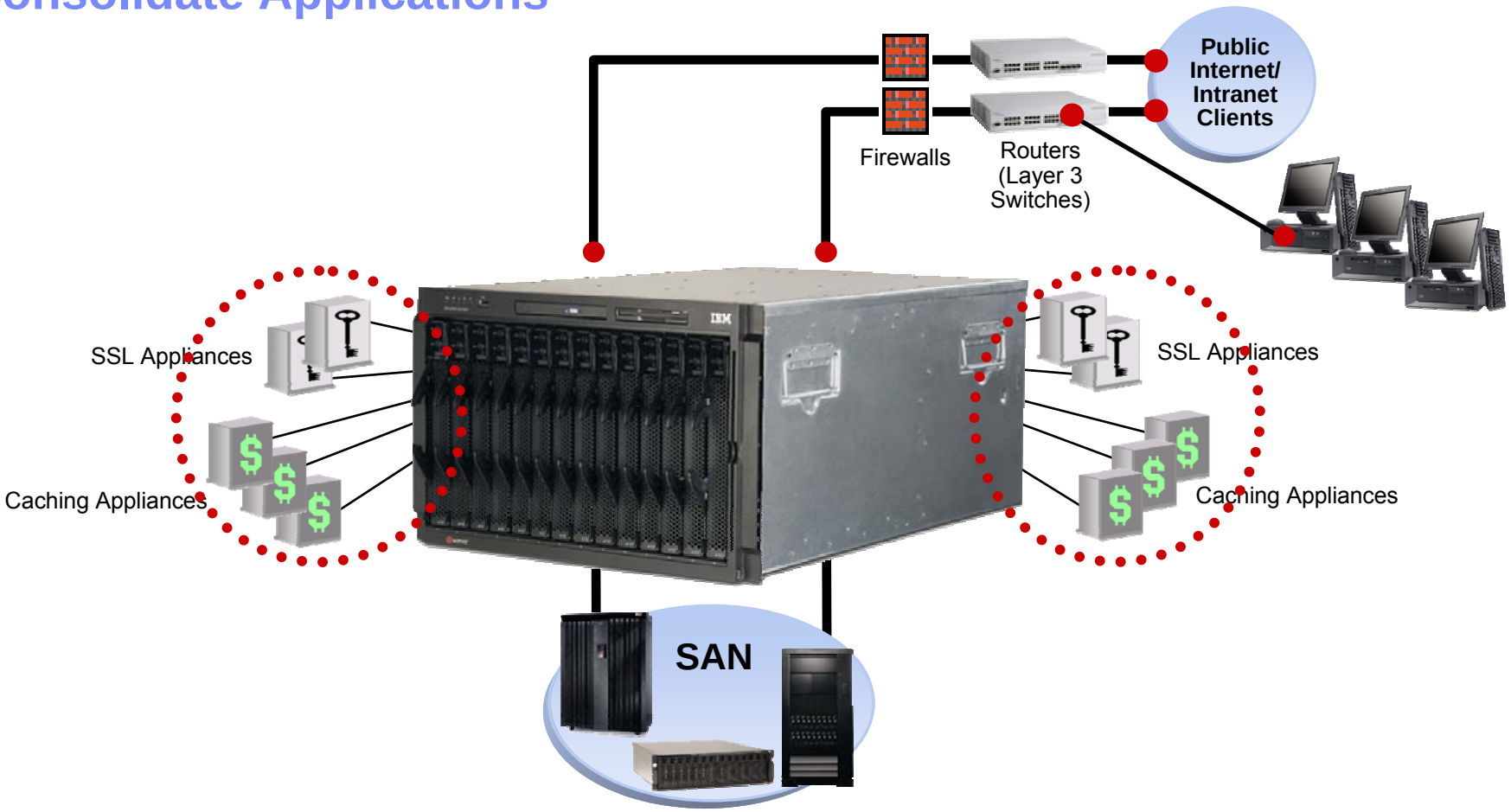
Step 3
Integrate Storage Fabric



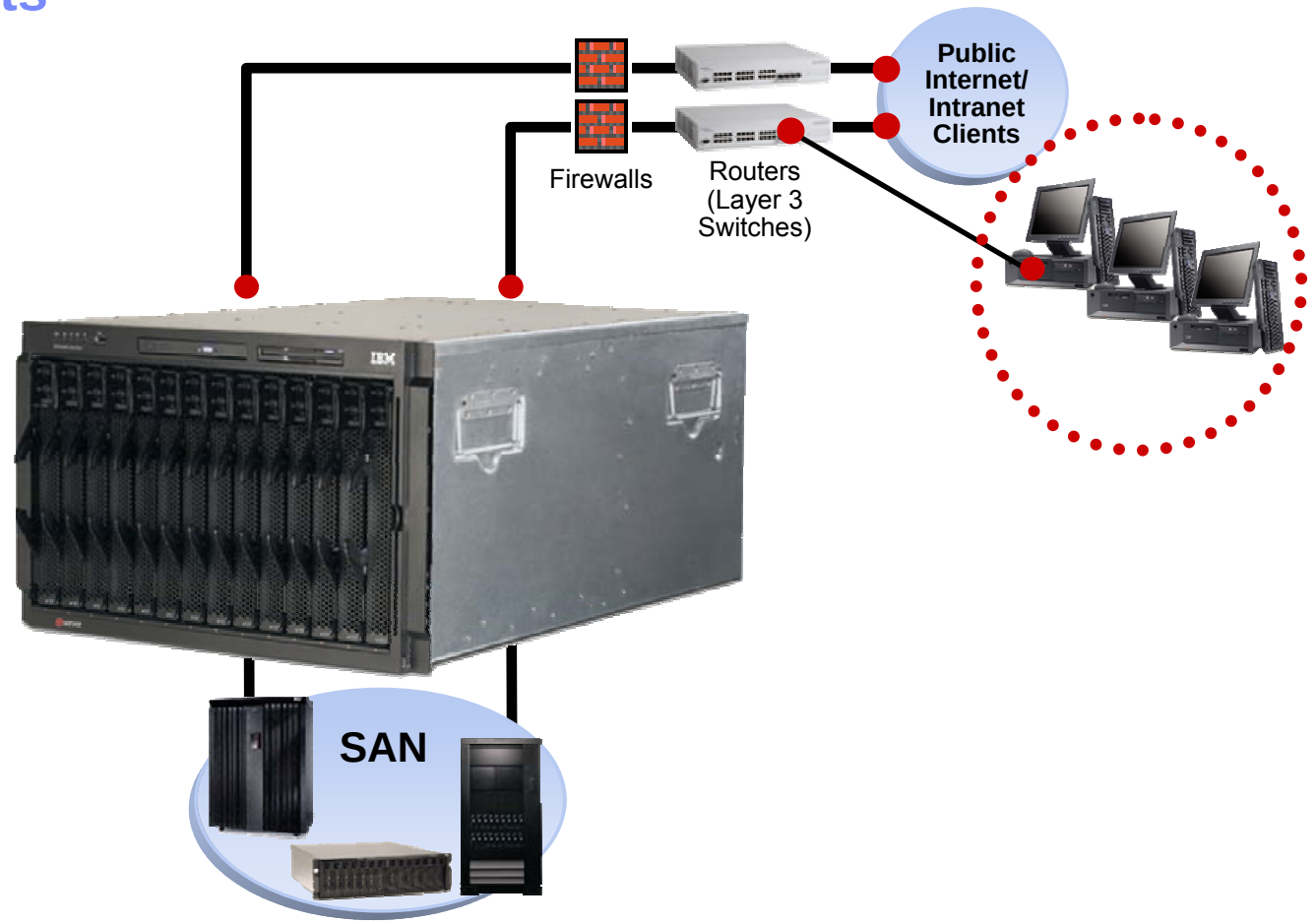
Step 4
Integrate Second Layer of the Network (L4-7)



Step 5
Consolidate Applications



Step 6
Consolidate Clients



What is a “Blade”

- A “server on a card”
  – each “Blade” has its own:
    - processor
    - networking
    - memory
    - optional storage
    - etc.

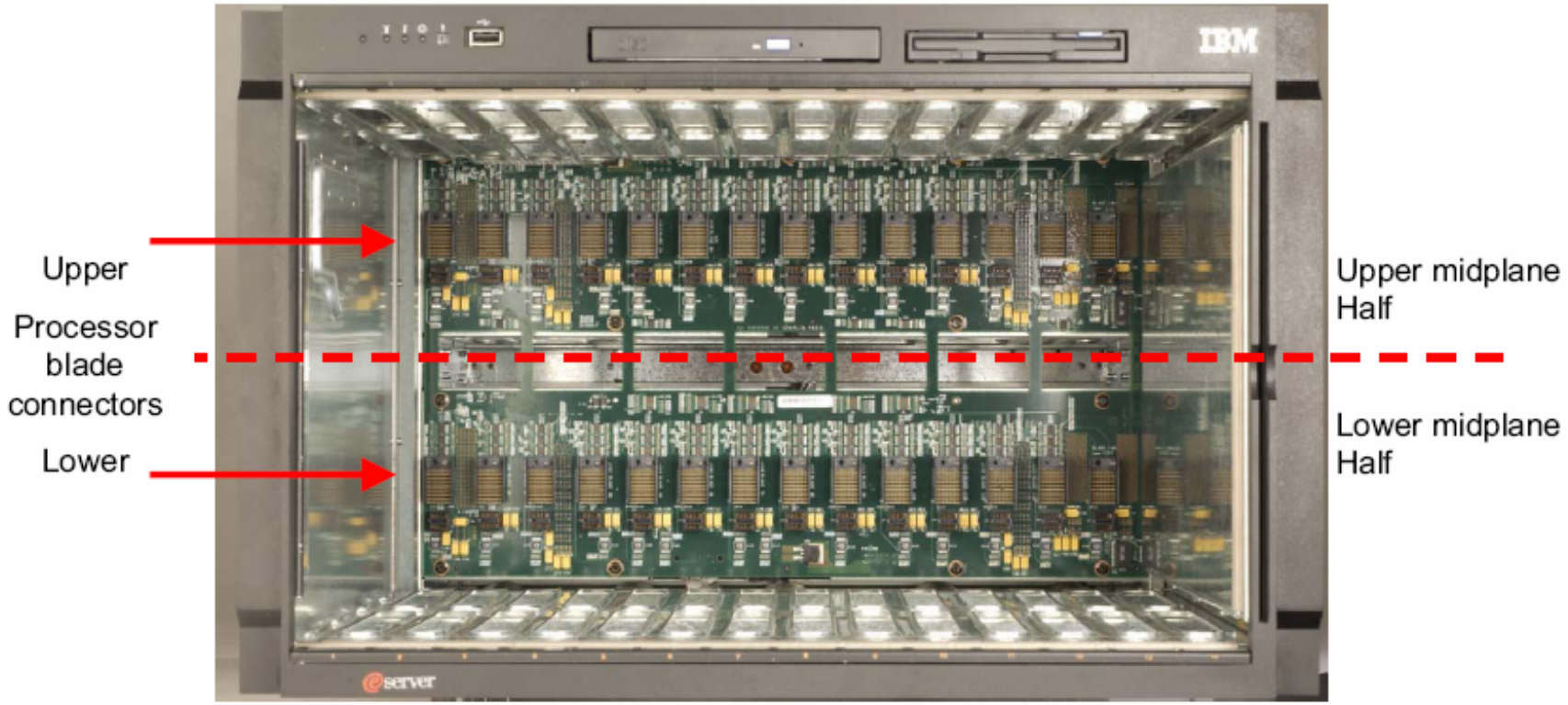
- The chassis provides shared:
    - Console Access (KVM)
    - Power Supplies
    - Cooling
    - Network Connectivity (SAN/LAN/Myrinet Switches)
    - CD-ROM drive
    - Diskette drive

IBM Blade - in its own ruggedized chassis

IBM Blade - with its cover on - ready for insertion into the BladeCenter

IBM BladeCenter chassis

Chassis Overview – Inside View



IBM eServer BladeCenter

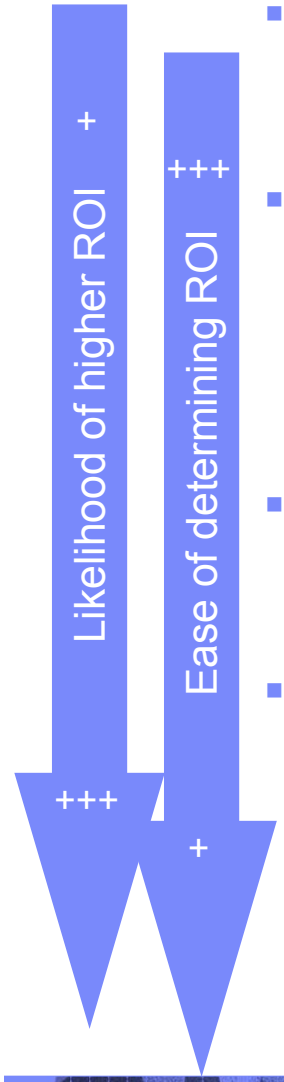
Up to 4 processors per blade

Up to 14 blades per chassis

Six 7U chassis per rack

Full performance and manageability of rack-optimised platforms ...
... at TWICE the density of most 1U servers

BladeCenter ROI/TCO factors



- **Purchase or Lease Price**
  - Blade servers vs. rack-optimized servers
  - Opportunities for infrastructure lease terms
- **Infrastructure Costs**
  - Floor space
  - Rack costs
  - Cables
  - Internal vs. external components
- **Ongoing operational Costs**
  - Power
  - Cooling
- **Management Costs**
  - Installation and deployment time
  - Remote management capabilities
  - Administrative personnel

CIO Priorities	BladeCenter Delivers
Cost pressures	Pay as you grow modular scalability
Shortage of skilled people	Manage more users with less IT staff
eBusiness demands	OnForever availability and XpandOnDemand
Sustained innovation	IBM delivers technology to market

BladeCenter One Family
Investment Protection

BladeCenter T
Announced: Apr. 2004

8 Blades, 8U

Ruggedised Chassis

Telco, Military,

Medical Imaging Apps

BladeCenter
Announced: Nov. 2002

14 Blades, 7U

Enterprise & SMB Chassis

Mainstream Applications

Remote Sites (stores)

BladeCenter H
Announced: Feb. 2006

14 Blades, 9U

High Speed (>10GB)

Extreme I/O for data intensive environments

Common Blades, Common Switches

BladeCenter One Family
Investment Protection

BladeCenter
Announced: Nov. 2002

14 Blades, 7U

Enterprise & SMB Chassis

Mainstream Applications

Remote Sites (stores)

Designed for Modular Flexibility

A. **Gigabit Ethernet Switches (Layer 2 / VLAN)**
   - 0 Standard, 1 Required/Option, 2 Max/Option

B. **Fibre Channel Switches (2Gb FC Fabric)**
   - 0 Standard, 2 Optional/Max

C. **Redundant Power (4 x 2000W load-balancing)**
   - 1 Redundant Power Pair (2 supplies) standard for Chassis and Blades 1-6
   - 2nd Redundant Power Pair (2 supplies) optional for Blades 7-14

D. **Redundant Cooling (Hot-Swap, Managed, Flow through)**

E. **KVM Switches / Management Modules**

Ethernet Switch Options

Redundant Blower

KVM Switch / Management Module

Redundant Power

BladeCenter Ethernet Components

Cisco Systems® Intelligent Gigabit Ethernet Switch Module

Nortel Networks® Layer 2/3 Fiber Gigabit Ethernet Switch Module

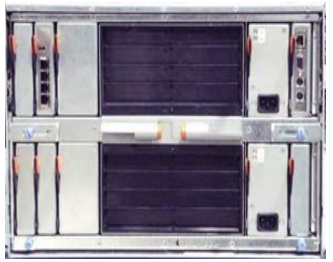
Nortel Layer 2/3 10Gb
(1) 10 Gb MM Fiber Ports
(2) 10 Gb Copper Ports

BladeCenter Telco

Cisco Systems® Fiber Intelligent Gigabit Ethernet Switch Module

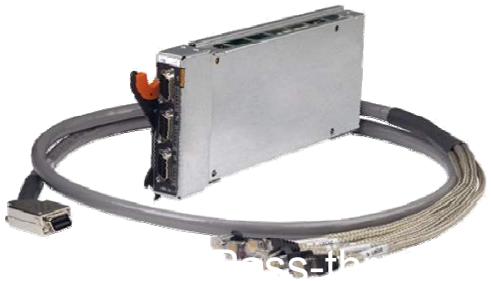
Nortel Networks® Layer 2-3 Gigabit Ethernet Switch Module

Intel® Gigabit Ethernet Switch Module



BladeCenter

Nortel Networks® Layer 2-7 Gigabit Ethernet Switch Module



BladeCenter H

BladeCenter Storage Components

McDATA® 6-port Fibre Channel Switch Module

Brocade® Enterprise SAN Switch Modules

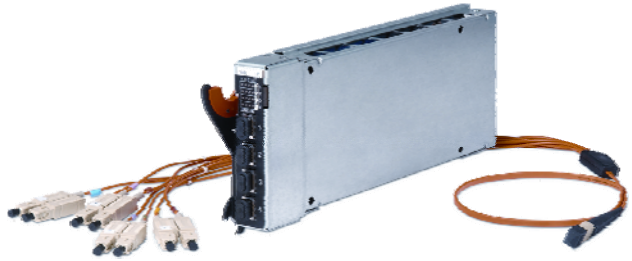
Brocade® Entry SAN Switch Modules

QLogic® Enterprise 6-port Fibre Channel Switch Module

iSCSI Expansion Card

Fibre Channel I/O Expansion Card (Stff)

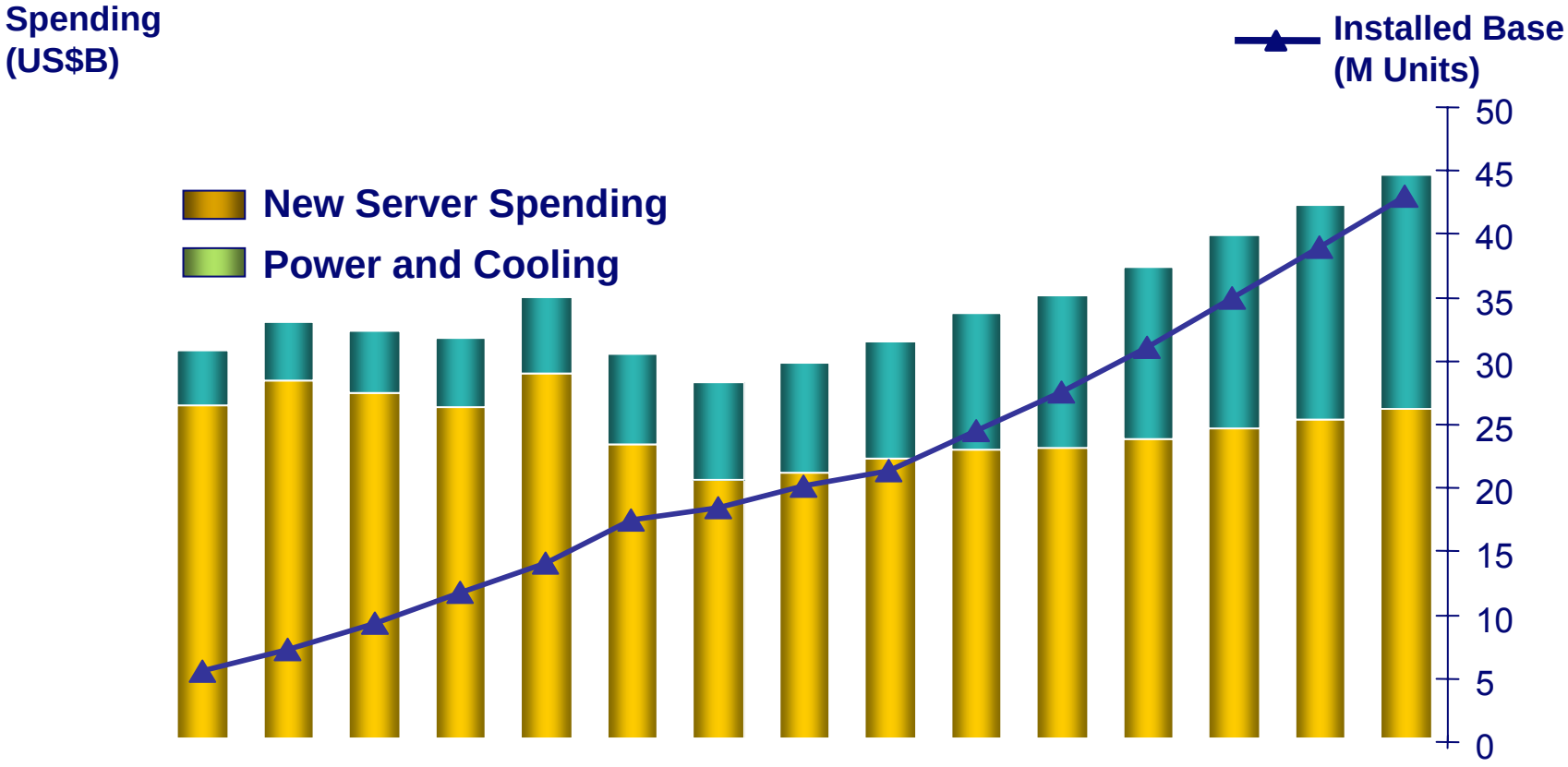
Fibre Channel I/O Expansion Card (Smff)



