

# Building a Better Infrastructure With IBM Middleware on IBM Power Systems

Consolidation Through Virtualization  
Saves Space, Energy and Costs

## Underutilization Drives Consolidation

What is your  
average server  
utilization?



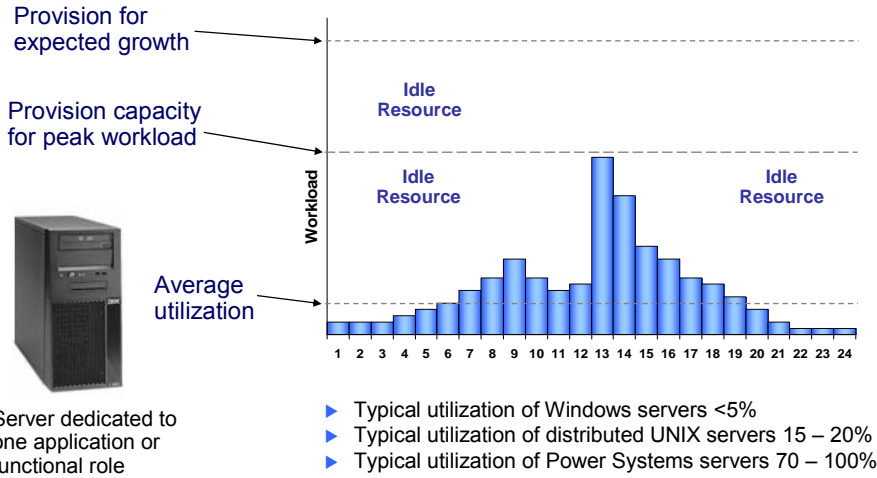
**Service Oriented Finance  
CIO**

Well,  
My Windows servers  
average 5-10%, and my  
UNIX servers average  
about 27% utilization.



**Data Center Manager**

# Utilization of Distributed Servers



# What's a CIO To Do?

Forget about your budget request for more servers. Fix this!



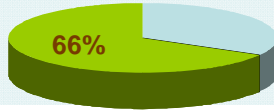
Service Oriented Finance  
CIO



Data Center Manager

## Many Businesses Today See Server Consolidation as the Answer

Percentage of companies consolidating to reduce costs



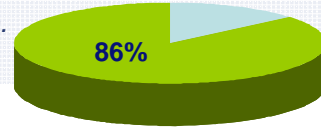
*Two-thirds of the companies surveyed prefer to run multiple applications per server in order to minimize costs and labor and to increase flexibility and system utilization.*

- IBM Market Intelligence Research, High End UNIX Buyers, November 2005

*"Most companies have already begun consolidating their servers — 86 percent of the CIOs we asked cited progress in this area. Virtualization is the next natural move."*

- McKinsey Quarterly, May 2006

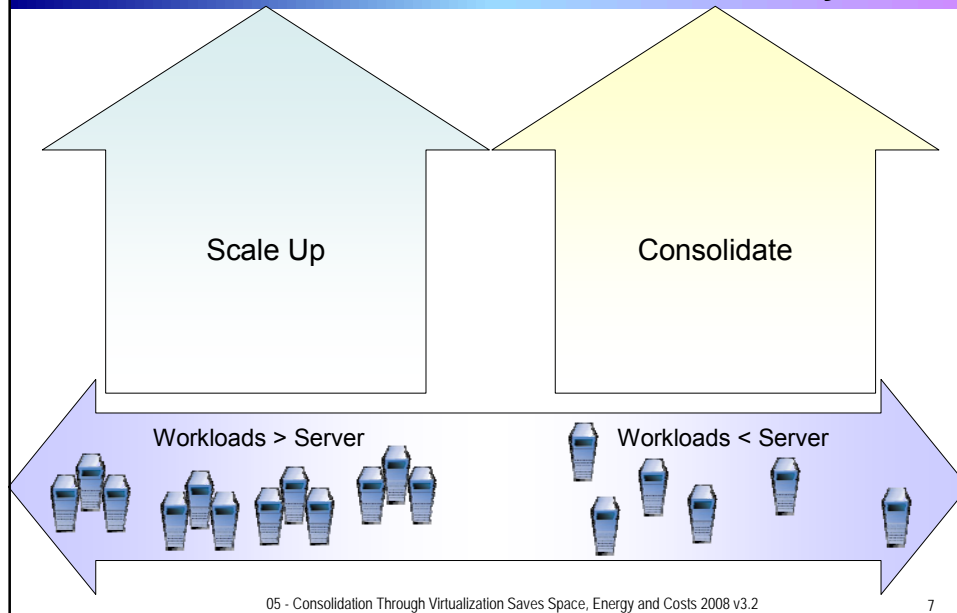
Percentage of CIOs consolidating servers



