IBM Systems and Technology Group University 2005

ON DEMAND BUSINESS™

2/14/2005

Server and Technology Group University

Linux Features and Futures

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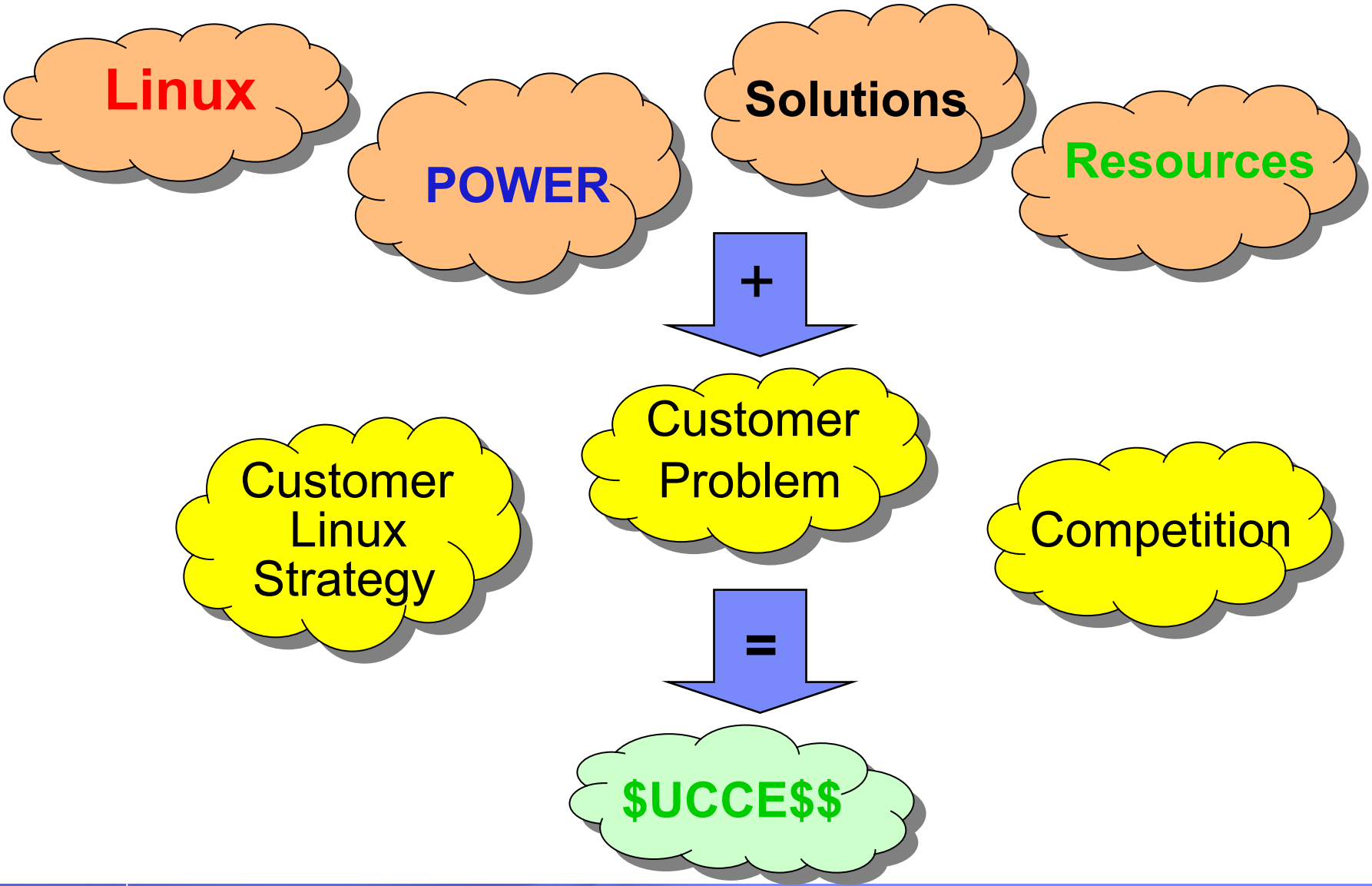
ON DEMAND BUSINESS™

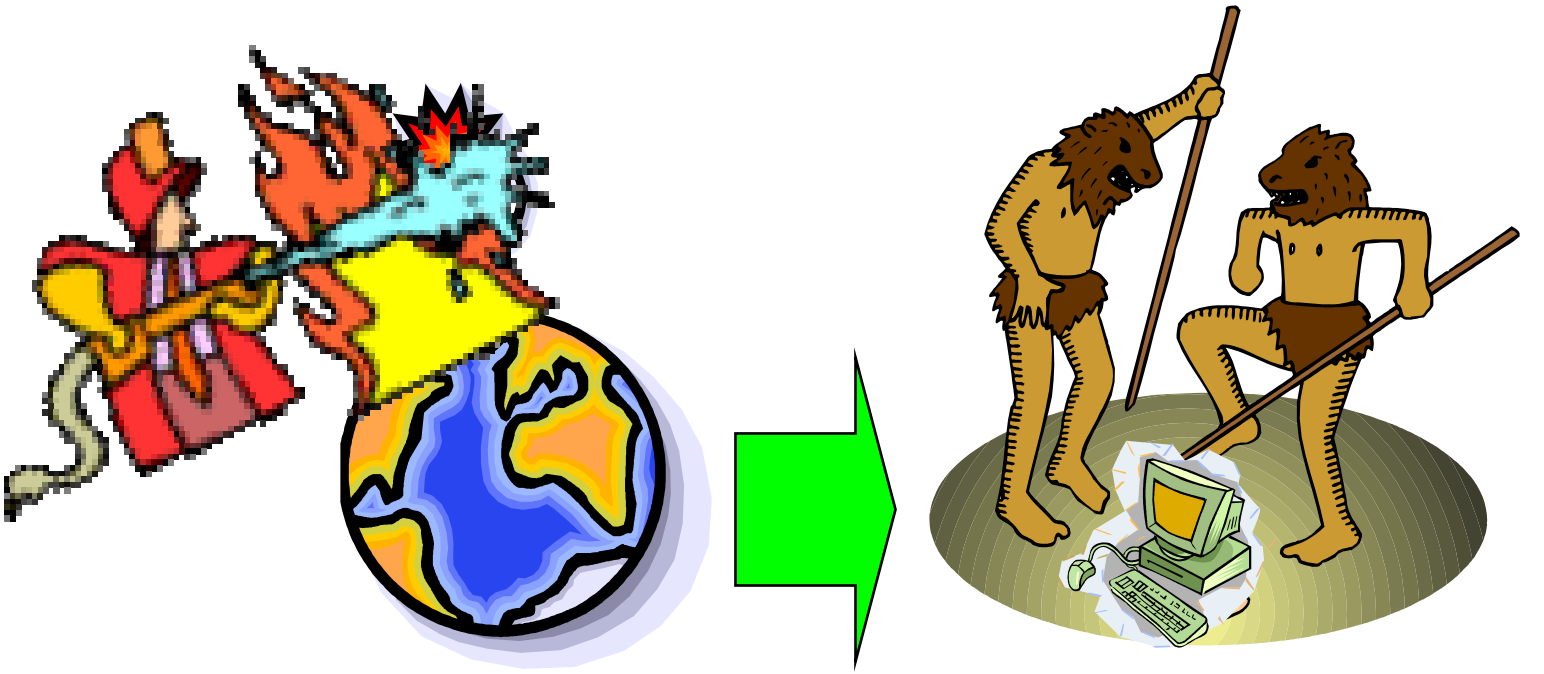
2/14/2005

OBJECTIVE & AGENDA :



The Quick History of Linux

First the earth cooled

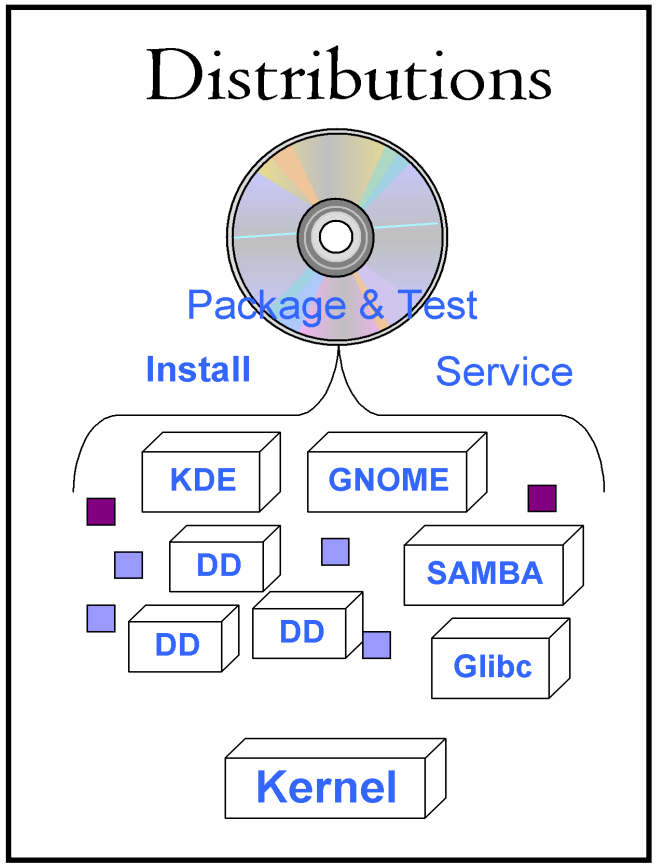


Then we invented the server

Are there any questions?

What is Linux?

- UNIX-like operating system
- Developed / tested by the Open Source community
  - POWER contributions by IBM LTC
- Packaged and shipped by distributors
  - Red Hat, Novell SUSE, Debian
  - Other regional distributors
    - Red Flag, Conectiva, Mandrake, etc...



"Hello everybody... I'm doing a (free) operating system (just a hobby, won't be big and professional...)."

Linus Torvalds, creator of Linux, from the first Internet announcement on August 25, 1991. Even he initially underestimated its potential.

Linux

www.kernel.org

(repository)

www.osdl.org

(control, direction)

2.4

Linux

www.kernel.org

(repository)

www.osdl.org

(control, direction)

2.5

Scaling

I/O

Performance

Virtual Memory

Linux

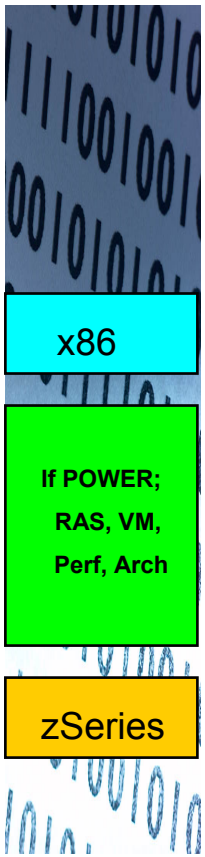
www.kernel.org

(repository)

www.osdl.org

(control, direction)

2.5



Scaling

I/O

Performance

Virtual Memory

LTC

POWER

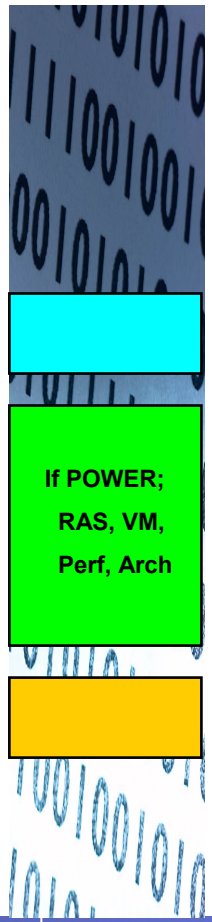
AIX

Linux

www.kernel.org

(repository)

2.6



www.osdl.org

(control, direction)

LDP's

SuSE

redhat

Different Builds

Compile w/ GCC:

arch=x86-32

arch=x86-64

arch=POWER

…with Open Source

- Device Drivers
- Admin
- Install
- File Systems
- Applications
- Support

Linux for x86

Dell, HP, Sun,
AMD, xSeries

Linux for POWER

pSeries, OpenPower,
JS20, iSeries

Morale of the Story:

Linux is Linux … single source tree

to application developers

licensing freedom

…BUT

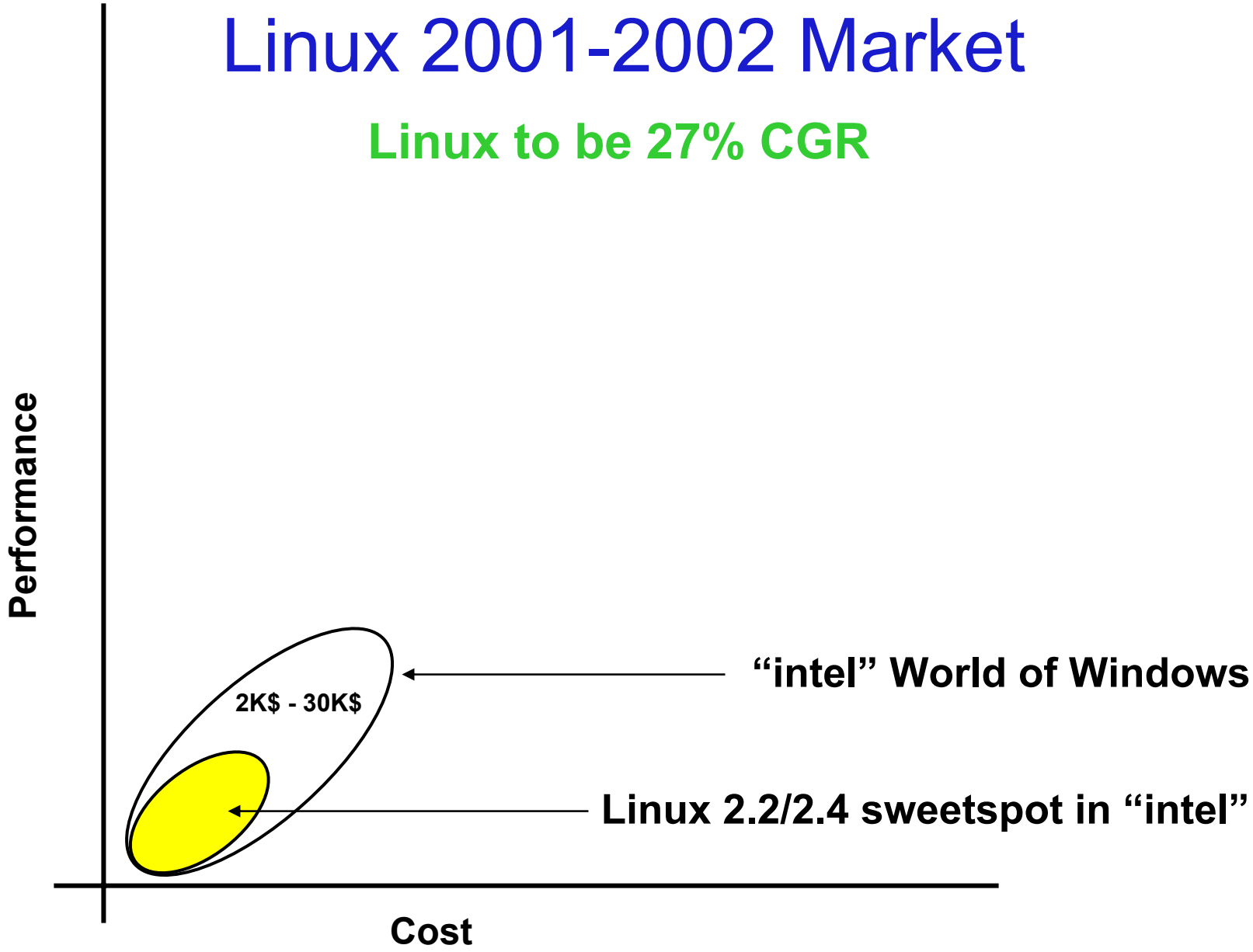
Linux Distributions are not the same ……

by platform

by Distributors

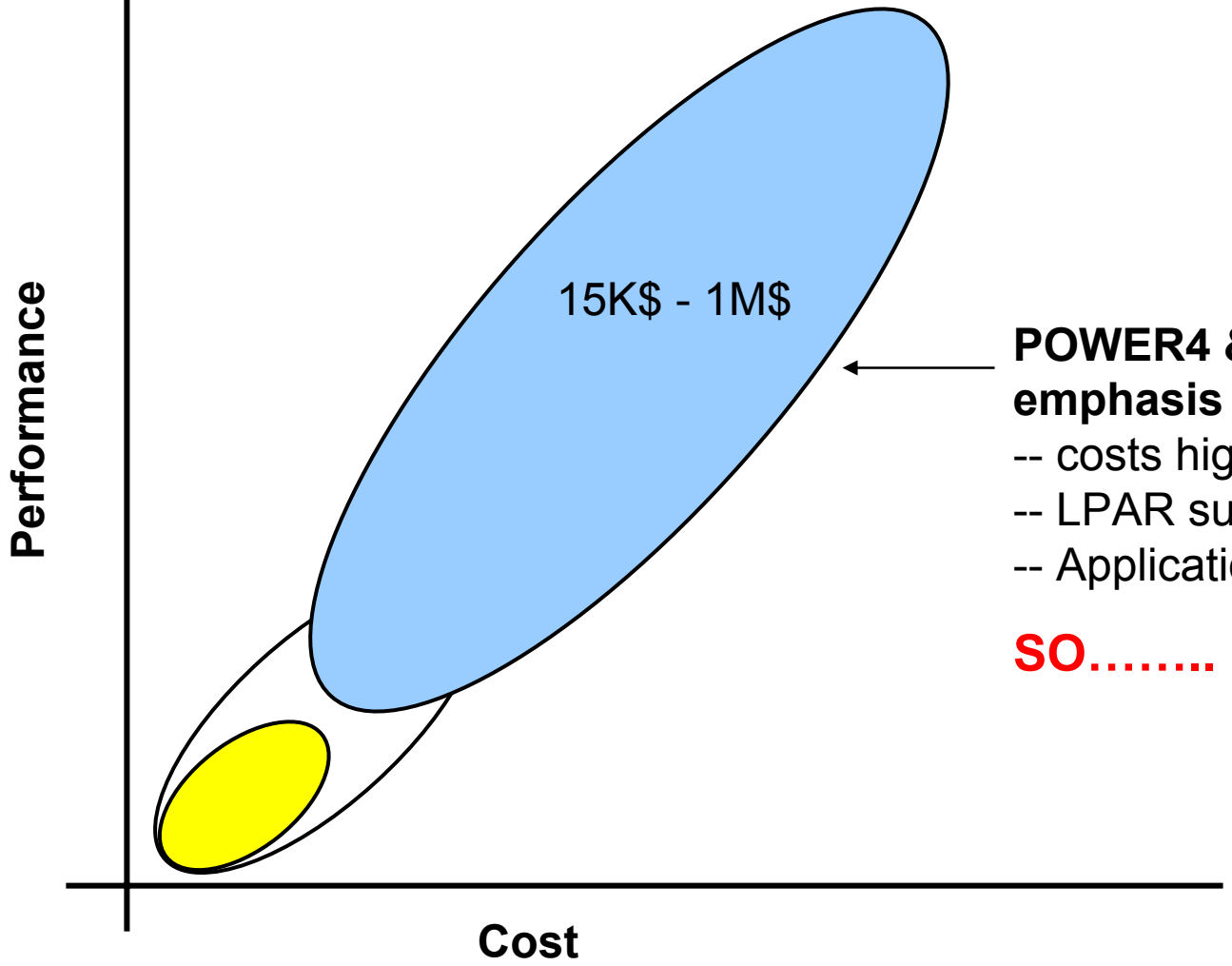
Linux 2001-2002 Market

Linux to be 27% CGR



Linux 2002-2003 Market

Linux to be 27% CGR



POWER4 & Linux emphasis … but

-- costs higher than Intel

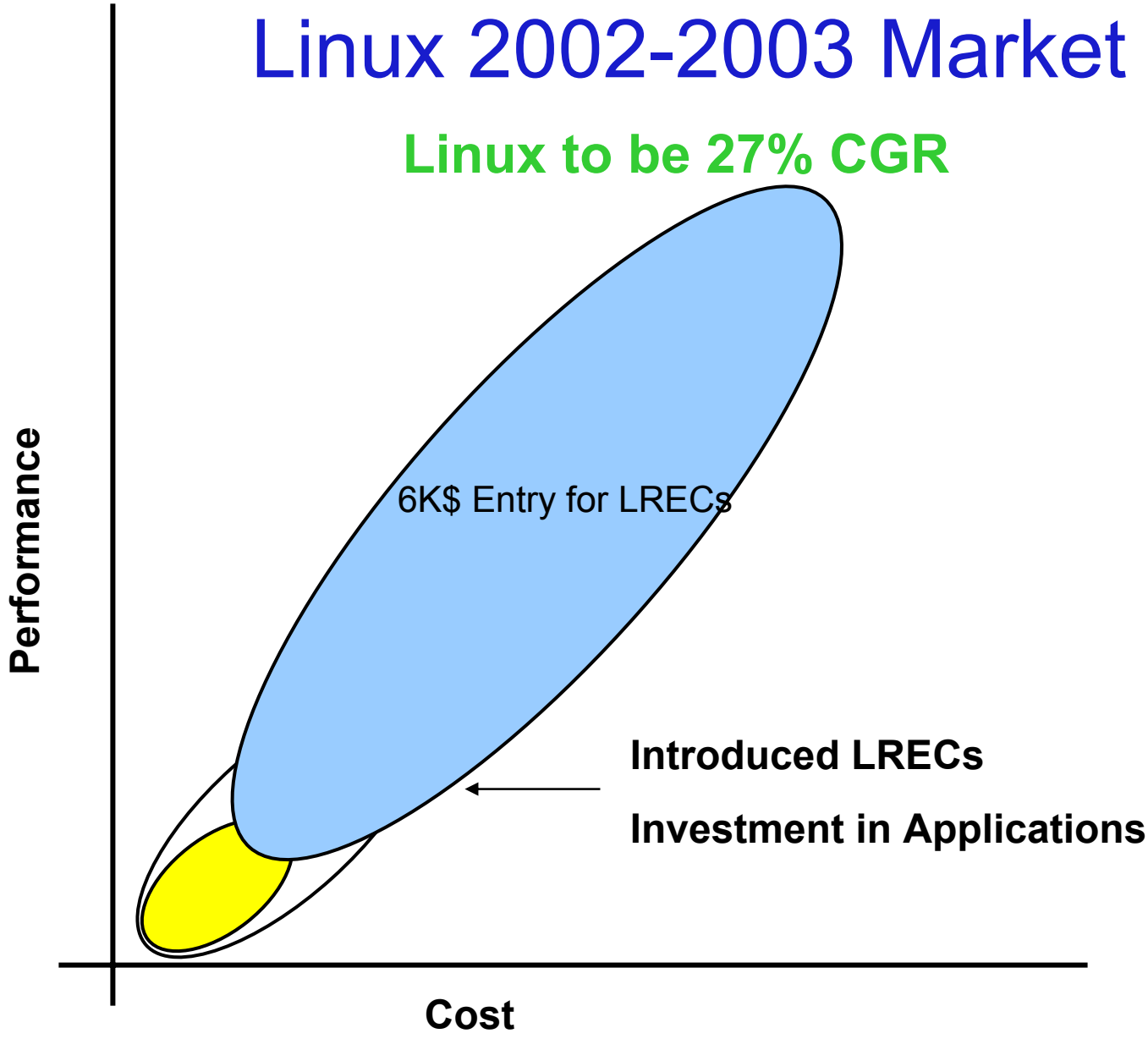
-- LPAR support costly

-- Applications needed

SO……..