Advanced Management Module (AMM) - Overview

Enterprise/entry and highspeed chassis advanced management module

Worldwide Server Market



IDC Analyze the Future

SOURCE: IDC, 'The Impact of Power and Cooling on Data Center Infrastructure,' Document #201722, May 2006"

Power Cost Calculation

- The cost of power varies widely across the world
  - Americas .05-.1US per KW/h
  - EMEA .08-.15US per KW/h
  - Japan as much as .25US KW/h
- To calculate the cost of power you only need a few data points
  - Power of server
  - Hours a day it will run
  - Days a year it will be on
  - Cost of a KW/h of electricity

0.220KW x $.1US x 24 hours x 365 days = $192/year

- Power is also consumed in AC to cool the resulting heat
  - Simple rule of thumb is that running the AC required an additional 40-100% more power than input into the server

Power in of $192 adds $96 of HVAC power = $288 total power cost

Holistic Approach to Power

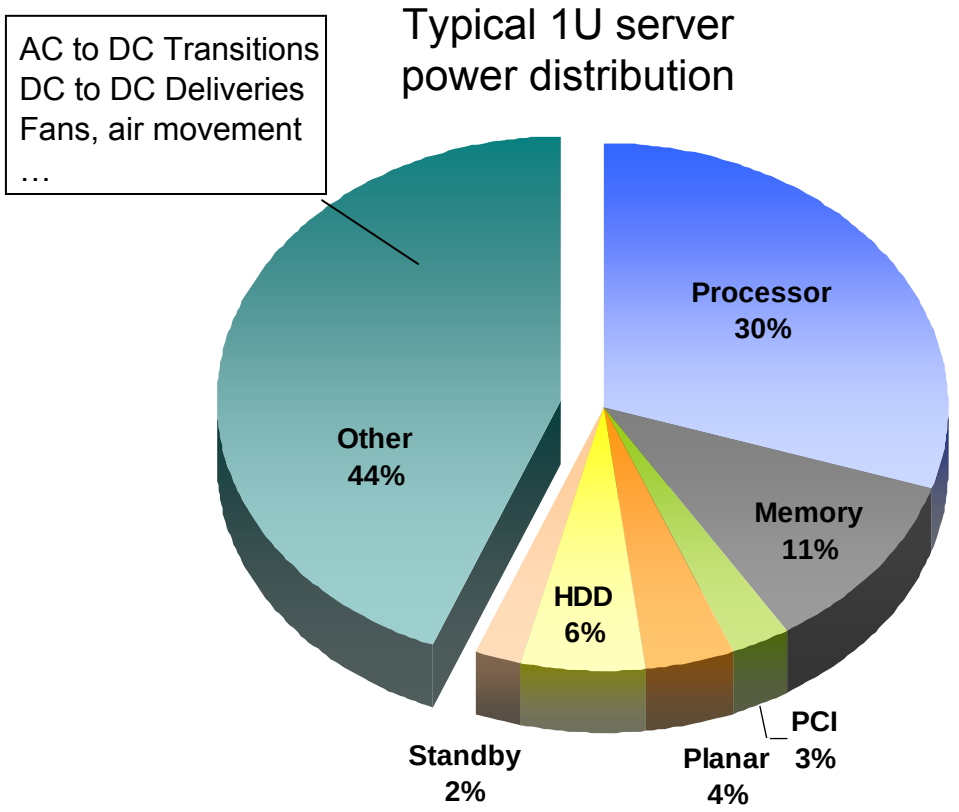
- **Design the server to be a more efficient user of power**
  - Calibrated Vector Cooling
  - A history of Super Efficient AC to DC conversion
- **Typical power supply 65-75% in the industry**
  - BladeCenter 82% in 2003
  - BladeCenter 91% in 2006 for BC and BCH
- **Use of lower power commodity parts**
  - 65W Intel
  - 68W Opteron
- **Cool Blue empowers users**
- **Power calculator for initial planning**
- **PowerExecutive™ for accurate understanding of your actual power draw**
- **Thermally engineered racks to optimize server level and room cooling**
- **Room level solutions**

How Does BladeCenter Use Less Power?

The more function you pack in the more power you need to run it

IBM innovations:

- **Efficient power supplies—fewer wasted watts in AC→DC transition**
- **Fewer parts, fewer components drawing power**
- **Smarter thermal solution—reduces fans from 112 to 2 low-power blowers**



IBM Thermal and Power Advantages
Inside The System - keep it all cool

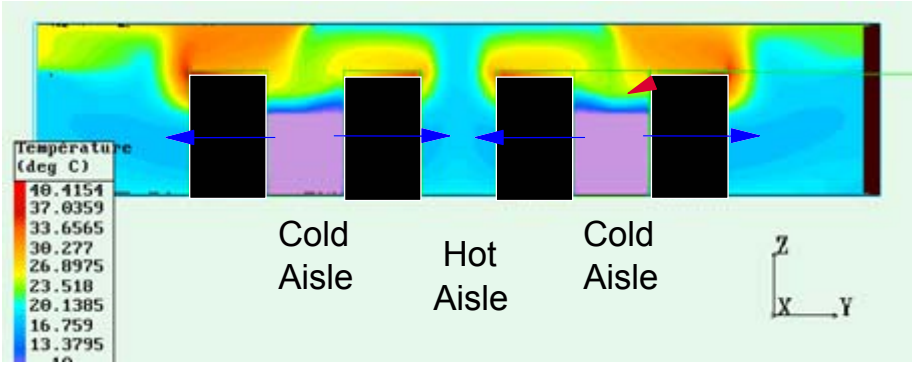
- **IBM's advanced designs allow IBM to pack more function in**
- **IBM builds in better efficiency into the systems**
  - **BladeCenter shares system infrastructure components, and uses 90% + efficient power supplies, and blowers to reduce power consumption by up to 20-40% over competitive servers**
  - **Calibrated Vector Cooling technology allows dual paths of air to each component improving uptime, longevity, and reducing wasteful air movement**
  - **All IBM servers utilize power supplies that are power factor corrected and deliver high energy efficiency to reduce wasteful electrical usage and heat output**
  - **Focus on the use of lower power components to stretch the available power budget of the system - Intel Dual Core ultra low power processors in the BladeCenter are a great example**

IBM Thermal and Power Advantages
Inside The Rack - keep it all cool

- IBM designs all of its servers to work at full density in a properly designed rack solution
- Designed to operate at extended temperature ranges to keep the system up and running in even the most extreme temperature and failure conditions
  - Operation up to 35C is our design point
  - We optimize the use of airflow in the system to prevent wasteful use of precious air conditioning
- IBM racks prevent air recirculation in the rack leading to better efficiency and lower operating temperatures
  - No way for hot air form rear of rack to re-circulate back to front
  - Cable management to clear the air path from the server

IBM Thermal and Power Advantages
At The Room Level - keep it all cool

Issue 3



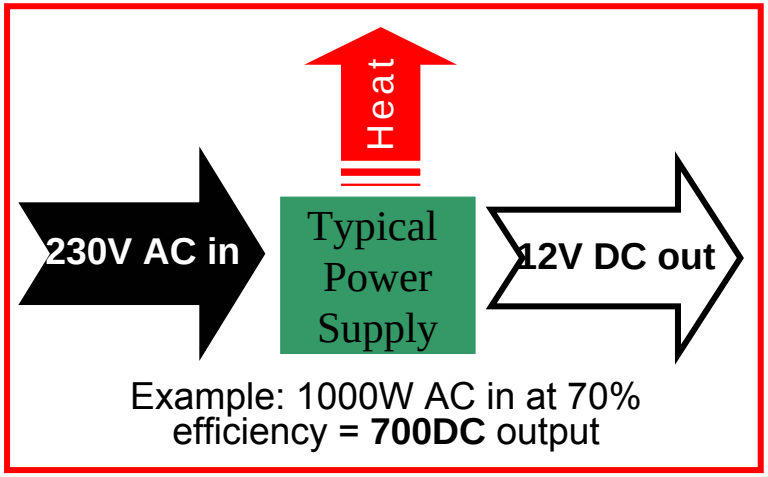
- **Power efficiency allows our systems to run with less power**
- **For some this is not enough**
  - **Older data centers were not designed to handle the heat loads**
  - **Customers run out of power/cooling filling the rack**

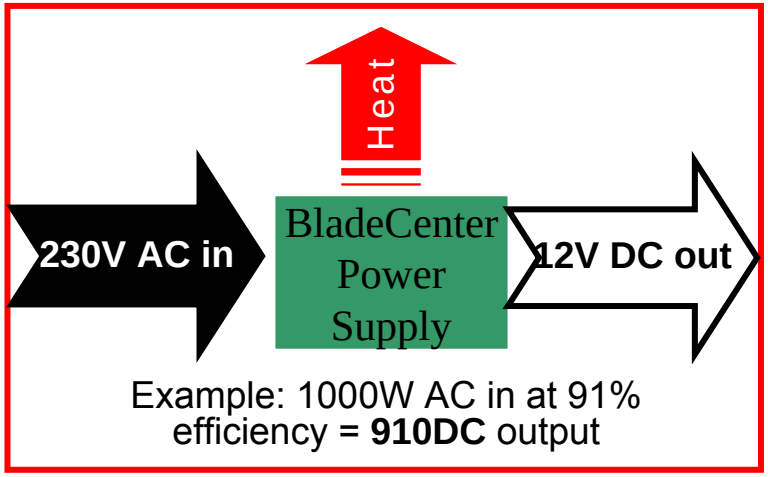
- **IBM developed the IBM Cool Blue rack based heat exchanger**
  - **Rack option does not change the foot print of racking**
  - **Handles up to 55% of the heat load from the rack (as much as 15KW)**
  - **Works with any IBM Enterprise Rack**

Efficient Power Delivery

There are two kinds of power

- **DC** – the type of power the server components run on
- **AC** – the type of power that we distribute in the data center
- Power supply converts AC to DC

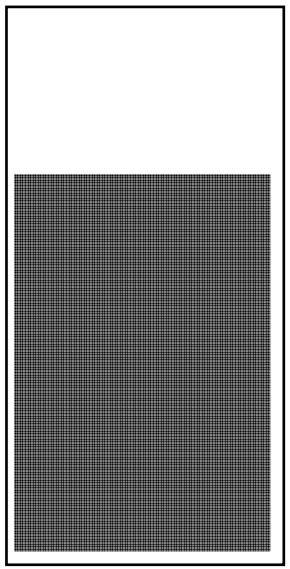




Are you Dense? An example of efficiency

10KW rack holds 37 Blades (270W)

28 1U servers



Same Number of servers

Same performance

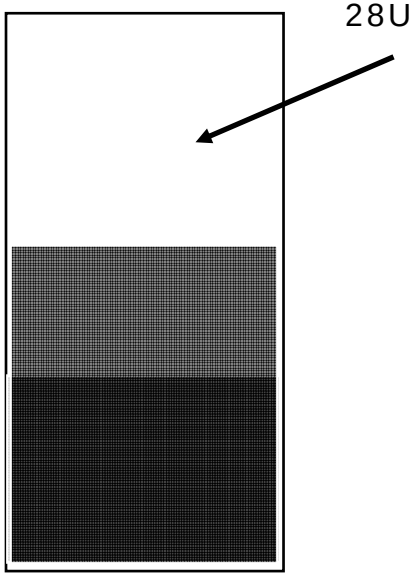
Same function

OR

25-40% more servers
at no additional power
or cooling

28 HS21 Blades

28U white space



10KW rack holds 28 1U servers (360W)

25-40% less power

25-40% less heat

Nearly 50% less air flow

40% less weight

Other IBM Advantages
Take back control of your power

- **IBM Power Calculator**
  - **Tool to deliver better sizing information about our clients solutions**
- **Power Executive**
  - **A powerful software suite designed to give users better information over their power consumption**
    - **Monitors power point in time and yields historical data**
    - **Better information leads to better decision making**
    - **Power Executive is used in BladeCenter to reduce the cost of power infrastructure required to run the system- saving cost**
    - **The future performance of systems will likely be based on vendors ability to control power - PEx is ready now.**
- **Virtualization**
  - **Typical x86 utilization is quite low (15-40%). Increasing utilization unlock new processing power without massive power increases at the rack level**

The IBM Power Calculator

The Information Needed to Right Size the Datacenter

- **IBM has made available its internal power calculator**
  - **Available via the web for customers and IBM business partners**
- **The tool will provide better data center sizing information for specific configurations of BladeCenter and other xSeries servers**
- **Tool provides the follow useful information**
  - **Power input (watts)**
  - **PDU sizing information (amps)**
  - **Heat Output (BTU)**
  - **Airflow requirements through chassis (CFM – cubic feet per minute)**
  - **VA Rating (VA)**
  - **Leakage current (mAmps)**
  - **Peak inrush current (Amps)**

To download the latest version of the power tool visit ibm.com at:
http://www-03.ibm.com/systems/bladecenter/powerconfig/

IBM® BladeCenter™ and System x™ Power Configurator Results

The IBM BladeCenter Power Calculator

What Information Does it Provide?

Measured number – solution on but at 0% utilization

Measured number – solution at 100% utilization

Worst case power for the MTM- based on power supply typically. Not effected by Configuration

Quantity	Description	Idle Power	Maximum Measured Power	Maximum Measured Input Current	Rated System Power
1	**Blade Center - IBM 2.8LV**	**1306 W**	**3087 W**	**13.4 A**	**5400 W**
	Domain 1	596 W	1409 W	6.1 A	2700 W
	Domain 2	710 W	1678 W	7.3 A	2700 W
1	IBM BladeCenter Chassis				
	Power Supplies for Blades 1-6: 2x 1400 W & Blades 7-14: 2x 1800 W				
	1 Management Module(s)				
	(2) 4-Port Gigabit Ehternet Switch Module				
	(2) No Switch				
14	HS20 EM64T				
	(2) 2.8GHz/800MHz/1MB L2 Xeon Processor - Low Voltage				
	(4) 1024 MB Dimm(s)				
	(2) 36.4GB 10K rpm Ultra320 SCSI HDD				

Summary of installed components in solution

Rack level data- cumulative of individual chassis above

Power Estimates for Total Configuration

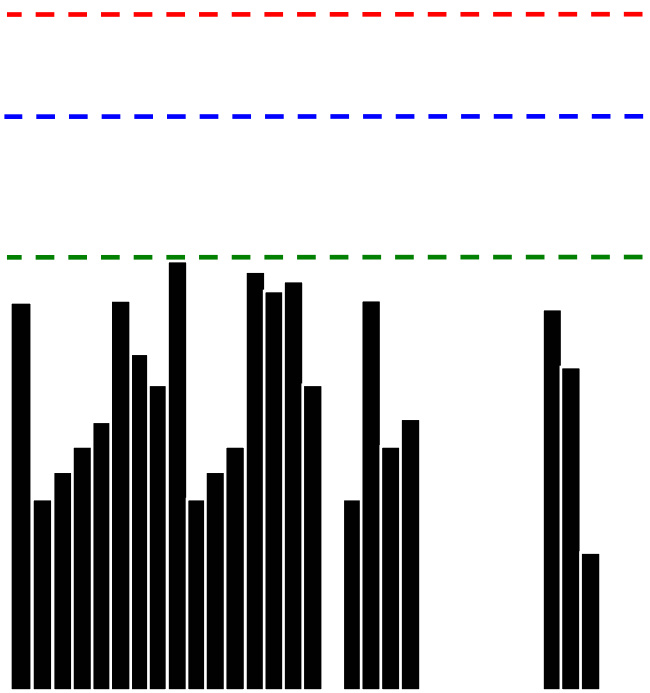
Date & Time:	**2/8/2006 12:34:26 AM**		
Country:	**United Kingdom**		
Voltage:	**230 V**		
Based on system(s) running at:	**IDLE**	**MAX MEASURED**	**SYSTEM MAX**
Power:	**1305 W**	**3086 W**	**5400 W**
Input Current:	**5.7 A**	**13.4 A**	**27 A**
BTU/HR:	**4450 BTU/Hr**	**10524 BTU/Hr**	**18414 BTU/**
CFM:	**252 CFM**	**462 CFM**	**462 CFM**
VA Rating:	**1332 VA**	**3149 VA**	**5510 VA**
Leakage Current:	**3 mA**	**3 mA**	**3 mA**
Peak Inrush Current (4ms):	**200 A**	**200 A**	**200 A**

Airflow at 25C or less CFM is temperature dependent not based on utilization

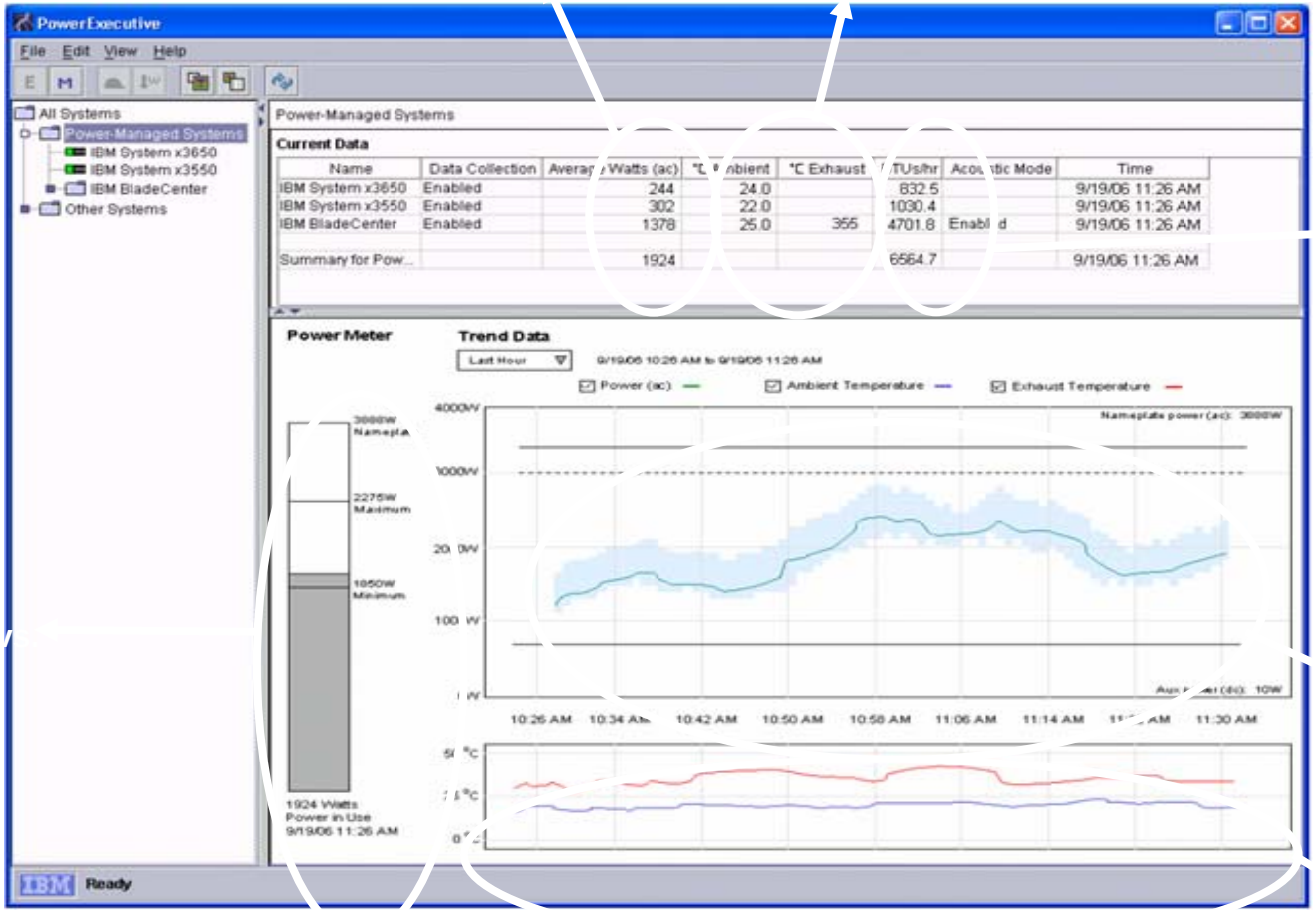
IBM PowerExecutive

Better Information Leads to Better Decisions

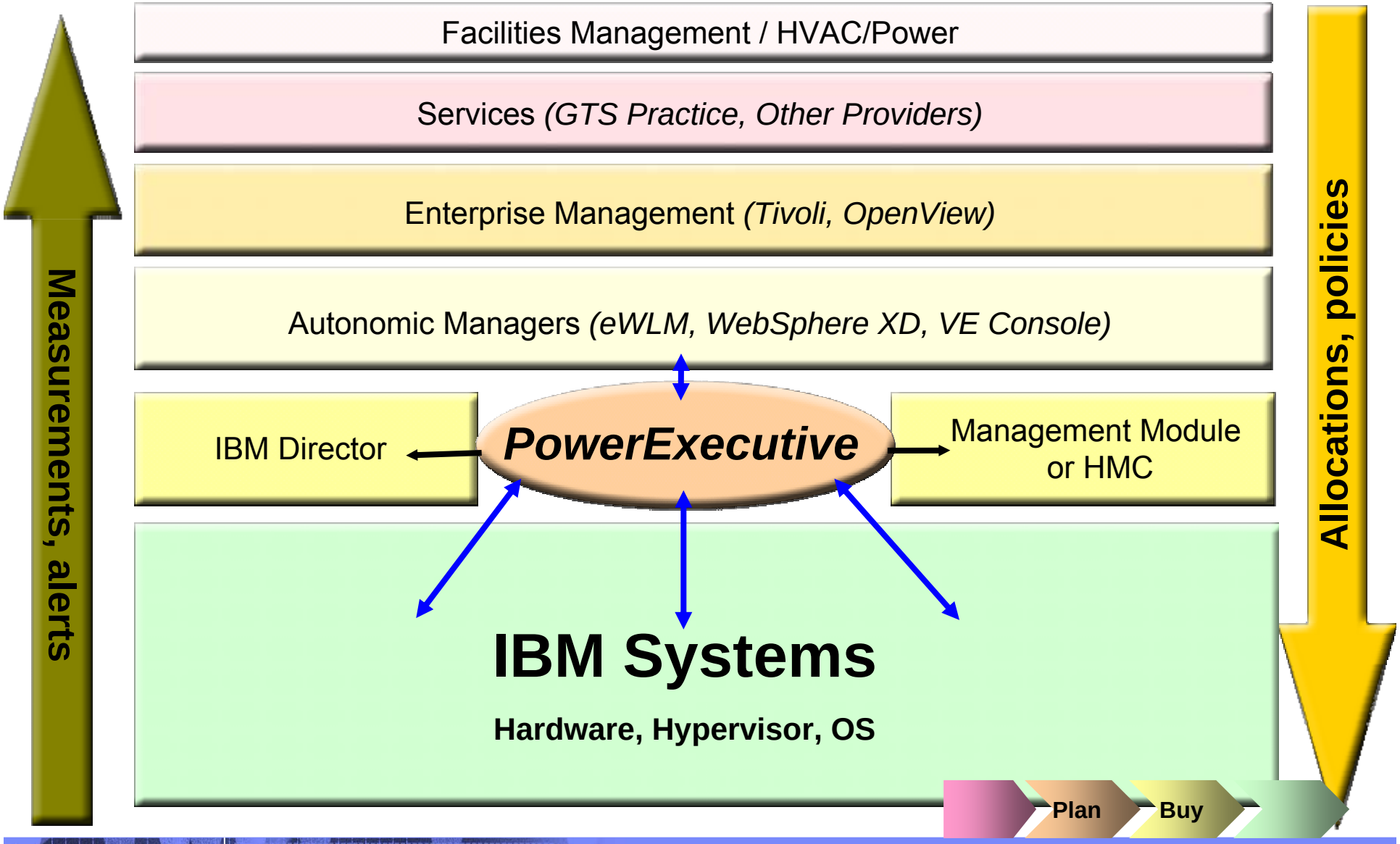
- **Power Executive is hardware and software working together to yield data on power consumption**
- **Knowing actual power allows you to 'right size' your data center design**
- **PowerExecutive can also deliver amazing reduction in power infrastructure to the rack by reacting to power shortages at the server level**
- **The future of PowerExecutive will allow customers to take even greater control of their power**



PowerExecutive™ in action!