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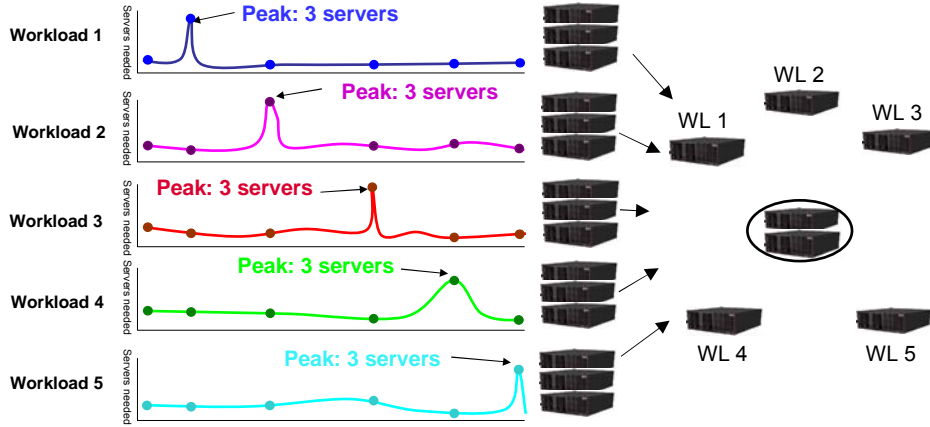
## Let's Focus on Consolidation With Power Systems



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## Theoretically Run the Same Workloads with Less Resources

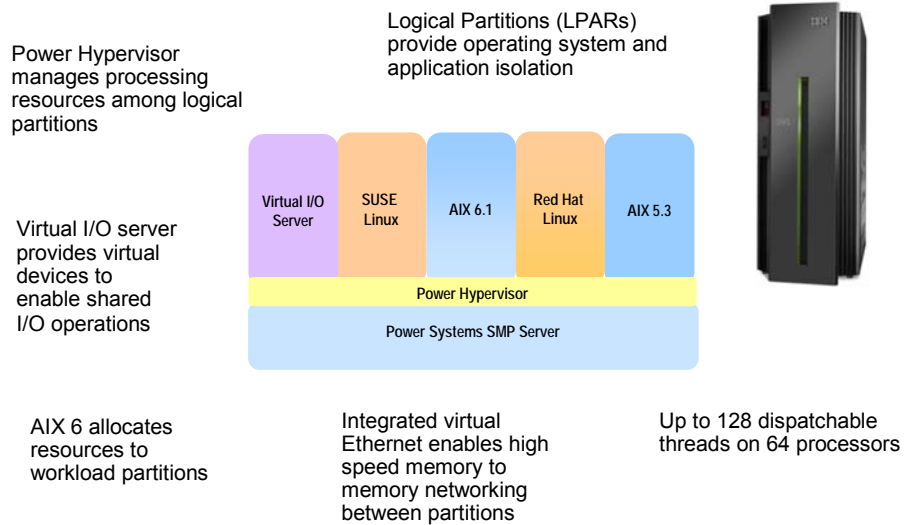


**What's Required: Virtualization and intelligent workload management to accommodate shifting workloads – Automatic on Power Systems**

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## Virtualization – How It Works on Power Systems

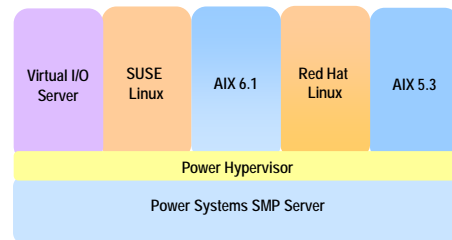


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## Logical Partitions (LPARs)