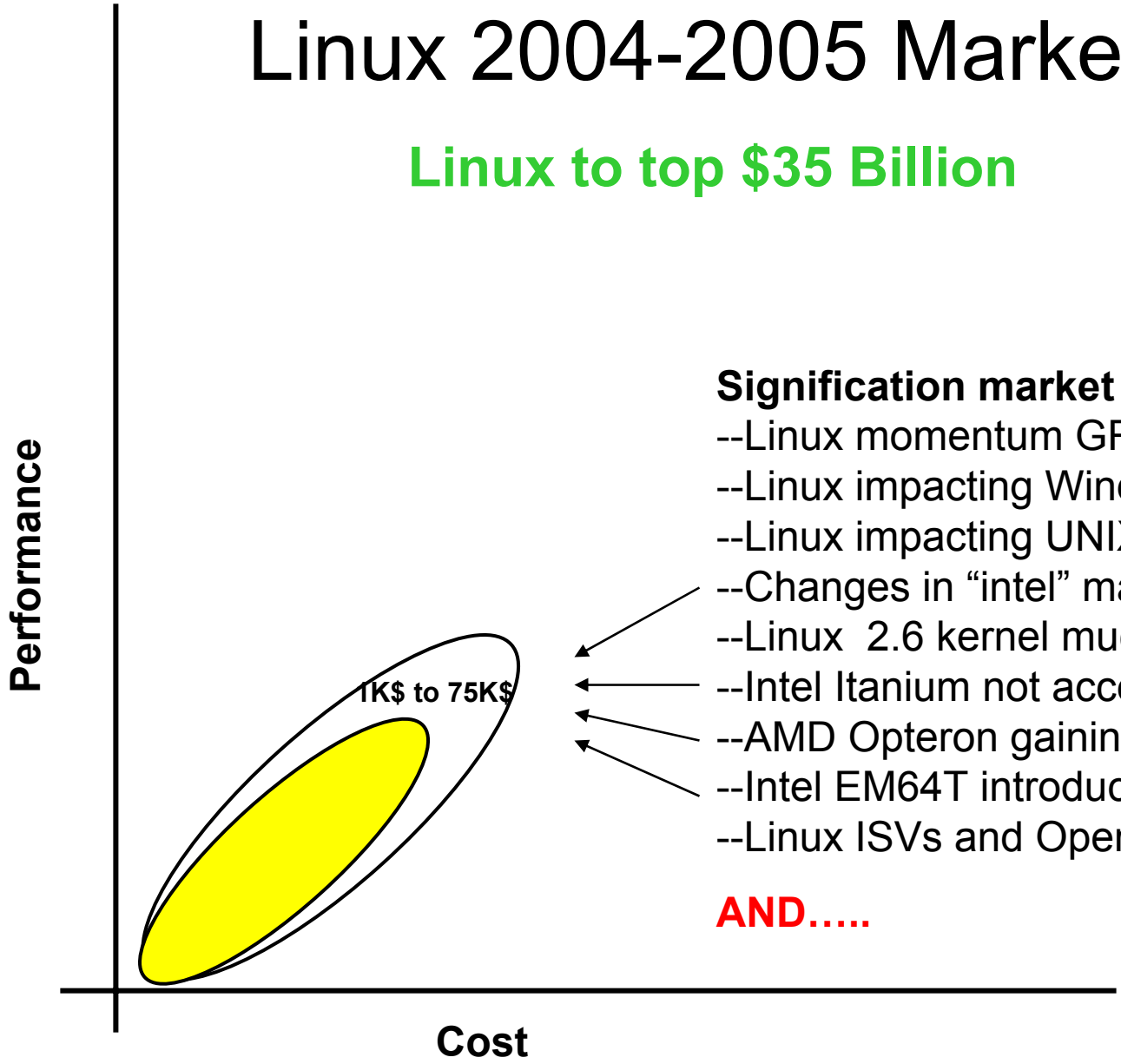
Linux 2002-2003 Market

Linux to be 27% CGR



Linux 2004-2005 Market

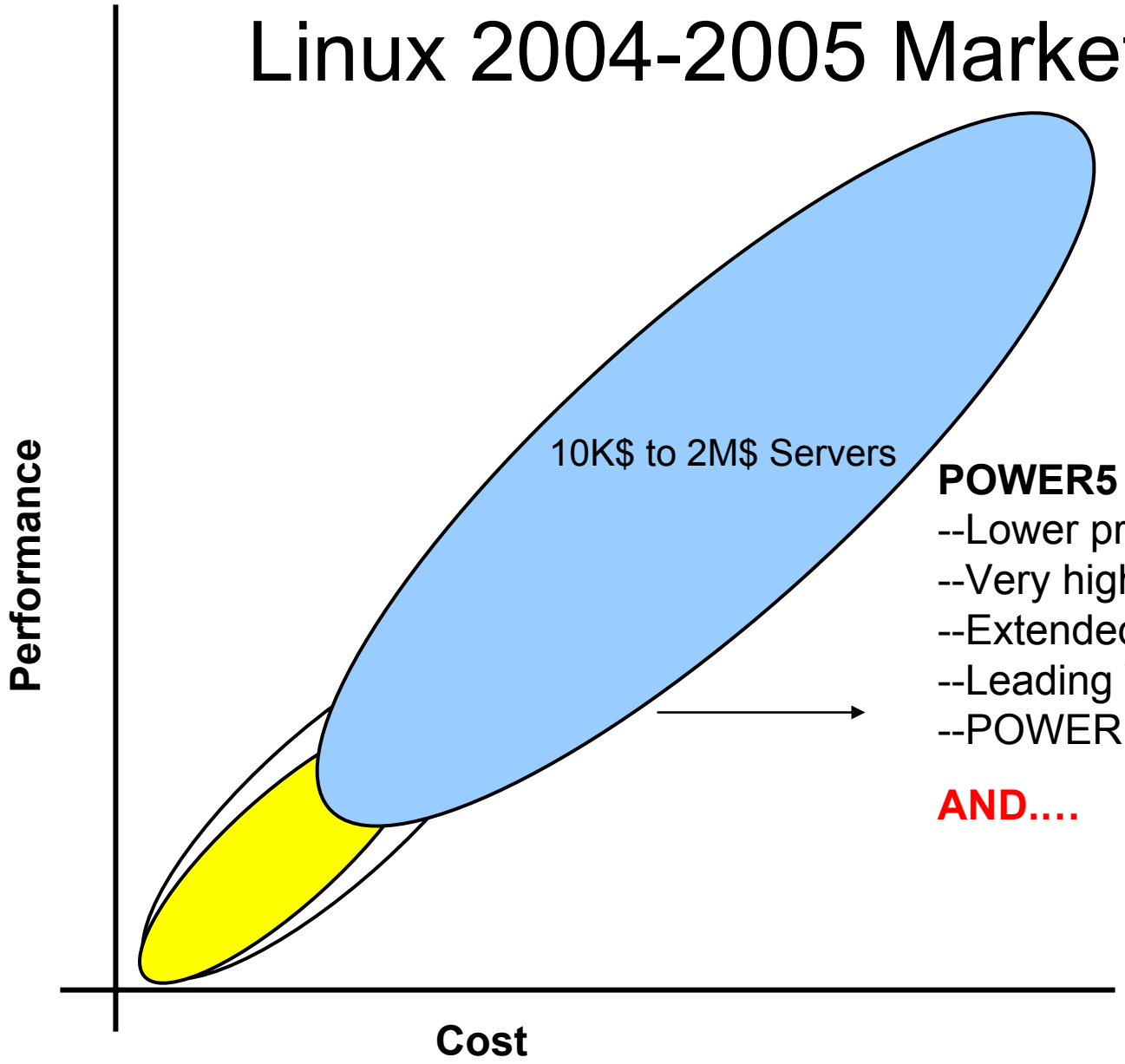
Linux to top $35 Billion



Signification market changes:
--Linux momentum GROWS!!
--Linux impacting Windows market
--Linux impacting UNIX market
--Changes in “intel” market
--Linux 2.6 kernel much more powerful
--Intel Itanium not accepted in market
--AMD Opteron gaining in popularity
--Intel EM64T introduced
--Linux ISVs and OpenSource growth

AND…..

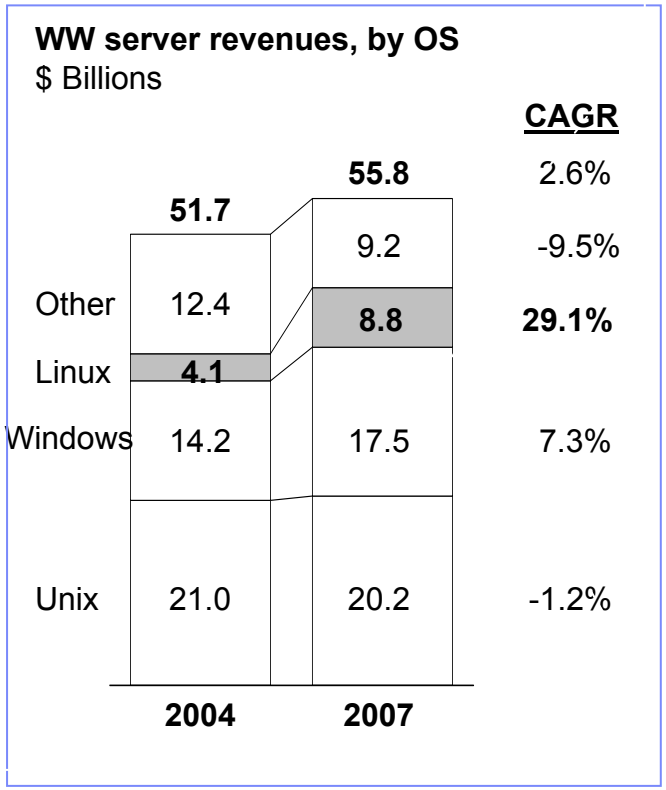
Linux 2004-2005 Market

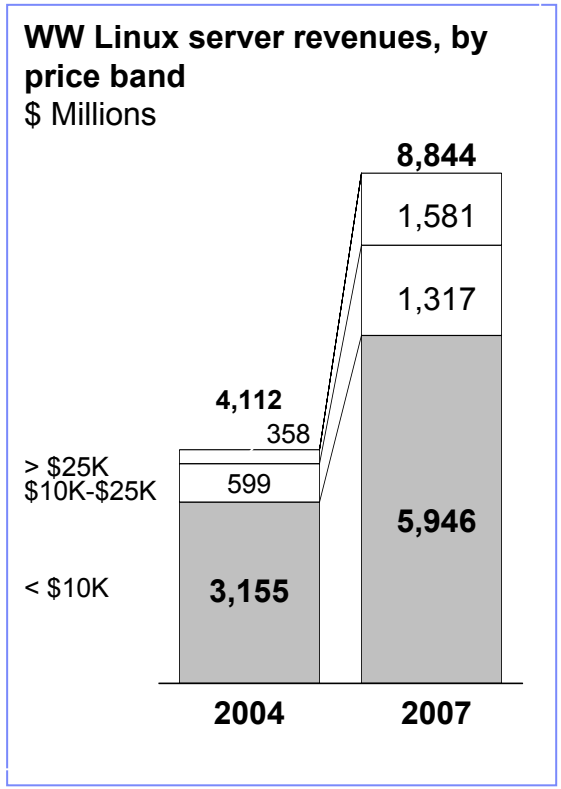


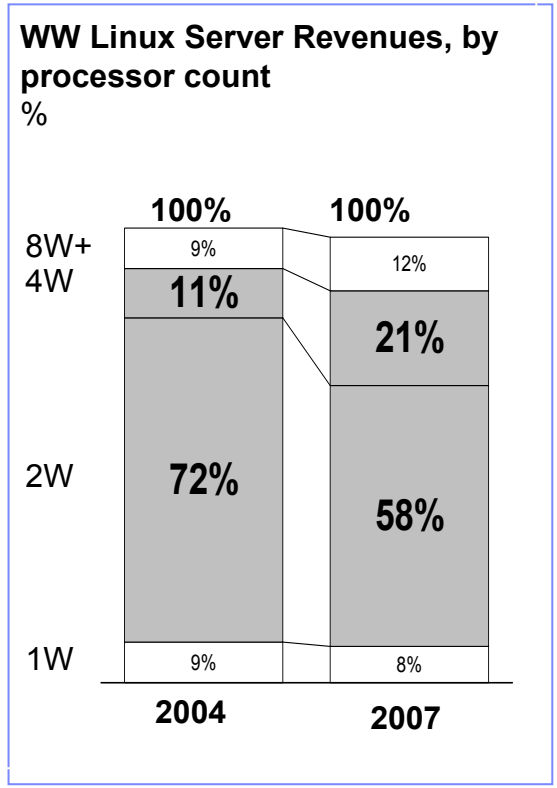
POWER5 introduced:
--Lower price/perf points
--Very high performance
--Extended reliability
--Leading Virtualization
--POWER ”tuned” Linux

AND….

Linux Market Server Characterization

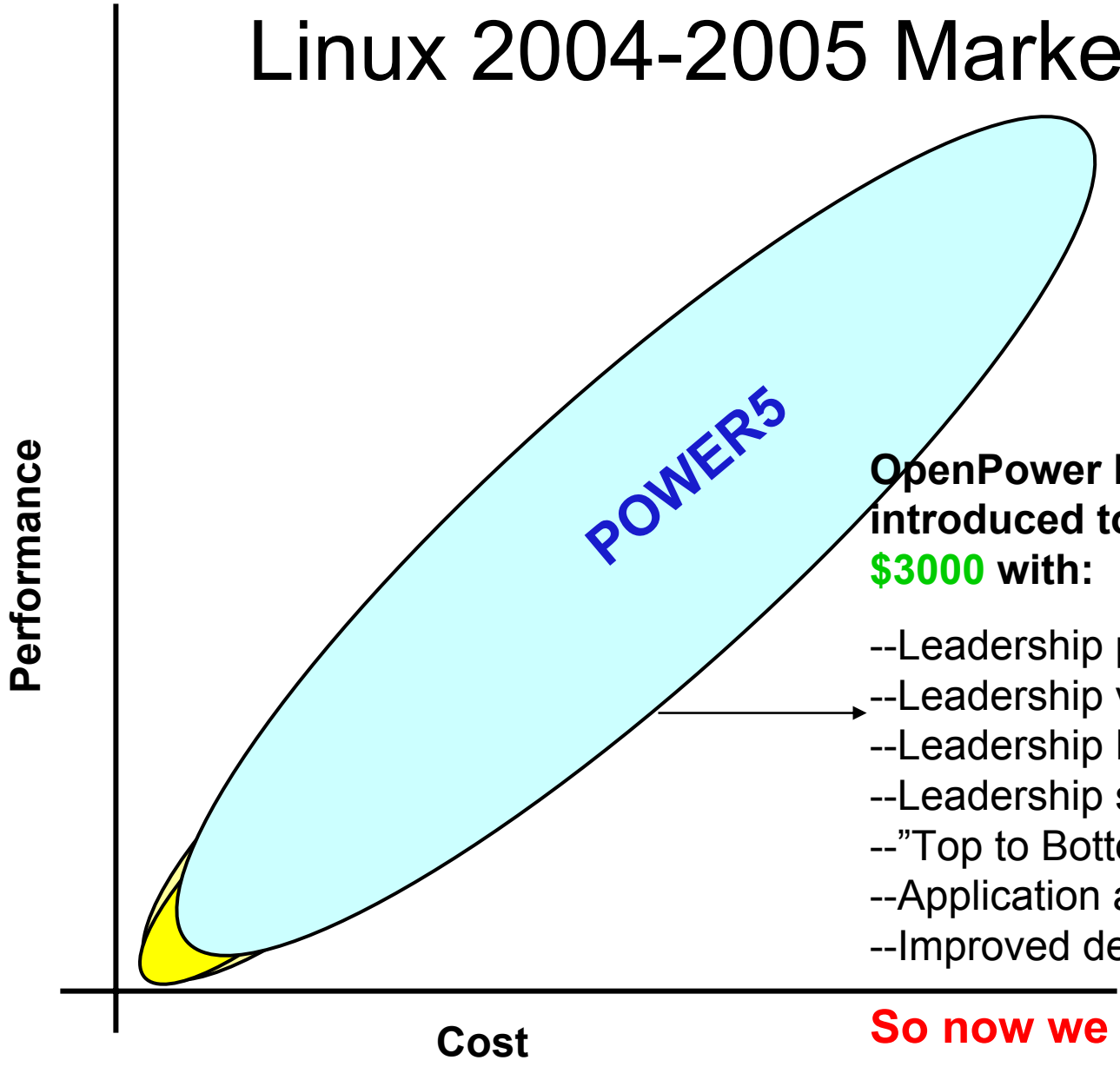






Source: 1H04 IBM GMV, based on industry data

Linux 2004-2005 Market

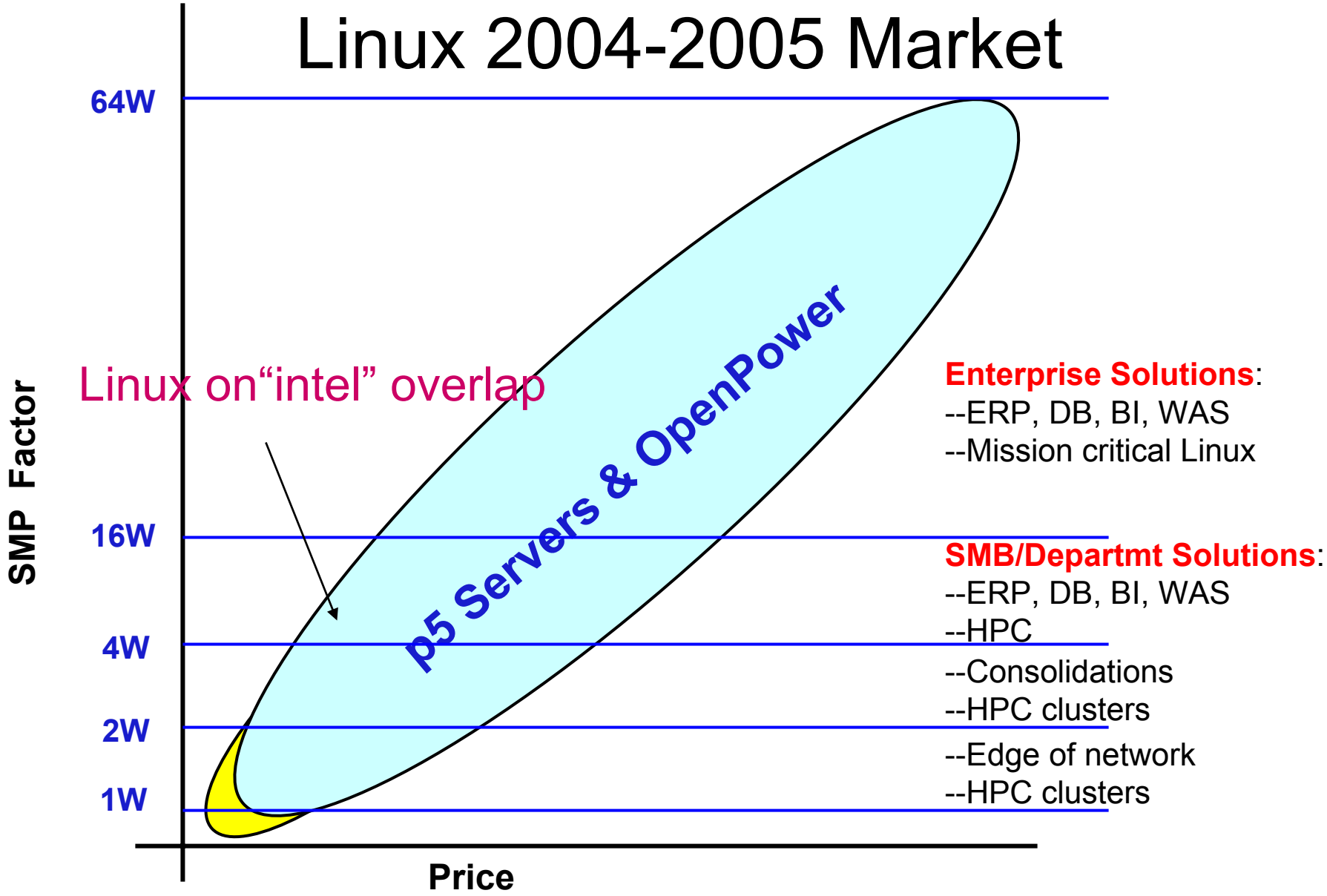


OpenPower Family introduced to lower cost to $3000 with:

--Leadership performance
--Leadership virtualization
--Leadership RAS
--Leadership support
--"Top to Bottom" Linux support
--Application availability
--Improved device support

So now we take share!

Linux 2004-2005 Market



Positioning the Linux on the POWER5 Family

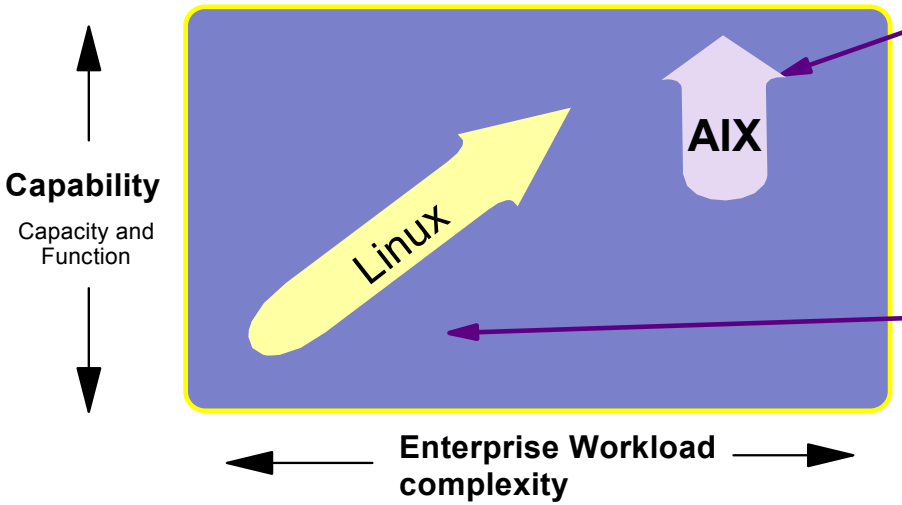
Strengths:	Weakness:
Performance	Application Availability
Virtualization Engine	TPC-C results
RAS Features	SpecInt versus AMD
Low Price and $/Performance	Device Drivers
Capacity (memory & processors)	Very Low-End market
Linux Support and Linux price	“Intel Emotion”
“Tuned” Linux	Lack of “image” in marketplace
Full family	
Opportunity:	**Threats:**
Enterprise Solutions	Evolving EM64T
Unix Migrations	Evolving AMD Opteron
Consolidation of Windows (?)	Virtualization solutions
Consolidation of Linux	Xeon price points being lowered
Linux with AIX	
Clustered Linus Solutions	

Linux and POWER

Dynamics for a new value proposition

Linux on POWER Strategy

UNIX Market Map



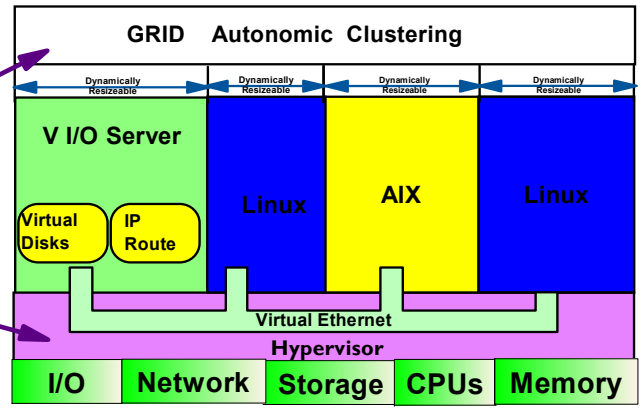
#1: Continue AIX leadership in UNIX for the Enterprise/High End

#2: Introduce POWER based Linux models integrated with standard Linux distributions providing

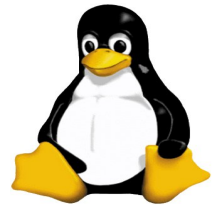
#3: Participate in advancing Linux on POWER thru LTC contribtions and POWER specifics and AIX ports

#4: Drive a high value layer of software and CuOD capabilities that can be delivered on both AIX and Linux

#5: Drive a high value Virtualization Engine enabling high utlization of server resources that can be delivered for both AIX and Linux



Linux Technology Evolution



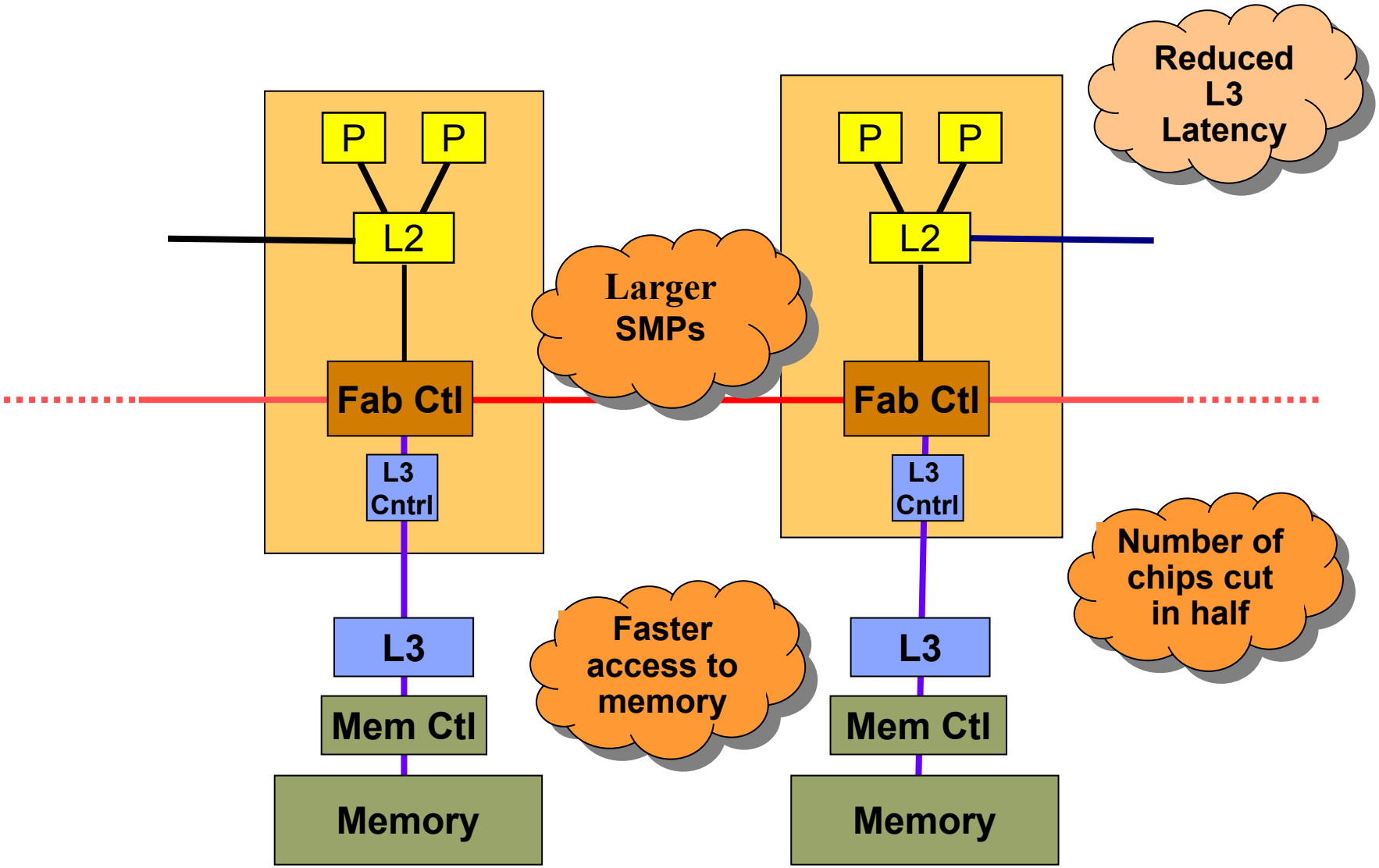
- Efficient 4-way SMP scalability
- 64-bit support
- Multi-tasking
- 1TB file size, Journaling
- Clustering
- IBM@server Partition support
- Enhanced RAS
- Advanced networking
- Linux standards base
- Sub-processor partitioning support

Recertification

- 16-way+ scalability
- I/O & file system performance
- Security enhancements
- Hyperthreading performance enhancements
- Kernel & driver 'hardening'
- Pre-emptive Kernel
- Improved Scheduler
- Large Page Support
- VM Enhancements
- Block I/O

This represents a combination of current open source community priorities and IBM LTC project plans. Open source communities dc schedules or commit to specific dates or functions.