PowerExecutive™ In the System Stack



IBM PowerExecutive™ beats the competition

- ***Help solve your customers' biggest problem today:***
  - **Intelligence, control to manage datacenter server power utilization**
  - **Hardware, embedded management logic**
- ***More accurate data center planning:***
  - **Actual power draw instead of conservative "label/spec power" estimates**
- **In Future – *cap actual power consumption***
  - **Match the power/thermal limits of the datacenter**
  - **Allocate power where needed**

Features	IBM	HP*	Dell	Benefits
Report Actual Power Draw Available Now	Yes	NO	NO	No more datacenter budgeting assumptions
Power Capping Expected to be Available 4Q06**	Yes	NO	NO	System level power cost savings
User Defined Power Capping Expected to be Available 4Q06**	Yes	NO	NO	Customer control of datacenter power costs
CPU Power Management Expected to be Available 1Q07**	Yes	NO	NO	Platform level power cost savings

IBM PowerExecutive takes the guess work out of datacenter power management

*HP Power Regulator does not display actual power utilization
**All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only

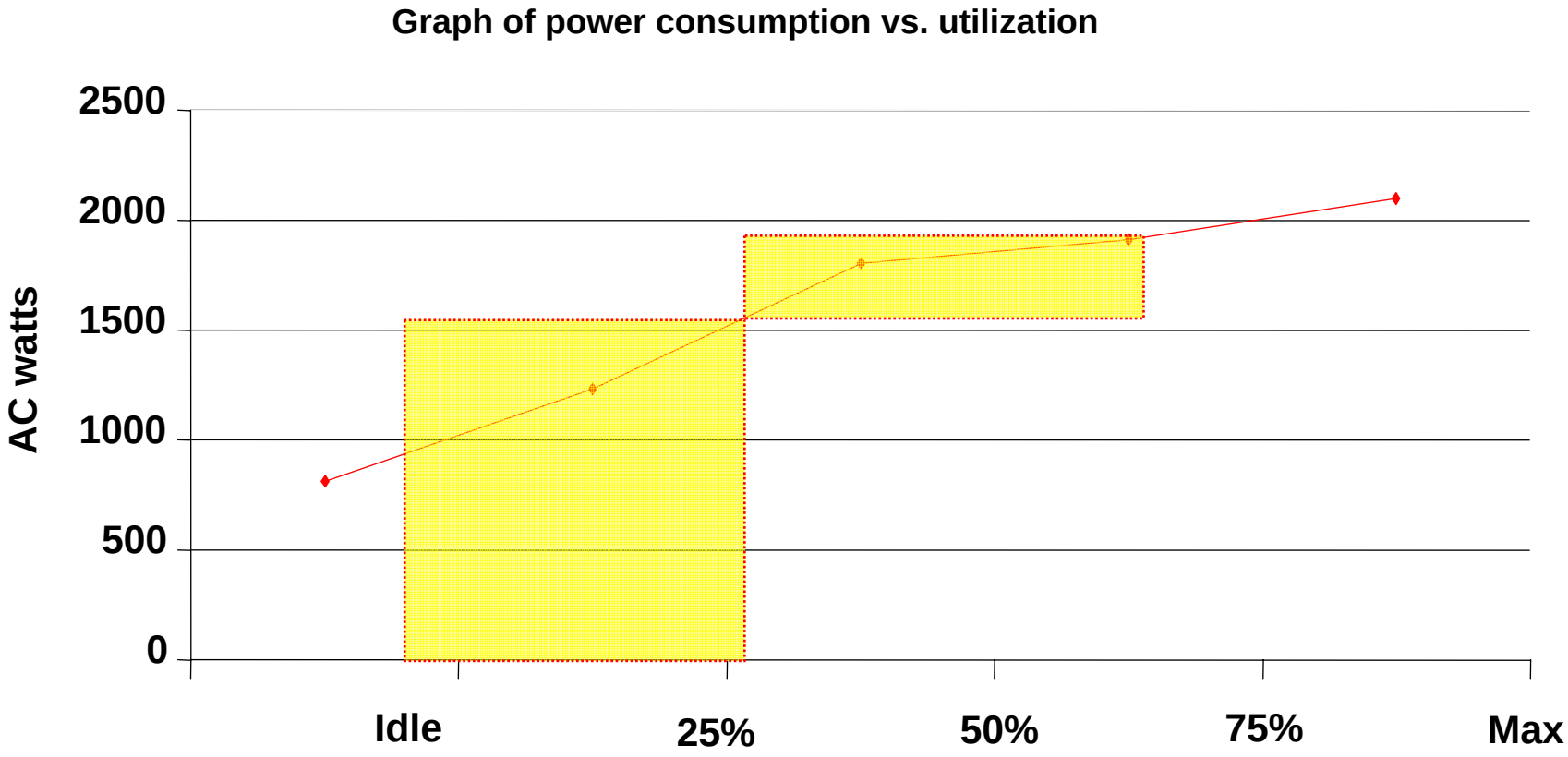
Supported Systems Landscape

	Metering	Power Trend Analysis	Power Capping	CPU Power Management
IBM PowerExecutive™				
IBM Blades	HS20 8843, LS20, JS21 8844, HS20 7981 Available Now	HS20 8843, LS20, JS21 8844, HS20 7981 Available Now	HS20 8843, LS20, JS21 8844, HS20 7981 Future Announce	HS20 8843, LS20, JS21 8844, HS20 7981 Future Announce
IBM Servers	Rack Mounted servers x3450 and x3650. Then x3655, x3755. Available Now	Rack Mounted servers x3450 and x3650. Then x3655, x3755. Available Now	Rack Mounted servers x3450 and x3650. Then x3655, x3755. Future Announce	Rack Mounted servers x3450 and x3650. Then x3655, x3755. Future Announce
HP Power Regulator				
HP Blades	None	None	None	None
HP Servers	None	None	None	None
Dell				
Dell Blades	None	None	None	None
Dell Servers	None	None	None	None

**All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

Can Virtualization Help?

- **Typical Intel type server utilization is quite low (15 - 40%)**
- **Virtualization can increase utilization and unlock new processing capability for scale up and scale out without adding to power at the rack level**



BladeCenter One Family
Investment Protection

BladeCenter H
Announced: Feb. 2006

14 Blades, 9U

High Speed (>10GB)

Extreme I/O for data intensive environments

BladeCenter H

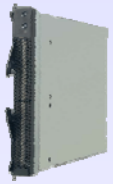
Extending the Value of Blades to Higher Performance

System Overview

- **9U Rack Mount**
- **14 Blades**
- **30 mm slots**
- **Optimized for 2006+ processors**
- **Legacy switch bays (qty 4)**
- **High speed switch bays (qty 4)**
- **High speed bridge bays (qty 4)**
- **Advanced Management Module Support**
- **2900 Watt Power supply (N+N redundant)**
- **2 Blowers, 12 Fans**

- Provide increased power and cooling capability over BladeCenter
- Provide high speed (10Gb) internal fabrics
- Concurrent KVM and media (cKVM/cMedia) capabilities
- **Compatibility with current blades and switches**

The portfolio continues to build . . .

	HS20 2-way Xeon	HS21- 2way Xeon	LS21 / LS41 2-4 way AMD	JS21 PowerPC	HS20 ULP 2-way	Cell BE Blade
Features	▪ Intel Xeon DP ▪ EM64T ▪ Mainstream rack dense blade ▪ High availability apps ▪ Optional HS HDD	▪ Intel Xeon MP processors ▪ Dual Core ▪ Supports Windows, Linux,	▪ Two socket Opteron ▪ Expands to 4 socket ▪ Dual core ▪ High speed Infrastructure enabled	▪ Two PowerPC® 970MP processors ▪ Dual Core ▪ 32-bit/64-bit solution for Linux & AIX 5L™ ▪ Micro Partitioning ▪ Performance for deep computing clusters	▪ Intel Xeon ULP (Ultra-Low Power) ▪ Dual Core ▪ 31Watts per Proc ▪ 180W per blade Max configuration	▪ Specialised HPC Blade ▪ 2 Sockets ▪ 9 Cores per socket
Target Apps	▪ Edge and mid-tier workloads ▪ Collaboration ▪ Web serving	Edge and mid-tier workloads Collaboration Web serving	▪ 32- or 64-bit ▪ HPC stellar performer	▪ 32-bit/64-bit HPC ▪ UNIX server consolidation	▪ General Windows / Linux Workloads ▪ HPC Integer based Workloads	▪ Ideal for HPC Graphical Manipulation Tasks
						

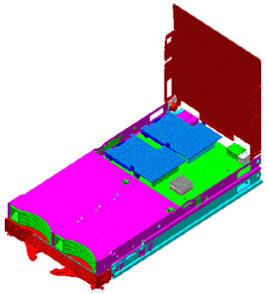
Common Chassis, Common Infrastructure, Mix in same Chassis

IBM BladeCenter HS20

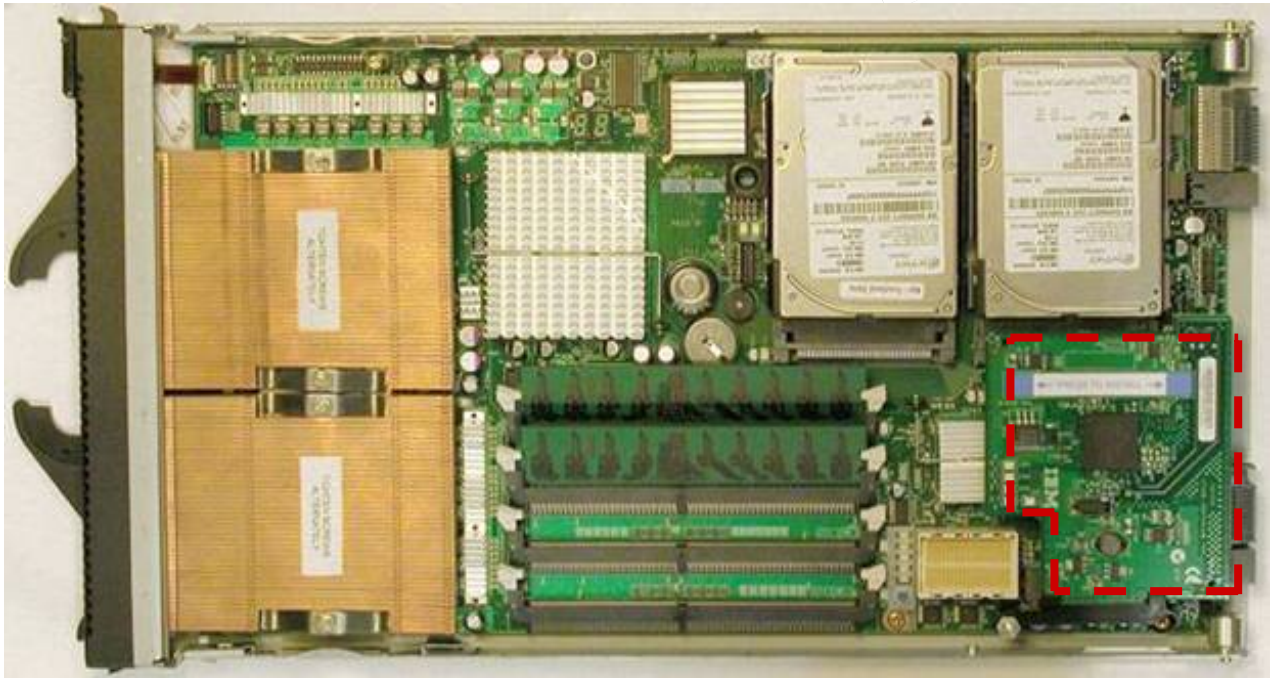
System x Technical presentation

The HS20 800

PCI EXPRESS™



New BSE2



intel inside XEON

With Intel® EM64T

DDR2 memory

SFF Exp Cards

HS20 - Performance

- **800 MHz Front Side Bus**
  - Up to 1.5 times the system bus bandwidth when compared to 533Mhz Front Side Bus
  - Helps support faster Web site response times, more users, and greater business
- **64-bit CPU core extensions (EM64T)**
  - Improved throughput in targeted applications
  - Full support for 64-bit OS with legacy support for 32-bit and 16-bit
- **DDR2 400 Memory**
  - Up to 20% increase in memory bandwidth over DDR333
  - Up to 40% reduction in the power required to run the memory
- **PCI-Express expansion capability**

With Intel® EM64T

spec

PCI EXPRESS™

Bottom Line: operational enhancements to increase performance, efficiency and timing margins for high performance computing

IBM BladeCenter HS20 Ultra Low Power

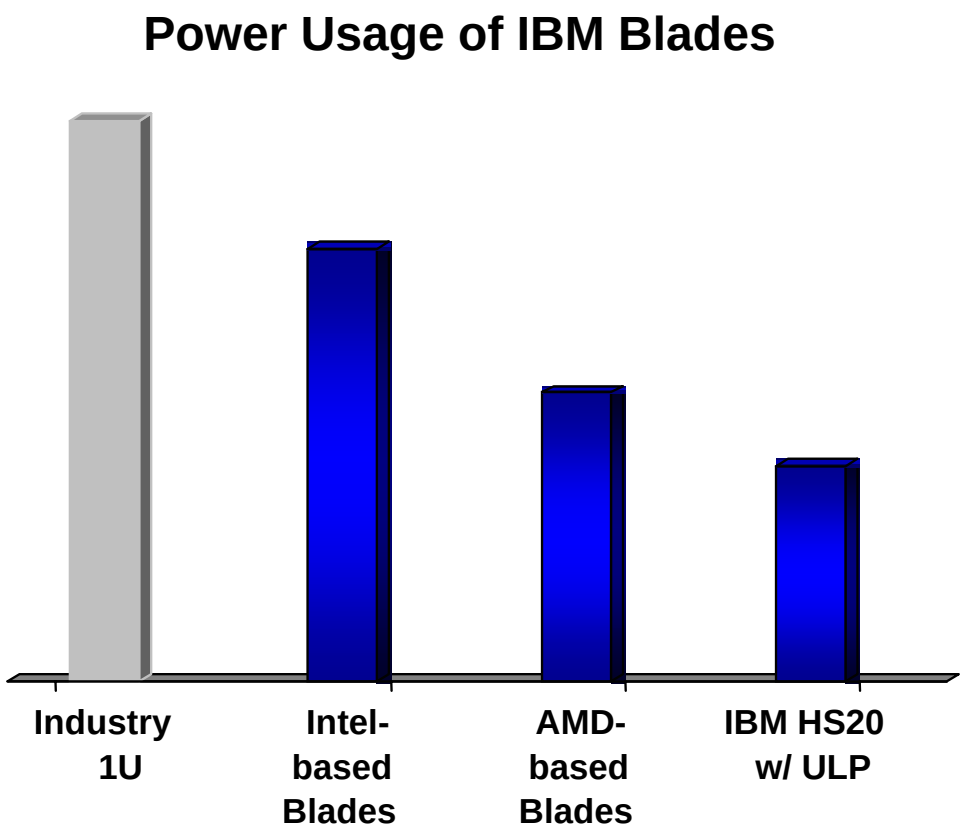
System x Technical presentation

BladeCenter Ultra Low Power HS20

Performance Without the Power

- **A new dual core, dual socket HS20 Intel Xeon blade with leadership performance per watt**
  - **Processor consumes only 31W of power**
  - **Blade draws only 180W in max configuration**
- **32-bit high performance, optimized for power and cooling**
- **Target markets: Windows workloads, integer-based HPC applications, customers dealing with power and cooling constraints**
- **General Availability: early April**

BladeCenter Energy Efficiency



•TCO Lowering Power and Cooling Design Saves Money

- **Saving power is key to lowering Total Cost of Ownership**

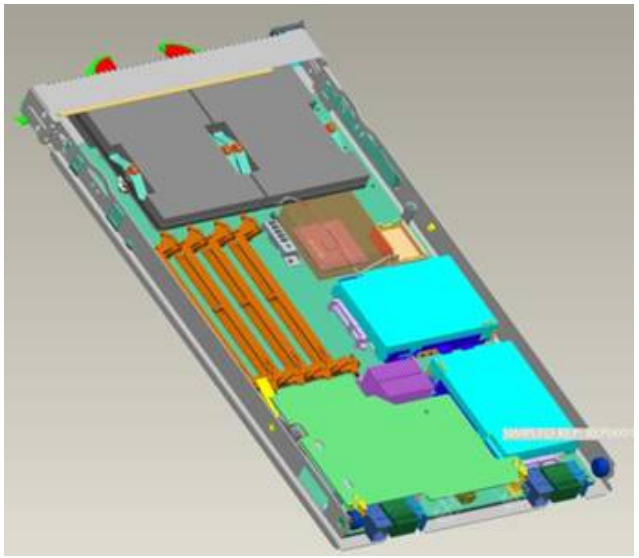
Source: Dell, HP and IBM Power Tools

IBM BladeCenter HS21

System x Technical presentation

BladeCenter HS21

- The 30mm High Density Offering
  - 4 FB DIMMs (up to 16GB of memory per blade)
  - 2 SFF Non Hot Swap 10K RPM SAS HDD
  - 2 NICs - TOE enabled
  - Supported in all chassis for 65W processors. BladeCenter H only with 80W processors
    - 3.0GHz only 80W part
    - 65W parts provide industry leading performance/watt
    - 1.66-2.66GHz (BIN-1)
  - Supported BladeCenter T with 65W part (available SS + 60days)



BladeCenter HS21
Intel Line Comparison

- DP Intel Xeon “Irwindale” 2.8 - 3.8GHz with 800MHz Front Side Bus
- Lindenhurst Chipset
- 14 Blades per Chassis (30mm blade width)
- 2 Gb Ethernet Ports standard (5704)
- 4 DIMM slots
- Up to (2) 73GB SFF SCSI with RAID 1 standard
- Internal Switches (Enet/FC/KVM)
- Support for BSE2 (2 HS HDD, 2 Exp Cards, RAID 1E)
- Support for dual SCSI drives and Expansion Card
- Support for IBM Director, RDM, ServerGuide, UpdateXpress, and Toolkit support

- DP Intel **Dual Core Woodcrest 1066/1333** MHz Front Side Bus
- Blackford Chipset
- 14 – 30mm mid power blades per chassis
- 7 – 60mm blades per chassis
- 2 Gb EN ports. TOE enabled (5708)
- 2 SFF **SAS** HDDs with RAID 0, 1 on base blade
- Support for SIO
  - 3 HS SAS HDD, 2 I/O Exp Cards, RAID 1E, optional RAID 5 with ServRAID and battery backed cache
- Support for legacy Exp Cards
- Support for new **High Speed Cards**
- **cKVM** and cMedia feature card support
- Support for IBM Director, RDM, ServerGuide, UpdateXpress, and Toolkit support