- Create Logical Partitions to run different workloads
- Install operating system and applications into each LPAR
- Power Hypervisor and Virtual I/O Server dynamically allocate and manage resources among LPARs
  - ▶ Logical Processors – shared or dedicated
  - ▶ Memory
  - ▶ Storage
  - ▶ Networking



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## Virtual I/O Server (VIOS) – A Special Purpose LPAR

- Runs in a logical partition itself
  - ▶ Based on AIX, but not a general purpose partition
  - ▶ No additional licenses needed – included in PowerVM
- Shares I/O resources among the Logical Partitions
- Provides the user interface for the Power Hypervisor to dynamically allocate resources
  - ▶ Hardware management functions
    - Integrated Virtualization Manager (IVM) user interface
- Provides the Power Hypervisor with resource usage data
  - ▶ To facilitate physical resource management and utilization

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## Processors Are Virtualized And Shared

- Physical processors are either dedicated to a specific LPAR or assigned to the shared pool
  - ▶ LPARs utilize available processing units in shared pool as needed
- The Power Hypervisor applies processing power where and when it is needed
  - ▶ Always makes sure an LPAR gets its entitled processing units
    - Min – how much the LPAR must get to be able to start
    - Max – the maximum amount the LPAR can ever get (a cap)
    - Entitled – how much the LPAR is always guaranteed when needed
- Core processing capacity is allocated to LPARs in one one-hundredth (0.01) increments
  - ▶ MicroPartitioning
- Dedicated processors can lend available processing units to the shared pool

## DEMO: Prepare to Consolidate by Creating a New LPAR

- Create a new LPAR for a new file server
  - ▶ Configure min, max and entitled values for processors and memory
  - ▶ Define virtual devices

**View/Modify Partitions**

To perform an action on a partition, first select the partition or partitions, and then select the task.

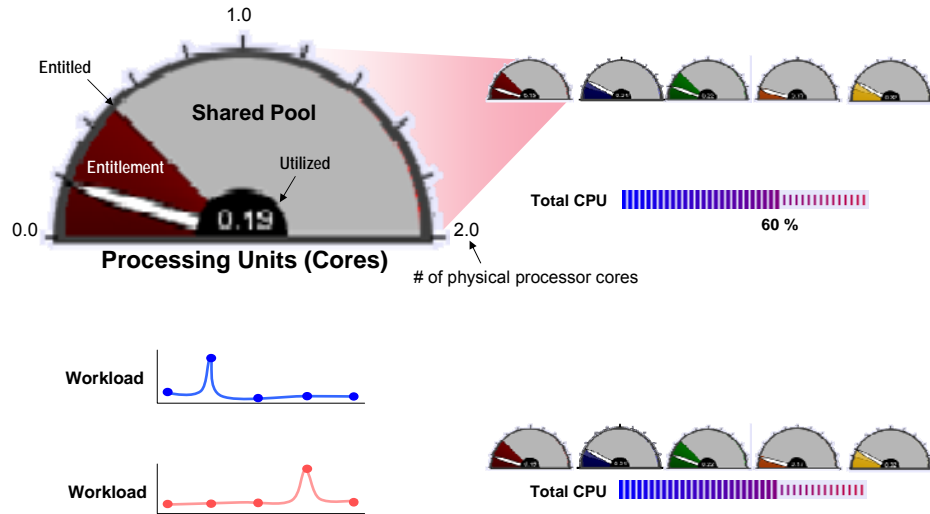
**System Overview**

Total system memory:	0 GB	Total processing units:	2
Memory available:	416 MB	Processing units available:	0
Reserved firmware memory:	272 MB	Processor pool utilization:	0.19 (9.5%)
System attention LED:	Inactive		