Modifications to POWER4 to create POWER5



IBM @server p5 family

Jaw-dropping performance, plus the power to put it to work

SuSE redhat AIX

p5-520
Up to 2-way

1.5 GHz POWER5™
1.65 GHz POWER5
Up to 32GB memory
Advanced POWER Virtualization [Optional]

p5-550
Up to 4-way

1.5 GHz POWER5
1.65 GHz POWER5
Up to 64GB memory
Advanced POWER Virtualization [Optional]

p5-570
Up to 16-way

1.5 GHz POWER5
1.65 GHz POWER5
1.9 GHz POWER5
'Pay as you grow' modular architecture
Up to 512GB memory
Advanced POWER Virtualization [Optional]
Capacity on Demand

p5-590
Up to 32-way

8-way to 32-way
1.65 GHz POWER5
Up to 1 TB memory
Advanced POWER Virtualization [Standard]
Up to 8 I/O drawers
Capacity on Demand

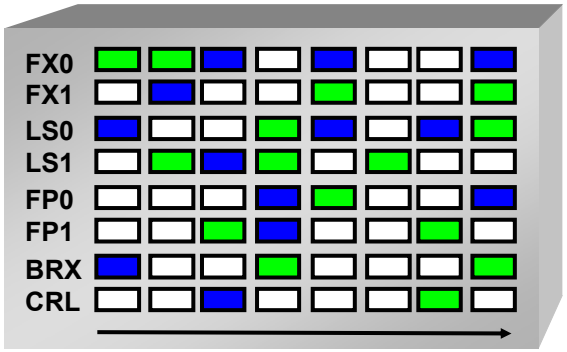
p5-595
Up to 64-way

16-way to 64-way
1.65 GHz POWER5
1.9 GHz POWER5
Up to 2TB memory
Advanced POWER Virtualization [Standard]
Up to 12 I/O drawers
Capacity on Demand

Simultaneous Multi-threading (SMT)

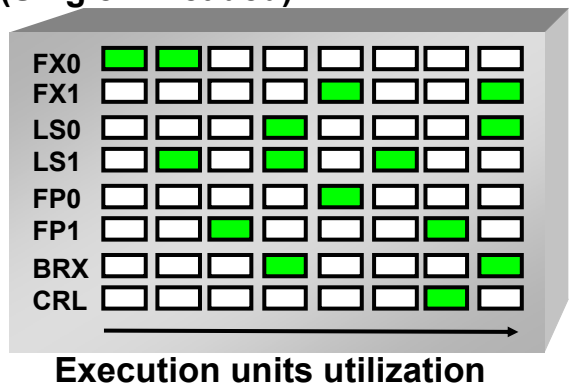
POWER5

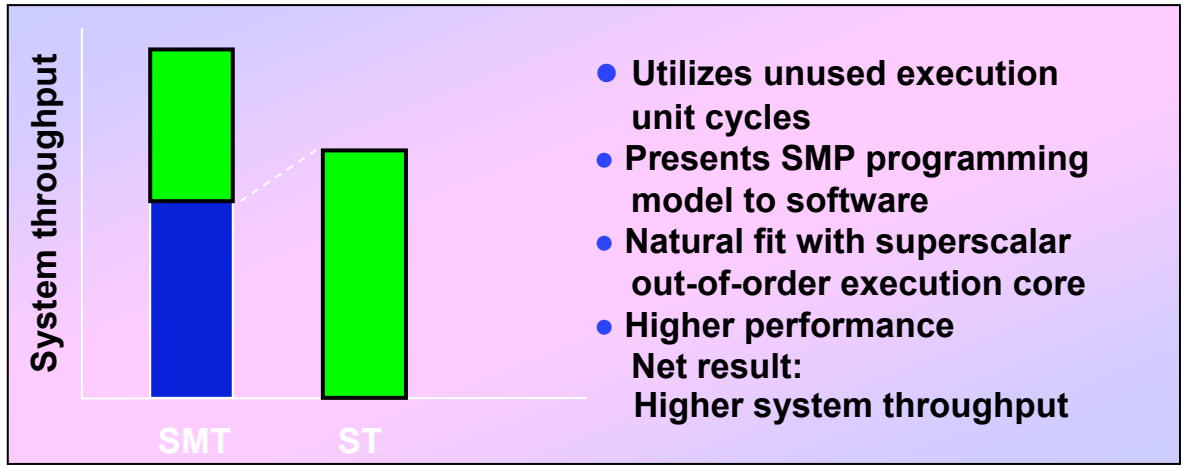
(Simultaneous Multi-threaded)



POWER4™

(Single Threaded)





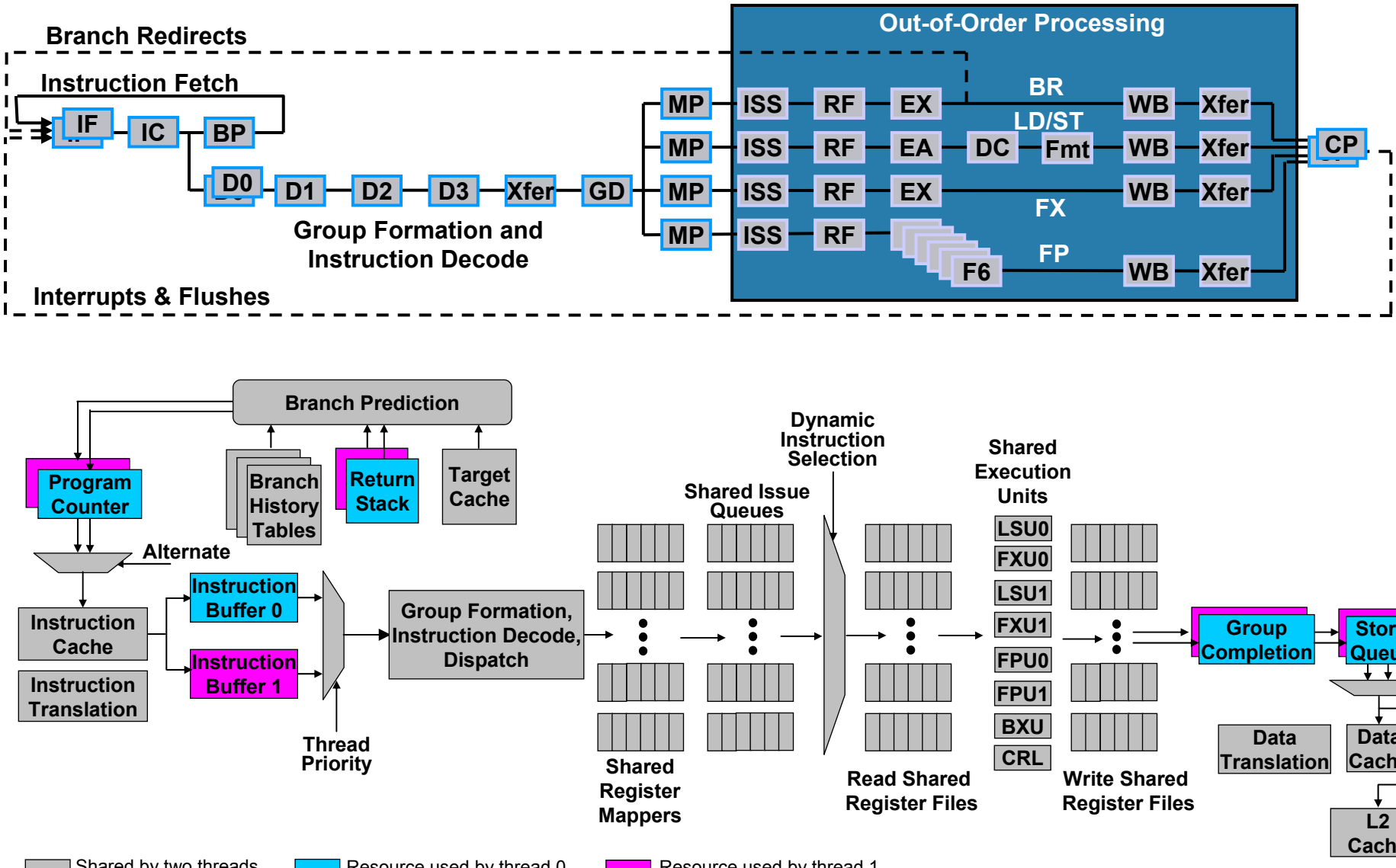
- Utilizes unused execution unit cycles
- Presents SMP programming model to software
- Natural fit with superscalar out-of-order execution core
- Higher performance

Net result:
Higher system throughput

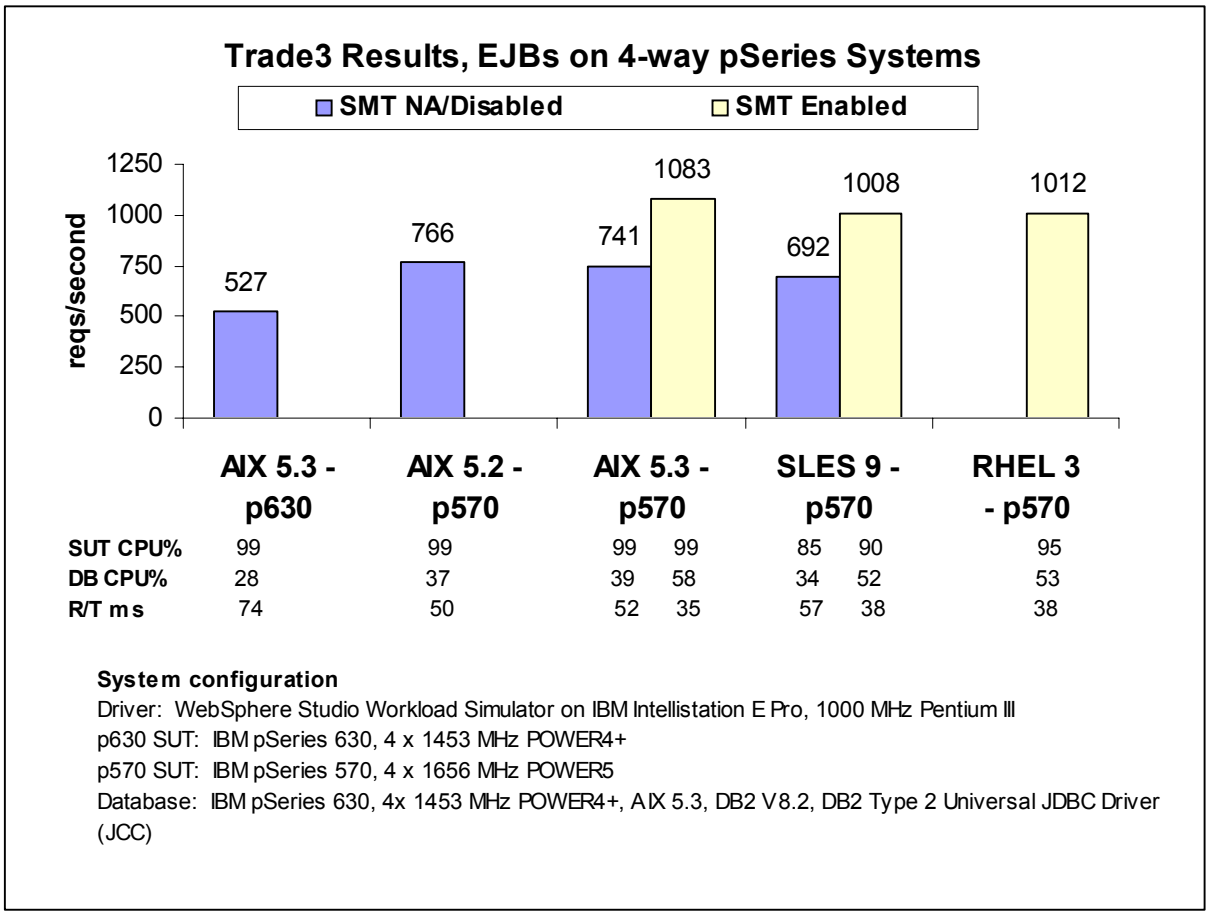
Legend

- Thread0 active
- No Thread active
- Thread1 active

Multithreaded Instruction Flow in Processor Pipeline



Trade3 Results, EJBs on 4-way pSeries Systems



- SMT (Simultaneous Multi-Threading) is enabled by default on supported POWER5 platforms and provides a 46% improvement for the Trade workload
- Comparing the POWER4+ based p630 to the POWER5 based p570 yields a 2X performance increase
- Linux on pSeries results are comparable to AIX on pSeries

POWER5 is "Tuned" for Linux

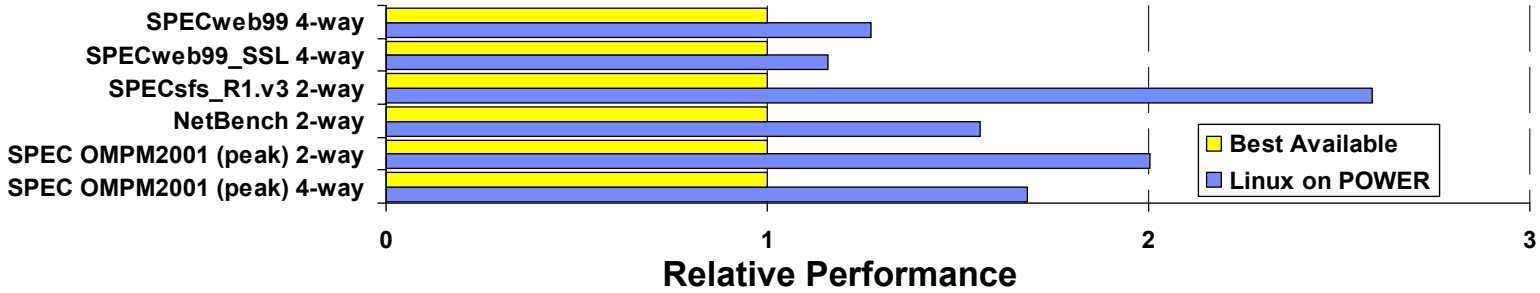
Processor	**For scaling, POWER5 offers better "synchronization mechanics" – hence runs better on Linux (than without the feature)**	**Improves TPC-C**
	Improved memory access by intelligently invalidating/rewriting specific OS pages from memory	**Improved performance**
	Improved data/instruction access efficiency by allowing for ID cache coherency to be automatically done for the Linux OS	**Improved performance**
	Faster lock acquisitions and releases. **Improves TPC-C performance**	**Improved TPC-C**
	Added capacity to POWER (like more directories) to reduce or eliminate "memory consistency retries"	**Improved performance**
System	**Linux kernel leverages POWER's Capacity Upgrade on Demand**	**Lower HW cost**
	Linux kernel leverages POWER's RAS capabilities **- First Failure Data Capture, HW diagnostics**	**Lower op. cost**
	Linux exploits POWER's hardware-based virtualization capabilities – sub processor partitioning, dynamic LPARs, virtual IO, virtual LAN, virtual storage, etc.	**Lower initial and op costs**

Linux on POWER – Leadership Performance

IBM published #1 results using Linux on POWER in:

- **4-way SPECweb99_SSL using SUSE LINUX Enterprise Server 9 (SLES 9)**
- **4-way SPECweb99 using Red Hat Enterprise Linux AS 3 (RHEL AS 3)**
- **4 Way SPECompM2001 using SLES 9**
- **2-way NetBench using SLES 9**
- **2 Way SPECompM2001 using RHEL AS 3**
- **2-way SPECsfs97_R1.v3 using SLES 9**
- **1-way NetBench using SLES 9**

Comparing the Linux on POWER™ results vs. the best available results



Benchmarks	# CPU	GHz	P5 Result	Prior BoB Result	P5 Faster By	Former Best of Breed (BoB) System
SPECweb99	4w	1.90	13,500	10601	27.3%	HP rp4440
SPECweb99_SSL	4w	1.90	5,140	4440	15.8%	Verari 2.4 GHz Opteron
SPECsfs_R1.v3	2w	1.90	45,586	17613	158.8%	Sun V250
NetBench 1-way	1w	1.65	787	DNP		
NetBench 2-way	2w	1.65	1,457	936	55.6%	HP ProLiant DL380 G3
SPEC OMPM2001 (peak)	2w	1.65	5,287	2,637	100.4%	HP rx2600 (1GHz)
SPEC OMPM2001 (peak)	4w	1.90	14,062	8,356	68.3%	IBM p655

Source: http://www.spec.org and http://www.veritest.com/clients/reports/

All results are as of 08/02/04
IBM SPEC results submitted to SPEC as of 8/02/04
* SPEC OMP results must be listed as "estimated" until approved by SPEC.
* IBM SPEC OMP results used 2 threads per processor

SPECjbb

CPUs	SLES 9 Results	AIX submission to be new BoB	Linux % AIX	Previous BoB Result	Linux % of Previous BoB	Linux % above Best Opteron/IA64/Xeon
2w	82,485	86,267	96%	79,544	4% (Opteron 250)	4% / 34% / 13%
4w	160,995	170,127	95%	133,427	21% (Opteron 850)	21% / 48% / 36%
8w	296,671	328,996	90%	214,932	38% (PA-RISC8800)	na / 56% / 230%
16W	542,145	633,106	86%	402,961	35% (SPARC64)	na / 59% / na

P570 1.9 ghz processors

Description of OpenPower 720

More information in OpenPower Session

OpenPower 720

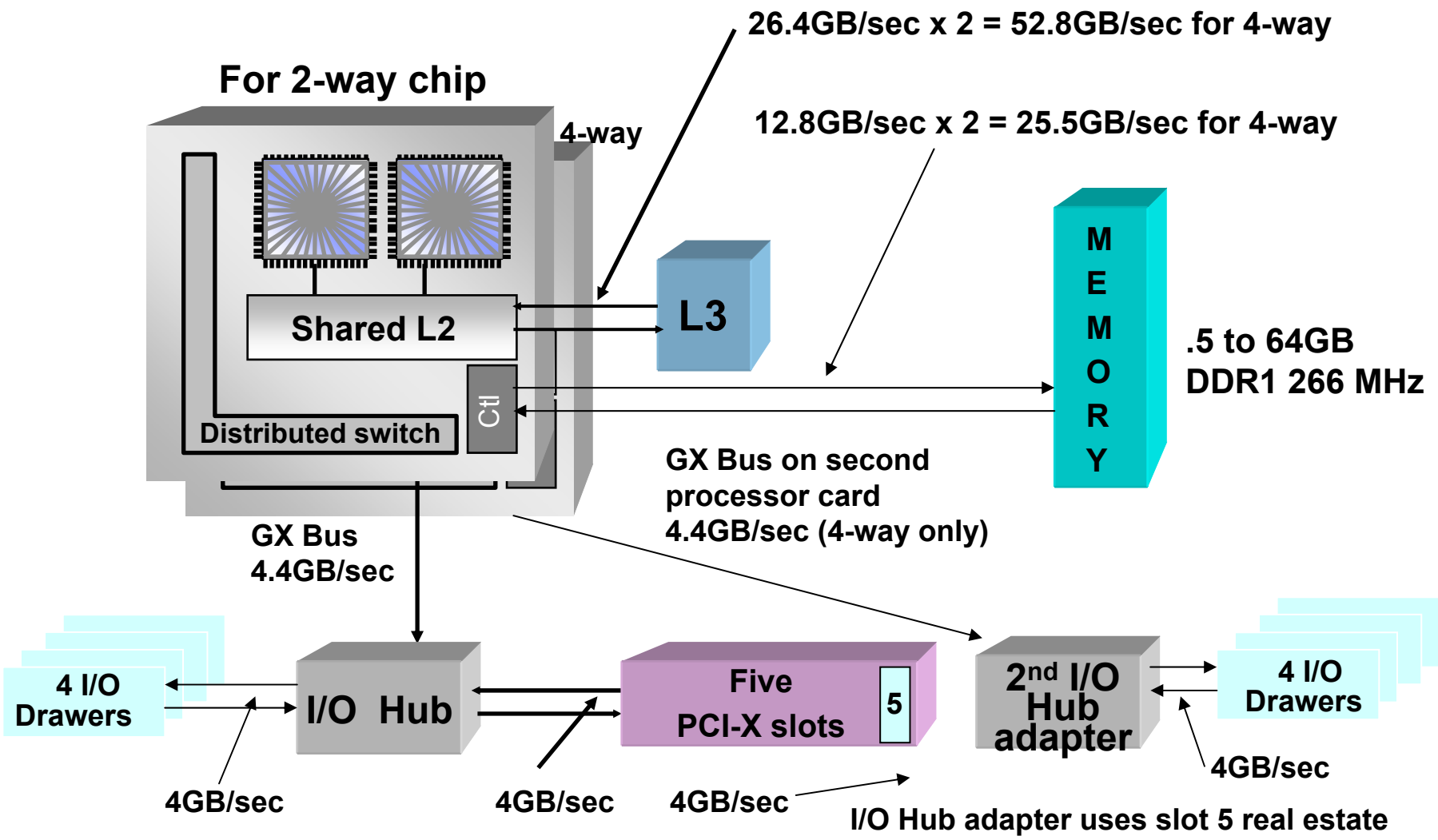
Specifications:

- 4U 4W, rack or tower
- Two speed sorts (1.65 and 1.5 GHz), 5 models
  - 1p 1.5 SCM
  - 2p, 4p 1.5 DCM
  - 2p, 4p 1.65 DCM
- Maximum memory 64 GB, 32 GB per processor card
- 8 bays for Ultra320 SCSI drives
- 5 PCI-X slots
- DVD ROM or DVD RAM included in base configuration
- Optional onboard RAID
- 3 year parts and labor NBD warranty and support
- Software support
  - SLES 9 from Novell SUSE LINUX
  - RHEL AS 3 from Red Hat
- System Management support
  - CSM
    - On RHEL3.3 (mid Sep GA)
    - On SLES9 (Dec GA, trying to pull ahead)
  - IBM Director MP
    - Agent only
    - Available on RHEL3.3 and SLES9 at HV4 GA (SLES9 to be confirmed)
- Advanced OpenPower Virtualization option (requires rack or desk side HMC)

$5000
(1W, 1GB, 1 Disk)

1 Entry: 1 processor, 512 MB mem, 1 36 GB SCSI drive; configured: 4 processors, 8 GB mem, 1 36 GB SCSI drive. US List Prices as of August 3, 2004. Price are subject to change without notice. Reseller prices may vary.

POWER5 DCM Server Peak Bandwidths per 1.65 GHz 2-way Chip

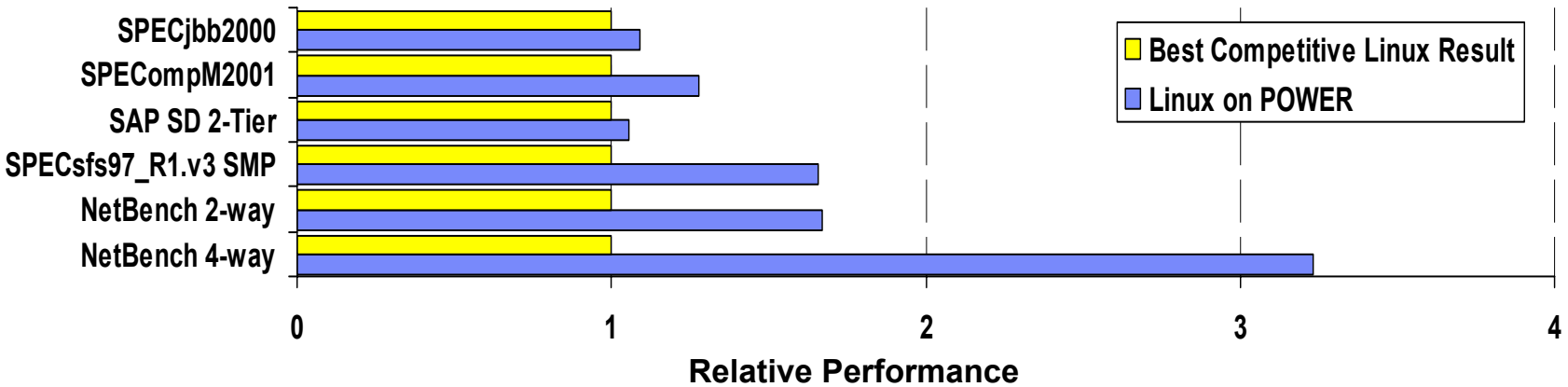


OpenPower 720 – Outstanding Performance

The performance of the OpenPower 720 beats all competitive systems in
- **4-way SPECompM2001**
- **4-way SPECjbb2001**

• It is also the top 4-way Linux system in
- **SAP SD 2-Tier**
- **SPECsfs_R1.v3**

Comparing the OpenPower 720 vs. Competitive Linux Results



Benchmark	# CPU's	GHz	IBM System	Result	Competitive Result	OpenPower Faster by	Competitive System running Linux
SPECjbb2000	4w	1.65	OP720	136,167	124,849	9.1%	QuatreX-64 running Red Hat Linux
SPECompM2001 (Peak)	4w	1.65	OP720	10,522	8,225	27.9%	HP Alpha 1280 running Tru64 UNIX
SAP SD 2-Tier	4w	1.65	OP720	864	820	5.4%	Sun V40z running SUSE LINUX
NetBench 2-way	2w	1.65	OP720	1,563	936	67.0%	HP ProLiant DL380 G3
NetBench 4-way	4w	1.65	OP720	2,911	901	223.1%	HP ProLiant DL760
SPECsfs97_R1.v3 SMP	4w	1.65	OP720	67,347	40,579	66.0%	HP AlphaServer 1280 running Tru64 UNIX

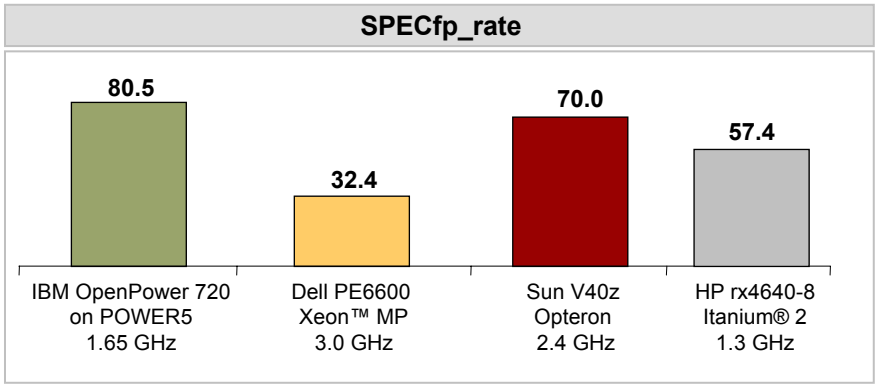
Source:
http://www.spec.org and http://www.sap.com/benchmark/ and http://www.veritest.com/clients/reports

All results are as of 11/01/04
* IBM SPEC OMP results used 2 threads per processor
** No 4-way competitive Linux results available.