IBM BladeCenter LS21 – LS41

AMD Opteron LS41 for IBM BladeCenter

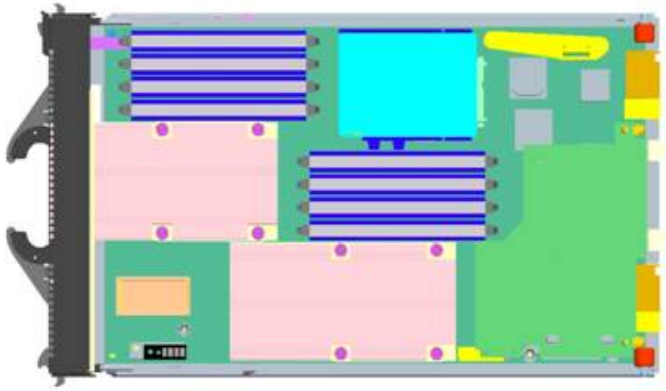
Scalable, Enterprise Performance Blade

- ***The Industry's first "snap-in" scalable blade***
  - ***Scales from 2-socket to 4-socket configuration in mere seconds***
- ***Leverages Innovative BladeCenter Design and Ecosystem***
  - ***Open and flexible***
  - ***Centralized management, more efficient power and cooling***
  - ***Largest selection of blade options available in the industry***
- ***Optimized for scalable enterprise workloads and large databases***
  - ***Outstanding multi-processor performance in a compact blade form factor***
  - ***Scalable design with 2/4 socket configuration allows pay-as-you grow flexibility***

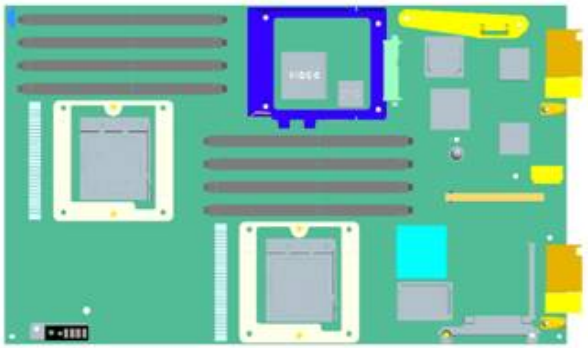
Target apps:

- Scalable Enterprise Workloads
- Data Marts/Data Warehouses
- Scientific and Technical Computing

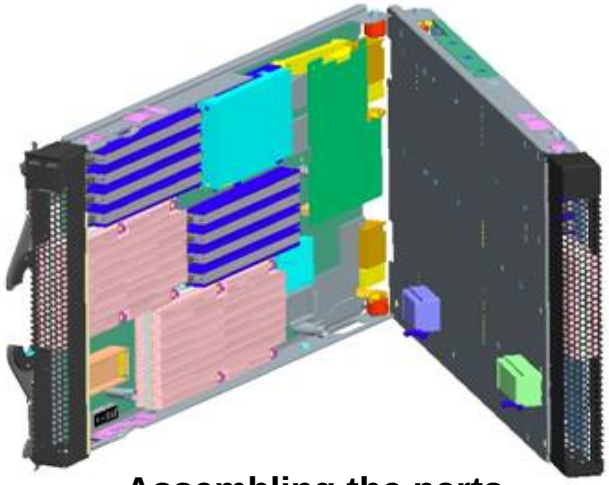
Introducing LS21 / LS41



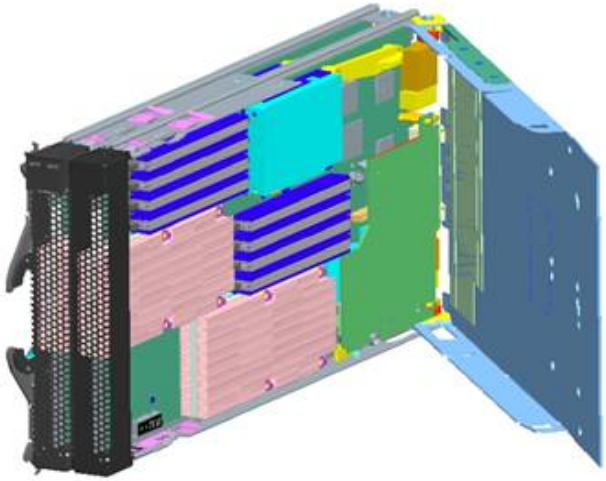
The LS21 MTM 7971



The MP Expansion Unit



Assembling the parts



The LS41 MTM 7972

LS21 2-way Technical Review

Mechanical	**30mm blades (14 per chassis)**
Chipset	**Serverworks HT2000 and HT1000**
Memory	**DDR2 667 / 8 DIMM / 32GB max**
Processors	**AMD Opteron 200 Series Dual Core 2MB L2 cache (Santa Rosa) 2.0Ghz and, 2.4Ghz (68W) and 2.2 and 2.6Ghz (95W)**
Controller	**SAS**
Gigabit Ethernet	**Two ports, Integrated Dual Gigabit Ethernet (Broadcom 5708) TOE**
System Management	**Integrated BMC, functions with BC Management Module**
I/O Slots	**(2) I/O Adapter slots. Legacy: (1) PCI-X supporting legacy daughter cards High speed: (1) PCI-E supporting new high speed cards**
Internal Tape Support	**External only**
Hard disk drives	**Standard: one 2.5” NHS SAS HDD Optional: (not in plan) support for one 2.5” NHS SATA drive**
Standard RAID	**SAS controller, supports SIO blade for RAID 1,1E, and 5.**
USB and video	**All on chassis: (2) USB – Front / (2) USB - Rear, 1 Video – Rear**
Power	**Shared inside BladeCenter chassis, fully redundant**
Cooling	**Shared inside BladeCenter, N+N, hot swap cooling**
OS Support	**Windows 64, RHEL 4.0 64 bit, RHEL 4.0 32 bit, SLES 9.0 64 bit, Windows 32 bit, SLES 9 32 bit, VMware ESX Server, SLES 10 64 bit, Solaris 10**

LS41 4-way Technical Review

Mechanical	**60mm blades (up to 7 per chassis)**
Chipset	**Serverworks HT2000 and HT1000**
Memory	**DDR2 667 / 16 DIMM / 64GB max**
Processors	**AMD Opteron 800 Series Dual Core 2MB L2 cache (Santa Rosa) 2.0Ghz and, 2.4Ghz (68W) and 2.2 and 2.6Ghz (95W)**
Controller	**SAS**
Gigabit Ethernet	**4 ports, Integrated Dual Gigabit Ethernet (Broadcom 5708 and 5706) TOE**
System Management	**Integrated BMC, functions with BC Management Module**
I/O Slots	**(Up to 3) I/O Adapter slots (not all can be used at once) Up to two Legacy: (2) PCI-X supporting legacy daughter cards High speed: (1) PCI-E supporting new high speed cards**
Internal Tape Support	**External only**
Hard disk drives	**Standard: two 2.5” NHS SAS HDDs Optional: (not in plan) two 2.5” NHS SATA drives**
Standard RAID	**RAID 0,1. Supports SIO blade for RAID 1,1E, and 5**
USB and video	**All on chassis: (2) USB – Front / (2) USB - Rear, 1 Video – Rear**
Power	**Shared inside BladeCenter chassis, fully redundant**
Cooling	**Shared inside BladeCenter, N+N, hot swap cooling**
OS Support	**Windows 64, RHEL 4.0 64 bit, RHEL 4.0 32 bit, SLES 9.0 64 bit, Windows 32 bit, SLES 9 32 bit, VMware ESX Server, SLES 10 64 bit, Solaris 10**

IBM BladeCenter JS21

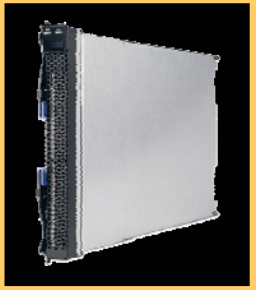
System x Technical presentation

3X performance with dual-core PowerPC 970MP versus JS20*

NEW!

IBM BladeCenter JS21 for HPC Linux Clusters, AIX 5L on Blades, server consolidation/workload migration, and Web serving

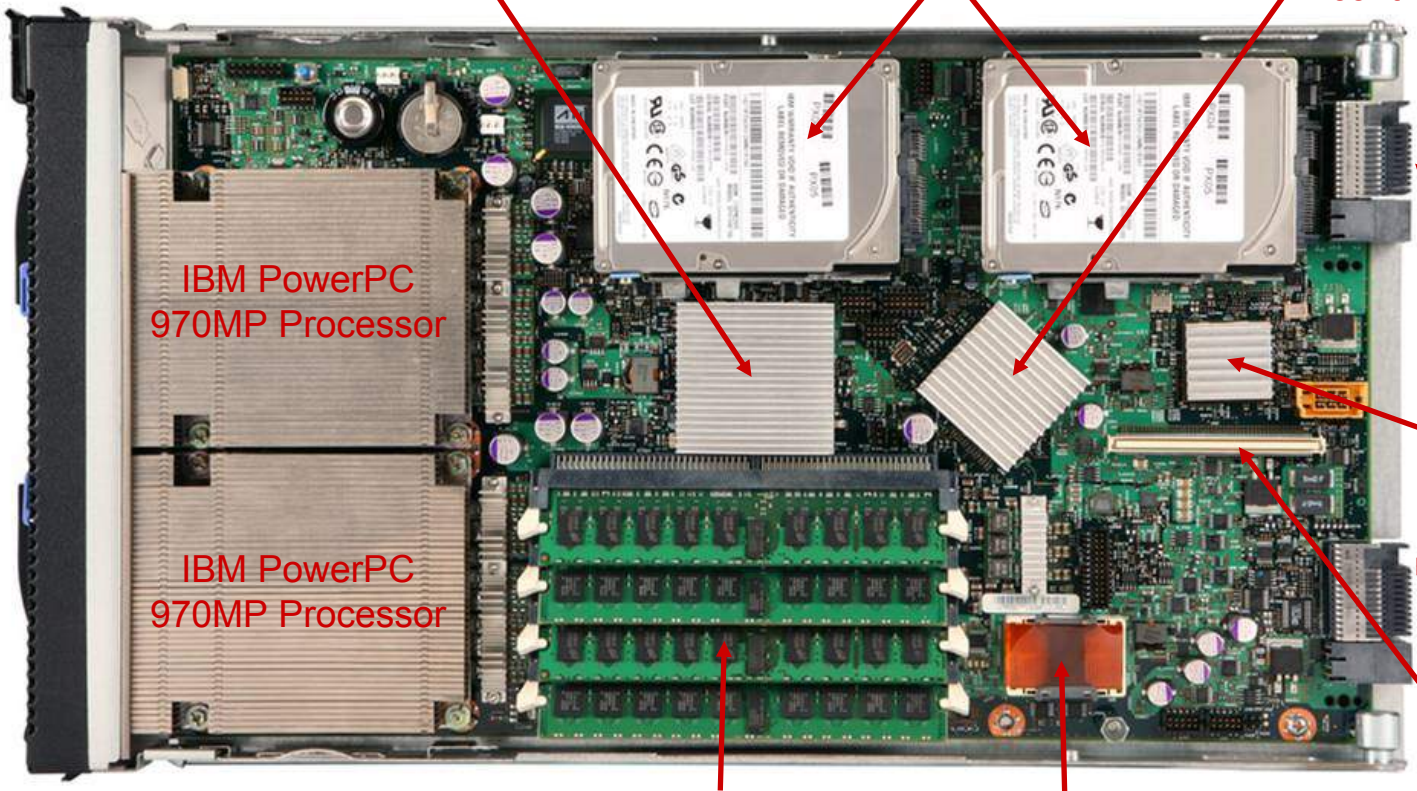
- Delivers up to twice the performance of HP BL60p Itanium® blade[1]
- First BladeCenter blade server with built-in virtualization (APV)[2]
- **First blade server designed for 10Gb-capable BladeCenter H**
- **Greater reliability and performance with SAS Hard drives, DDR2 memory and integrated PCI-Express**
- Differentiated solution for life and earth sciences with AltiVec acceleration, HPC Linux® Clusters, server consolidation, and WebSphere on AIX 5L



What's your requirement?

- High-speed, low-latency fabric such as InfiniBand for HPC
- Blade that supports AIX 5L for WebSphere or server consolidation

JS21 side view



Cell Blade

Cell-based Blade Specifics

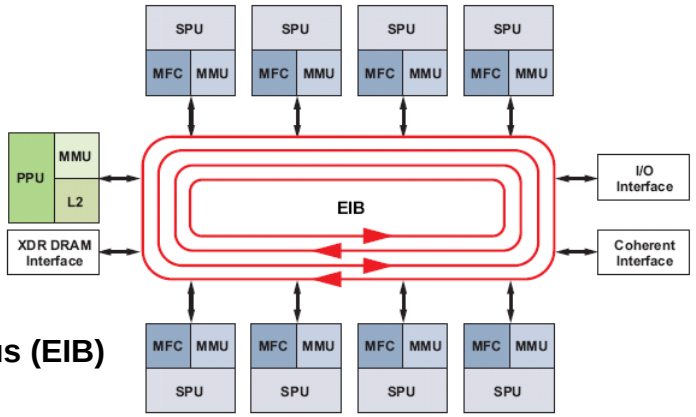


Figure 1. Cell Broadband Engine Processor Block Diagram

- **Dual Cell BE based Processors**
  - **Each with nine-cores: 1 Power Processing Element (PPE) plus 8 Synergistic Processing Units (SPUs) connected via high speed data ring (192 GB/sec), the Element Interconnect Bus (EIB)**
- **EIB is extended transparently across high-speed coherent interface between dual Cell BE Processors**
  - **Runs at 20GB/sec in each direction between processors**

- **Double-wide blade; up to 7 blades per chassis**
- **Supports 1 IDE drive per blade**
- **2 embedded 1Gb NICs and 2 InfiniBand daughter cards supported on each blade for connection to external I/O**
- **Evaluation Cell BE software available on IBM alphaworks website**
- **Open source software available at University of Barcelona website**



















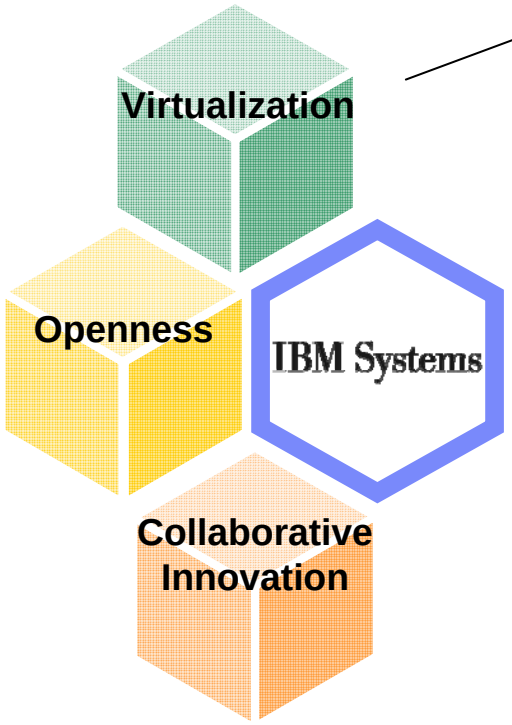
Blade.org - Partnership to success

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- **Virtualisation**
- Systems Management
- Futures
- Q & A

VMware -

Systems Agenda



IBM Virtualization Engine

Virtual Resource Access

VE Console | Productivity Center

VE Console

IBM TotalStorage Productivity Center

Virtual Resource Management

Workload & performance managers
Resource management, modeling, mapping

Enterprise Workload Manager

IBM Director 5.10

Resource Dependency Service 2.1

Virtual Resources

Resource virtualizers
Partitioning, virtual machines, I/O, networks, VTS

IBM Server & Storage Systems

TotalStorage®

Series ™

xSeries

pSeries®

System z9™ zSeries®

BladeCenter ™

OpenPower®

VMware

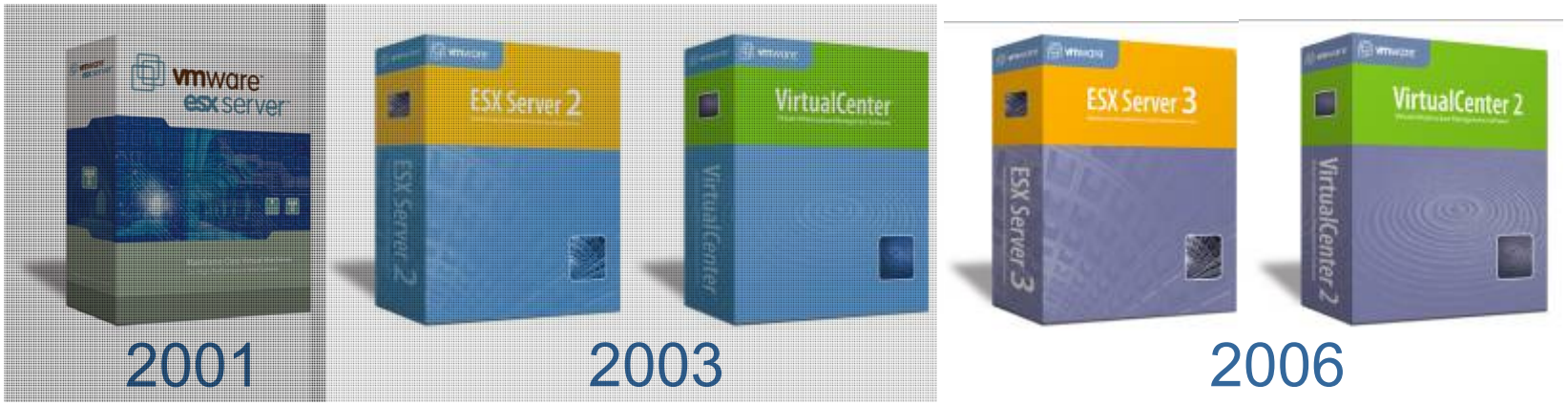
Virtualization and x86

- **Concept and practice dates back to mainframe systems**
  - Divide underutilized processors into fractional processing units (today)
  - Assign processes to separate or different cores (tomorrow)
  - Will become key to exploiting multi-core technology
- **Two general varieties of technology**
  - Type 1 Hypervisor – installs beneath OS
  - Type 2 Hypervisor – installs above OS
- **IBM covers all virtualization fronts**
  - IBM and VMware were early partners to bring solutions to the market when virtualization was in it's infancy.
  - IBM and Microsoft partner to ensure Virtual Server works on IBM hardware, and provides a Windows solution.
  - IBM contributes to the Xen open source for future Linux and Windows solutions.