**Partition Details**

Select	ID	Name	State	Uptime	Memory	Processors	Entitled Processing Units	Utilized Processing Units	Ref
<input type="checkbox"/>	1	VIOS	Running	2.94 Hours	512 MB	1	0.5	0.03	
<input type="checkbox"/>	2	DB_Server	Running		1.2 GB	2	0.2	0.00	C2001
<input type="checkbox"/>	3	SLES	Running	2.91 Hours	1.31 GB	2	0.5	0.02	SuSE
<input type="checkbox"/>	4	Mail_Server	Running	2.91 Hours	1 GB	2	0.2	0.02	
<input type="checkbox"/>	5	AI06	Running	2.91 Hours	1.31 GB	2	0.2	0.04	
<input type="checkbox"/>	6	App_Server_1	Running	3.6 Minutes	1 GB	2	0.2	0.04	
<input type="checkbox"/>	7	App_Server_2	Running	1.49 Hours	1 GB	2	0.2	0.04	

## DEMO: Maximize Processor Utilization with Shared Processors



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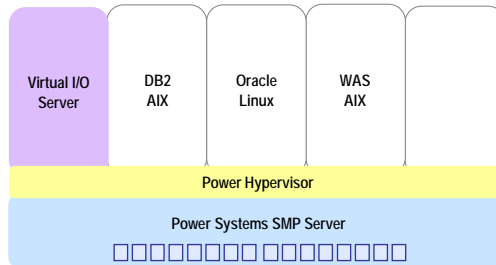
## Candidates for Easy Workload Consolidation on Power Systems

Workload	How
Workloads from smaller Power Systems	Deploy
Middleware workloads <ul style="list-style-type: none"> <li>▶ Infrastructure (Web, file servers, DNS, DHCP...)</li> <li>▶ Database (DB2, Oracle, Informix ...)</li> <li>▶ Java and J2EE Web Application Servers</li> <li>▶ Collaboration (Domino, SameTime ...)</li> <li>▶ Systems Management (Tivoli ...)</li> </ul>	Deploy
Other Linux Workloads <ul style="list-style-type: none"> <li>▶ C/C++ Applications</li> <li>▶ Intel-specific Linux applications</li> </ul>	Recompile PowerVM Lx86
SOA and Emerging Applications <ul style="list-style-type: none"> <li>▶ Web 2.0</li> <li>▶ ESB and SOA stack infrastructure</li> <li>▶ New media</li> <li>▶ Enterprise search and analytics</li> </ul>	Deploy

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## Consolidating Workloads on Power Systems



Workloads less than server capacity



## PowerVM Lx86 Runs Your Linux x86 Applications

- Run your 32-bit Linux x86 applications without any modifications – not even recompilation
  - ▶ Full 32-bit Intel x86 ISA, including MMX and Floating-point
  - ▶ Support for Red Hat AS 4 U4 and newer and Novell SLES 9 and 10
  - ▶ Interoperability between applications running on PowerVM Lx86 and native POWER
- Useful when the source code is not available
- Performance
  - ▶ Targeted application performance 80%+ of native Linux for POWER

Linux x86 Application

PowerVM Lx86



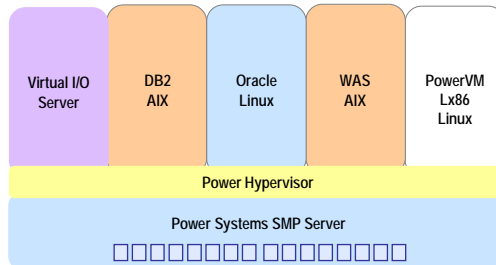
Linux on x86



Linux LPAR on Power Systems



## Consolidating Workloads on Power Systems



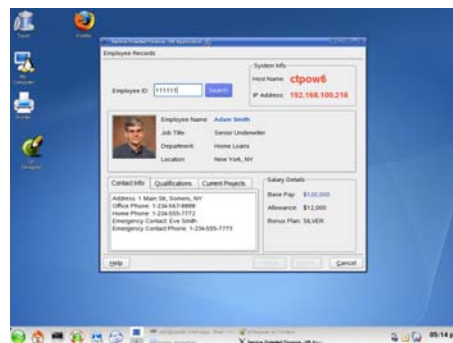
Workloads  
less than  
server  
capacity