OpenPower 720 delivers leadership performance at breakthrough prices

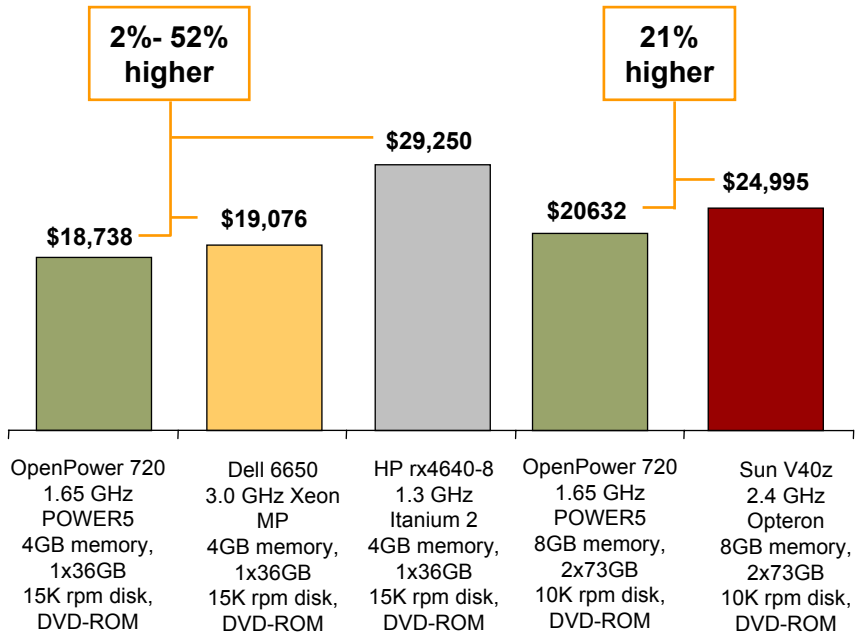
Leadership performance…

Performance of 4-way systems*



…at superior prices

US list prices of competitive offerings and OpenPower 720 – 4 processor models, US$**



* SPECfp_rate and SPECjbb results of IBM, Dell, Sun, HP, Verari servers and AMD Opteron™ processors are published in http://www.spec.org
** Prices of Sun, Dell, and HP products from http://www.dell.com, http://www.sun.com, http://www.hp.com as of December 8, 2004. Reseller prices may vary

Example 2 - 3 Year HW+SW Cost Comparison

Basis: Equivalent Performance (IDC Performance*)

Server	IDC Perf	# CPUs (#Servers)	Total Cost of Ownership (3 yr)		
			HW + Maint	Oracle+Maint	Total
x346, 2x3.0GHz Nocona, Linux, VMware, Oracle	3,846	9.2 (4.6)	$85,785	$180,276	$266,061
e326, 2x2.2GHz Opteron, Linux, VMware, Oracle	4,712	7.6 (3.8)	$70,019	$147,144	$217,163
p550, 4x1.65GHz POWER5, AIX, Oracle, micropartitioning	17,778	4.0 (1.0)	$63,881	$76,339	$140,221
e720, 4x1.65GHz POWER5, Linux, Oracle**, micropartitioning	16,000	4.4 (1.1)	$41,536	$86,667	$128,203
V890, 8x1.2GHz SparcIV, Solaris (no partitioning)	15,093	9.6 (1.2)	$96,027	189,855	$295,882

* http://www.ideasinternational.com

**Statement of Direction

Description of OpenPower 710

More information in OpenPower Session

OpenPower 710

Specifications:

- 2U up to 2-way, rack
- 1.65 GHz processor frequency, 3 models
  - 1.65 GHz 1W DCM
  - 1.65 GHz 2W DCM
- Maximum memory 32 GB
- 4 bays for Ultra320 SCSI drives
- 3 PCI-X slots
- DVDROM base
- Off board RAID
- 3 year parts and labor NBD warranty and support
- Software support
  - SLES 9 SP1 from Novell SUSE LINUX*
  - RHEL AS 3 Update 4 from Red Hat*
- OpenPower virtualization option

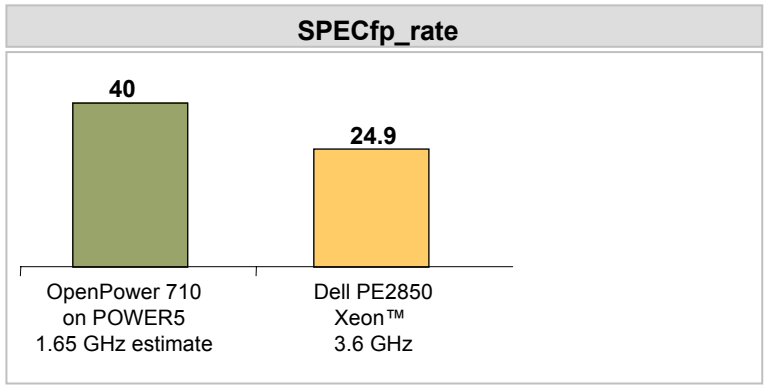
$3435
(1W, 1GB, 73 GB Disk)

•IBM Confidential - This educational piece is intended for your use in selling. It is NOT a customer deliverable until announced.

OpenPower 710 deliverx superior performance at competitive prices

Superior performance in 2W

Performance of 2-way systems*



* OpenPower 710 results are IBM estimates. SPECfp_rate and SPECompM2001 results of Dell, Sun, and HP published in www.spec.org_ verified 12/6/04
** Prices of Sun, Dell, and HP products from http://www.dell.com, http://www.sun.com, http://www.hp.com as of December 7, 2004. Reseller prices may vary

OpenPower 720 and 710 are well positioned to cover your customers key workloads

Workload	Sub-workloads	720	710
Technical	Engineering, Scientific, HPC		●
Business Processes	ERP, CRM, OLTP, Batch	●	
Decision Support	Data Warehouse/Mart, Data Analysis/Mining	●	
Web Infrastructure	Streaming Media, Web serving	●	●
Collaboration	Email, Workgroup	●	●
Application Development	Application Development		●
IT Infrastructure	F/P, Networking, caching, security, system management	●	●

…with growth into POWER5 family of servers

IBM Bladecenter JS20

More information in BladeCenter Sessions

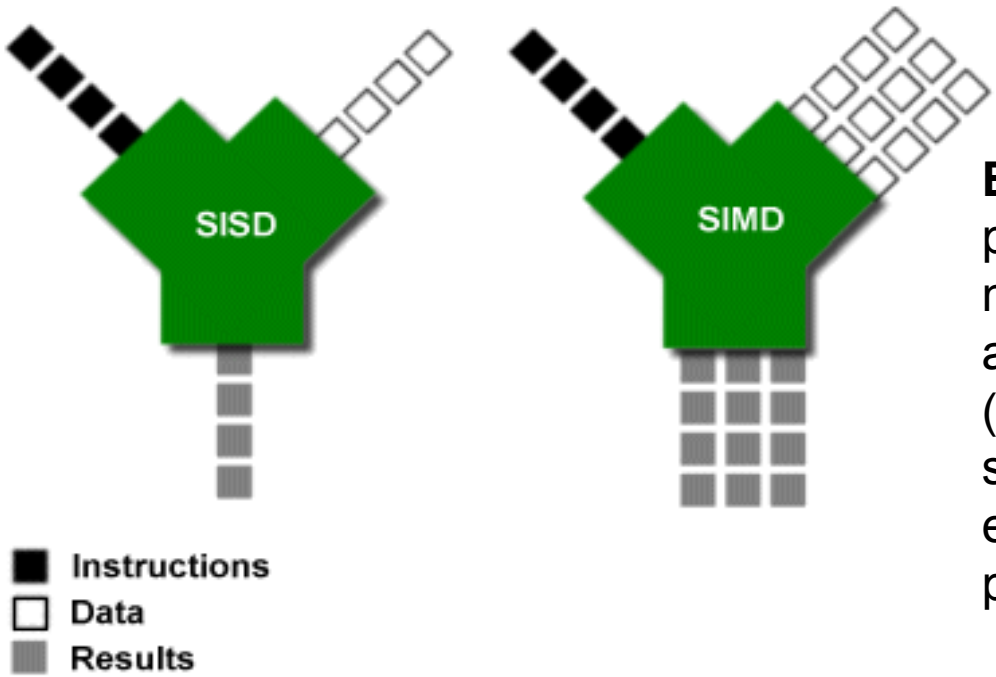
BladeCenter JS20

Features:

- PowerPC 970 Based BladeCenter Blade
- One Speed sort, one model
  - 2.2GHz PPC 970, 2 Way Blade
- Maximum memory: 4 GB
- IDE Drives: 2, 40GB
- 2, Daughter Cards available (Ethernet, Fibre Channel w/Boot Support)
- Myrinet supported today
- 3 year parts and labor NBD warranty and support
- Power Consumption for fully loaded BladeCenter: 1635 watts (14 JS20s)
- Density: 84 JS20 Blades per 42u rack for 1TFLOP
- Software support
  - SLES 8 or SLES 9 from Novell SUSE LINUX
  - RHEL AS 3 from Red Hat
  - AIX 5.2 from IBM
- System Management support
  - CSM
    - On RHEL3.3
    - On SLES8 today
    - On SLES9
    - IBM Director 4.12 and 4.2
- Linux Applications suited to performance
  - HPC & Floating point scientific aps with and without VMX
- Linux Applications suited to price
  - File serve/print serve
  - Collaboration
  - Web Serving with GA2 (Oct)
- JS20 2.2Ghz 2 Way AIX performance exceeds p610s & p615 1.2GHz 1Way

$2699

SIMD – Single Instruction Multiple Data



Example: inverting an RGB picture to produce its negative. Iteration through an array of uniform integer values (pixels), and perform the same operation (inversion) on each one -- multiple data points, a single operation.

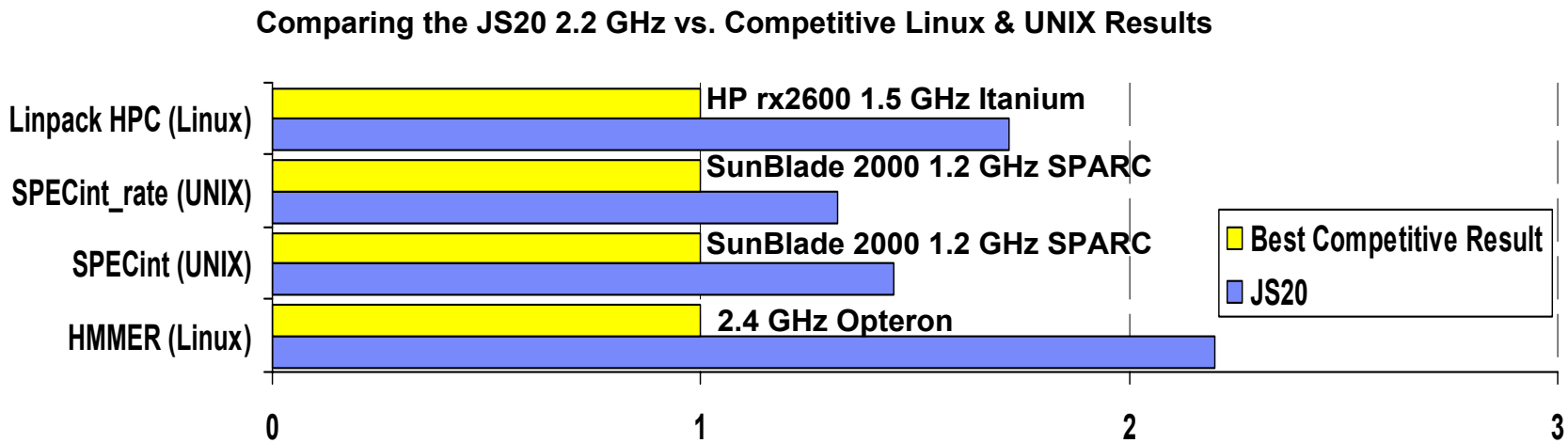
- **VMX (Vector Multimedia eXtension) is a SIMD instruction set designed and owned by IBM, Motorola and Apple**
- **Implemented on the PowerPC processor family; Motorola's G4 and IBM's PPC 970**
- **VMX is the brand name that IBM uses ; AltiVec is the brand name used solely by Motorola and Velocity Engine is the name used by Apple.**

JS20 2.2 GHz – Improving Performance

Improved performance over previous JS20 blade with 40% higher frequency
- 40% higher floating point performance
- 50% higher integer performance

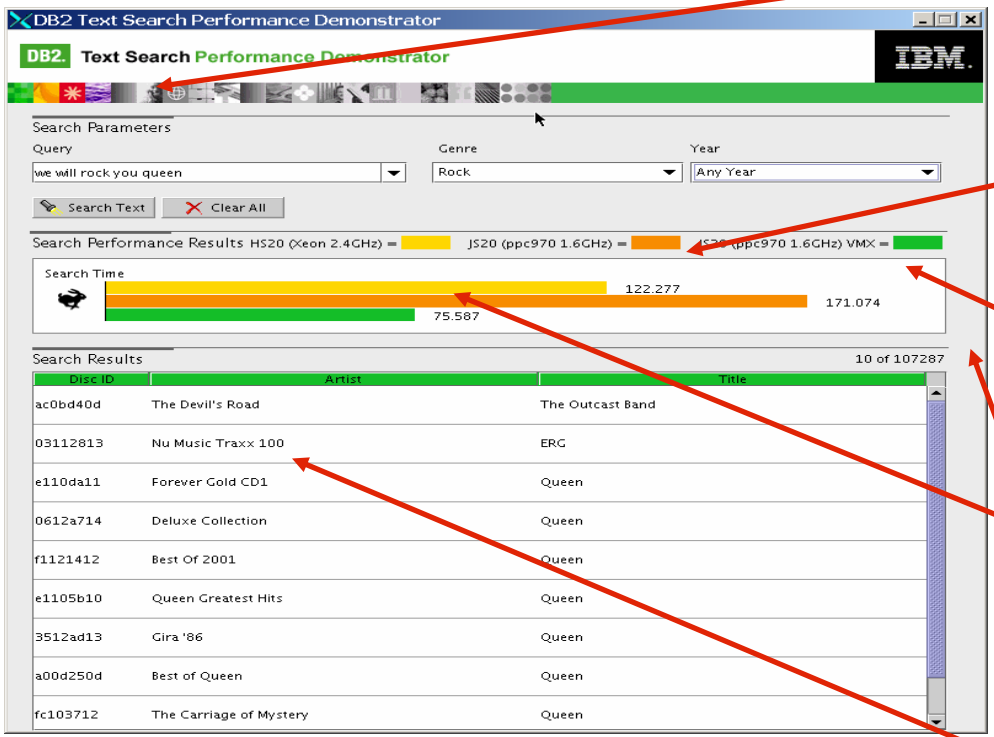
JS20 has industry leadership Linpack HPC performance (>13000)

MareNostrum
- #1 European SuperComputer; #5 WorldWide
- 20.5 TFLOPs performance on 1782 nodes



•JS20 1.6 GHz benchmark results as of 3/30/04 running AIX 5L 5.2 or Linux SLES 8 with 2GB memory, JS20 2.2 GHz benchmark results as of 9/30/04 running AIX5L V5.2 or
•Linux SUSE SLES9 with 4GB memory. SPECfp_rate SPECint_rate, and SPECint results of Sun Blade 2000 running Solaris V9 with 2GB memory are published in
• http://www.spec.org_ verified 9/30/04. SPECjbb results of HP rx2600 are published in http://www.spec.org_ verified 9/30/04, Linpack HPC results of HP rx2600 are published in
• http://www.netlib.org/ verified 9/30/04 running Linux SLES 8

DB2 Text Search Performance Demonstrator



Query
- **Words (OR)**
- **Optional restriction to specific “Genre”**
- **Optional restriction to specific “Year”**

HS20 2.4 GHz Xeon 122 msec
- **Runtime in msec for query**
- **Original code for Linux/Intel**
- **Intel C++ compiler (32-Bit)**

JS20 1.6 GHz ppc970 171 msec
- **Runtime in msec for query**
- **Original code on pLinux (SuSE)**
- **g++ 3.2 compiler (32-Bit)**

JS20 1.6 GHz ppc970 75 msec
- **Runtime in msec for query**
- **Vectorized version for ppc970/VMX**
- **g++ 3.2 compiler (32-Bit)**

of results 107287

Results (best 10 displayed)

Linux on POWER – participation in Virtualization

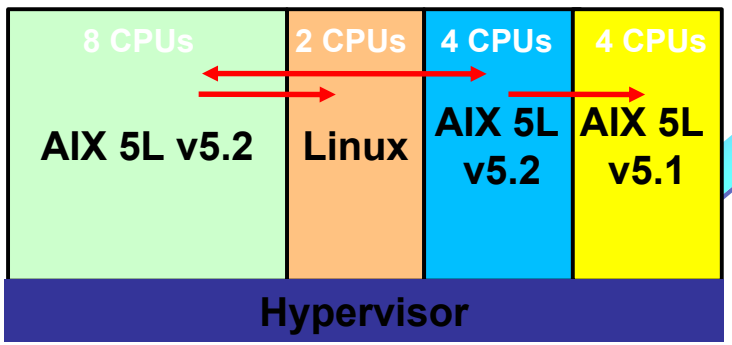
Linux
Static LPAR
- *1 processsor minimum*
- *Ethernet cable connection of partitions*

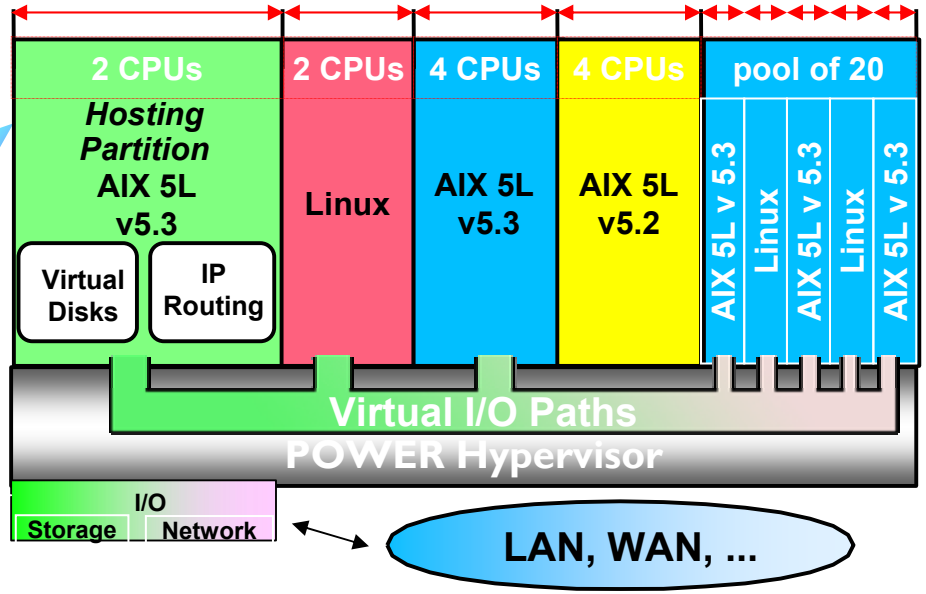
Linux
Simplification through virtualization
- ***Micro-partitioning***
- ***Shared processor pools***
- ***Dynamic LPAR***
- ***Virtual I/O, LAN, storage***
- ***No PLM support for Linux***

OpenPower VE cost:
$1000 Hyperv/syst
$186 V I/O (per proc)
$31 / yr V I/O SWMA

Reduced resources
- ***Fewer processors & I/O adapters***

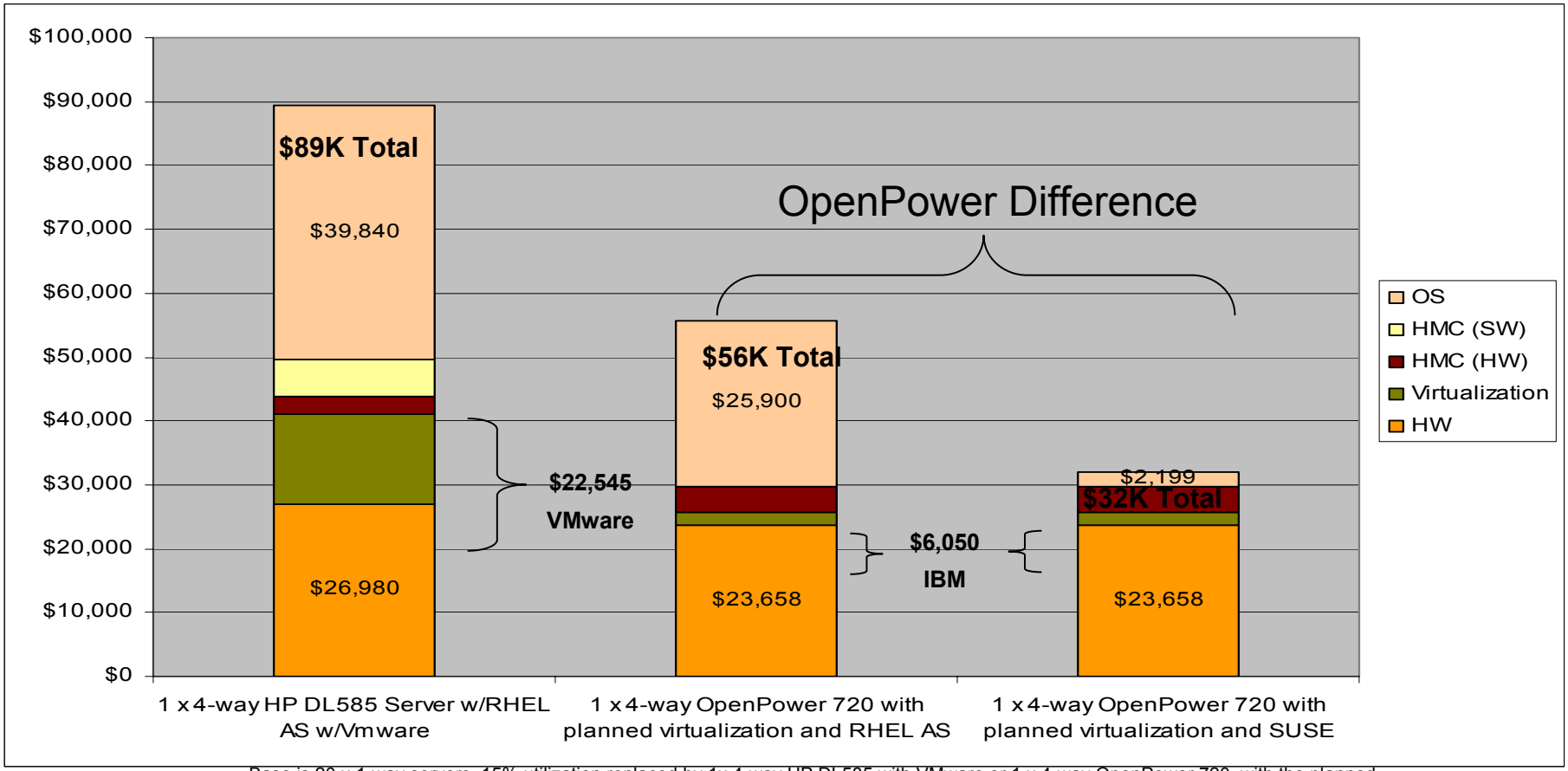
Increased overall system utilization and performance but no dynamic memory for Linux





Advanced OpenPower Virtualization reduces acquisition costs

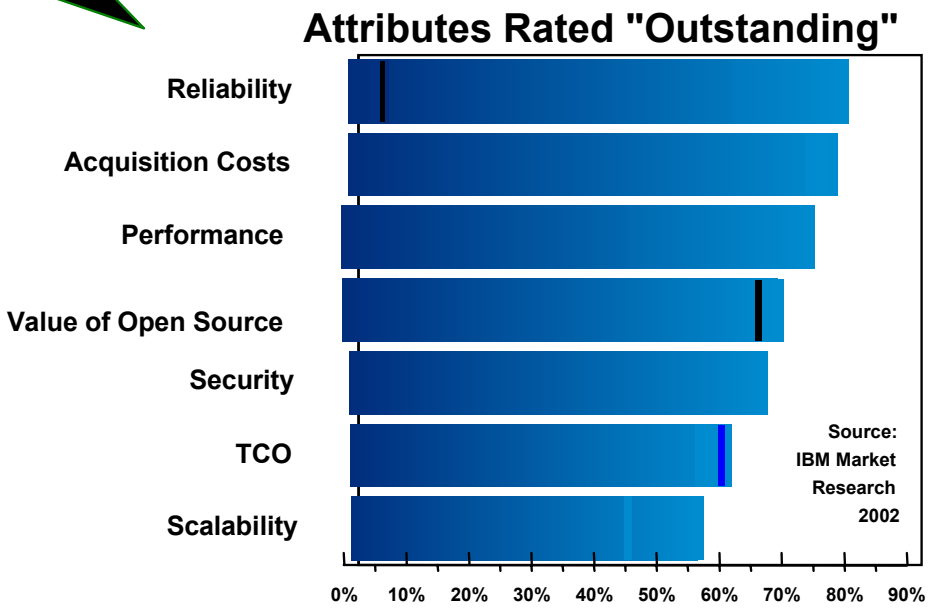
Versus other partitioning solutions



- Base is 20 x 1-way servers, 15% utilization replaced by 1x 4-way HP DL585 with VMware or 1 x 4-way OpenPower 720 with the planned OpenPower virtualization options
- Current prices for VMware off HP's Web site (8-30-04) for DL580 model Virtual Infrastructure Node. VMware Web site indicates DL585 is supported in 32-bit mode only.
- HP/VMware HMC estimates based of HP DL140 Web site price (8-30-04) and current xSeries price for VirtualCenter (8-30-04)