Microsoft Windows Server System

Xen Source

VMware Virtual Infrastructure Evolution



VMware Infrastructure 3

Expanded storage support

White box server support

ESX Server 2 - VirtualCenter 1

Blade Servers

Multi-server Infrastructure

Virtual SMP

VMotion

SAN Integration

Virtual SDK

ESX Server 1

First x86 Hypervisor

Infrastructure-wide services

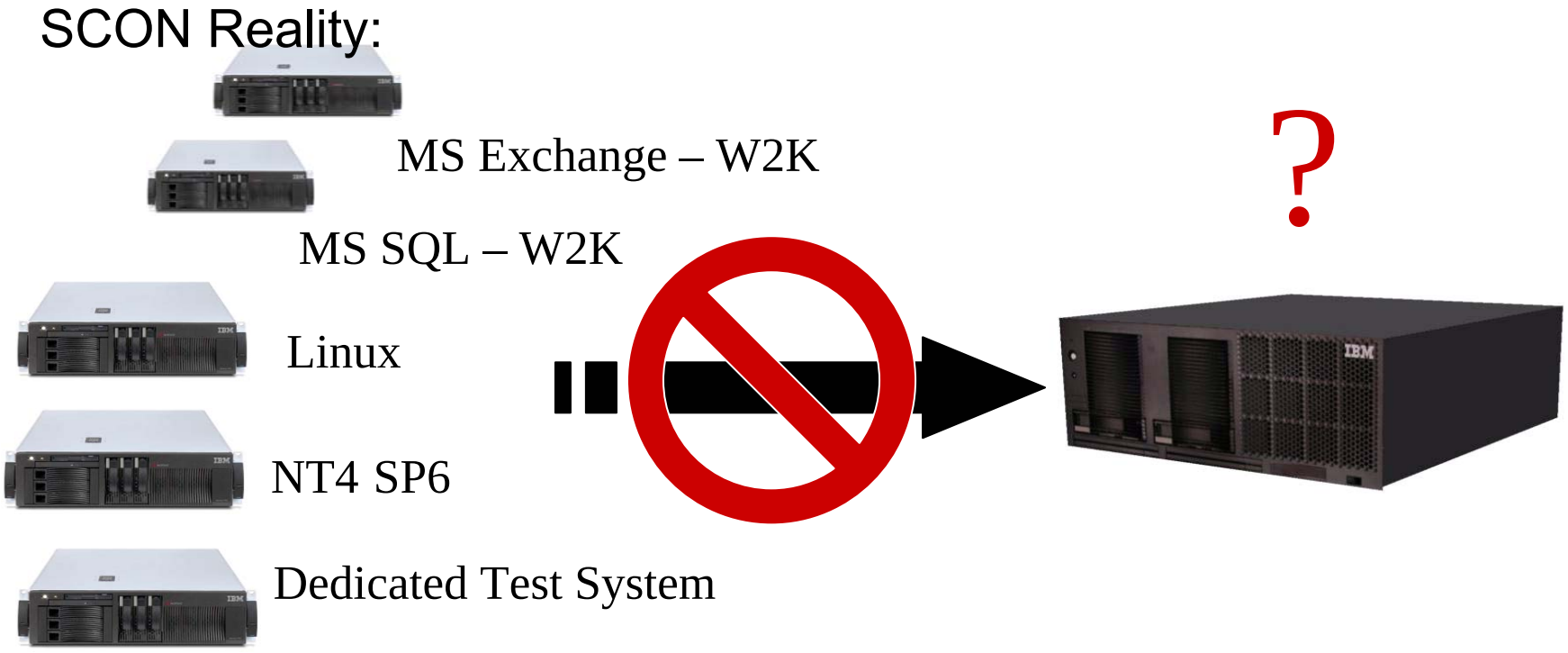
Expanded VM capacity

Increased scalability

Improved management

Reduced Platform Cost ⟷ **Improved Capabilities**

Industry Trend cont. – Server Consolidation



Problem: Mutually Incompatible

Server Consolidation - The VMware Approach

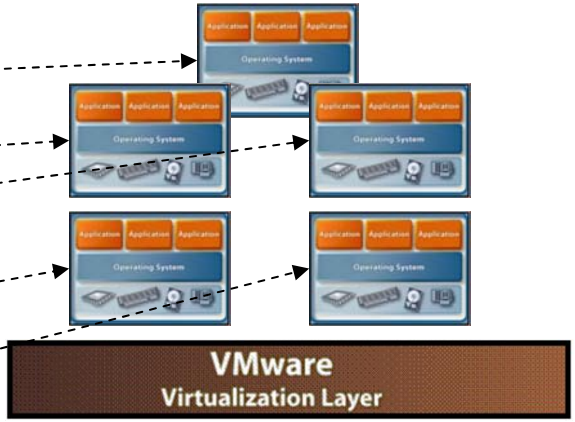
MS Exchange – W2K

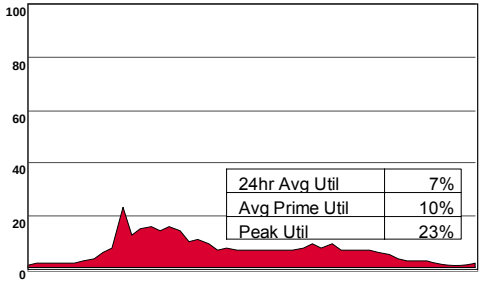
MS SQL – W2K

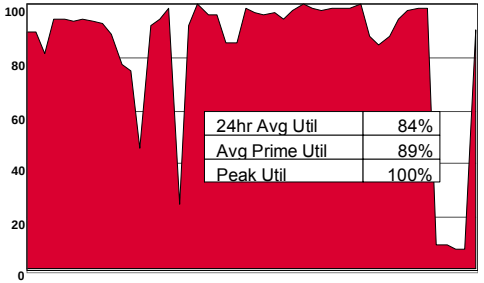
Linux

NT4 SP6

NT4-SP3 +
in-house application requiring SP3

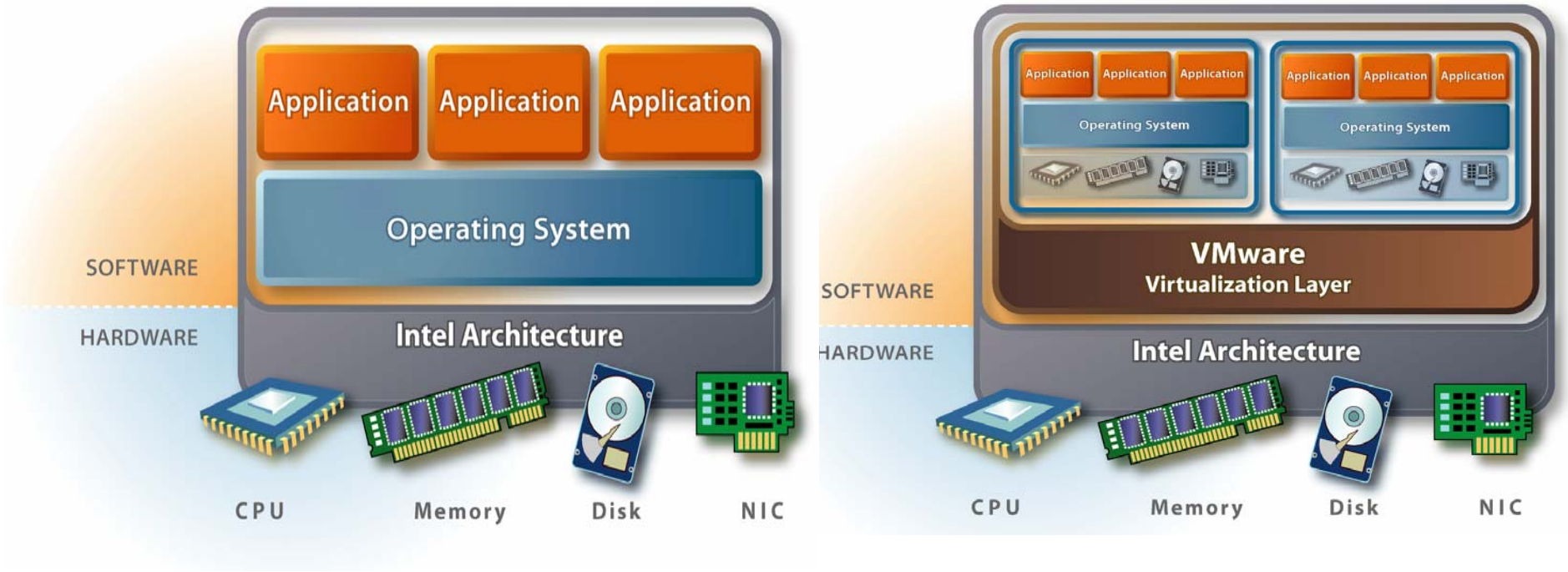




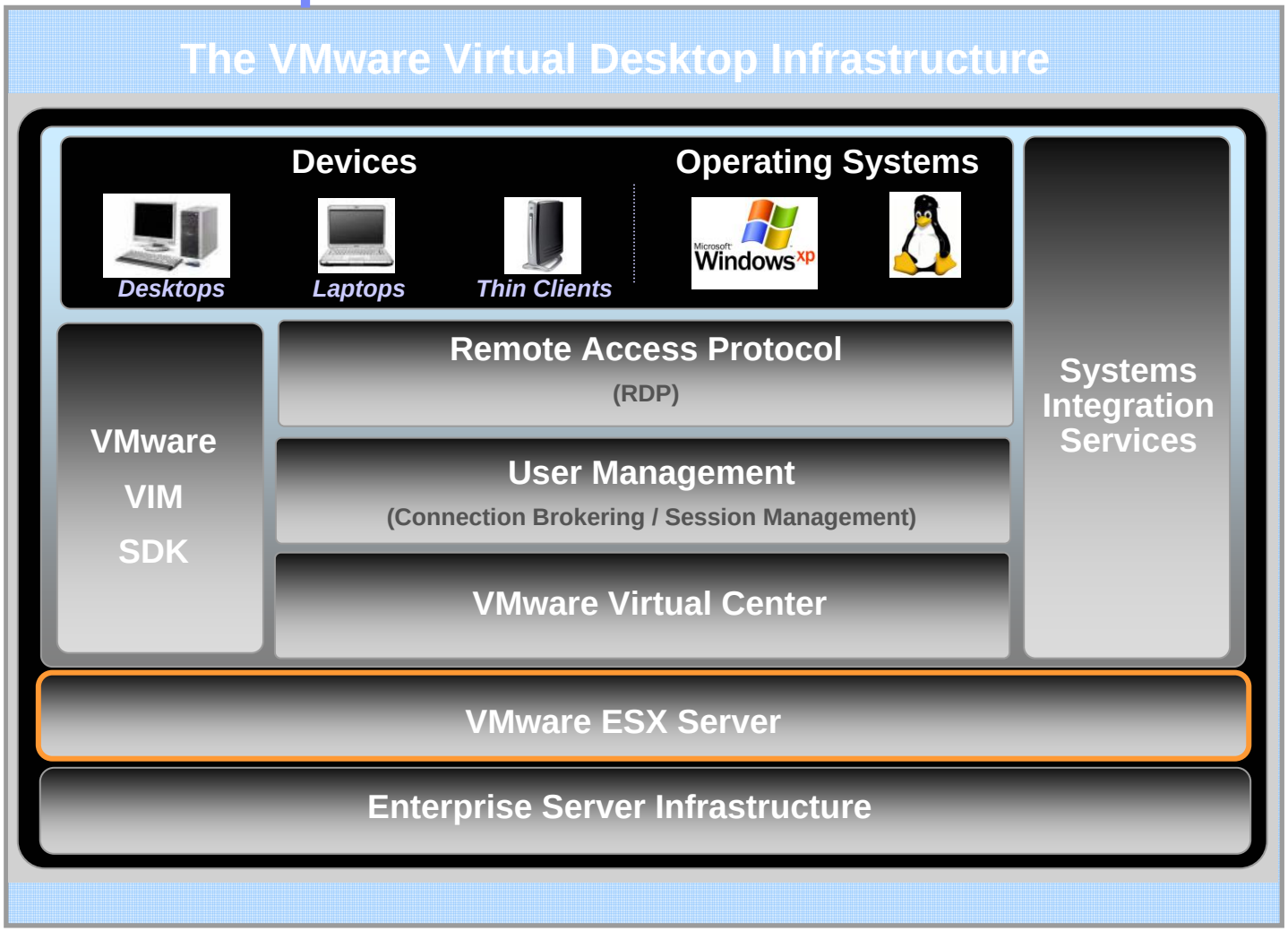


VMware ESX Architecture

"standard" computer v ESX architecture



Virtual Desktop Infrastructure

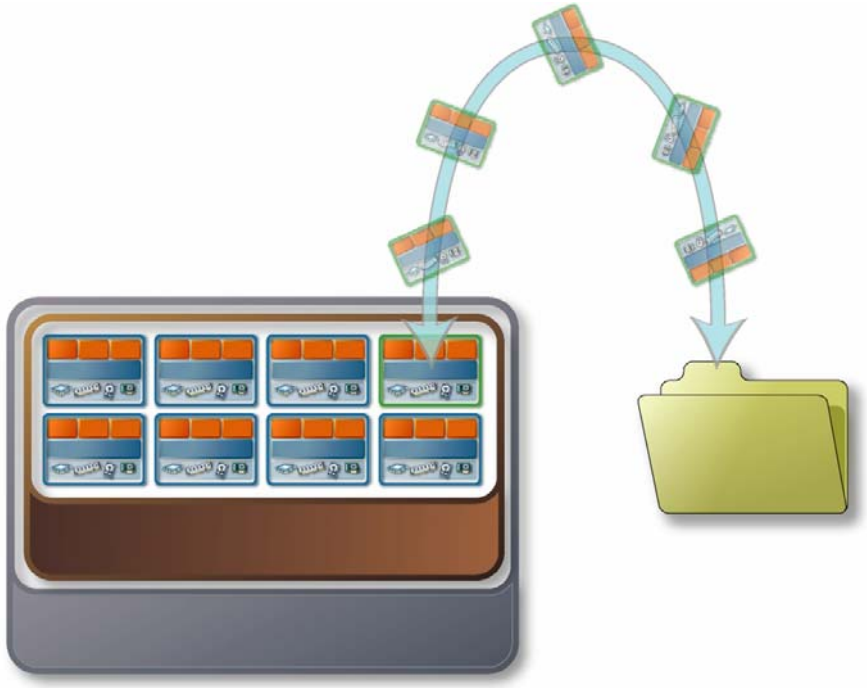


Feature: Isolation

- Key: uses CPU hardware (protection)
- Fault, performance, and security isolation
- CPU, RAM, Disk, and network resource controls*
- Guarantee service levels*

Feature: Encapsulation

- Entire state of the VM is encapsulated
  - Memory, disk images, I/O device state
- VM state can be saved to a file
- VM state can be transferred through time and space
  - Time: store in a file
  - Space: transfer over a network



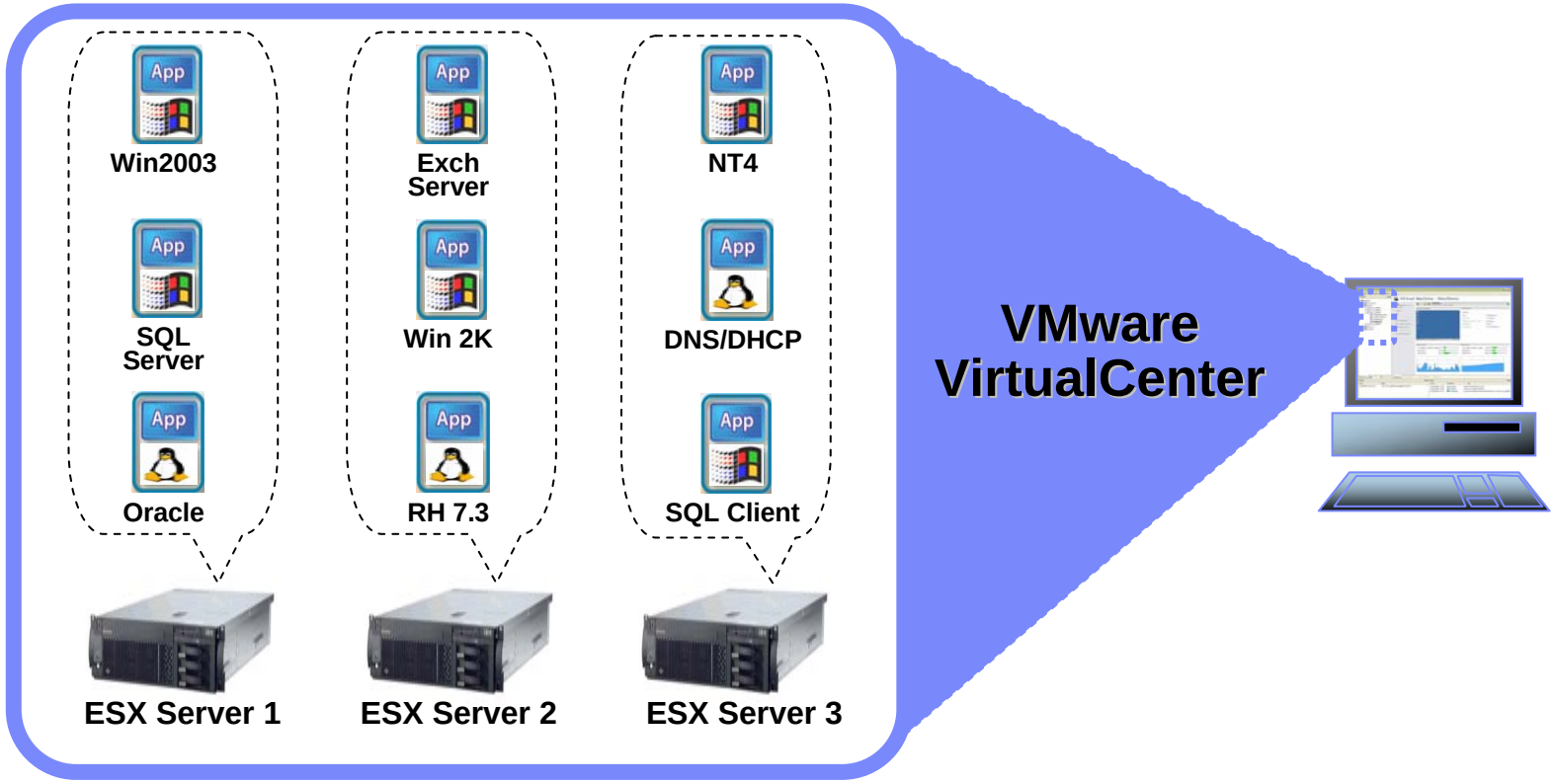
Feature: Disk Modes

Three virtual disk modes are available

Mode	*Changes to disk*	*On Power Off*	*Usage*
Persistent	**Written immediately**	**No change**	▪ **Standard mode**
Undoable	**Written to REDO log**	**Permanently apply or discard changes**	▪ **Beta installs** ▪ **Testing** ▪ **Development**
Non-persistent	**Written to REDO log**	**Discards changes**	▪ **Demo** ▪ **Training** ▪ **Testing/QA**

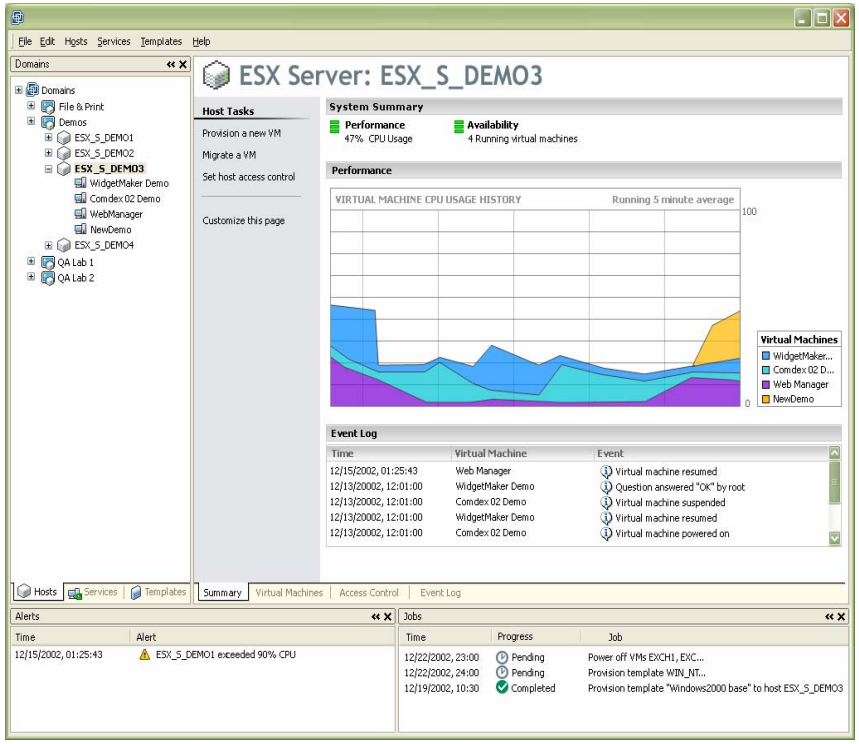
Centralized Management Console

Centrally manage a heterogeneous computing environment from a single graphical user interface



Virtual Machine Dashboard

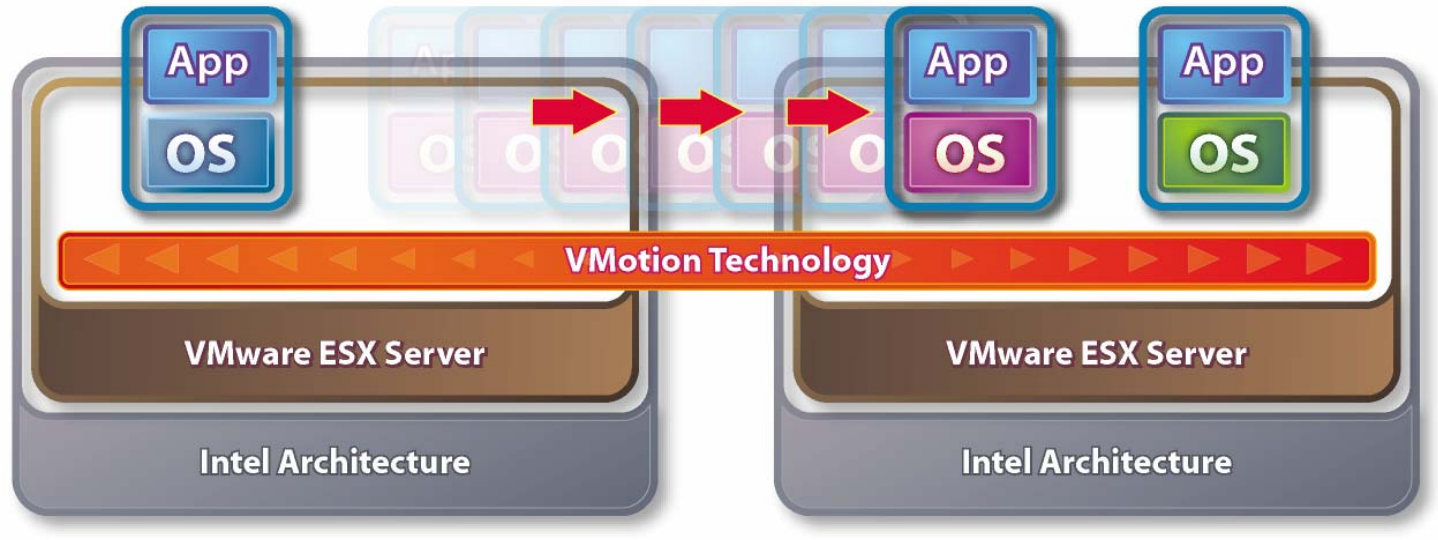
Track VM-specific usage metrics to identify performance bottlenecks



- Monitor and report on each VM's resource usage
- Export Data to Databases
- Use pre-built alerts to proactively identify resource contention trends
- Set triggers and alerts for key performance and availability metrics
- Quickly identify good candidate hosts when provisioning new VMs