## DEMO: Consolidating an Application onto PowerVM Lx86 on Power Systems

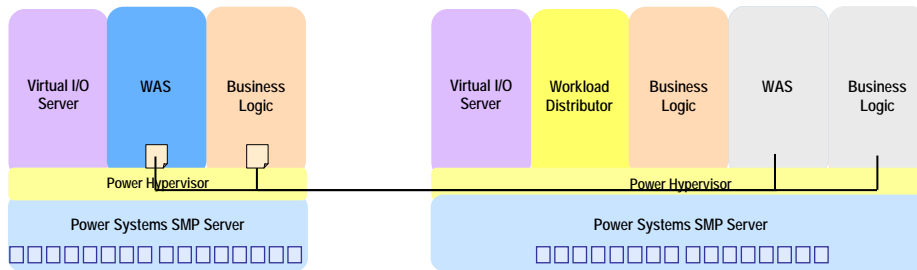
- Human Resource application
- Running on a Linux x86 system with X Windows
- Source code is not available
- Consolidate on PowerVM Lx86 with no recompilation

HR Application on PowerVM Lx86



## PowerVM Live Partition Mobility Moves Running LPARs Between Machines

- No LPAR downtime
- Move LPAR within the same or different physical servers
  - ▶ Both LPARs must share access to the same storage
- Manual or automatically initiated (e.g load usage, cron tasks ...)
- Useful for workload balancing, maintenance and weekend shutdowns
- Live application mobility is a similar concept for PowerVM AIX Workload Partitions



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## The Competitors Can't Match Power Systems Virtualization Capabilities

	IBM PowerVM	Sun Logical Domains	HP Integrity IVM	VMware ESX Server
<b>Bare metal hypervisor</b>	Integrated with hardware	T1, T2 with limitations	No	Implemented in software
<b>Hardware assists</b>	Hardware, hypervisor integration	New technology, not complete	Third party, not complete	Third party, not complete
<b>Maximum number of cores per partition</b>	64	8	4	4
<b>Secure virtualization</b>	EAL4+	Not Certified	Not Certified	EAL2
<b>Live Partition Mobility</b>	PowerVM integrated	No	No	VirtualCenter
<b>Workload Partitions</b>	AIX6	Solaris 10	No	No
<b>Live Application Mobility</b>	Auto or Manual	Manual (requires stop)	No	No

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## What's Possible with IBM Software on Power Systems?



- Any data center growth would have required multimillion dollar build out
- Consolidated **65** HP servers on **2** IBM Power Systems p5-595 servers (one primary and one backup)
  - ▶ Leveraged LPAR technology to manage capacity and plan for growth while lowering existing data center costs and eliminating build out requirement.
- Production, development and test requirements meant significant underutilized capacity in the data center
- Using LPAR technology, consolidated **30** preexisting servers into **1** IBM Power 570 running AIX
- Additional capacity now available as well

## Power Systems Consolidation Optimizes IT

### Increase operational efficiency:

- Improvement of resource utilization
- Ability to quickly add new services on demand
- Delivery of higher levels of availability
- Simplified IT environment

### Lower the cost of IT by minimizing:

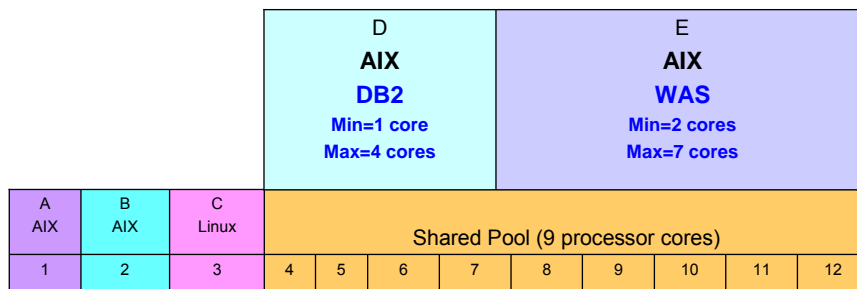
- Hardware and software costs
- Environmental costs
- Labor
- Networking costs

## IBM's Sub-Capacity Pricing For Software

- Flexible payment options for IBM software according to logical partition (LPAR) usage on Power Systems
  - ▶ Dedicated and Shared cores
- *You* decide how many processors to license per software application
- *You* decide how to assign processor partition workloads
- *You* can revise processor assignments to meet requirements

## License Counting: Shared Pool with Multiple Partitions

**Server with 12 processor cores**



**DB2 cores to license:**

- 4 for partition D

**WAS cores to license:**

- 7 for partition E

## Oracle Has No Sub-Capacity Pricing

“Oracle does not offer special licensing terms for server usage models where the number of CPUs can be scaled down or their usage varied – the ‘Pay Per Use’ or ‘Pay Per Forecast’ models.”