Linux Market Momentum

Reliability – key driver



Linux on OpenPower compared to Linux on Intel on RAS

Reliability/Availability features	AIX 5L™	Linux on OpenPower	Linux on Intel	Comments
Automatic First-Failure Data Capture and diagnostic fault isolation capabilities	**Yes**	**Yes**	**No**	**Used by Error Log Analysis Tool**
Self-healing internal POWER5 processor array redundancy	**Yes**	**Yes**	**No**	**ECC, bit steering, memory scrubbing, etc**
Industry-first PCI bus parity error recovery	**Yes**	**Limited**	**No**	**EEH detection: partition down vs system**
Scrubbing and redundant bit-steering for self-healing in main storage	**Yes**	**Yes**	**Limited**	**Lintel not as robust**
ECC and Chipkill correction in main storage	**Yes**	**Yes**	**Yes**	
Fault tolerance with N+1 redundancy, dual line cords, and concurrent maintenance for power/cooling	**Yes**	**Yes**	**Yes**	
Predictive failure analysis on processors, caches, memory, I/O and DASD	**Yes**	**Yes**	**Limited**	**Lintel does not have predictive analysis of I/O**
Processor run-time and boot-time de-allocation based on run-time errors (Dynamic Processor De-allocation and Persistent Processor De-allocation)	**Yes**	**Yes**	**No**	**FFDC advantage**
Fault avoidance through highly reliable component selection, component minimization and error mitigation technology internal to chips	**Yes**	**Yes**	**No**	
Concurrent run-time diagnostics based on First-Failure Data Capture for power, cooling, and I/O	**Yes**	**No**	**No**	**Targeted fir 2005**
Service Processor is a separate, independent processor that provides hardware initialization during system IPL, operation monitoring of environmental and error events	**Yes**	**Yes**	**Limited**	**Linux on Intel not as robust**

Extended POWER RAS features supported by Linux 2.6

RAS Functions	AIX '04	SUSE/RH 2.6 Kernel	Intel Linux 2.6 Kernel
Dynamic CPU Deallocation	Yes	Yes	No
SUE Guard	Yes	Yes	No
Service Focal Point	Yes	Yes	No
DLPAR	Yes	Yes	No
EPOW Warnings	Yes	Yes	Yes
Concurrent System Firmware	Yes	Yes	No
Hot Plug (I/O, SCSI)	Yes	Yes	Yes
Service Agent	Yes	Yes	No
Error Log Analysis	Yes	Yes	No
Predictive callout	Yes	Yes	Yes
Platform errors to syslog	Yes	Yes	Yes
Scan Dump	Yes	Yes	No

RAS Functions	AIX '04	SUSE/RH 2.6 Kernel	Intel Linux 2.6 Kernel
lscfg	Yes	Yes	No
I/O Errors Reporting	Yes	Yes	No
EEH	Yes	No	No
Concurrent Diags	Yes	No (2Q05)	No
Inventory Scout	Yes	Yes	Some
Update System Firmware	Yes	Yes	Some
Update IOA Firmware	Yes	Yes	No
Concurrent IOA Firmware	Yes	No	No

Linux Distributors

Linux on POWER Distributions

Content:

Equivalent to Distributors' Intel Versions with
POWER specific support and Service Toolkit improvements
Open Source Tools & Applications
- available with Distributor's code and from OSS
  - Apache
  - Samba
  - MySQL
  - sendmail
  - Development Tools

Support (details in backup)

IBM Global Services Support Line Offerings
IBM Service Packs on OpenPower
Distributor Offerings
IBM Business Partners

Ordering pSeries, p5, OpenPower, & JS20 systems and Linux

Customer orders POWER Servers
- Linux provided by Distributor
- Linux can be ordered and delivered through IBM with system
  (LESS EXPENSIVE!!! Thru IBM)

Certified Linux Distributors for POWER

	Red Hat	Novell/SUSE
Offerings	RHEL3	SLES8, SLES9
Channels	AAS & HVEC	AAS & HVEC
Platforms	JS20, OpenPower, pSeries, p5	JS20, OpenPower, pSeries p5
Ordering	CD With the Box (AAS) CD in the Box (HVEC)	CD with the Box (AAS) CD in the Box(HVEC)
Key Messages	• Pricing less than IA32 offerings • Unbundled Maint and Support to allow customer selection of best offering • 1 and 3 year options for Support • Pricing is per Instance • Support available from RH or IGS	• Pricing is per System means potential lower prices for Partitioned Systems • SLES 9 uses Linux 2.6 Kernal and maximizes usage of p5 Arch • Support Offerings available from Novell and IGS

	Standard	Premium	Standard	Premium
IBM Price	$295 2w sub only; $595 8w sub only; $995 2w sub & sup. $1,295 8w sub & sup. per instance Cluster lic:$115/syst - no supt	$795 8w sub only $1,995 8w sub & sup per instance	$495 2w sub $1,095 16w sub $799 additl 8w $210/$105 Cluster +$35 media	$495 2w sub $1,095 16w sub $799 additl 8w $210/$105 Cluster +$35 media
Current LDP Price	$1,499 lic & support	$2,499 lic & support	$689 2w sub $1,379 8w sub (8) $1299 16w sub (9) $900 supt per svr +$109 media	$689 2w sub $1,379 8w sub (8) $1299 16w sub (9) $5800 supt unl svr with 10 incidents +$109 media

Selling

Customer Selling

1. People are choosing Linux in your accounts!!

Execs

Gearheads

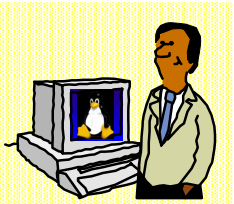
2. Server Choice driven by **PRICE** and then:
   a. System Reliability
   b. Performance and Speed
   c. Compatibility and easy to migrate to
   d. Warranty and Support
3. Default is Intel based systems unless you promote:
   Performance of POWER
   Virtualization for higher utilization
   RAS of POWER
   Growth/Scaling/Future of POWER
   eServer OpenPower for 1-4 way Linux solutions

Selling POWER Servers for Linux Solutions:

- **You are NOT selling Linux!!!!**
- **You are selling pSeries/OpenPower/JS20 for Linux solutions**

- **Ask customer: "What is your Linux strategy?"**
- **Ask customer: "What applications do you need to support your strategy?"**

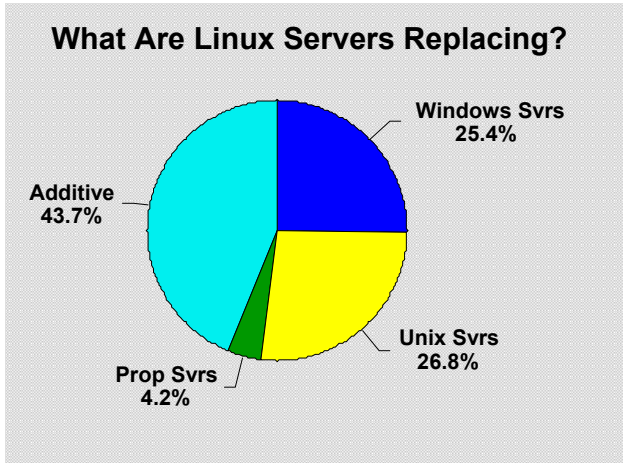
Linux on POWER Customer Opportunities

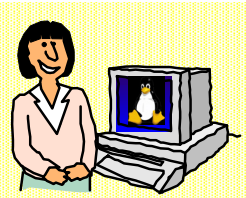


Linux Customers
- Already sold, skills exist
- Need higher performance
- Need reliable servers

Expand to pSeries
- affordable, proven 64-bit performance, partitioning, RAS

44% of customers adding Linux servers for web services, technical computing clusters





Windows Customers
- Do not like "lock in"
- Looking for lower cost
- Hardware is Intel
- Need better QOS

Expand to xSeries and to pSeries depending on workload & TCO

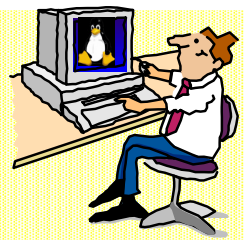
This is happening!
18% moving to Linux*

HP/Sun Customers
- Linux easy transition
- Cannot run Unix & Linux
- Want lower costs
- Need same QOS

Replace with pSeries
- proven platform with clear roadmap

SUN is very vunerable - **9% moving to Linux***

AIX customers
- Are looking at Linux
- Have UNIX skills
- Solutions exist for Linux
- Used to UNIX QOS



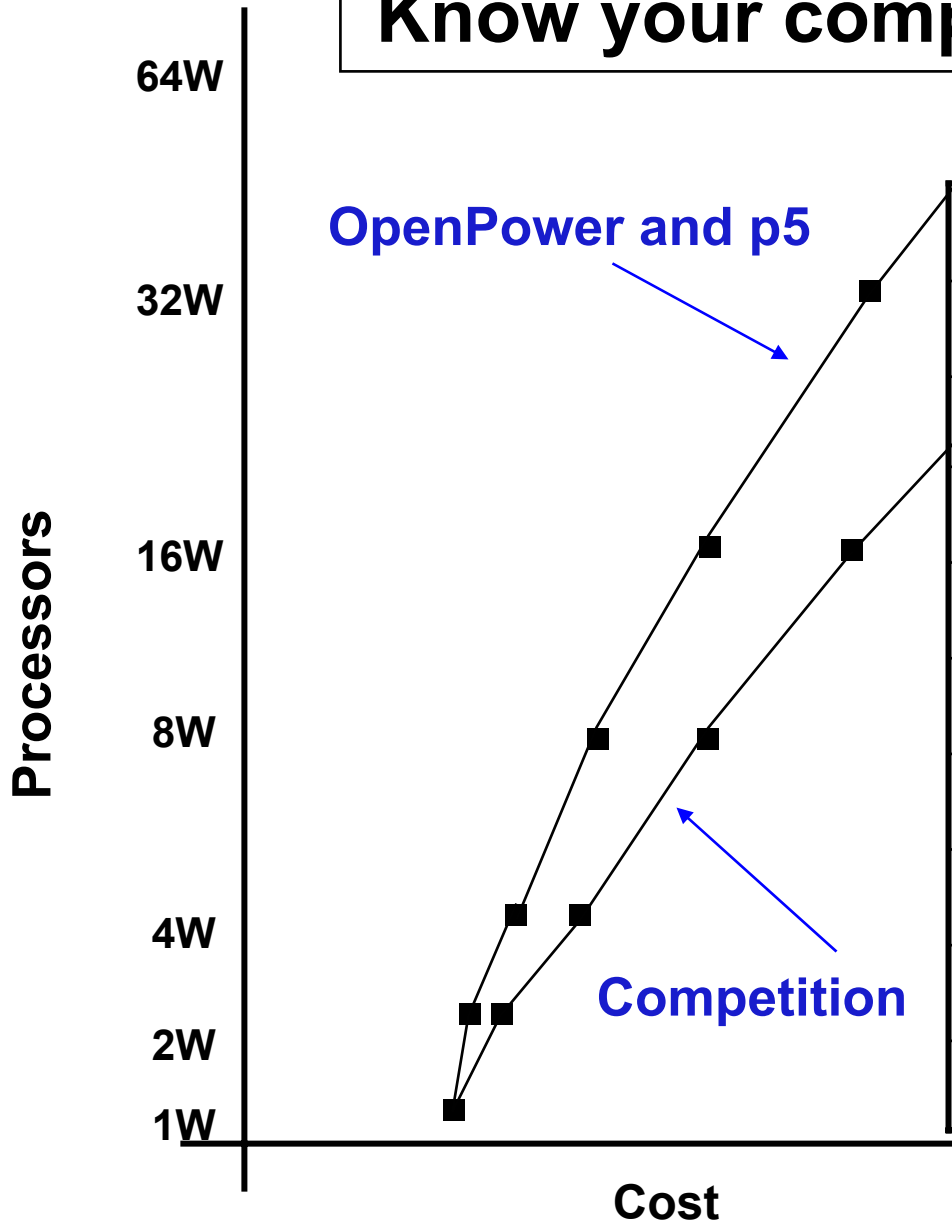
Expand to Linux in a Partition or start with dedicated pSeries Linux server

Will create growth - **16% have Linux**

Selling Linux on the POWER5 Family

Strengths:	Weakness:
Performance	Application Availability
Virtualization	TPC-C results
RAS Features	SpecInt versus AMD
Low Price and $/Performance	Device Drivers
Capacity (memory & processors)	Very Low-End market
Linux Support and Linux price	“Intel Emotion”
“Tuned” Linux	Lack of “image” in marketplace
Full family	
Opportunity:	**Threats:**
Enterprise Solutions	Evolving EM64T
Unix Migrations	Evolving AMD Opteron
Consolidation of Windows (?)	Virtualization solutions
Consolidation of Linux	Xeon price points being lowered
Linux with AIX	
Clustered Linus Solutions	

Know your competition



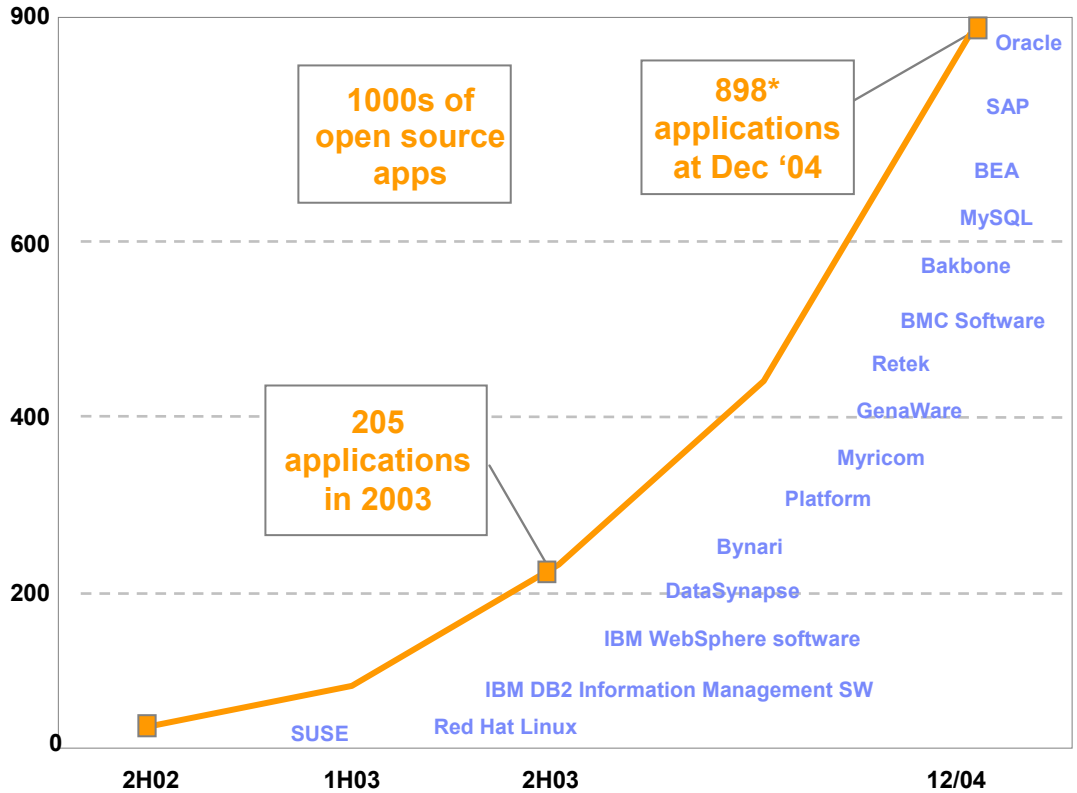
	Processor	N-way	Maximum Memory	Cost
Open Power	p5 1.65	1- 4	64gb	$3k-40k
pSeries	p5 1.9	2 - 64	2 tb	$6k-2m
Dell – IA64	1.0, 1.5	1- 4	32gb	$8k-56k
Dell – EM64T	3.6	1- 2	12gb	$5k-13k
Dell – x86	3.0, 3.6	1- 4	32 gb	$3k–35k
HP - AMD	2.2, 2.4	1 - 4	64 gb	$8k–50k
HP – x86	3.0, 3.6	1 - 8	64gb	$1k–60K
HP – IA64	1.3, 1.6	1 - 128	1 tb	$5K-2m
SUN - AMD	2.2, 2.4	1 - 4	32gb	$3-45k

Know your competition

	Linux cost	Windows cost	VMware GSX	VMware ESX	Advanced O.P. Virt
2 way 710	RH $295 SUSE $495	n/a	n/a	n/a	$1372
4 way 720	RH $595 SUSE $1095	n/a	n/a	n/a	$1744
2 way Dell "intel"	RH $899 SUSE na	$3295 EE $799 SE	$1694	$4688	n/a
4 way Dell "intel	RH $899 SUSE na	$3295 EE $799 SE	$3388	$9375	n/a

Growing by over 4x in 2004, a wide portfolio of tools, infrastructure and industry applications is now available

More information in Selling Linux Solutions Session



lop@us.ibm.com

IBM Middleware applications
- Full complement of core software from IBM WebSphere®, IBM DB2®, Tivoli®, IBM Informix®
- IBM Compilers, Cluster Management

ISV infrastructure and tools
- Cognos, BEA Weblogic Server, MySQL DB, Bakbone, NetVault, BMC Patrol Agent & KMs, Novell, Acucorp, Absoft, Myricom, Storix, Platform Computing, Oracle 10g client & others

Open source infrastructure and tools
- Apache, SAMBA, Sendmail, others
- Distributed with Red Hat & Novell SuSE

Workload applications
- Deep computing – growing portfolio of Life Sciences, Petroleum & Open Source apps
- SAP now available for LoP

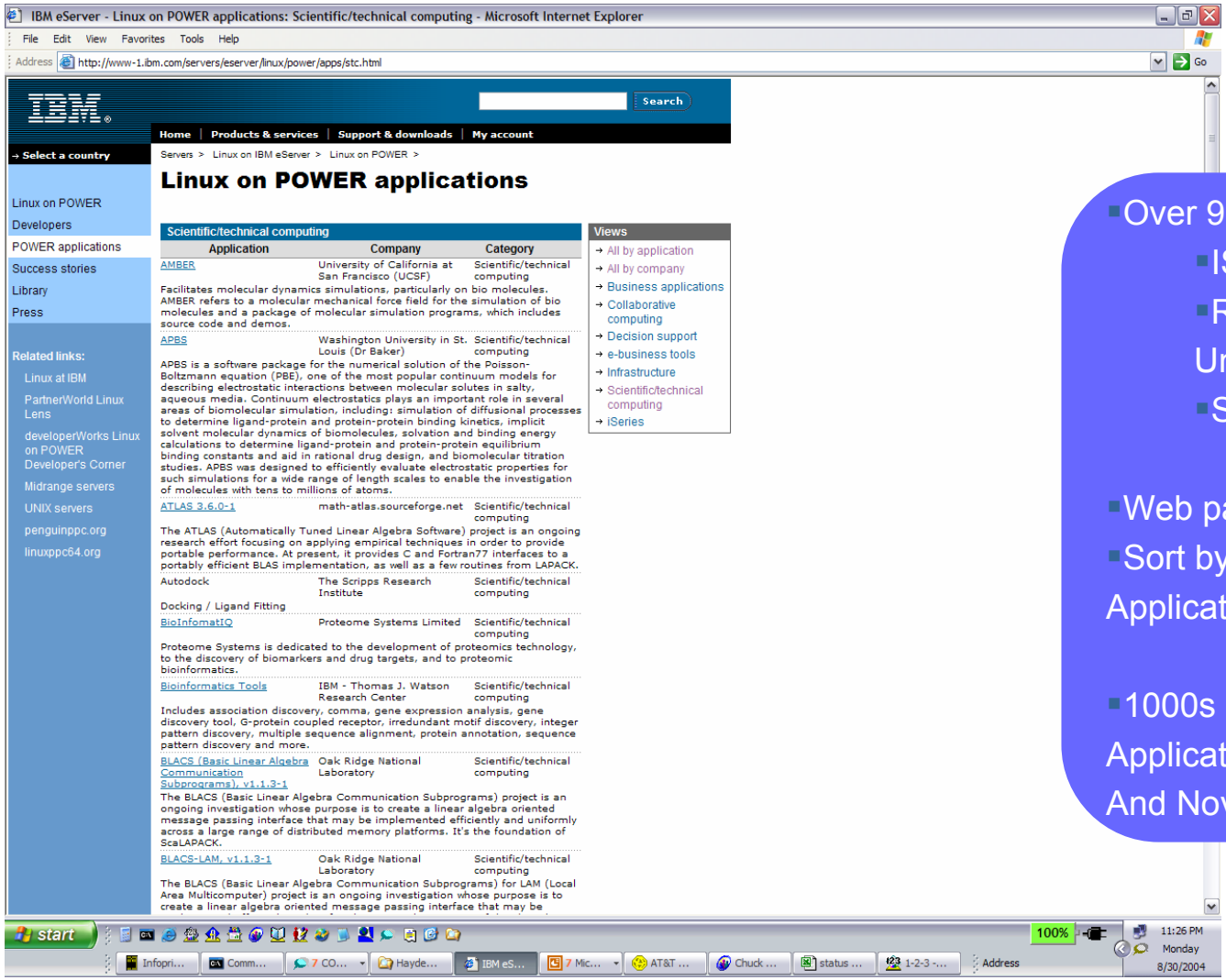
Industry and regional applications
- Temenos, Fair Isaac, Genaware, Hansa, Tecsys, Evant, eOne, Triversity & others

http://www.ibm.com.servers/eserver/linux/power/apps/all.html

*Number of applications depends on distribution level.

http://w3-1.ibm.com/sales/systems/portal/_s.155/254?navID=f240s280&geoID=All&prodID=pSeries&docID=lopavail

Applications for Linux on POWER



- Over 900 certified applications
  - ISV applications
  - Research lab & University applications
  - Source available apps
- Web page updated monthly
- Sort by company name or Application Name
- 1000s of additional Open Source Applications available on Red Hat And Novell SUSE distributions

Clients have made the move to Linux on POWER

ADP

AMVESCAP

Cambridge University

CJ Systems

CNIO: Centro Nacional de Investigaciones Oncológicas

DGDDI: Direction Générale des Douanes et Droits Indirects

Effisis

Electronics & Telecommunication Research Institute

ICMCB: Institut de Chimie de la Matière Condensée de Bordeaux

Intermountain Health Care

LexCom GmbH

Medical College of Wisconsin

Chinese Ministry of Railway

National Semiconductor

Princeton University

Prudential Life Insurance

Russian Joint Supercomputer

State University of New York at Albany

Tata Consultancy Services

Tata Motors

The Chinese University of Hong Kong

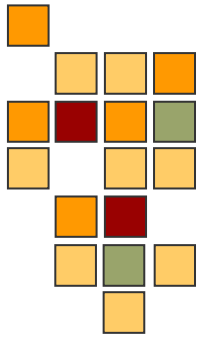
University of Oregon

University of Ottawa

University of Reading

University of Washington

UTI Bank



Arabic

Futures

POWER server roadmap → *The beat goes on!*

2002-3	2004-5	2005-6	2006-7	2007-8
POWER4+	POWER5	POWER5+ Planned *	POWER6 Planned *	POWER6+ Planned *
130 nm	130 nm	90 nm	65 nm	65 nm
1.2-1.9 GHz Core, 1.2-1.9 GHz Core, Shared L2, Distributed Switch	1.5-1.9 GHz Core, 1.5-1.9 GHz Core, Shared L2, Distributed Switch	> GHz Core, > GHz Core, Shared L2, Distributed Switch	Ultra high frequency cores, L2 caches, Advanced System Features	> Ultra high frequency cores, L2 caches, Advanced System Features

Chip Multi Processing
- **Distributed Switch**
- **Shared L2**

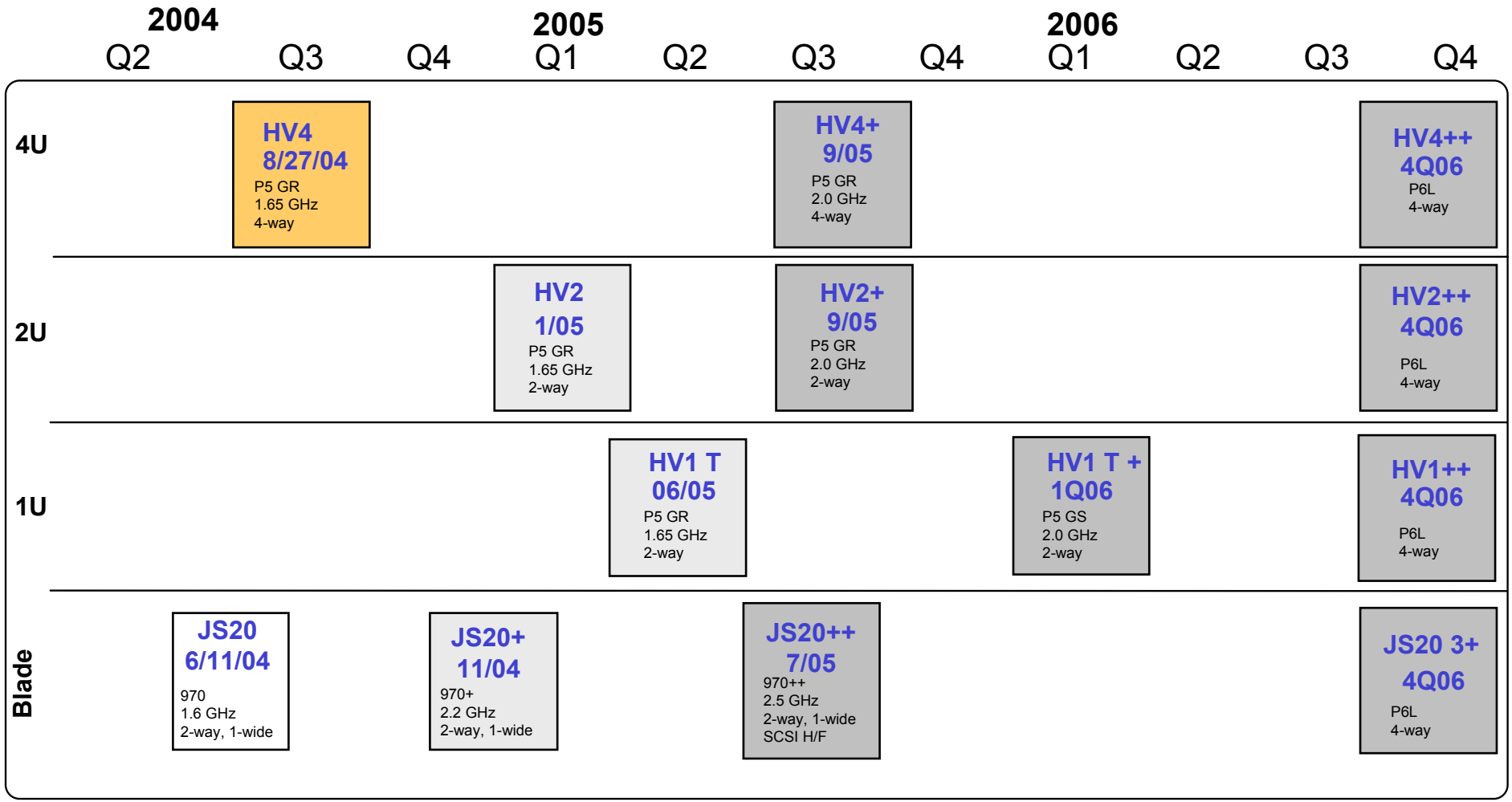
Dynamic LPARs (32)

Simultaneous multi-threading
Micro-partitioning
Virtual Storage, Virtual Ethernet
Dynamic firmware updates
Enhanced scalability, parallelism
Enhanced memory subsystem

Enhanced virtualization
Advanced memory subsystem
Derivative chip for low end
POWER6+ with enhanced transistor for higher frequencies

Autonomic Computing Enhancements

High Volume Products - Linux on POWER Roadmap



Announcing on 8/3

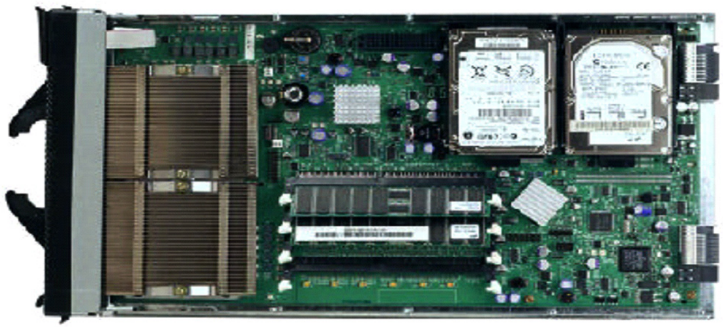
SOD on 8/3, in POR

Future offerings

* Entry 1p, 512 MB, 1 drive; Fully configured 4 p, 8 GB memory, 1 drive

Planned BladeCenter JS20 Roadmap

Current



JS20 Blade

- 2x (std.) 2.2 GHz PPC 970+
- 512MB (std.) to 4GB Memory
- 0-2 40, 60GB IDE drives
- SLES 8/9, RHEL AS 3,

AIX 5L V5.2/5.3 Myrinet, CSM, USB DVD-ROM

* All statements regarding IBM future directions and intent are subject to change or withdrawal without notice.