VMotion™ Technology

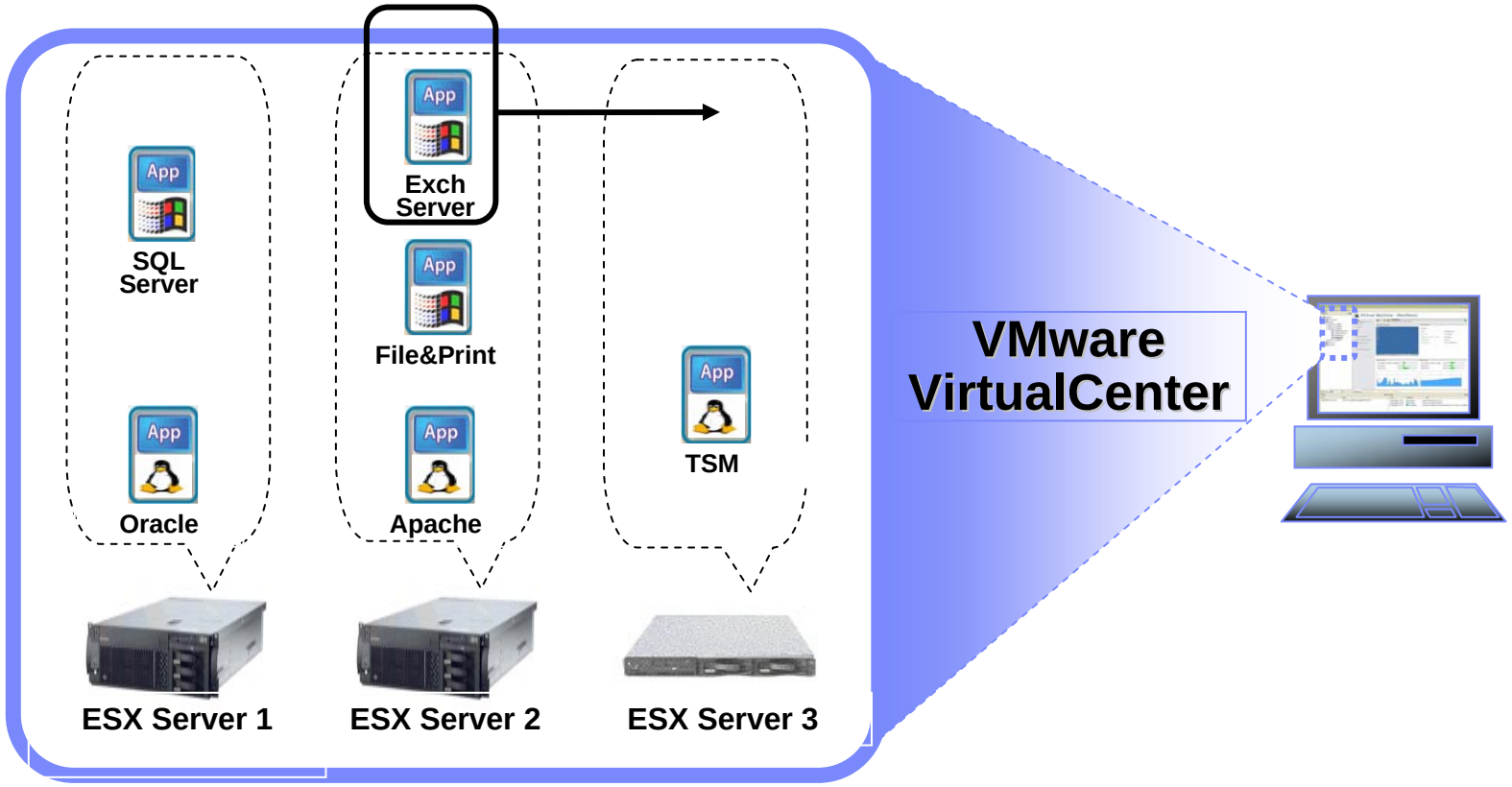
Instantly shift running systems across hosts often with imperceptible downtime



- High application availability
- High transaction integrity
- High data availability
- High transparent to end users

VMotion™ #1- On-Demand Workload Management

Dynamically manage workloads across a heterogeneous environment, in response to an unexpected increase in SAP utilization

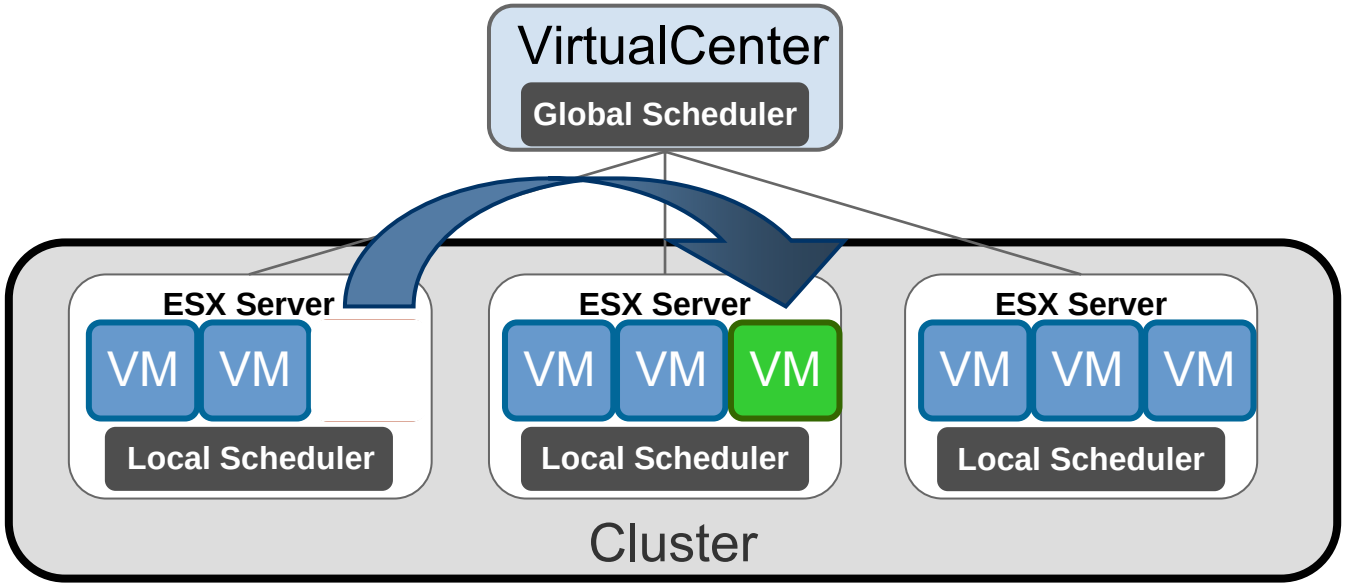


VirtualCenter 2

- **Virtual Center 2**
  - **Common GUI**
  - **Topology Maps**
  - **New VMotion Capabilities**
- **New Services**
  - **Distributed Resource Scheduler**
  - **Distributed Availability Manager**

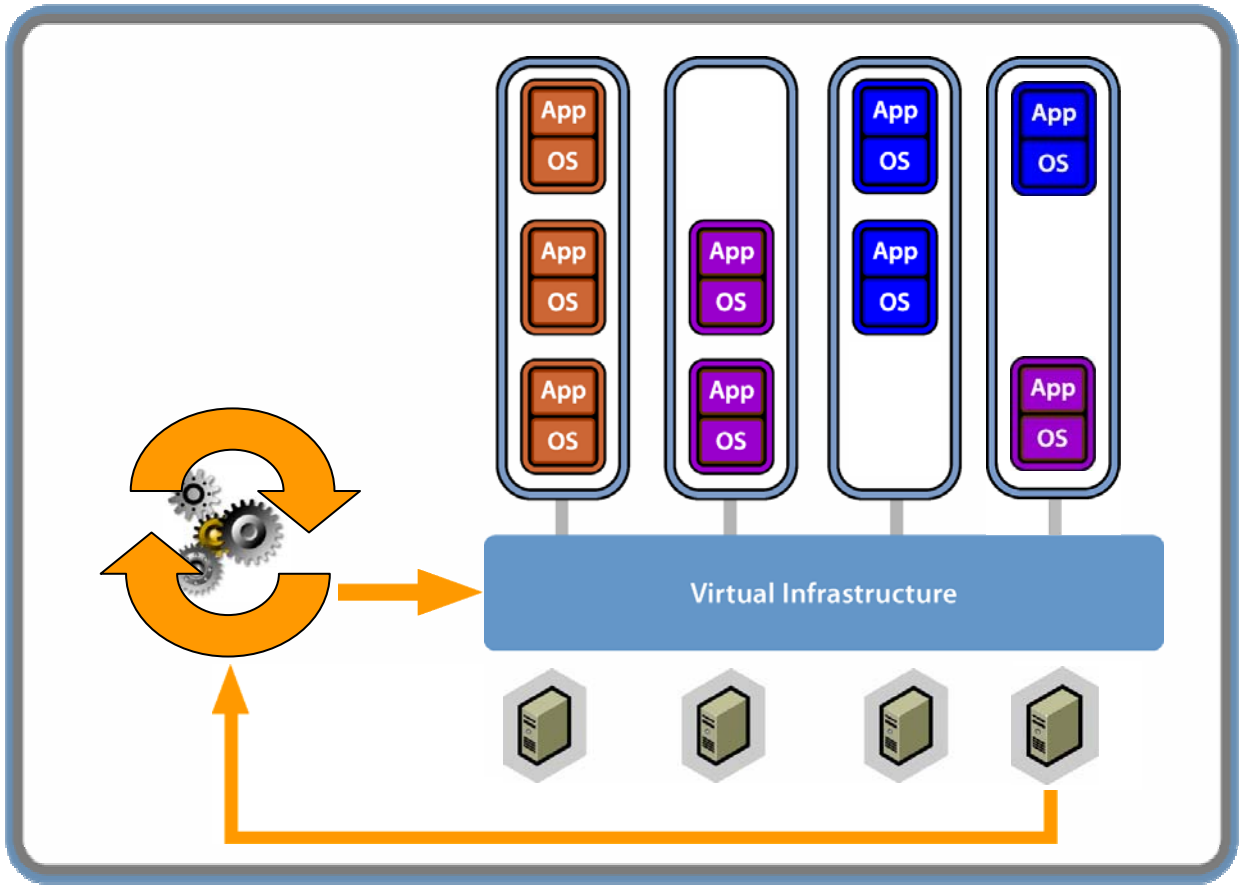
DRS – Distributed Resource Scheduler

- **DRS**
  - **(fee-based) plug-in for Virtual Center**
  - **Automatic virtual machine placement**
  - **Cluster-wide resource management, Resource Pools**
  - **Policy based VMotion**
  - **32 hosts, LAN – not WAN**



DRS

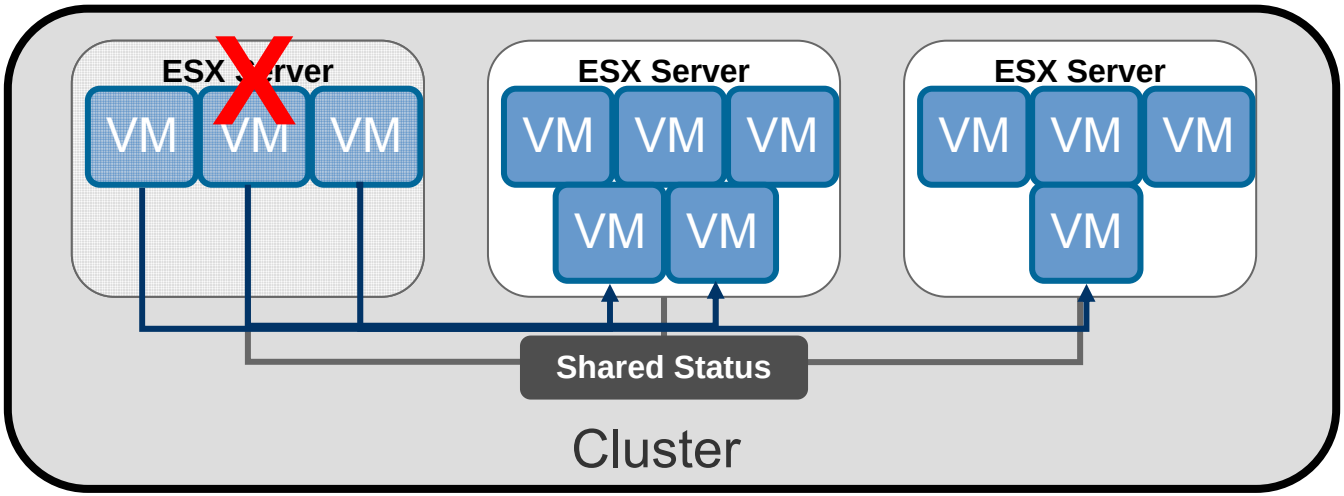
- **Instand capacity on demand**
  - **Combine with bare-metal provisioning**



High Availability

- HA
  - (fee-based) plug-in for Virtual Center
  - Automatic "failover" of virtual machines between physical ESX servers
  - Placement optimised by global scheduler (in conjunction with DRS)

None of the complexity of “classic” clustering, OS independent



Heterogeneous Operating System Support

Freedom to choose the most appropriate OS for any application

Windows .NET Server 2003	Windows Server 2003 Standard, Enterprise, Web Editions, and Small Business Server
Windows 2000	Windows 2000 Server and Advanced Server
Windows NT	Windows NT : 4.0 Server
Windows XP	Windows XP Professional
Red Hat	Red Hat Linux 7.2, 7.3, 8.0, & 9.0 Red Hat Enterprise Linux 2.1 & 3
Solaris	Solaris 10 (on x86) NEW
SUSE	SUSE Linux 8.2, 9.0 and 9.1 SUSE Linux Enterprise Server 8
Novell	Novell NetWare 5.1, 6.0 and 6.5
FreeBSD	FreeBSD 4.9

- Rigorously tested to run 28 versions of all major operating systems
- 64-bit operating system support – Support becoming available – Please check website for latest support info

Why IBM - Technology

- IBM and VMware – a strong relationship
  - IBM and VMware signed Joint Development Agreement (JDA) in February, 2002
  - IBM was the first tier-one vendor to sign a JDA with VMware
  - Allows future enhanced management in VMware environments
  - Allows VMware ESX Server to run optimally on IBM's EXA/X3 technology

- IBM's outstanding consulting experience with server consolidation and other major projects can help to reduce risks and implementation time
  - Server Optimisation workshops and studies
  - Migration services and tools
  - Comprehensive Systems Management (VMM integration) and integration with IBM applications

- IBM Servers providing unprecedented scalability, performance and manageability
  - Unmatched scalability with X3 Architecture x366 and x460
    - ESX is optimised for NUMA
  - Industry leading IBM eServer BladeCenter

Why IBM - Support

IBM resells and supports VMware directly, providing a **single point of contact** for the complete solution, helping to reduce risk and downtime

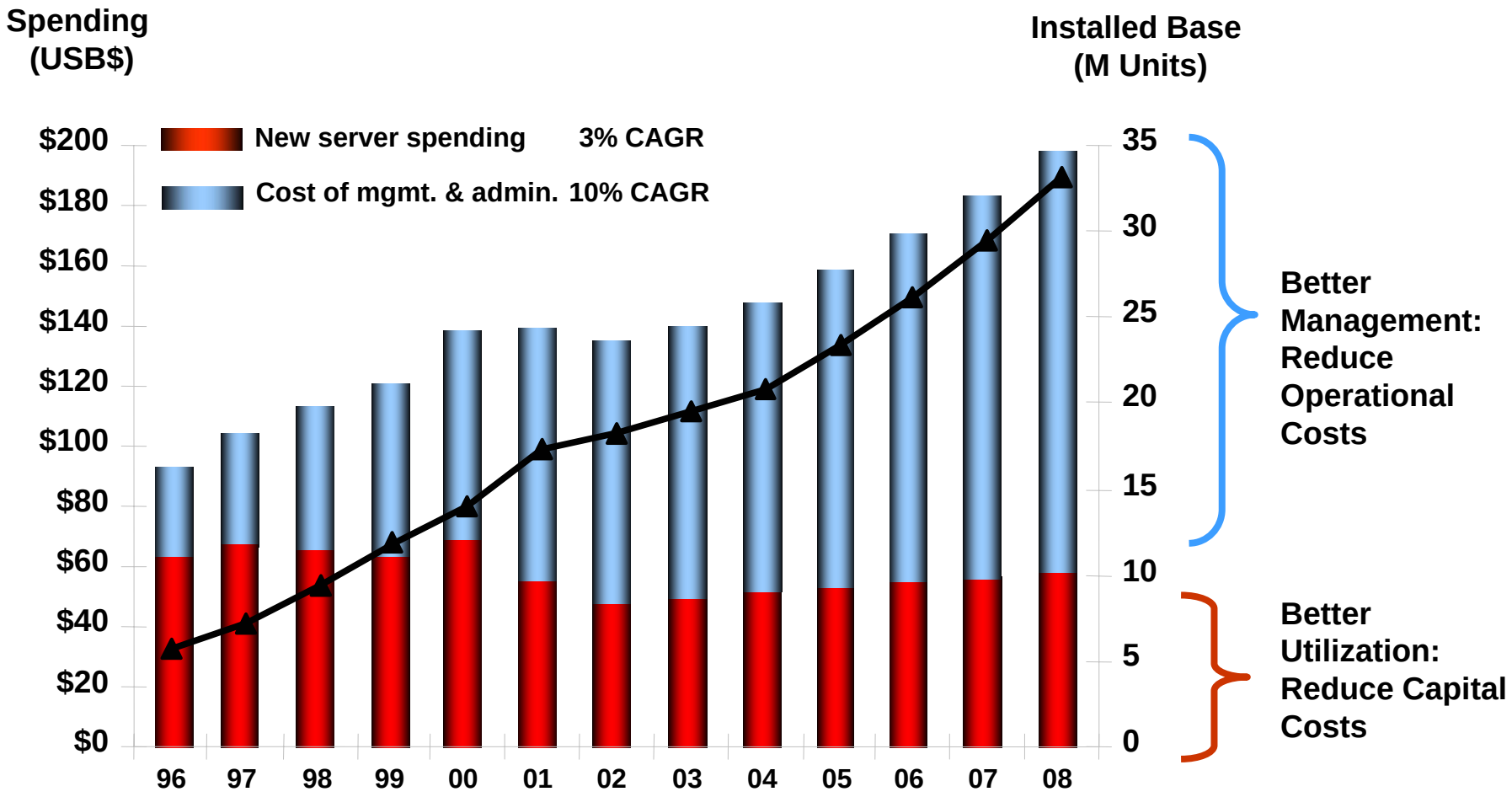
- IBM directly **resells**:
  - VMware ESX
  - VMware GSX
  - VMware VirtualCenter
  - VMware ESX Virtual SMP
  - VMware ESX Processor Upgrades
  - Virtual Infrastructure Nodes (VIN)
  - BladeCenter Bundles

- IBM directly **supports**:
  - VMware ESX
  - Main guest Operating Systems running in the virtual machines (Windows + Linux)
  - Selected Applications running in the virtual machines via ITS Support Line
  - Support orderable via IBM p/nr, no special bid negotiations required, charged by CPU

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- **Systems Management**
- Futures
- Q & A

Total cost of ownership (TCO) for servers continues to rise, even as total server spend remains flat — and operational costs are the reason



IDC, 2006

Reducing Complexity Delivers Value

Easy to Use

- Get started faster
- Accomplish more in a shorter period of time
- Help reduce training costs for IT staff

Open Design

- Extend functionality to meet your specific needs
- Simplify with a single tool to manage different server platforms and non-IBM systems
- Take advantage of the latest industry standards

Integrated Toolset

- Help reduce costs with a consistent, single point-of management
- Complement your existing IT investment

IBM Systems Director family

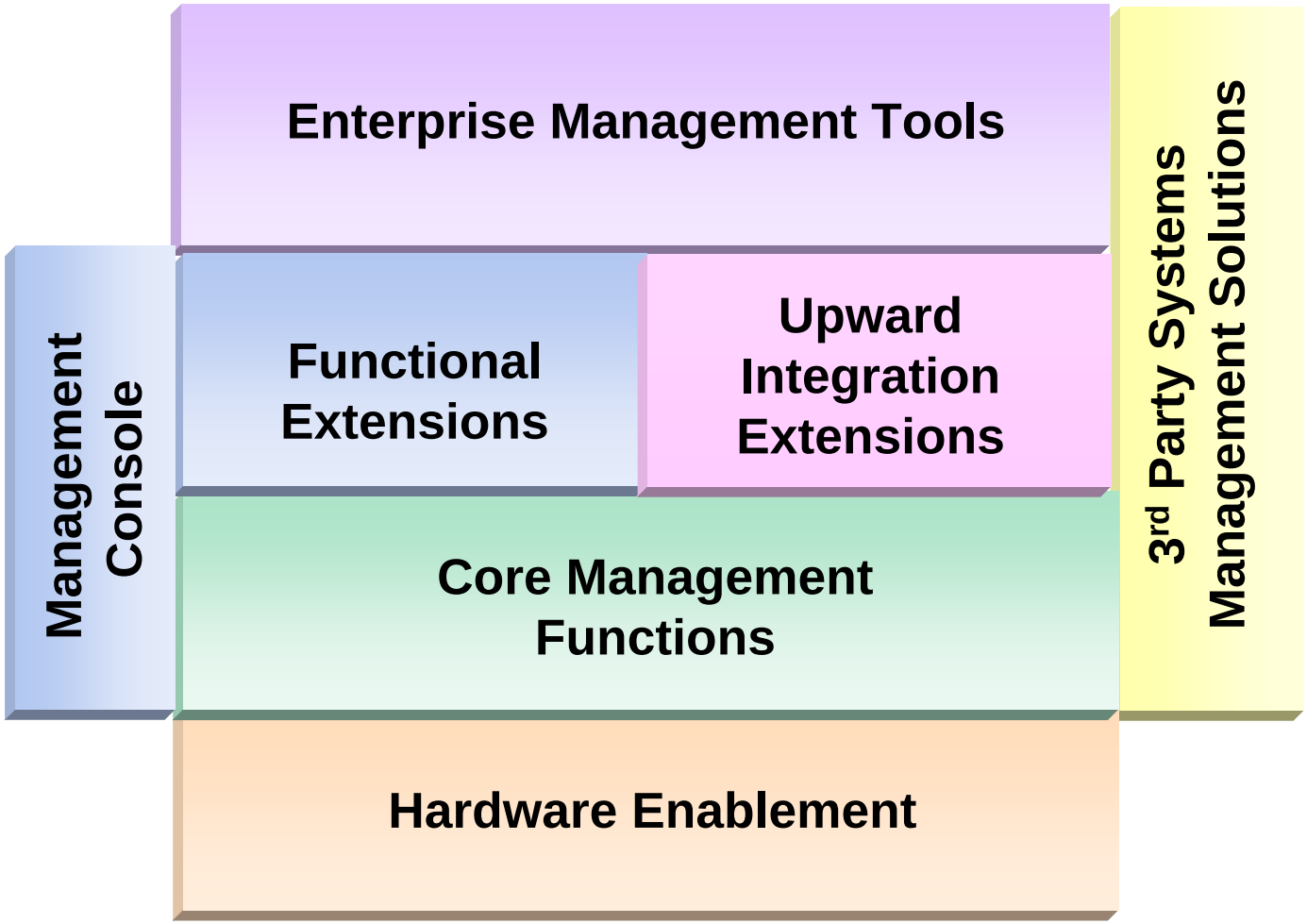
Virtualize more, manage less

- IBM's unified family of platform management offerings
- Common toolset for managing:
  - **Physical and virtual resources together**
  - **Servers, storage, and networking**
  - **IBM and compatible non-IBM resources**
- Modular, industry standards based approach that builds on existing IBM platform management offerings
- Seamless integration with IBM Service Management offerings from Tivoli
- IBM and 3rd party value added extensions