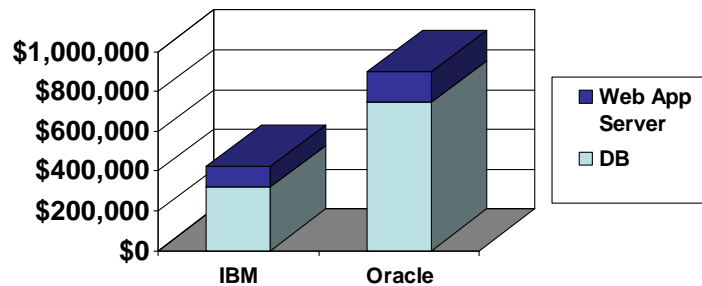
Source: Oracle Corporation, Jan 15, 2008 - <http://www.oracle.com/corporate/pricing/partitioning.pdf>

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## Middleware on Power Systems: IBM vs. Oracle Pricing

Price of DB & Web App Server on 4 Cores of a 12-core Power 570



Price Sources: DB2, Partitioning, WAS ND: IBM.com Passport Advantage Express Software Catalog, Oracle Database EE, Partitioning, Server SE: Oracle Technology Global Price List, September 4, 2007.

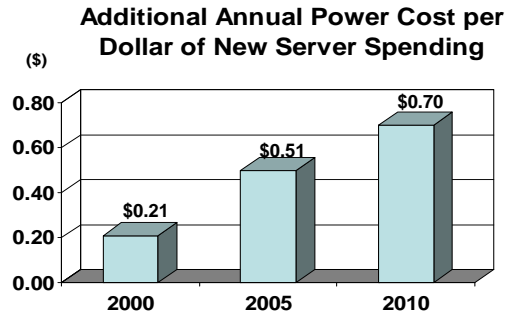
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# Cost of Power and Cooling

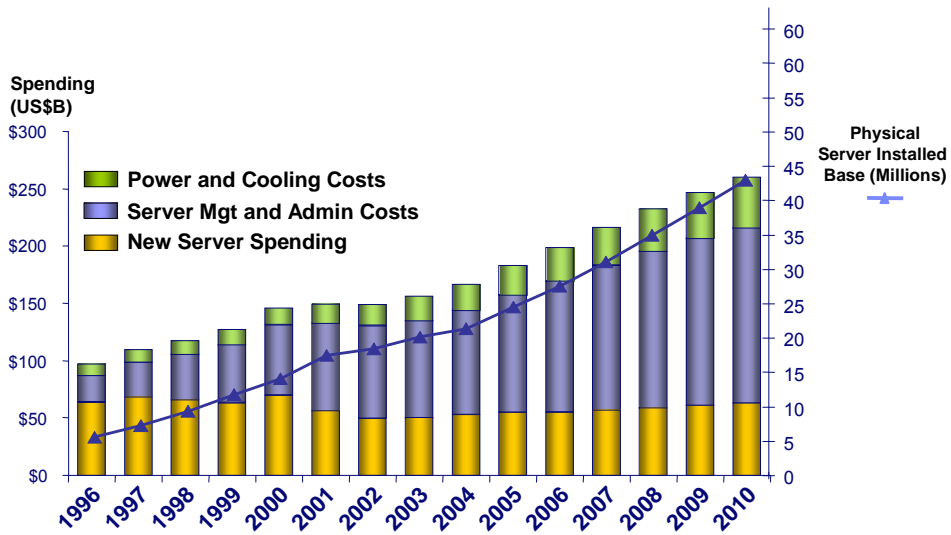
## Data Center Power Crisis

- Half of the data centers in the world are going to be unable to support server power requirements by the end of 2008.
  - **Energy costs will become the second largest operating cost** in 70% of data centers by 2009.
- Gartner Group, 25<sup>th</sup> Annual Data Center Conference, December 2006.