Technology Enhancements

1H / 2005

- 1X InfiniBand
- iSCSI Software Initiator
- Support for 8MB of memory (New Model)
- BCT & NEBs Support

2H / 2005

- iSCSI TOE Hardware
- iSCSI Target Blade support
- 4Gb Fibre Channel

New Generation JS20++

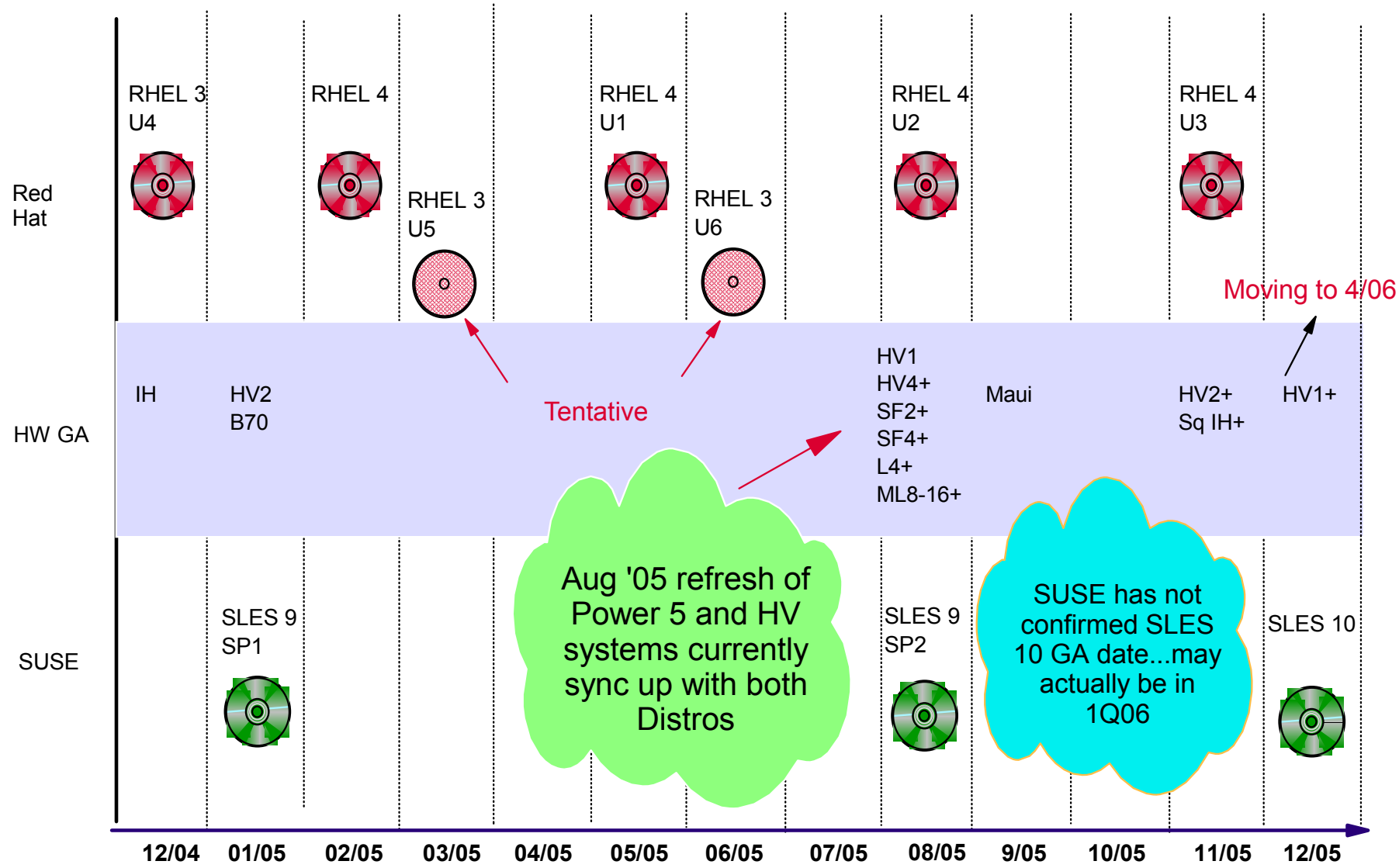
1H / 2006

- 2x 2.8 GHz PowerPC 970++ **(BC-2)**
  - 1GB to 16GB Memory
- 4x 2.4 GHz PPC 970++ **(BC-2)**
  - 2GB to 16GB Memory

Both with

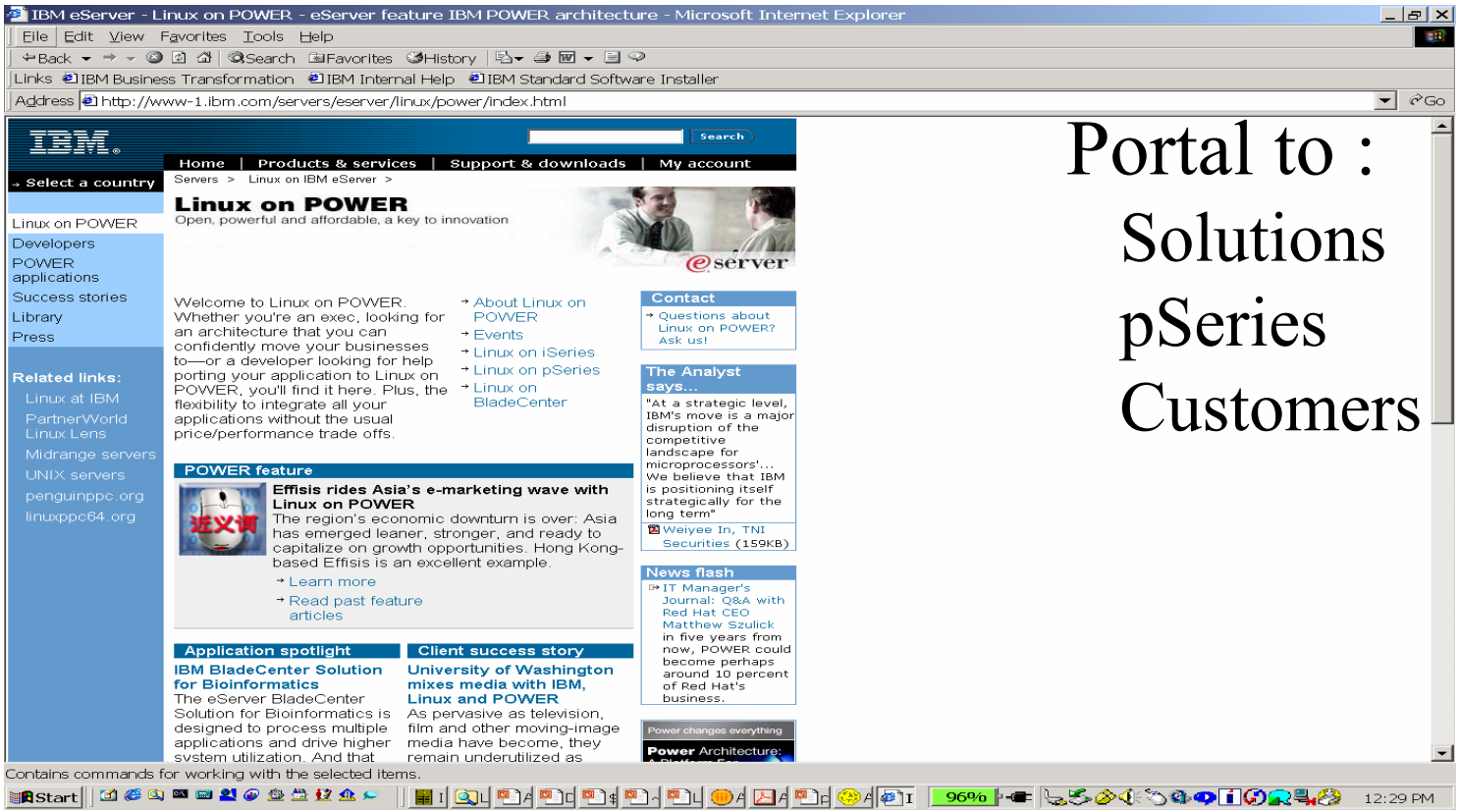
- POWER Hypervisor
- Virtualization (Partitioning) support
- SFF SAS, SCSI Expansion Blade, PCI Expansion Blade, 4X IB, SLES 9/10, RHEL 3/4, AIX 5L V5.2 /5.3,

Linux on Power Roadmap - Distro Releases and Hardware GAs



Resources

www.ibm.com/linux/power



Summary

Linux on POWER technology — performance and reliability for an on demand world

Linux

- Fastest-growing operating environment
- Provides unmatched versatility
- A cost-effective, security-rich environment, powerful enough to run business-critical applications
- Hundreds of applications available

+

POWER

- A unifying architecture featuring the most innovative chip available
- Exceptional reliability, availability and serviceability — and the scalability you need to power your business
- IBM Virtualization Engine enables consistent management of heterogeneous environments

=

Linux on POWER

Great today, even better tomorrow

A clear path for the future, backed by an industry leader

BACKUP CHARTS

Linux Support Comparisons

IBM Confidential

	Red Hat Standard	Red Hat Premium	SUSE 9 Standard	SUSE 9 Premium	IGS Standard	IGS Advanced
IBM Price	$295 2w sub only; $595 8w sub only; $995 2w sub & sup. $1,295 8w sub & sup. per instance Cluster lic:$115/cpu	$795 8w sub only $1,995 8w sub & sup per instance	$495 2w sub $1,095 16w sub $799 8 proc upgde $210/$105 Cluster +$35 media	$495 2w sub $1,095 16w sub $799 8 proc upgde $210/$105 Cluster +$35 media	***eConfig:*** $800/cpu+ $300/ add.cpu ***ServicePacs:*** Blades $500/serv OP720 $800/serv	35% above Standard
Current Price	$1,499 lic & support	$2,499 lic & support	SLES 9 $689 1-2w sub $1,299 16w sub $900 supt per svr +$109 media	SLES 9 $689 1-2w sub $1299 16w sub $3800 supt unl svr with 10 incidents +$109 media	$2,200 + $200/cpu & decreasing $/cpu for total systems in Enterprise	35% above Standard
Web Support	24/7	24/7	24/7	24/7	24/7	24/7
Phone Support	North Am: 9-9 ET M-F Global: 9-5 GMT/CET M-F	24/7 (severity 1)	12/5 24/7 system down	24/7 (severity 1-3)	8-5 M-F customer's time zone	24/7
Web Response Time/SLA	2 business days	1 business day	4 hours	2 hours	2 hours prime shift; next day w/i 2 hours off shift	2 hours prime shift; 2-4 hrs off shift
Phone Response Time/SLA	4 hours	1 hour (severity1)	4 hours	2 hours	2 hours	2 hours prime shift; 2-4 hrs off shift
Scope of Coverage	1 year: Standard Coverage	1 year: Premium Coverage	1 year	1 year;	1 year; No customer apps support	1 year; No customer apps support
Method of Ordering	Red Hat IBM AAS IBM HVEC	Red Hat IBM AAS IBM HVEC	SUSE IBM AAS-not sup IBM HVEC-not sup	SUSE IBM AAS-not sup IBM HVEC-not sup	IBM AAS IBM HVEC(SPac) IBM CHIS(Renew)	IBM AAS IBM HVEC(SPac) IBM CHIS(Renew)

Power5 Linux OS Functionality Support

Function	AIX 5.2F 5/04	AIX 5.3 IGS 5/04	AIX 5.3 10/04	OS400 V5R3 5/04	*Linux SLES 9 8/04*	*Linux RHEL 3 U3 8/04*
Max 254 Partitions	N	Y	Y	Y	Y	Y
Sub Processor partition w/ 0.1 granularity	N	Y	Y	Y	Y	Y
Capped and Uncapped partitions	N	Y	Y	Y	Y	Y
CUoD*						
--> Processors	Y	Y	Y	Y	Y	Static only
--> Memory	Y	Y	Y	Y	Static only	Static only
DLPAR						
--> Processors	Y	Y	Y	Y	Y	N
--> Memory	Y	Y	Y	Y	N	N
--> IO	Y	Y	Y	Y	Y	N
Power 5 Processor Support						
--> Base	Y	Y	Y	Y	Y	Y
--> SMT	N	Y	Y	Y	Y	Y
Virtual SCSI Server	N	Y	Y	Y	N	N
Virtual SCSI Client	N	Y	Y	N	Y iSeries initially pSeries w/AIX 5.3	Y iSeries initially pSeries w/AIX 5.3)
Virtual LAN	N	Y	Y	Y	Y	Y
eWLM Agent Support	N	N	Y	Y	N	N
EEH recovery	Y	Y	Y	Y	N	N
Large page support	Y	Y	Y	N	Y	N
Concurrent Diagnostics	Y	Y	Y	Y	N	N
PCI Hot Plug	Y	Y	Y	Y	Y	N
I/O drawer/tower concurrent add/remove*	Y	Y	Y	Y	N	N
Memory resilience	N	N	Y	N/A	N	N
SUE machine check handling	Y	Y	Y	Y	Y	Y

Top priority Linux on Power ISVs by Industry

Info as of 10/15/04

Distribution-Retail
- 360Commerce*
- Blue Martini Software Inc.*
- MarCole Enterprises, Inc.
- Pironet NDH AG*
- Selectica, Inc.*
- Triversity Inc.*
- Retek (require Oracle DB)

SMBs
- BISON Group c/o Bison Schweiz AG*
- eOne Group*
- Evant, Inc.*
- Hansa Business Solutions (UK) Limited*
- ACCPAC International, Inc*
- Tecsys Inc.*
- Intentia International AB
- Abas
- Khimetrics (require Oracle DB)

Financial Services – Banking
- Temenos Headquarters SA*
- Fair Isaac Corporation*
- Sybase
- Oasis eFunds

Industry – Other Industrial Industries
- UGSPLM NX-Nastran
- LSTC LS-Dyna
- Adapco Star-CD
- Ansys
- Cadence Nanorouter

Cross Industry
- Apache*, Tomcat*, JBOSS*
- Samba*, MySQL*
- IBM SWG DB2*
- IBM SWG Tivoli*
- IBM SWG WebSphere*
- IBM Cluster Systems Mgr.*
- IBM C/C++*, Fortran*, ESSL*
- Bakbone Software, Inc *
- Acucorp *
- BEA Systems*
- BMC Software, Inc.*
- Bynari, Inc.*
- Foedero*
- Novell, Inc*
- SAP AG (app server)
- Storix*
- Taxware*
- Myricom*
- MicroFocus
- IBM GPFS*, Loadleveler*
- Rogue Wave Software
- SAP AG (app server+DB2)
- Cognos
- Oracle Corporation
- IBM Rational Clearcase
- IBM SWG Lotus
- Stonesoft
- SAP AG (app server+Oracle)

Public Sector
- GenaWare Group Asia Pacific Pty Ltd*
- Healthtrio
- Cerner Corp. (require Oracle DB)

Public Sectors-Life Sciences
- Scripps Institute - AMBER 8 app*
- FFTW.org*
- Thermo Electron SEQUEST
- Iowa State University - GAMESS app*
- UCSF (AMBER 7)*
- University of Virginia - FASTA app*
- Gaussian, Inc*
- National Center for Biotechnology Information - BLAST app*

Communications
- Intelliden
- Ubiquity
- Zvolve

Target Date for Power5 Support
(Applications supporting Power5 will also support Power4 on SLES9 or RHEL3u3)

Available now

4Q04

1H05

* available on Power4 today (SLES8 or RHEL3)

OpenPower and pSeries File and Print Solution

Brings a new level of performance to a real-world workload

NetBench: eServer OpenPower 720 beats AMD and exhibits extraordinary scalability

Challenges addressed

- UNIX servers aging
- Microsoft Windows NT® support disappearing
- Servers underutilized
- Server sprawl
- Inflexible infrastructure

Business value

- Exceptional performance
- Large # of files, users, Domains
- Simplify through consolidation
- Flexible consolidation of user groups

Selling tools

- Tested and qualified
- Sizing Guide for capacity planning
- Solution brief w/ recommended configs.
- Proof-point
- New solution web site

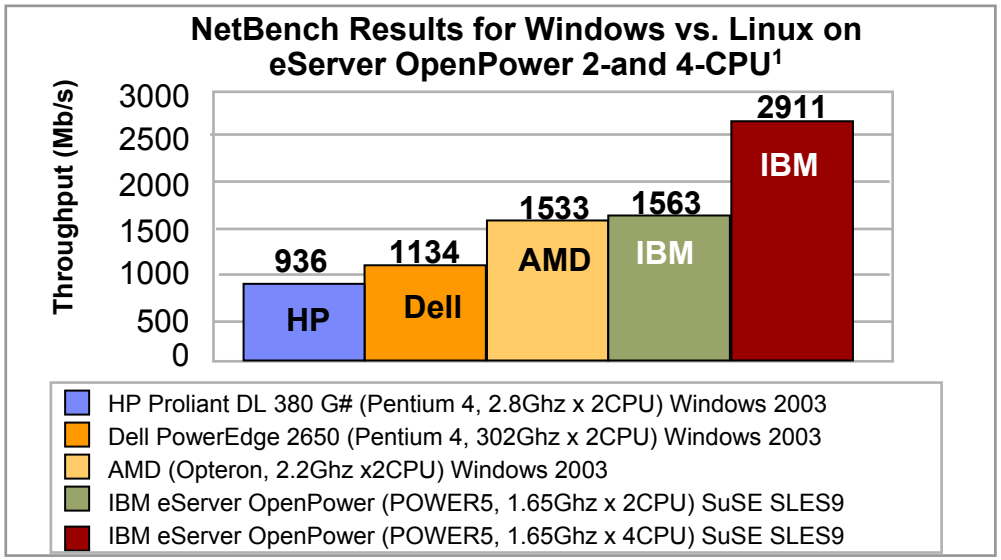
http://www-1.ibm.com/linux/solutions/linuxonpower.shtml

Target Market:

- Competitive assault: *Primary:* Windows NT upgrade *Secondary:* Sun/HP aging servers,
- Large and mid-sized customers, pSeries customers

Opportunity Size: Approximately 20,000 servers in Q4

Date Available: **NOW**



[1]Based on published Ziff Davis Media NetBench benchmark result of 1,563.42 Mb/s on a 2-way 1.65 GHz POWER5 IBM eServer OpenPower 720 and 2,911.04 Mb/s on a 4-way 1.65 Ghz POWER5 IBM eServer OpenPower 720 (http://www.veritest.com/clients/reports/ibm/). HP results published in (http://www.veritest.com/clients/reports/microsoft/ms_samba.pdf). AMD and Dell results published in (http://www.veritest.com/clients/reports/amd/amd_opteron.pdf)

OpenPower Consolidation Solution

Virtualization of infrastructure workloads simplified

Reference architecture thoroughly tested by IBM Engineers to accelerate time-to-value

Challenges addressed

- Servers underutilized
- Servers undersized based on forecasted demand
- Server sprawl complicating management
- IT not easily adaptable to changing requirements

Business value

- Simplified infrastructure – less servers, more performance, easier to manage
- Flexibility – resources assigned as/when needed
- Utilized – get more from your servers
- Scalable – grow IT with your business
- Robust – improve customer satisfaction
- Easy to implement – optimize your staffing

Selling tools

- Recommended configs tuned for performance
- Install, set-up and configuration scripts
- Sizing guide and tuning instructions
- Solution brief & scripted customer presentation
- Proposal letter and ROC campaign
- Part of GSMB ROC in January
- New solution web site
  ibm.com/eserver/openpower/solutions/consolidation

Target Market:

- Competitive assault: Sun/HP aging servers, Windows NT upgrade
- Customers: Large & mid-sized, pSeries
- Target: Already doing consolidation, making strategic Linux decisions

Opportunity Size:

- Approximately 1,500 servers in Q4 (10% of total "farms", assuming 7.5 to 1)

Date Available: Launch Oct 19, GA Nov. 26

Tested Solution Stack	
Apps	**Directory/Authentication**: OpenLDAP **Firewall:** SUSEfirewall2 **File and Print:** Samba 3 **Web Serving:** Apache **Mail:** Bynari Insight Server
OS	SUSE Linux Enterprise Server 9 for POWER
HW	eServer OpenPower 720

IBM @server OpenPower Consolidation Solution

Solution description

The IBM @server OpenPower Consolidation solution helps to consolidate legacy servers running infrastructure workloads, including file and print services, Web serving, email, directory services and firewall. Through consolation, customers simplify their IT (less servers, easier management), increase their flexibility, improve their utilization and lower their overall IT costs.