IBM Director Helps Reduce IT Costs

Select IT Cost Estimates	IBM Director Can Help
Downtime	Hardware Health Automated Event Action Plans
Virtualization	Virtual Machine Manager
Software maintenance and deployment	Software Health Check Software Distribution Remote Deployment Manager
performance incidences	Capacity Manager Application Workload Manager

Comprehensive Systems Management

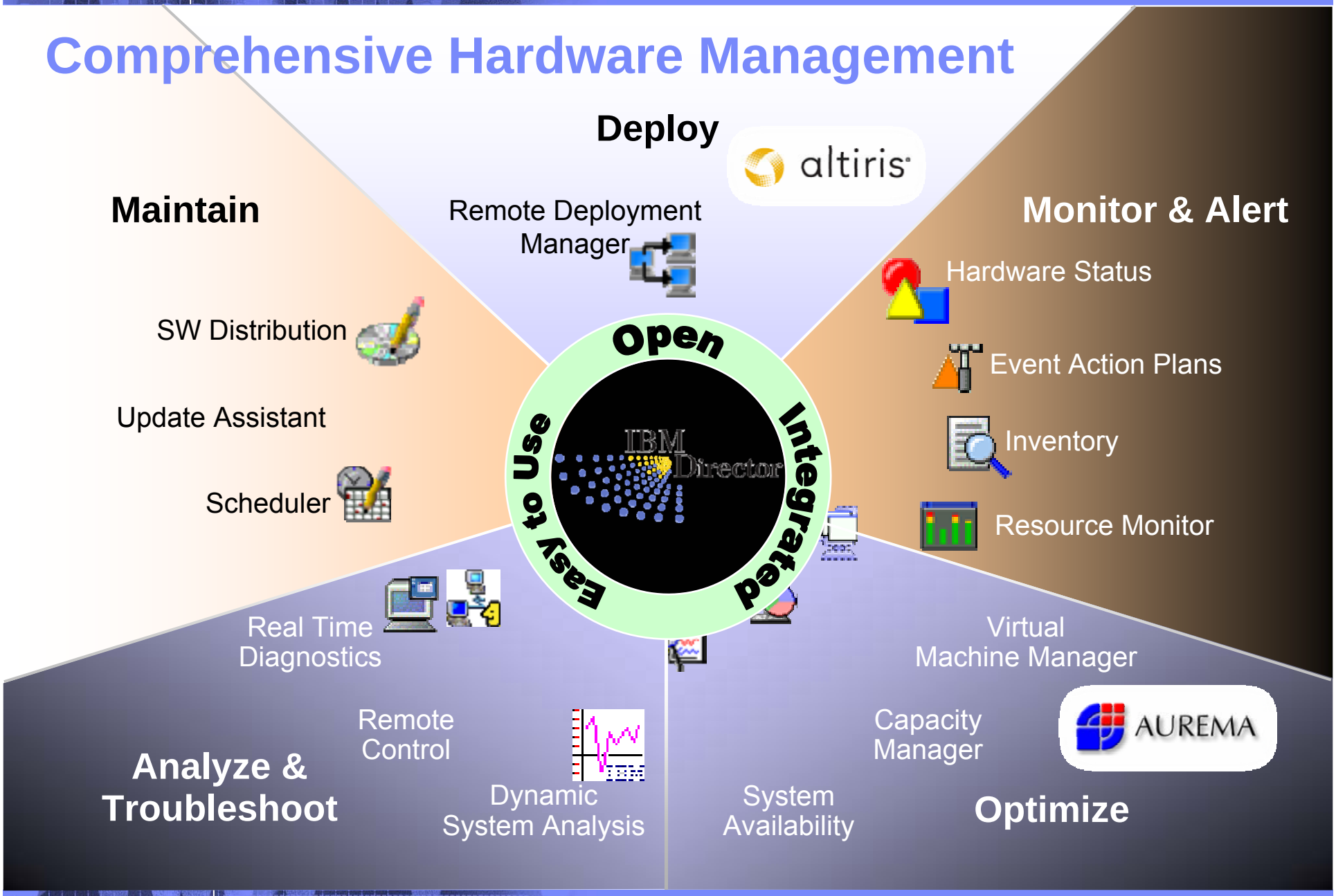


IBM Director Topology

IBM Director

- 3-tiered architecture
- Up to 5000 managed nodes
- Upward Integration
  - Tivoli, Tivoli Netcool, CA, HP, MS, SMS, MOM, BMC, NetIQ)

Comprehensive Hardware Management



IBM Systems Director family

Open, modular design with a broad range of capability

Extensions

Advanced Monitoring

Virtualization Management

Replication

Usage & Accounting

Workload Management

Power Management

Availability

Configuration

Maintenance

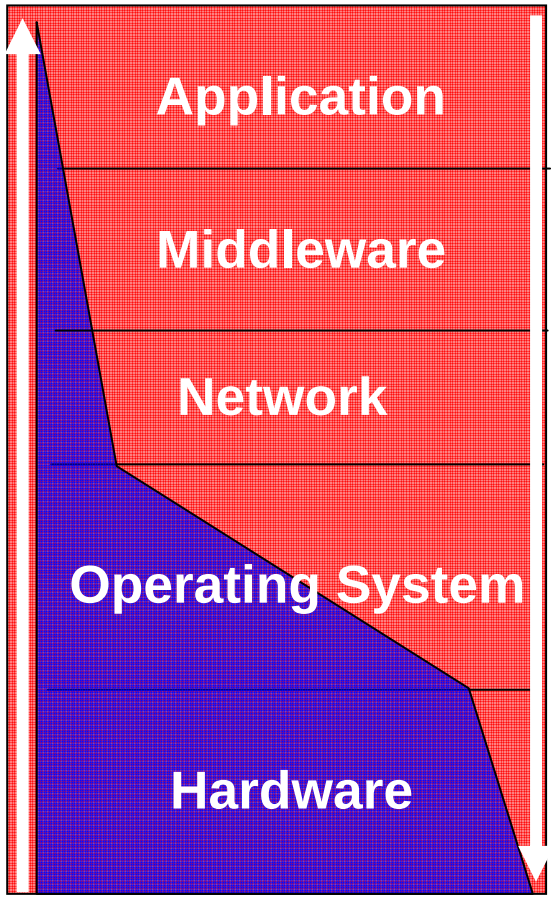
Deployment

Problem Determination

Monitoring

Foundation

IBM Director with Tivoli

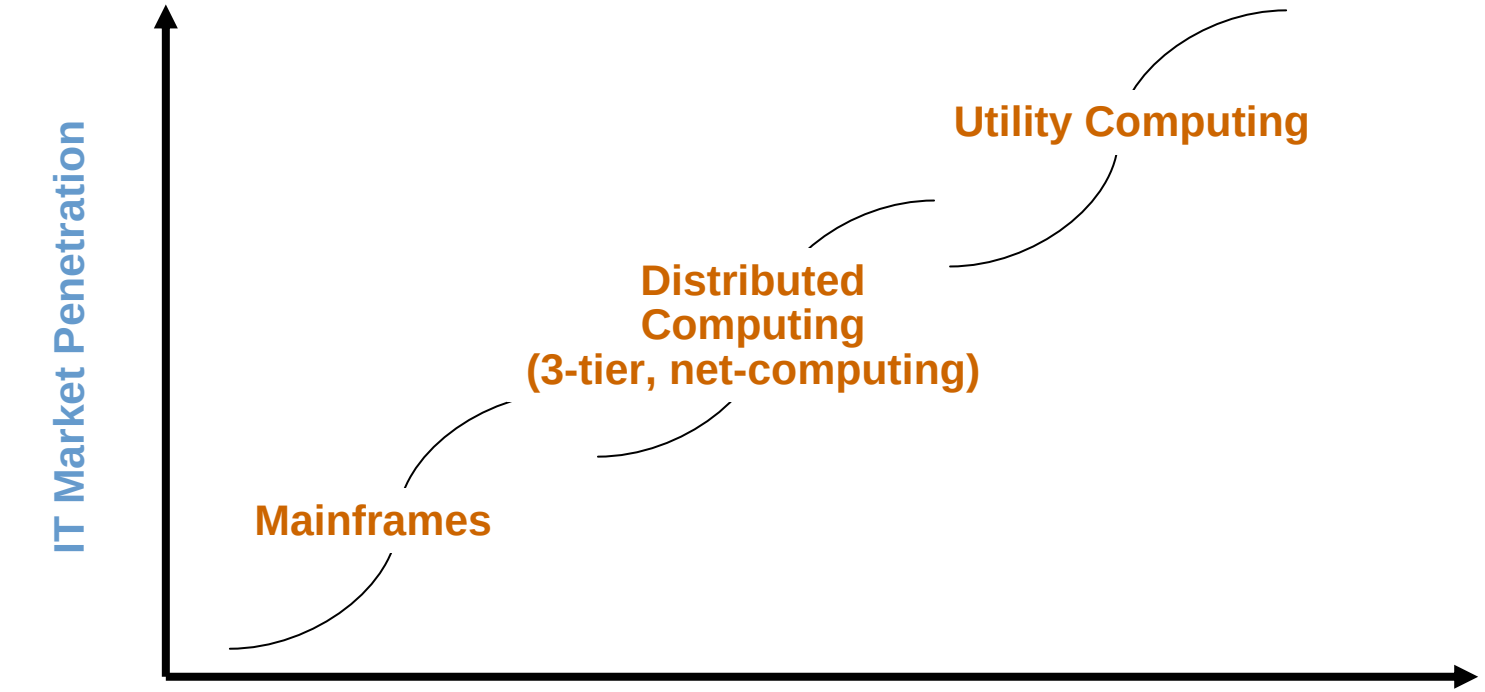


Tivoli and IBM Director together deliver the most comprehensive, ultra-scalable end-to-end systems and service management in the industry!

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- **Futures**
- Q & A

Industry Trend

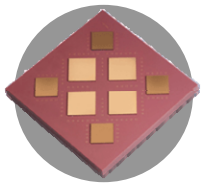


+ Scalable, available
− Expensive, only for a few critical apps

+ Affordable, IT everywhere
− Server Proliferation, Sacrificed simplicity and flexibility

+ Simple, flexible
+ Economical
+ W/O giving up scalability, availability

Technology Innovation Enablers

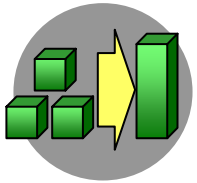


Multi Core

- **Multi-core enabled systems create new opportunities to advance application and solution architecture**

Virtualization

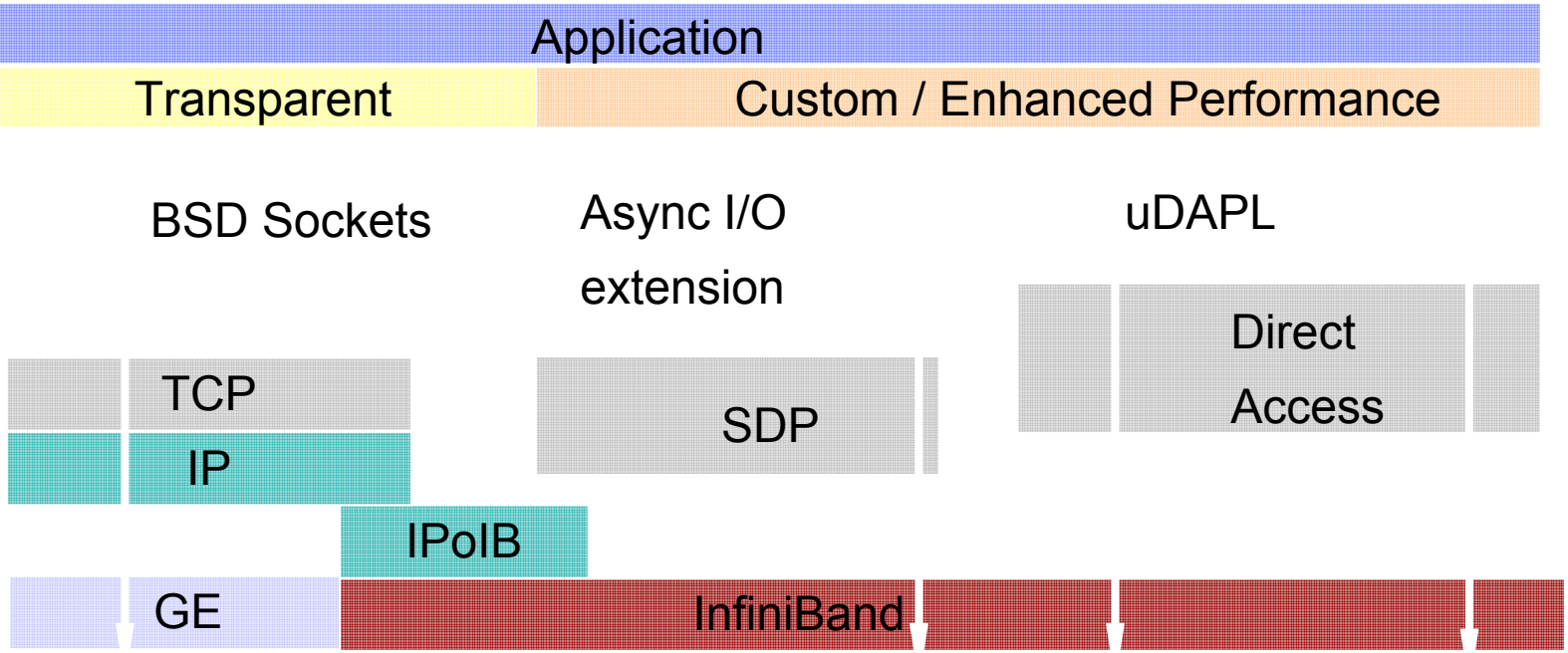
- **Virtualization solutions are a tipping point for rearchitecting and consolidating IT architectures**



Manageability

- **Manageability is critical to addressing the complexity of business critical and virtualized architecture**

Infiniband Performance Estimates on BladeCenter



Throughput	**0.8 Gb/s**	**1.2 Gb/s**	**1.9 Gb/s**	**1.8Gb/s**	**1.9Gb/s**	**1.9Gb/s**
Latency	**60+ usec**	**33 usec**	**25 usec**	**25 usec**	**10 usec**	**7 usec**

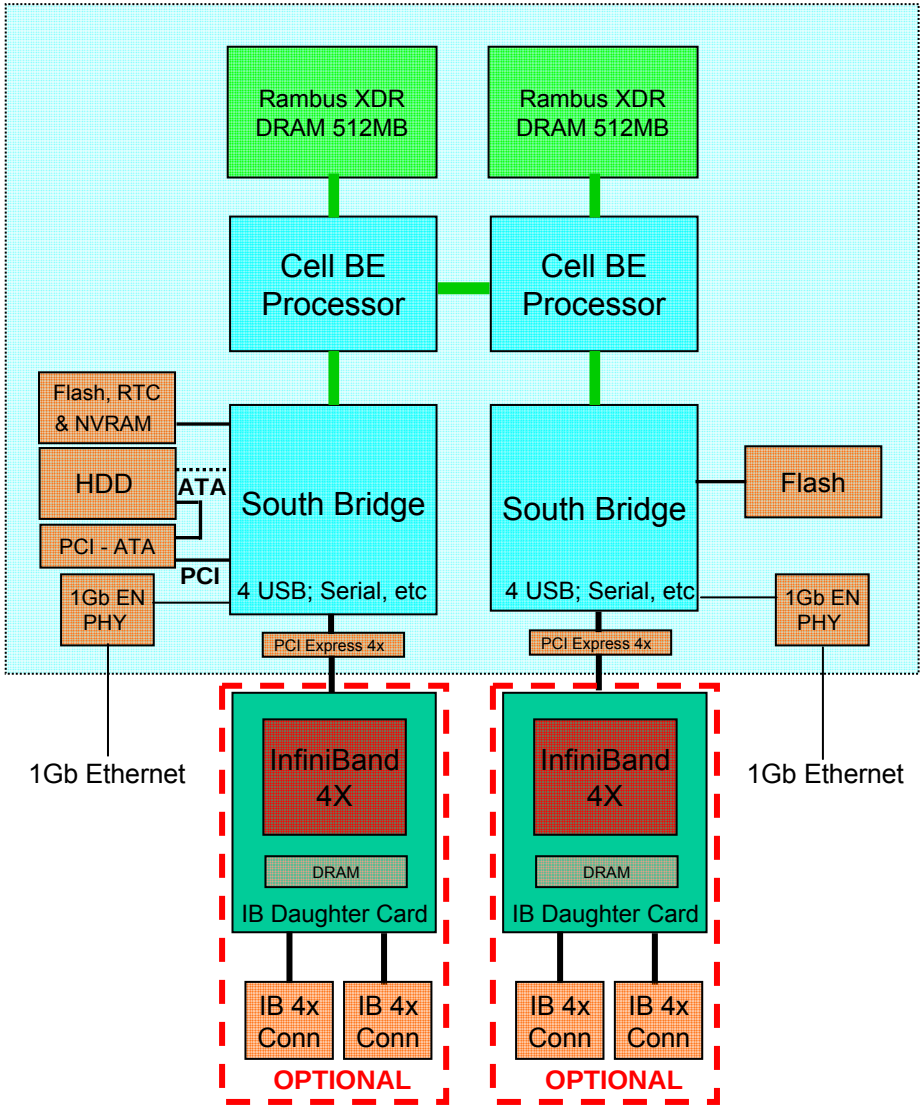
InfiniBand on BladeCenter

- **Expanding BladeCenter Ecosystem with Cisco Systems**
  - Switch module based on Topspin 120 InfiniBand Switch
  - Daughter card provides dual-port InfiniBand connectivity to each blade
- **Help Reduce Total Cost of Ownership**
  - Reduce the number of adapters, cables, and switch ports required
  - Manage the addition or removal of I/O or storage bandwidth centrally
  - Enable users to adjust resources on demand without downtime
- **High Performance Computing**
  - Leverages RDMA to deliver low latency performance
  - Replaces proprietary interconnect protocols
  - Delivers higher bandwidth connectivity (80 Gbps to chassis)
- **Commercial Enterprise Solution**
  - I/O Virtualization
  - Seamless Connection to SAN and LAN networks
  - Achieve Port consolidation through I/O Consolidation