Source: Enabling Technologies for Power and Cooling, IDC, September 2006.

# When Budgets Are Fixed, More Money for Labor Means Less for New Projects



Source: IDC, May 2006.

## Annual Cost Per Unconsolidated Server

### Annual Cost\*

Power	\$731
Floor Space	\$987
Annual Server Maintenance	\$777
Annual Connectivity Maintenance	\$213
Annual Disk Maintenance	\$203
Annual Software Support	\$10,153
Annual Enterprise Network	\$1,024
Annual Sysadmin	\$20,359
<b>Total Annual Costs</b>	<b>\$34,447</b>

Wow!  
\$34,447!



\* Source: IBM Internal consolidation project

*For 30 unconsolidated servers, annual costs are \$1,033,410*

## Consolidation Cost Summary and Comparison – 30 Servers to 1 Power 570

### Power Systems One Time Charge

Server Acquisition	\$ 725,582
Connectivity Acquisition	\$ 38,321
Disk Acquisition	\$ 98,718
Software Licenses	\$ 488,678
Migration Cost	\$ 505,488
<b>Total OTC (Cost of migration)</b>	<b>\$ 1,856,787</b>

75% reduction in annual operations cost

80+% reduction in power consumption

(Includes cost of migration!)

### Power Systems Annual Cost

	Year 1	Years 2+
Power	\$ 4,214	\$ 4,214
Space	\$ 375	\$ 375
Annual Server Maint.	\$ 33,564	\$ 33,564
Annual Connectivity Maint.	\$ 1,532	\$ 1,532
Annual Disk Storage Maint.	\$ 3,948	\$ 3,948
Annual SW Support	\$ 1,499	\$ 97,469
Annual Ent. Network	\$ 13,824	\$ 13,824
Annual Sys Admin.	\$ 82,888	\$ 82,888
<b>Total Annual Costs</b>	<b>\$141,844</b>	<b>\$ 237,814</b>

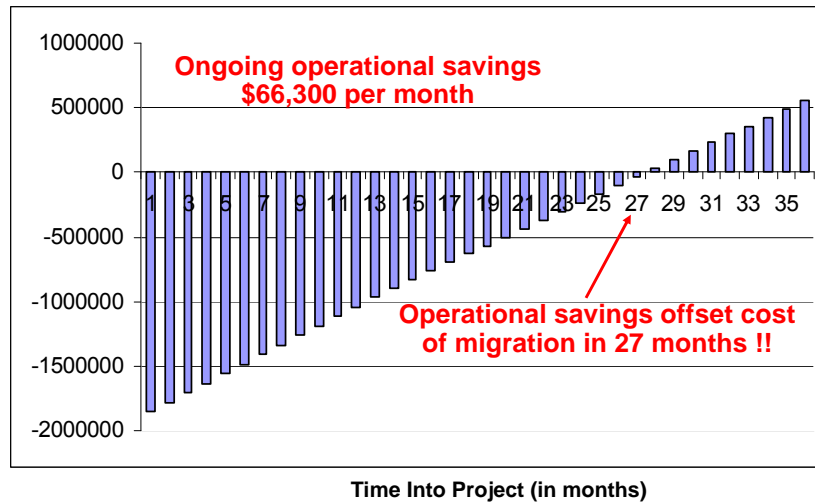
### Unconsolidated Annual Cost

	Per Year
Power	\$ 21,930
Space	\$ 29,610
Annual Server Maint.	\$ 23,310
Annual Connectivity Maint.	\$ 6,390
Annual Disk Storage Maint.	\$ 6,090
Annual SW Support	\$ 304,590
Annual Ent. Network	\$ 30,720
Annual Sys Admin.	\$ 610,770
<b>Total Annual Costs</b>	<b>\$ 1,033,410</b>

**Operational cost savings = \$ 891,566 yr 1, \$795,596 yrs 2+, Break even in 27 months!**

## Cash Flow Analysis

Savings Cash Flow When Consolidating 30 Servers to 1 Power 570



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## What Else Can Consolidation Do For You?

Over \$66,000 per month savings!  
That's great!



Data Center Manager

Don't forget network complexity and downtime cost you money too...