Customer pain points

Currently using UNIX for IT/Web Infrastructure

- Aging servers with inadequate performance
- Server farm sprawl creating complexity
- Encouraged to migrate (e.g. from PA-RISC to Itanium)
- Limited flexibility to adapt to changing requirements

Currently using Windows for IT Infrastructure

- Expensive OS and virtualization options
- Feels "locked-in" and controlled
- Windows NT® and Windows 2000 support disappearing
- Server farm sprawl creating complexity
- Limited flexibility to adapt to changing requirements

What the solution does for your clients

- Reduce operational cost of their server environment used for common IT tasks
- Reduce complexity in their IT Infrastructure
- Improve productivity of their IT personnel
- Get more out of their server investment
- Enhance their adaptability to changing demand

Target clients

- Already using, considering or open to Linux
- Currently running Windows NT® , Windows 2000, and/or Sun/HP UNIX® servers for IT/Web with aging servers
- Undertaking or considering a consolidation project
- Have **not yet** migrated infrastructure to Windows 2003
- Business growth/change (e.g. merger, new business venture) placing **new** demands on **old** infrastructure
- Looking to improve infrastructure service delivery and flexibility to employees/customers (e.g. complaints)
- **Do not target:** 1) Customers using "white box" servers for these workloads 2) Small user requirements (<50)

Solution Elements

- IBM @server® OpenPower™ 720
- Hardware Management Console (HMC)
- Advanced OpenPower Virtualization option
- SUSE LINUX Enterprise Server 9 (SLES 9) OS
- Solution Blueprint and Fast Start script includes:
  - Pre-tested "Solution Starter Points"
  - Recommended LPAR and Micro-Partitioning™ configurations
  - Tailored installation and configuration scripts
  - Manual with tailored install, configure, integrate and tune instructions
  - Sizing for popular combinations of stack components
    - **Directory/Authentication**: OpenLDAP
    - **Firewall**: SUSEFirewall2
    - **File and print**: Samba 3
    - **Web server**: IBM HTTP Server
    - **E-mail**: Bynari Insight Server from Bynari, Inc.
- Optional SupportLine for Linux®
- Optional IBM Services for implementation and migration
- Optional IGF financing

Note: Fast Start Kit available at GA in November

Solution Sizing

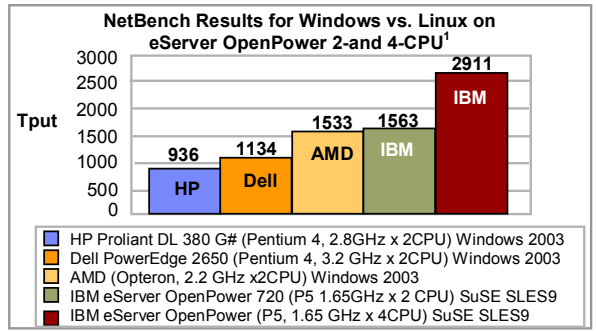
"Small" Starting Point "suite spot": 100 Users, 3 Partitions
"Medium" Starting Point "suite spot": 250 Users, 5 Partitions
"Large" Starting Point "suite spot": 500 Users, 6 Partitions
(Note: See configuration details in Appendix)

Competitive Advantages

Performance and scalability advantages

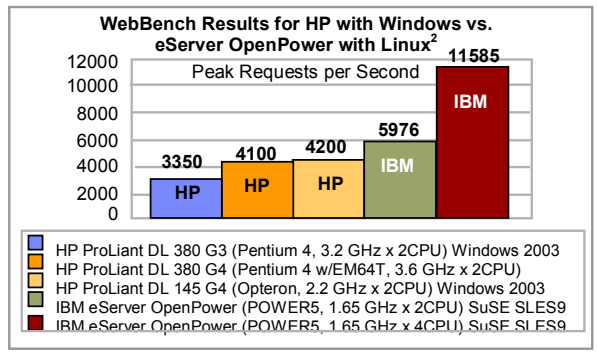
1. NetBench

- **NetBench® benchmark** for file and print serving using Linux and SAMBA 3 vs. Windows
- OpenPower running Linux beats all others running Windows 2003
- OpenPower beat Intel Xeon by up to **63%**
- OpenPower scales **93%** from 2 to 4 processors; Opteron scales **67%** from 1 to 2 processors (a **38%** advantage for OpenPower)



2. WebBench

- **WebBench® benchmark** performance of Web serving using Apache vs. Microsoft IIS
- OpenPower running Linux beats HP Opteron running Windows 2003 by **42%**
- OpenPower running Linux beats HP Xeon running Windows 2003 by **46%**
- OpenPower scales **97%** from 2 to 4 processors; HP Opteron scales **71%** from 1 to 2 processors (a **37%** advantage for OpenPower)

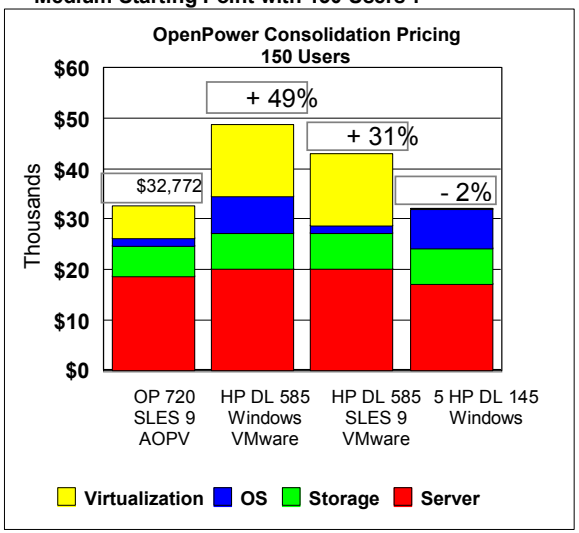


IBM @server OpenPower Consolidation Solution

Acquisition cost advantages

- OpenPower Consolidation solution significantly reduces acquisition cost [2]
- OpenPower with virtualization is priced **49%** lower than a similarly configured HP 4-way Opteron server with VMware running Windows 2003
- OpenPower with virtualization is priced **31%** lower than a similarly configured HP 4-way Opteron server with VMware running Windows 2003
- OpenPower with virtualization is priced **equally** (+2%) to five (5) HP 2-way Opteron servers each dedicated to one of the workloads in the solution

Medium Starting Point with 150 Users[3]:



Configuration Summary:

- All systems configured with "Medium" starting point: (See appendix for details)
- OpenPower configured with AOPV to consolidate all 5 workloads
- HP DL 585 configured with VMware and Windows 2003 and SUSE Linux
- Five (5) HP DL 145s configured with Windows 2003 and no virtualization, each dedicated to a single workload

Advantage Summary:

Compared to UNIX for IT/Web Infrastructure

- Open (Linux vs. UNIX version)
- Lower price (e.g. OpenPower vs. Sun SPARC)
- High-end virtualization functionality in entry system
- POWER5 performance better than SPARC

Compared to Wintel/Lintel for IT/Web Infrastructure

- Open (Linux vs. proprietary Windows)
- Higher performance on these workload (up to 63%)
- Lower price on these workloads (up to 49%)
- Better scalability on these workloads (38%)
- Superior virtualization
- OpenPower/Linux reliability better than Intel/Windows
- Less servers to manage, administer, upgrade
- Higher server utilization when resources shared
- Dynamic resource sharing (flexible provisioning)

Competitive Solution Alternatives

1. **"More of the same"** (Same architecture/same OS): 2-way Intel server(s) with Windows 2003 or low-end Sun/Solaris servers configured in server farms (no virtualization)
2. **"Same architecture/new OS":** 2-way branded Intel servers running Linux configured in server farms
3. **"New architecture"** (Virtualization): 4-way Intel server running Windows or Linux with virtualization using VMware

Competititor's Weaknesses

OpenPower solution:

1. Requires some migration in most cases
2. Linux stack not as integrated as Windows/UNIX
3. NFS (used frequently by UNIX) is not supported
4. Red Hat distribution not supported by solution

"More of the same":

1. Closed, proprietary architecture
2. Expensive (UNIX hardware, Windows OS)
3. Inefficient (dedicated servers prevents resource sharing)
4. More complex IT approach (more servers to manage)

Lintel server farms:

1. Inadequate RAS features and scalability
2. Inefficient (dedicated servers prevents resource sharing)
3. More complex IT approach (more servers to manage)

Lintel/Wintel with VMware:

1. Very expensive
2. Unproven
3. High overhead
4. 32-bit only (runs 32-bit on Opteron/ EM64T servers)

How to overcome objections (weakness)

Objection: *Requires migration*
Response: With the OpenPower solution no more migration is needed beyond standard Linux on Intel server farms. For companies considering Linux, our solution gives a much better ROI than a Linux/Intel server farm. IBM and its Linux-enabled Business Partners can provide assistance with the migration through services. Migration will typically be of the form of migration and user authentication. IBM understands the mapping between Windows directory and OpenLDAP with Samba 3. Our partner Bynari has undertaken many Exchange to Linux email migrations and is an expert.
Objection: *Linux stack not as integrated*
Response: With the OpenPower Consolidation solution IBM has developed comprehensive installation and configuration scripts to ensure fast and efficient set-up. The recommended configurations have been tested and are ready to deploy.
Objection: *NFS not supported by solution*
Response: We will support NFS as a standard pre-tested and configured element of the solution in the next revision due at early in 2005. IBM and its BPs can provide assistance today through services
Objection: *Red Hat distribution not supported by solution*
Response: We will support Red Hat as a standard pre-tested OS base for the solution in the next revision due at early in 2005.

How to capitalize on competition's weakness

"More of the same":

- Attack the impression that "Intel is good enough" for this workload. Stress the benefits of on demand virtualization. Emphasize that these benefits come AT A LOWER EFFECTIVE PRICE than UNUX and AT AN EQUAL PRICE to server farm configurations. So the customer gets more for their investment

Emphasize that Linux on POWER is the same price as Linux on Intel but provides substantially more advanced

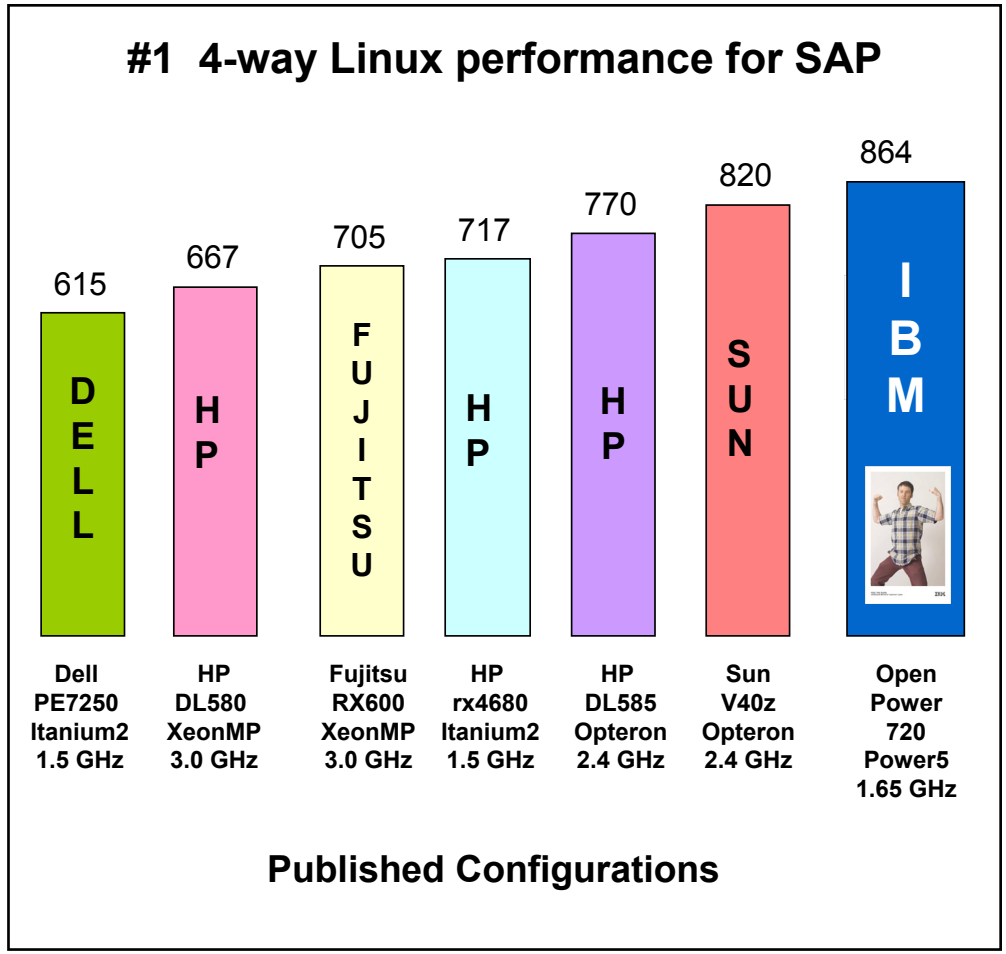
SAP on @server OpenPower Solution

Superior price/performance helping customers drive down the total cost of ownership

Challenges addressed
- High SAP infrastructure costs
- Poor efficiency and productivity
- Downtime impacting QoS
- Scalability and flexibility

Business Value
- Reduced total cost of ownership
- Improved application performance
- Accelerated ROI
- Infrastructure flexibility
- Improved ability to respond to changing business needs

Deploy with confidence
- Proven and stable 64-bit technology
- Scalable and reliable Linux infrastructure
- High quality of service they demand from an optimized Linux environment
- A business solution that can grow as their needs grow.



(1) www.sap.com/benchmark

IBM @server OpenPower SAP Application Server Play

DB2

Solution Description

The IBM eServer OpenPower application server play positions the OpenPower 720 as a powerful new alternative for SAP application servers helping customers to get more price/performance with the utmost reliability for their SAP solution deployment. Immediate opportunities can be found with customers who are looking at adding new application servers to an already existing SAP implementation.

Customer Pain Points

- Aging application servers impacting performance
- High SAP infrastructure costs
- Poor efficiency and productivity
- Downtime impacting QoS
- Scalability and flexibility
- Increased responsiveness to users and meet growing business demands on SAP environment

What the solution does for your clients

- Reduce SAP infrastructure costs
- Increase responsiveness to users and overall solution productivity
- Accelerate ROI with a server delivering best-in-class price/performance
- Improved availability reducing downtime enhancing QoS

Target Clients

- Linux affinity (planning or already using Linux within their IT environment)
- Looking for alternative to Wintel, Sun/Solaris, or HP-UX
- Wants Unix performance, reliability, and efficiency, but wants reduced costs
- Needs to improve application server performance to provide better quality of service
- Existing AIX customer that might want to add Linux server for SAP solution
- **Do not target:** Customers who have wide implementations of Windows and have standardized on Microsoft SQL as the back end database with no Linux strategy.

Solution Elements

- IBM @server® OpenPower™ 720
- SUSE LINUX Enterprise Server 9 (SLES 9) OS
- SAP Solution Support
  - **TODAY -** Support for ABAP application server (6.40 kernel) for SuSE Linux Enterprise Server 9. The database support for these application servers are DB2 UDB v8.2, SAP maxDB v7.5.
  - **December** - application server layer and database layer (DB2 UDB v8.2 and SAP maxDB v7.5). In addition, application server support for iSeries (DB2). The pilot phase for this release stage starts in Oct/Nov 2004 in which customers can deploy for a development environment.

For more detailed release support, please visit: http://w3.ncs.ibm.com/solution.nsf/SOL/JWKZ-65BG6G?OpenDocument&TableRow=1.4#1.

Solution Sizing

The number of users that OpenPower will be able to support is dependent on the architecture deployed – combination of number of application servers and database server size. An OpenPower 2-Tier solution can support up to 4330 SAPS. http://w3.ncs.ibm.com/solution.nsf/SAP/KTOS-5PHLFD?OpenDocument

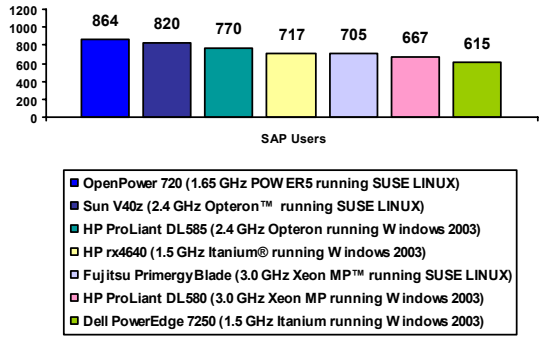
Competitive Solution Alternatives

Here are some competitive solution alternatives that you might be facing as you propose IBM eServer OpenPower for an SAP solution:

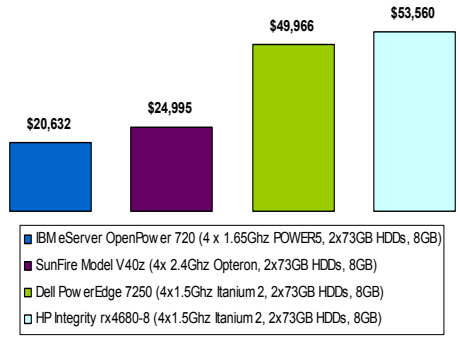
- Intel 32-bit with Windows (most common)
- Intel 32/64-bit (EM64T) with Linux – new in Q4
- Itanium 2 with Linux or Windows (still ramping up)
- AMD with Linux – 64-bit support new in Q4
- Sun Solaris – common and with old install base
- HP-UX – common and with old install base

Competitive Advantage

- Proven processor architecture demonstrating uncompromised 64-bit performance



- #1 Leadership Linux based SAP 4.7 SD 2-Tier results compared with other 4-way based servers – up to **40%** better performance
- **20%** better performance compared with the best 4-way Itanium 2 and Windows based benchmark



- Up to 2.5x price advantage compared with competing 4-way based solutions
- If your customer is looking at buying 6 application servers using the prices above, a customer considering the HP rx4680-8 will pay a total of $321,360 and with the OpenPower 720 the price tag would be $123,792, a staggering difference of **$197,568**.
- Using the SD 2-Tier benchmark result to estimate expected performance for the application server, you will

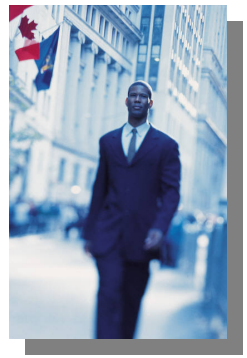
BI Appliance Solution

Sector: Public, Distribution, Fin. Mkts.
Focus area: Cross-industry apps in SMB
Industries: Fin. Mkts, Banking, Retail, Gvnt.

- Background
  - Business Intelligence identified as key area where customers will deploy Linux, moving toward solutions approach
- Objective
  - Deliver a fully integrated hard bundle, priced to overall IBM economics, that is competitive on time-to-value.
  - Expand share in target SMB segments leveraging Linux popularity in data warehouse workload.
  - Respond to new competitive entrants offering low-cost, data warehouse "appliances"

Value proposition
- Simplify deployment to accelerate time-to-value
- Leading price/performance
- Proven technology from a vendor you can trust

Offering Configuration



OpenPower Web Solution

Brings enterprise-class at entry prices to replace aging, proprietary Sun/HP servers

WebBench: eServer OpenPower 720 beats HP Opteron/Xeon and exhibits 97% scalability

Challenges addressed
- UNIX servers aging
- Proprietary Solaris OS
- Uncompetitive price/performance
- Server sprawl
- Inflexible infrastructure

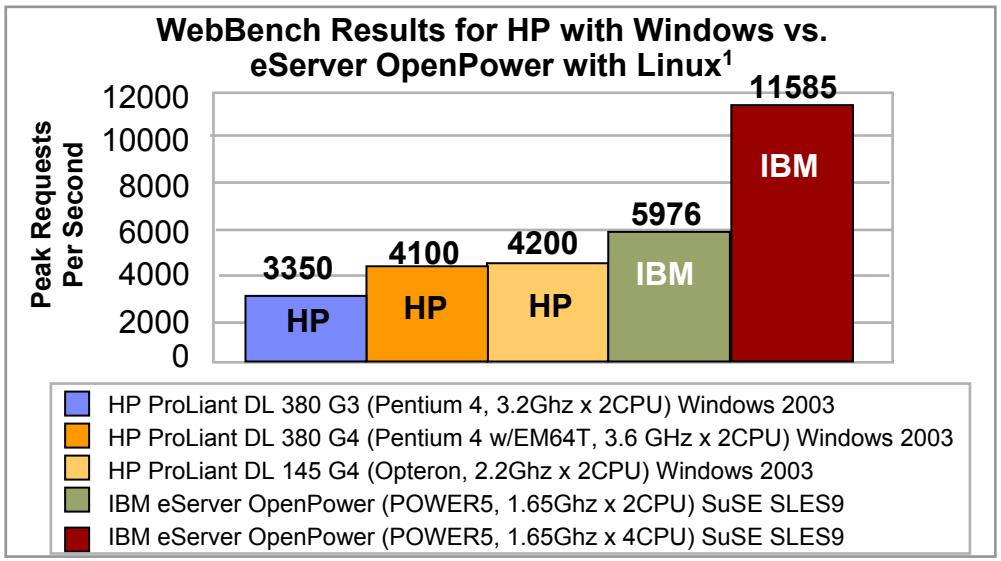
Business value
- Exceptional performance
- Improved price/performance
- Familiar, open technology - Apache
- Simplify through consolidation
- Fewer servers to manage

Selling tools
- Tested and qualified
- Solutions brief w/ recommended configs.
- Sizing Guide for capacity planning
- Proof-point
- Solution Web site

Target Market:
- Competitive assault: *Primary:* Sun/HP aging servers, *Secondary:* Windows NT upgrade
- Large and mid-sized customers, pSeries customers

Opportunity Size: Approximately 50,000 servers in Q4

Date Available: **October 29th 2004**



[1]Based on published Ziff Davis Media WebBench benchmark result of 5,976.6 requests/s on a 2-way 1.65 GHz POWER5 IBM eServer OpenPower 720 and 11,585 requests/s on a 4-way 1.65 Ghz POWER5 IBM eServer OpenPower 720 (http://www.veritest.com/clients/reports/ibm/). HP results published in (ftp://ftp.compaq.com/pub/products/servers/benchmarks/dl380g4-webbench.pdf). and (http://h18004.www1.hp.com/products/servers/benchmarks/dl145-webbench.pdf)

OpenPower and pSeries email Solution

Brings greater flexibility and performance while reducing costs

Cost effective COMPATIBLE alternative for Outlook users on enterprise-class h/w

Background

- Texas, US based, easy to work with
- Linux based full-function mail server
- Utilizes open architecture, Open Source & standard protocols
- Supports 95% functions of Exchange

Business value

- Improve reliability, perf. and scale
- Simplify through consolidation
- Open solution improves flexibility

Selling tools

- Solution brief for pSeries
  http://www.bynari.net/index.php?id=3494
- TCO Calculator
  mfelberg@bynari.net or 813.855.8621
- pSeries workload estimator (Sizing)
  http://www.bynari.net/index.php?id=3748
- OpenPower = Intel pricing coming (Bynari)
- OpenPower Sizing Guide coming
- OpenPower Solution Brief coming

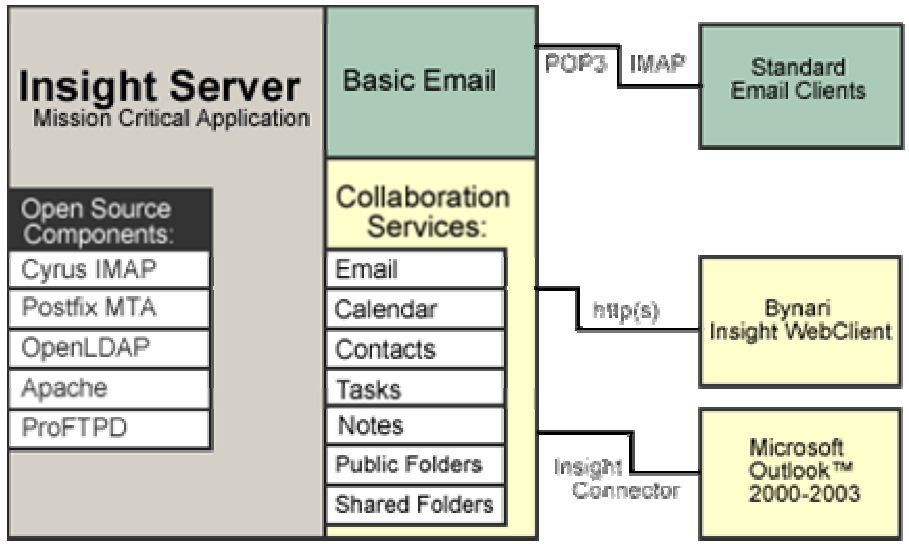
Target Market:

- Exchange e-mail and messaging market
- Linux groupware market

Opportunity Size: Approximately 37,500 servers in Q4

Date Available: **pSeries now; OpenPower Nov 26th**

Bynari Insight Server



Proteomics (Scale-Up)

Sector: Public (Life sciences/health)

Focus area: Industry app in LE & SMB

Industries: Pharma, Gov't, academia

- Background
  - Proteomics uses computational tools in the study of proteins.
  - Large opportunity for 64-bit optimized performance, large number of immediate prospects (1000+)
    - Market is moving to Linux
    - High-performance improves time-to-answer
    - High-throughput is important
  - IBM has a great relationship with the top ISVs; ISVs are very interested in working with us

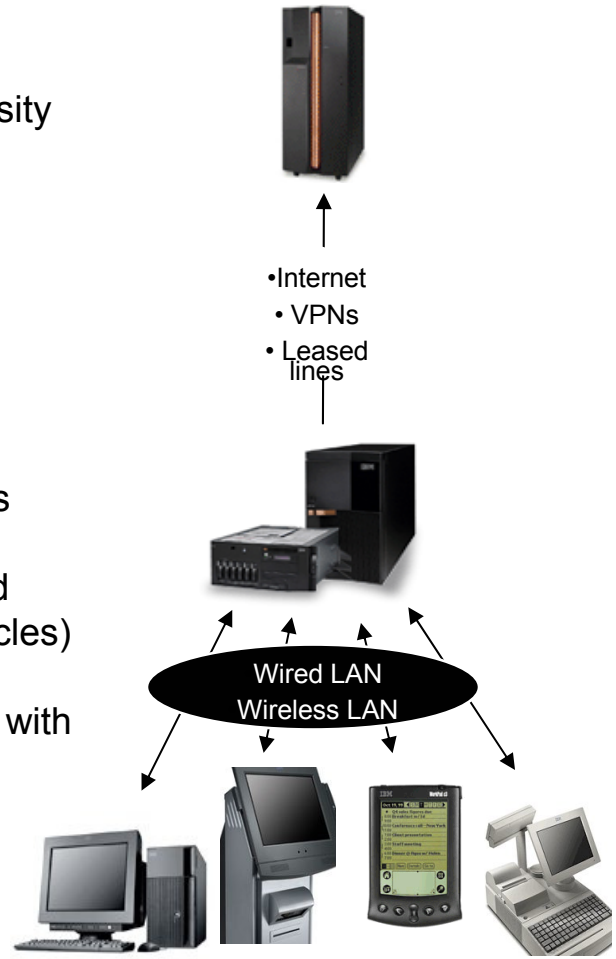
- Deep & Narrow Play
  - Objective
    - Ported, optimized and benchmarked codes available from ISVs.
    - Drive to a leadership position in a segment that is ripe for 64-bit performance
  - Value proposition
    - HV and IBM TotalStorage will allow Proteomics customers to process and store more data proving a quicker time to solution at a price point that is competitive with Intel Architecture based systems which will maximize customer time-to-value
      - Process more data, faster, at a competitive price point (vs. IA-32)
      - Maximize time to value

Solution Stack	
Applications	PLGS 2.0 (Waters/MicroMass) **Sequest 3.1 (Thermo Electron)** **MASCOT 2.0 (Matrix Science)**
Middleware & Tools	**Apache, JAVA, IBM C/C++, XL Fortran, GCC**
System Mgmt	**TSM (optional)**
OS	**SLES9**
Hardware	**OpenPower, p5, TotalStorage**