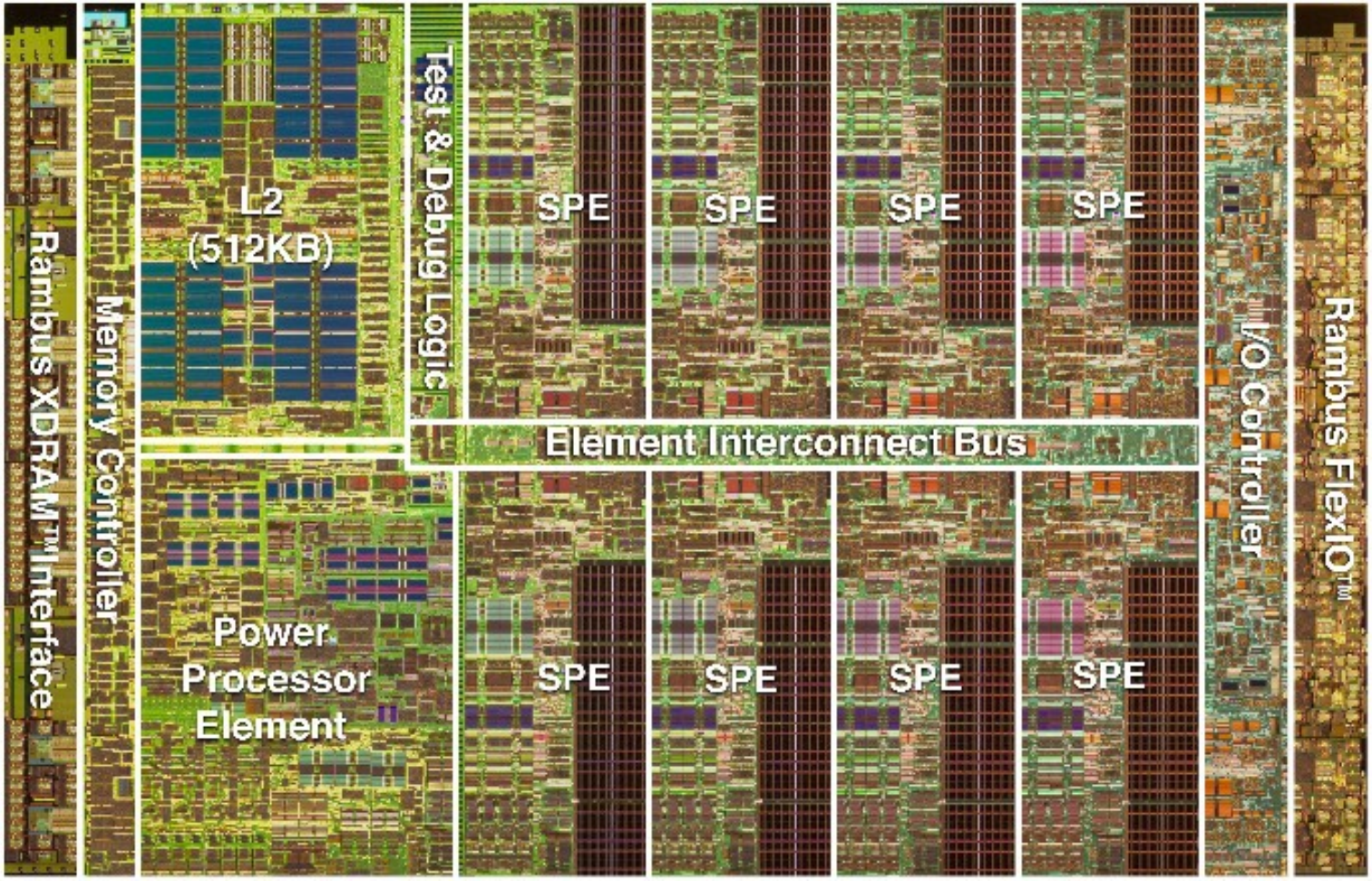
BladeCenter InfiniBand Solution provides high-speed, low latency solutions while lowering TCO

IBM BladeCenter QS20 Overview

- Cell BE Processor Blade **(~400GFLOPS peak)**
  - Dual 3.2GHz Cell BE Processor Configuration
  - 1GB XDRAM (512MB per processor)
  - Blade-mounted 40GB IDE HDD
  - Dual Gigabit Ethernet (GbE) controllers
  - Double-wide blade (uses 2 BladeCenter slots)
  - Infiniband (IB) Option:
    - Qty 0-2 IB 4x Host Channel Adapters
  - 1 yr warranty (upgrades available for purchase)
- BC Chassis Configuration **(~2.8TFLOPS peak)**
  - Standard IBM BladeCenter One
  - Max. 7 Blades per chassis (QS20 - 2 slots each)
  - 2 Gigabit Ethernet switches
  - External IB switches required for IB option
  - Note: Intermixing Cell Blades with other blades in same chassis is not supported



IBM Cell Processor



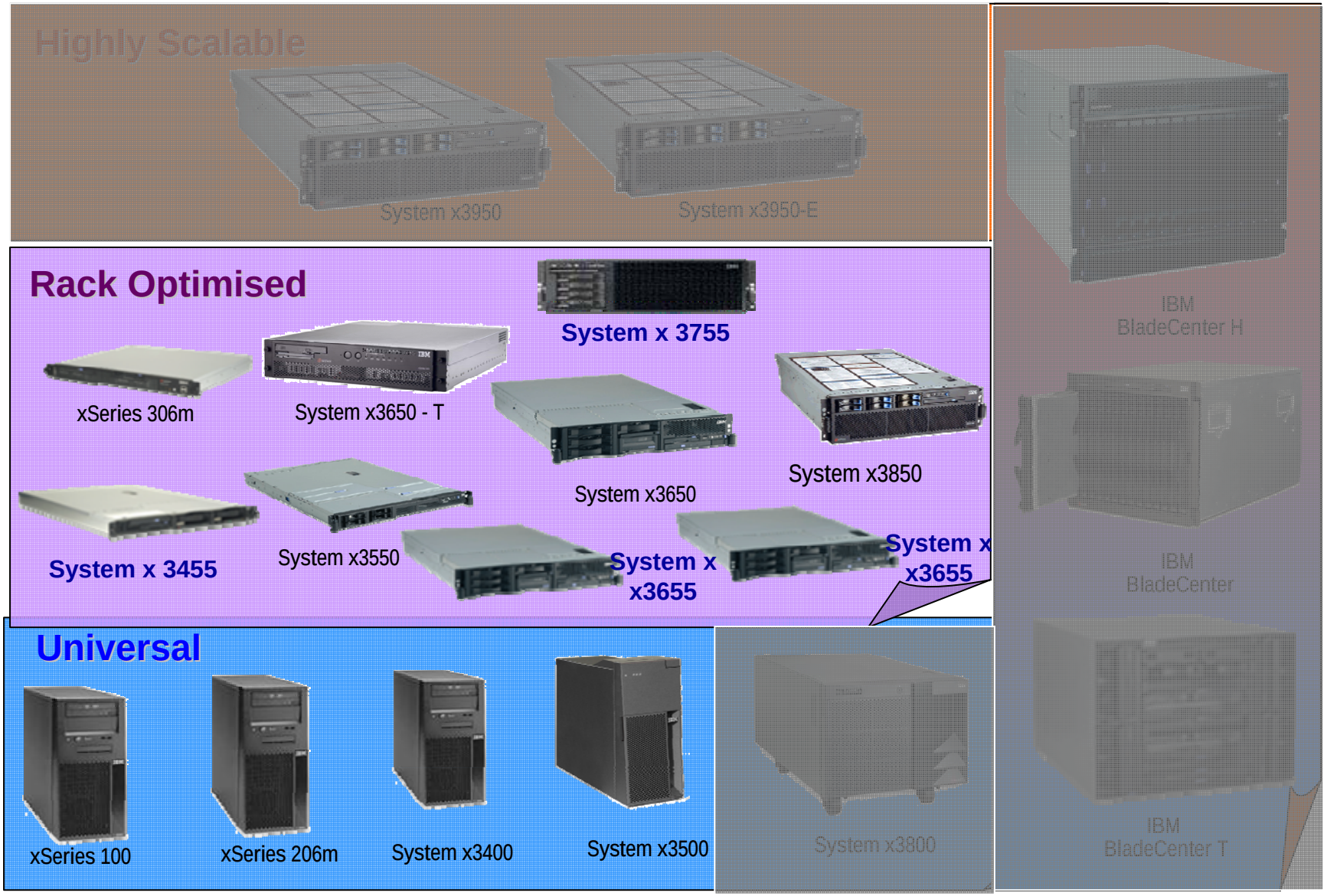
Customer example: Performance improvement

- Pricing european options
  - Financial analytic instrument using Monte-carlo methods
  - 200,000,000 simulations
- Results
  - Intel P4 1.7GHz 195s
  - Intel Xeon 3.8GHz 65s
  - AMD 2.2GHz Dual core 57s
  - Cell blade (SP) 0.8s
  - Cell blade (DP) 4.8s
- Consider the infrastructure value of replacing whole BladeCenters chassis with a single Cell blade!!
  - heat / power / space etc.

Agenda

- Introduction
- Market and Technology Trends
- IBM Systems Agenda
- Intel / AMD Portfolio
- Scale Up Solutions
- Scale Out Solutions
- Virtualisation
- Systems Management
- Futures
- Q & A

Product Line-up for Q3 2006



Rack-Optimized Products

x3250

Lowest cost edge of network server

1U, 1 Socket

Apps: Web, infrastructure, security

- Maximum Density
  - Optimize Space
  - Lowest cost
    - Lower budget
  - Storage Options
    - Investment Protection

x3455

The best HPC price/performance

1U, 2 Socket

Apps: HPC, Engineering, research, oil and gas, manufacturing

- Lowest cost design
  - The best price/ Performance
- Memory expansion
  - Scale Performance
- Cluster-optimized (HTx)
  - High performance expansion

x3550

Application density for power managed datacenters

1U, 2 Socket

Apps:, Database, ERP, e-mail collaboration, file/print, virtualization

- Application Density
  - Optimize Space
- Power Executive
  - Optimize/lower power cost
- Advanced Management
  - Lower support costs

x3650

Business Critical application server

2U, 2 Socket

Apps: eBusiness, email/Collaboration, application consolidation, ERP, terminal services,

- Stable Integrated function
  - Lower business support costs
- High availability
  - Protect data/lower costs
- Power Executive
  - Optimize/lower power cost

x3655

Business critical application with performance

2U, 2 Socket

Apps: Database, ERP, Video, and virtualization

- Maximum Memory Expansion
  - Maximum performance
  - Investment protection
- eXtended I/O
  - Expansion on demand to protect investment
- Power Executive

	x346	x3650
Processors	Intel Xeon 800MHz FSB	**Intel Xeon Dual Core/667-1066-1333MHz FSB**
Memory	DDR2 / 8 DIMM / 16 GB maximum Online hot-spare / memory mirroring	**DDR2-667 Fully Buffered / 12 DIMM / 48GB max** Online Spare / Memory Mirroring
Controller	Dual Channel Ultra320 SCSI (Adaptec 7902)	**Dual Channel Adaptec SAS with ServeRAID 8k-l standard**
Gigabit Ethernet	Integrated Dual Gigabit Ethernet (Broadcom 5721)	**Broadcom 5708 – Dual port TOE/Jumbo frames**
System Management	Integrated BMC, w/ RSA-II SlimLine option	Integrated BMC IPMI 2.0, with RSA II SlimLine option
PCI Slots	2 x 64-bit/100MHz slots (low profile), 2 64-bit/133MHz slots (full size) Optional PCI-E Riser w/ 2 full size slots (x4)	**4 PCI-Express Slots (1 x8 full length/1 x8 ½ length/2 x4 low profile). Optional riser card for 2 PCI-X 133MHz slots, full length and ½ length**
Internal Backup	Optional DDS5 Tape in 3.5-inch SCSI drives	**Optional GoVault or DDS6 Tape in all models**
Hard Disk Drives	Up to 6 HS SCSI HDDs	Up to 6x 3.5-inch (876GB max) or **8x 2.5-inch HS SAS HDDs (584GB max)**
Standard RAID	SCSI RAID 0, 1, 10 Embedded RAID ServeRAID-7k RAID 5 option	**Key Largo hardware-based RAID 0/1/10 or optional slotless RAID 5 (Key Biscayne)**
Local KVM mgmt	ACT Cabling	**Front video port and 2 USB ports; Rear video port and 4 USB ports, and ACT**
Power	Hot-swap/redundant power supplies	Hot-swap/redundant 830W power supplies.
Cooling	Hot-swap/redundant fans	Hot-swap/redundant fans

	x336	x3550
Processors	Intel Xeon (Irwindale 800MHz FSB)	**Intel Xeon (Woodcrest Dual Core/1333MHz FSB)**
Memory	DDR2 / 8 DIMM / 16 GB maximum Online Spare / Memory Mirroring	**DDR2 667 PC2-4200 Fully Buffered** / 8 DIMM / 32 GB max / Online Spare / Memory Mirroring
SCSI controller	Single Channel LSI1020	**Single Channel SAS/SATA Controller (Aurora Lite)**
Gigabit Ethernet	Dual Broadcom 5721	**Broadcom 5708 – Dual port Jumbo frames and Broadcom TOE support**
System Management	Vulture Integrated BMC, Optional RSA-II Daughter card	**Integrated BMC, with lower cost RSA II SlimLine option**
PCI Slots	133MHz PCI-X full length and 100MHz PCI-X low profile. Support for optional PCI-Express (x8) slot	**Two PCI-Express x8 half length/full height adapter slots.** Support for optional 133MHz PCI-X riser card
Hard disk drives	2x 3.5 inch Ultra 320 SCSI, 4x 2.5 inch Ultra 320 SCSI or 2x 3.5 inch SATA	2x 3.5 inch or 4x 2.5 inch SAS, and 2x 3.5 inch SATA models
Media	No internal DVD-CD	**Internal DVD-CD/RW Combo**
Standard RAID	SCSI RAID 1 and 1E, Optional ServeRAID 6i+	**Optional low cost SAS and SATA hardware RAID 0 and 1, Optional advanced high performance RAID DC**
Local KVM management	Standard KVM ports	**Front video port and 2 USB ports; Rear video port and 4 USB ports**
Power	Hot-swap/redundant 585W power supplies	Hot-swap/redundant 670W power supplies. **Optional DC power model**
Cooling	Hot-swap/redundant fans	Hot-swap/redundant fans

Volume Tower Product Positioning

xSeries Dual core 64-bit Tower servers:
- Optimize for business growth
- Manage remote business to lower costs
- Protect all data and IT investment

x3105

Value for the smallest business

Uni Socket
Apps: File/print, small-business management

- Lowest Cost
  - Affordable
- Easy to use
  - Low cost to install

x3200

Affordable enterprise class availability

Uni Socket
Apps: Distributed/Retail applications, Messaging, File & print,

- Dual Core
  - Investment Protection
- Redundant Power Models
  - Data Protection

x3400

Affordable performance for growing business

Dual Socket
Apps: Collaboration, SMB business applications

- Low cost 2-way design
  - Affordable business growth
- Flexible Configuration options
  - Flexible business deployment
- Optional redundancy
  - Protect critical data

x3500

Stable Business Critical application server

Dual Socket
Apps: Messaging / collaboration
Distributed CRM/SCM, Workgroup applications, Consolidation

- Stable Platform life
  - Lower management costs fc large roll outs
- Integrated HA and Managemer
  - Lowest solution price
- Maximum memory expansion
  - Grows with your business
- Large data storage
  - Long term Investment prote

	x236	x3500
Chipset	Intel Lindenhurst	**Intel Blackford**
Memory	DDR2/ 8 DIMM / 16 GB maximum Online Spare / Memory Mirroring	**DDR2 PC2-5300 Fully Buffered / 12 DIMM / 48GB maximum; Online Spare / Memory Mirroring**
Processors	Intel Xeon (Nocona/Irwindale 800MHz FSB)	**Intel Xeon (Dempsey Dual Core/667 or 1066MHz FSB)**
SCSI controller	Dual Channel Ultra320 SCSI (Adaptec 7902)	**SAS (Aurora: 8-port)**
Gigabit Ethernet	Integrated Dual Gigabit Ethernet (Broadcom 5721)	**Integrated Dual Gigabit Ethernet (Broadcom 5708)**
System Management	Vulture Integrated BMC, RSA-II SlimLine option	Integrated BMC**, RSA II SlimLine option**
PCI Slots	2 x 64-bit/100MHz , 1 x 64-bit/133Mhz (1 Hot Plug), 2 x (x4 connector) PCI-E and 1 x 32/33Mhz Legacy	**3 x PCI-Express (2x8, 1x4)** **1 x 32-bit/33MHz PCI slots (full size)** **2 x 64-bit/133MHz PCI-X slots (full size)**
Internal Tape	Supports Full High Tape	Supports Full High Tape
Hard disk drives	9 Total: 6 standard with 3-pack option	**8 HS SAS or SATA**
Standard RAID	SCSI RAID 0, 1. Embedded RAID ServeRAID 7k option for RAID 5	**Standard SAS RAID 0,1,5,10, Embedded**
Power	Hot-swap/redundant power supplies	Hot-swap/redundant power supplies
Cooling	Hot-swap/redundant fans	Hot-swap/redundant fans

	x226	x3400
Chipset	Intel Tumwater	**Intel Blackford with ESB2**
Memory	DDR2 / 6 DIMM / 16GB maximum Online Spare Memory	**DDR2 PC2-5300 Fully Buffered / 8 DIMM /32GB max, Online Spare Memory**
Processors	Intel Xeon (Nocona 800MHz FSB 1MB L2 cache) Intel Xeon (Irwindale 800MHz FSB 2MB L2 cache)	**Intel Xeon (Woodcrest Dual Core/1333MHz FSB)**
SCSI controller	Dual Channel Ultra320 SCSI (Adaptec 7902)	**SAS (Aurora: 8-port)**
Internal Tape	Yes, half high	Yes, half high
Gigabit Ethernet	Integrated Gigabit Enet (Broadcom 5721)	Integrated Gigabit Enet (Braodcom 5721)
System Management	IBM Director with ASF2.0, optional RSA II	**BMC with IPMI, optional RSA II Slimline**
PCI Slots	2 x 32-bit/33MHz PCI slots (full size) 2 x 64-bit/100MHz PCI-X slots (full size) 1 x 64-bit/133MHz PCI-X slots (full size) 1 x PCI-Express (x16)	**3 x PCI-Express (2x8, 1x4)** **1 x 32-bit/33MHz PCI slots (full size)** **2 x 64-bit/133MHz PCI-X slots (full size)**
Hard disk drives	Up to 6 HS SCSI or up to 4 simple-swap SATA	**4 SS SATA-Entry** **4+4 HS SAS - Mid**
Standard RAID	Integrated IBM ServeRAID 7e (0 or 1)	Integrated ROMB: - H/WRaid 0,1, 10 – ServeRAID 8-kl Standard - H/W Raid 5 - ServeRAID 8-k Optional
Power	Models with hot-swap/redundant power supplies	Models with H/S Power Redundant Power/Cooling (Option)

Consumer Reports 2-way guide – best solution fit

Solution Area	Floating Point Perf	Memory Through put	Integer Performance	I/O & I Storage	Density	High Availability	Systems Management	Distributed Deployment	x3650	x3550	x3500	x3400
File and Print									Better	Good	Best	Best
Business Intelligence									Better	Better	Good	Good
Web Serving									Best	Best	Better	Good
E-mail									Best	Good	Best	Better
Security									Better	Best	Good	Good
Retail									Better	Good	Best	Better
Branch Banking									Better	Good	Best	Better
ERP – SAP, SSA									Best	Better	Better	Good
VHCI									Best	Good	Better	Good
Financial Sector									Best	Better	Good	Good
S&TC and HPC									Better	Best	Good	Good
Telco									Best	Best	Good	Good
Virtualization/Consol									Best	Better	Best	Good

Important — Nice to have — Can do without

Best | Better | Good

Confidently gain competitive advantage with industry-leading performance, reliability and control

System x

x3455

High Performance Compute Node

- Fastest, leanest compute node on the planet
- Ideally suited for HPC clusters, Linux or MSFT

x3655

Business performance Server

- The perfect mix of IBM mainframe inspired reliability and application performance
- Leadership I/O and large memory capacity

x3755

HPC large memory compute node

- Unmatched price/performance and leadership design
- Maximum configurable I/O slots
- Fastest, largest memory capacity

BladeCenter

2-socket high performance computing

Scalable 4-socket performance

- Outstanding performance/watt performance for HPC and scalable enterprise workloads
- First “snap in” scalable blade. Design allows “pay as you grow” flexibility
- Compatible with existing and future chassis

PowerExecutive™: Power Management at Your Control

Footnotes

Visit *www.ibm.com/pc/safecomputing* periodically for the latest information on safe and effective computing. Warranty Information: For a copy of applicable product warranties, write to: Warranty Information, P.O. Box 12195, RTP, NC 27709, Attn: Dept. JDJA/B203. IBM makes no representation or warranty regarding third-party products or services.

IBM makes no representation or warranty regarding third-party products or services including those designated as ServerProven or ClusterProven.

All offers subject to availability. IBM reserves the right to alter product offerings and specifications at any time without notice. IBM is not responsible for photographic or typographic errors.

This publication was developed for products and services offered in the United Kingdom. IBM may not offer the products, services or features discussed in this document in other countries. Information is subject to change without notice. Consult your local IBM representative for information on offerings available in your area.

All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and representgoals and objectives only. Contact your local IBM office or IBM authorized reseller for the full text of a specific Statement of General Direction.

The examples given in this paper are hypothetical examples of how a customer can use the products described herein and examples of potential cost or efficiency savings are not based on any actual case study. There is no guarantee of comparable results. Many factors determine the sizing requirements and performance of a systems architecture. IBM assumes no liability for the methodology used for determining the configurations recommended in this document nor for the results it provides. Any performance data contained in this presentation was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements quoted in this presentation may have been made on development-level systems. There is no guarantee these measurements will be the same on generally-available systems. Some measurements quoted in this presentation may have been estimated through extrapolation. Actual results may vary. Users of this presentation should verify the applicable data for their specific environment.

Information in this presentation concerning non-IBM products was obtained from the suppliers of these products, published announcement material or other publicly available sources. IBM has not tested these products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Prices do not include tax or shipping and are subject to change without notice. [Price includes applicable discounts.] Reseller prices may vary. Unless otherwise specified, pricing informationis current as of original publication of this document.

MB, GB, and TB = 1,000,000, 1,000,000,000 and 1,000,000,000,000 bytes, respectively, when referring to storage capacity. Accessible capacity is less.; up to 3GB is used in service partition. Actual storage capacity will vary based upon many factors and may be less than stated. Some numbers given for storage capacities give capacity in native mode followed by capacity using data compression technology.

Maximum internal hard disk and memory capacities may require the replacement of any standard hard drives and/or memory and the population of all hard disk bays and memory slots with the largest currently supported drives available.

Telephone support may be subject to additional charges. For onsite labor, IBM will attempt to diagnose and resolve the problem remotely before sending a technician.