Retail POS

Sector: Distribution
Focus area: Bus. app In LE & SMB
Industry: Retail

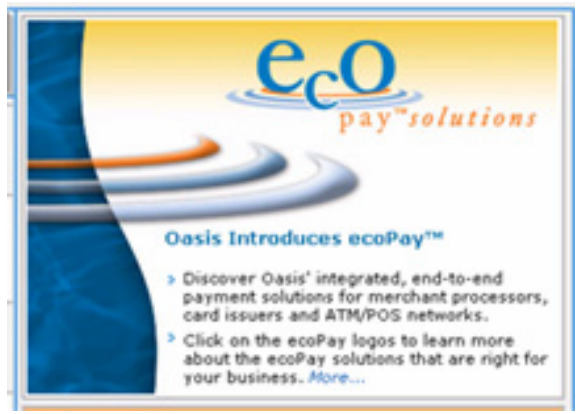
- Background
  - Retailers integrating & modernizing infrastructure
  - IBM RSS strategy – Store Integration Framework
- Solution
  - Fully integrate POWER into IRES framework
  - Novell/SuSE SLES 9 with Retail-segment features
  - Retail IRES certified ISVs supporting HV: 360 Commerce, Triversity
  - Solution opportunities being assessed:
    - OpenPower as POS controller, ISP controller or both consolidated
    - Consumer Services
    - Upgrade aging Unix point applications
    - Older 4690 applications migration to Linux using Applator
    - Server for new Self-check out client
- Value Proposition
  - Very low price (equivalent to Intel for 100s or 1000s of stores)
  - Very robust (Enterprise RAS capability POWER reliability, means retailers can make the platform "retail hardened")
  - Very stable (Long life-cycles, controlled release cycles, published roadmaps, means retailers can have long deployment roll-out cycles)
  - Very flexible (includes built in virtualization, means retailers can affordably and efficiently consolidate POS controller functionality with in-store app server functionality in one box x2 for HA)
  - Very high performance (Better than the latest Intel servers, meaning retailers will have the ability to use an open middleware framework without concern for overhead)



POWER in Retail Payments

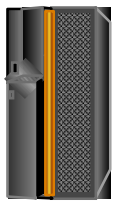
Sector: Finance
Focus area: Payments in LE in SMB
Industry: Banking

- Background
  - Linux acceptance in Banking increasing
  - Tandem is the Financial Payments leader
  - IBM's play now is with zSeries/zOS & Linux developing
  - Sector lead ISV - S2 - supports Linux on x & i; p in future
  - Payments is at the hub of financial transactions and is visible
  - eFunds, an IBM cluster partner looking to rekindle partnership - eager to work with IBM on Tandem take-out
    - Oasis will become eFunds' lead software in the future



IBM eserver BladeCenter

OR



redhat OR SuSE

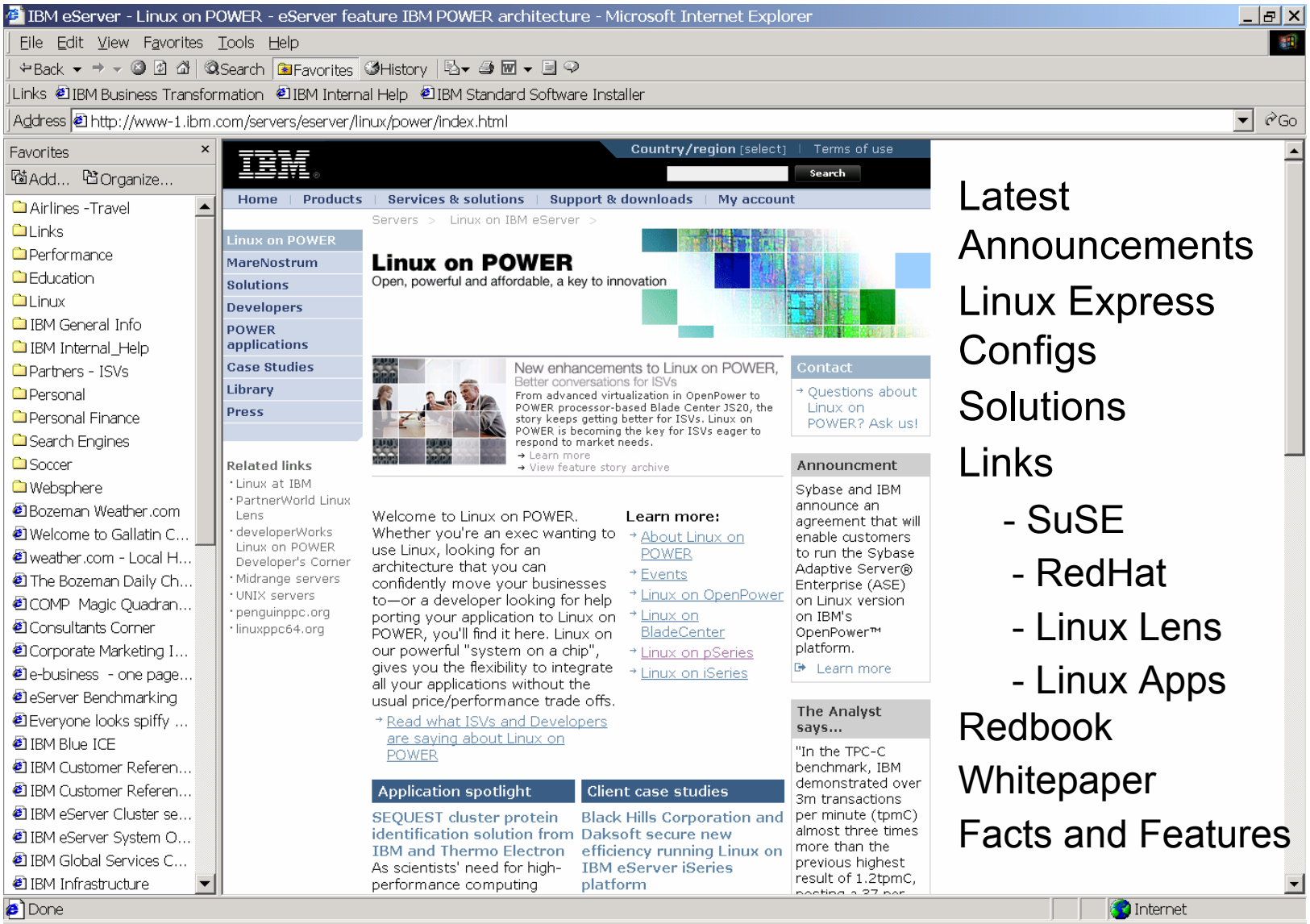
IBM TotalStorage™

DB2 **UDB**

Tivoli **System automation for Linux**

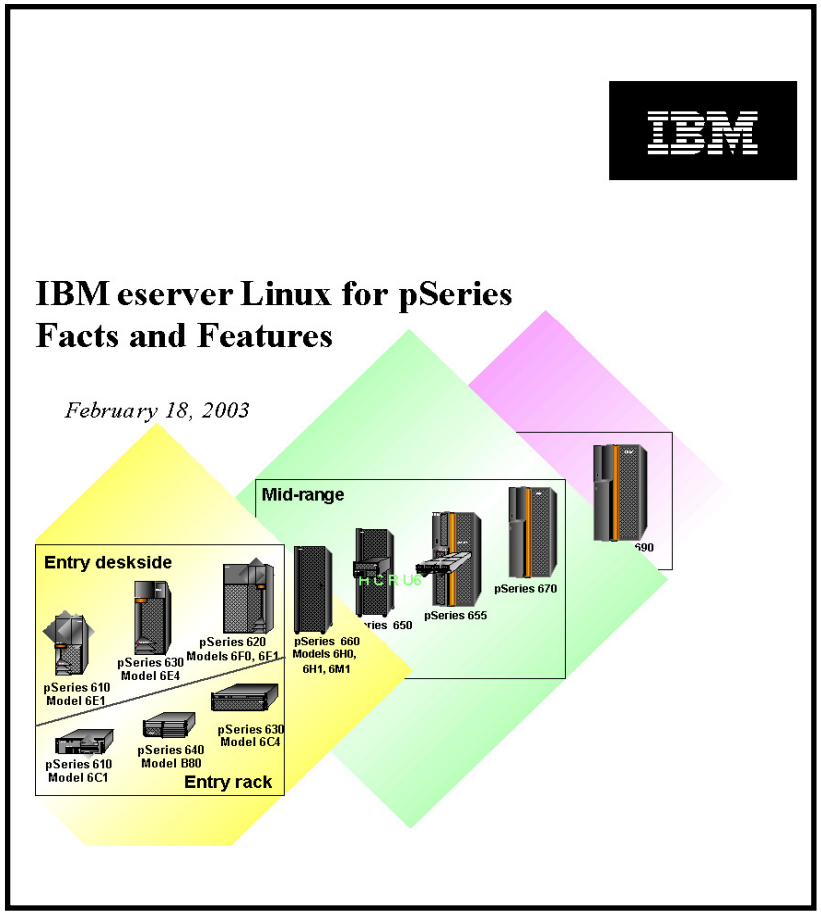
Linux-based Electronics Payments Switch

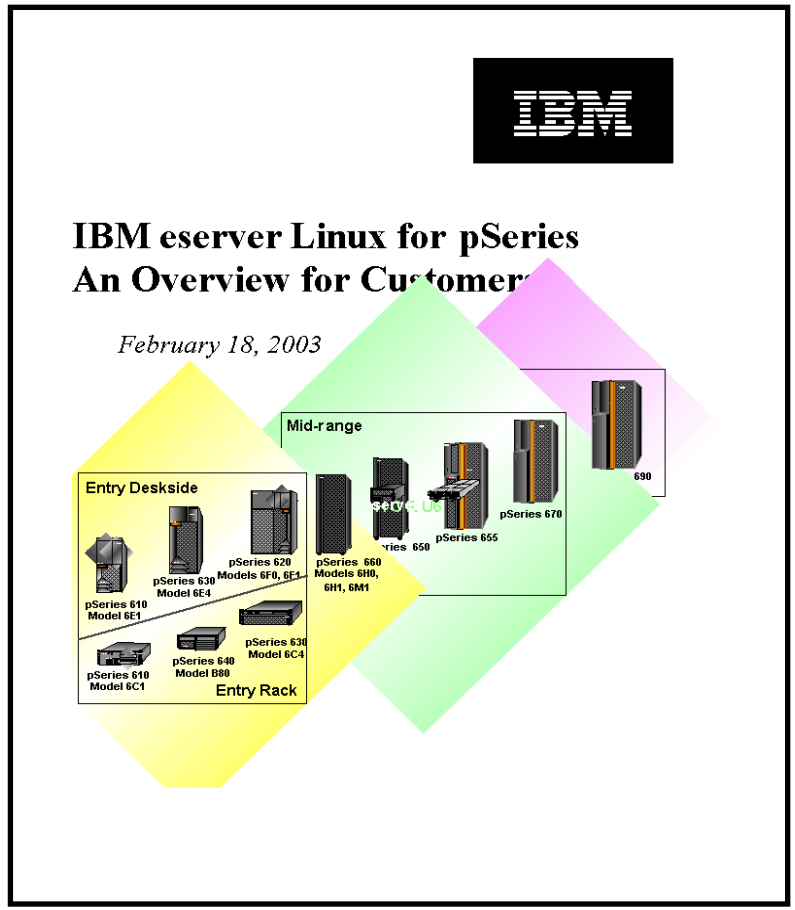
www.ibm.com/linux/power



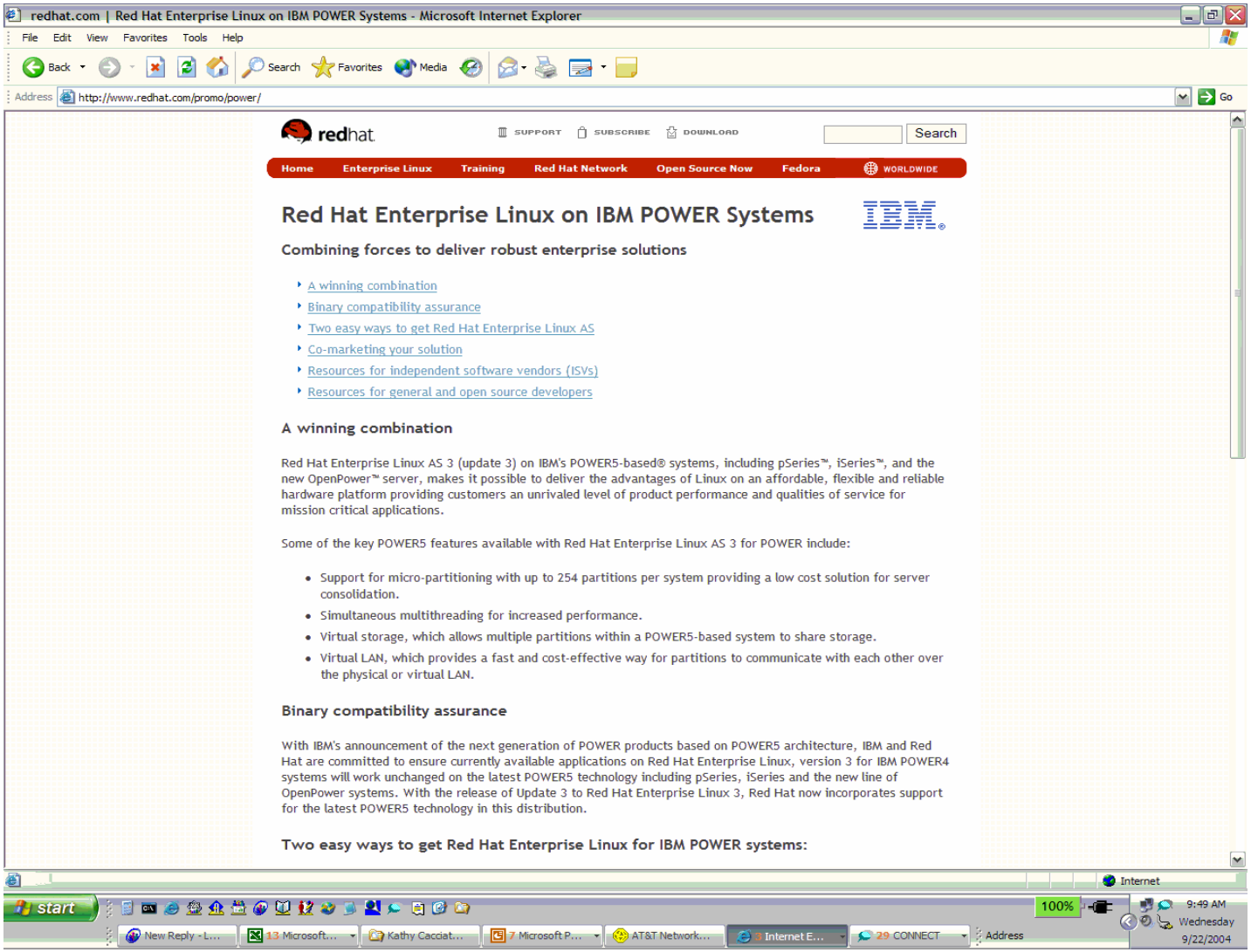
- Latest Announcements
- Linux Express Configs
- Solutions
- Links
  - SuSE
  - RedHat
  - Linux Lens
  - Linux Apps
- Redbook
- Whitepaper
- Facts and Features

Customer Deliverable for pSeries Linux

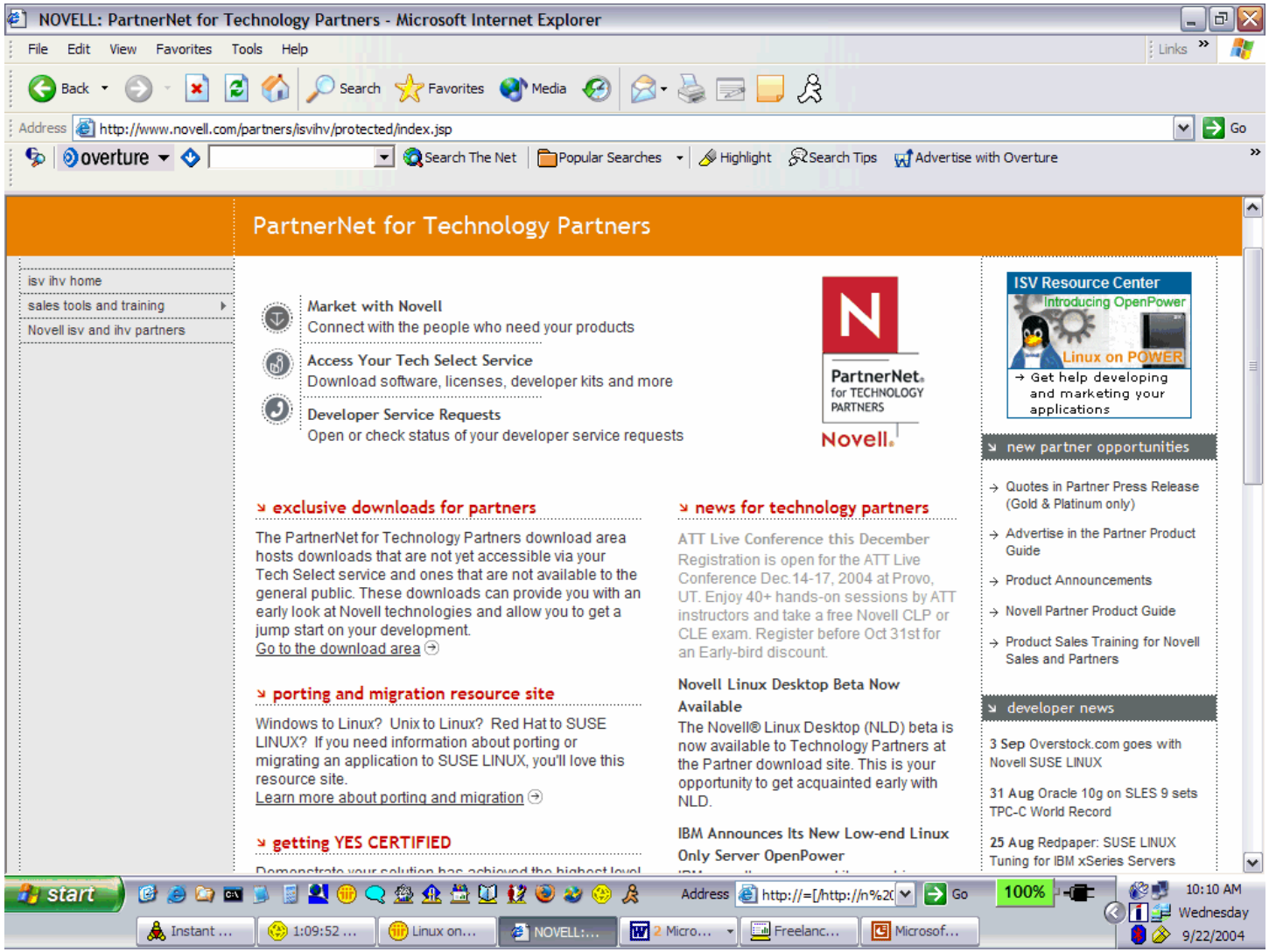


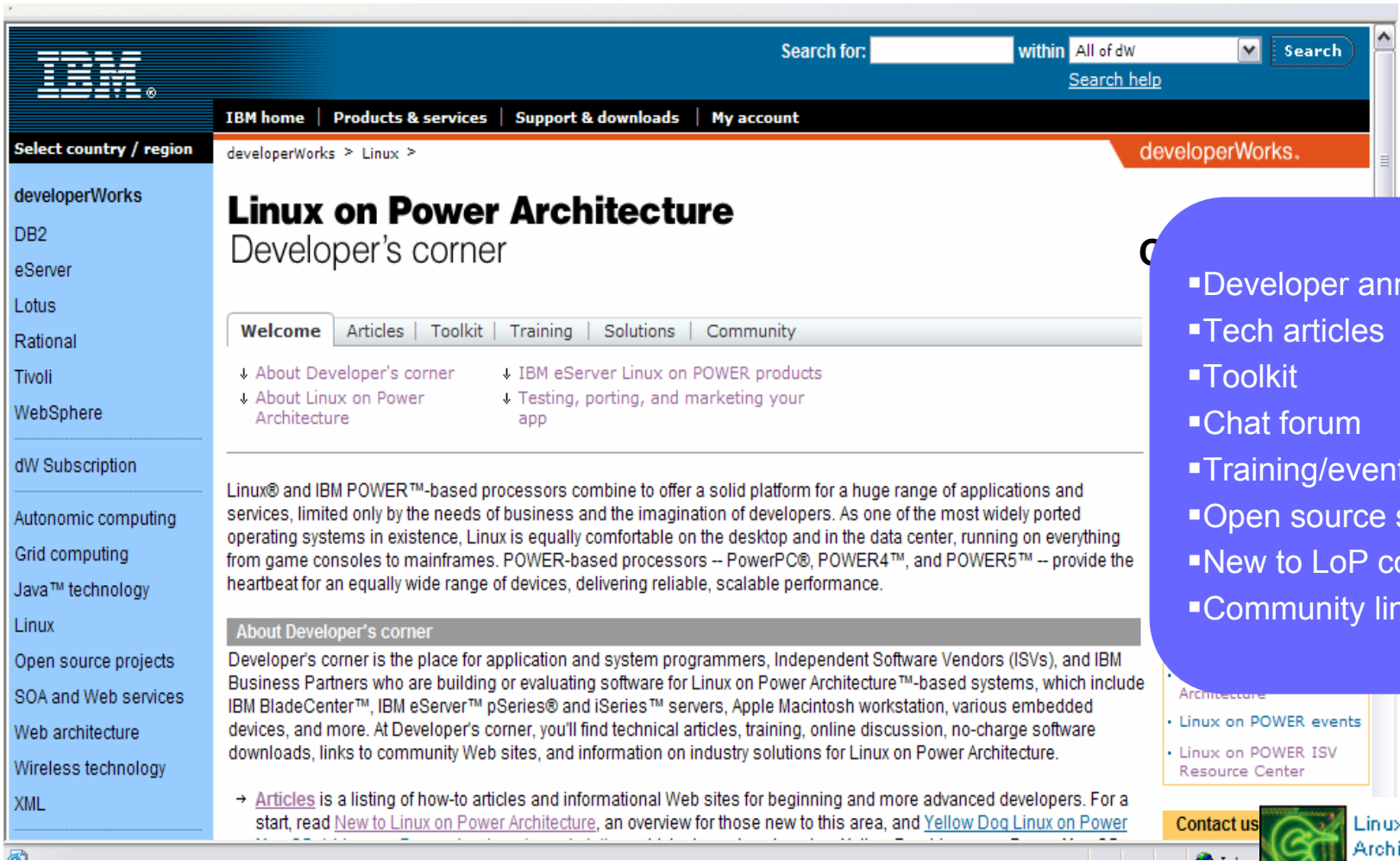


Red Hat POWER Promo Page



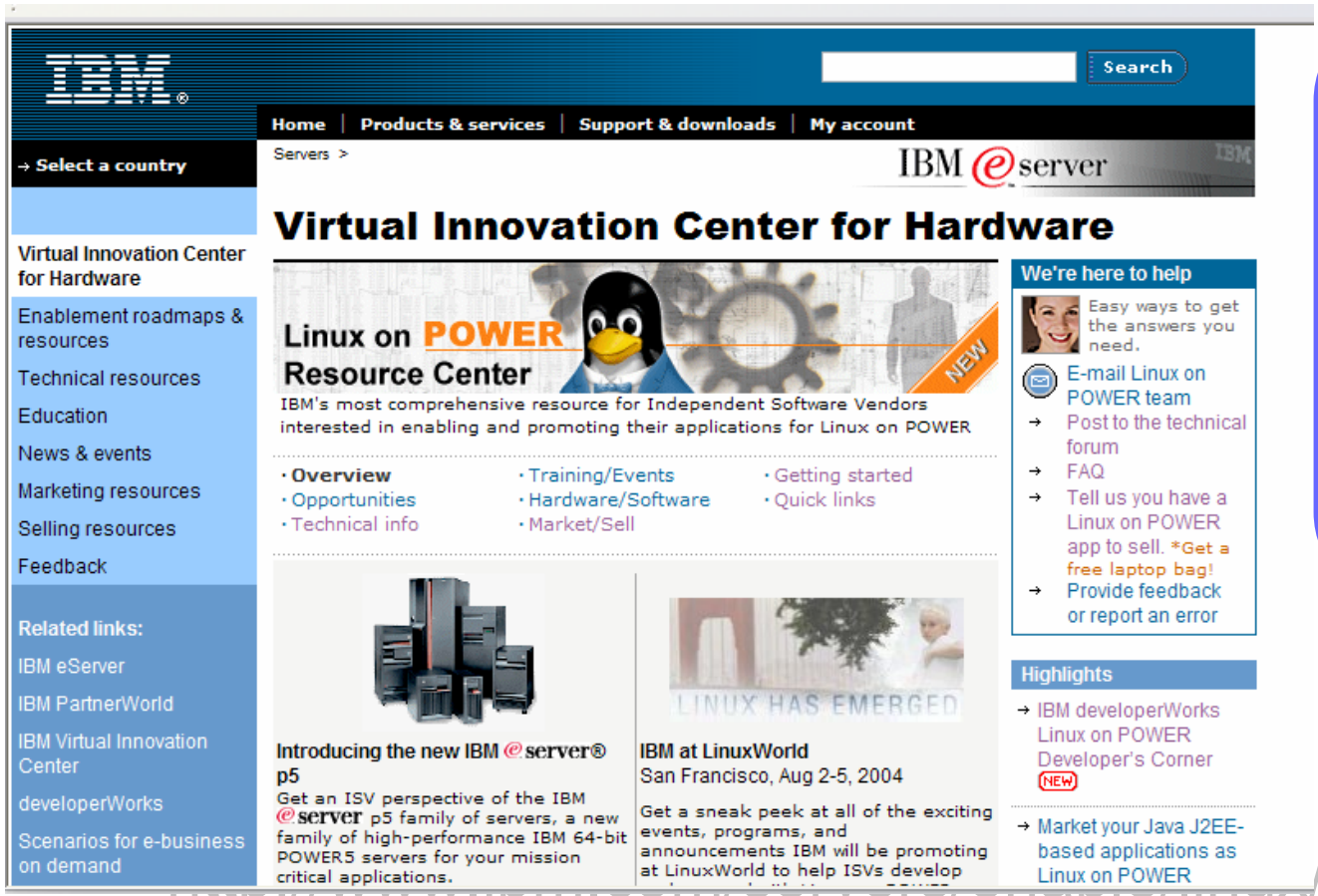
Novell Partner Page





- Developer announcements
- Tech articles
- Toolkit
- Chat forum
- Training/events
- Open source solutions
- New to LoP content
- Community links

http://www.ibm.com/developerworks/linux/power



- Announcements
- Biz opportunities
- Roadmaps
- Tech collateral
- Training/Events
- Hardware/Software resources
- Market/Sell resources
- Tech support
- FAQ
- Quick links

http://www.ibm.com/servers/enable/linux/power

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Revised February 6, 2004

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