IBM

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## Network Sprawl is Another Legacy of Unconsolidated Servers



- Unconsolidated Servers Lead High Maintenance Cabling
- Raised Floors Clean Up Appearances On The Rack
  - ▶ Have the same issues, just buried under the floor



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## Even When Done Right, it is Hard to Service

- Even when properly organized administrators have to deal with a large number of cables
  - ▶ A single rack can have over 100 cables
- One misplaced connector or label can cause havoc in the whole network
- Once cables are strapped together, it is very hard to make changes



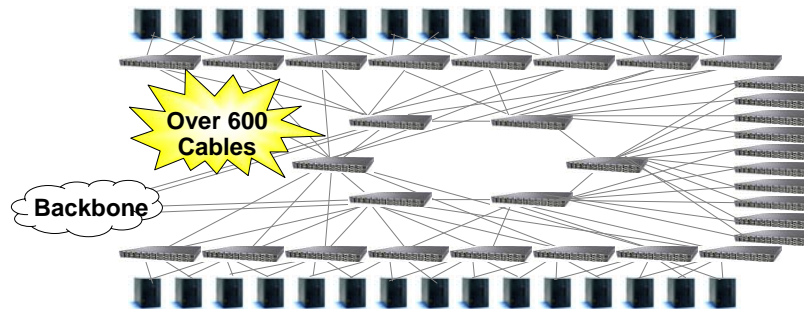
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## Case Study: Network Consolidation

- **Quebec Government**
  - Consolidated 292 servers into 2 System z's
- Before consolidation network required:
  - ▶ 25 stackable switches with 24 1-gigabit ports
  - ▶ 6 level 3 switches with 12 10GBps ports to connect switches

The diagram shows only 30 of the 292 Servers

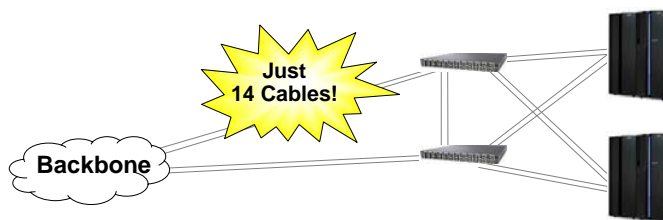


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## Case Study: After Consolidation of 292 Servers to 2 System z's

- The new network uses less hardware
  - ▶ 2 level 3 switches with 12 10GBps ports
- Better performance
  - ▶ Most traffic handled within the server virtual network
- Network cost savings of over **\$200,000.00** per year
  - ▶ Re-use existing networking hardware (no new purchases)
- Easier to manage and troubleshoot network



\*Estimate based on the ECM Study numbers for network connectivity costs. Physical server annual cost of \$1,237.00 X 292 servers and Virtual server annual cost of \$524 X 292 servers. Annual net savings of \$208,196.00

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## Hourly Downtime Cost by Industry

Industry	Hourly Business Cost	Per Employee
Energy	\$2,817,846	\$569
Telecommunications	\$2,066,245	\$187
Manufacturing	\$1,610,654	\$134
Finance/Brokerage	\$1,495,134	\$1,080
Information Technology	\$1,344,461	\$184
Insurance	\$1,202,444	\$371
Retail	\$1,107,274	\$244
Pharmaceuticals	\$1,082,252	\$168
Banking	\$996,802	\$131
Food Processing	\$804,192	\$153
Consumer	\$785,719	\$128
Chemicals	\$704,101	\$195
<b>Average</b>	<b>\$1,010,536</b>	<b>\$206</b>

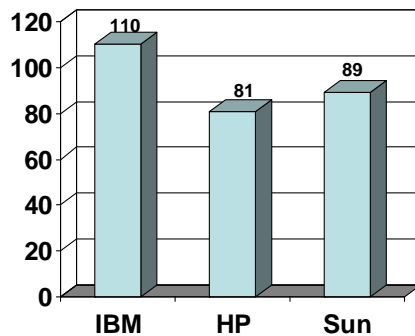
Source: IT Performance Engineering & Measurement Strategies: Quantifying Performance Loss, Meta Group, October 2000.

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## Customers Say Power Systems Availability Is Highest

### Observed Availability



Scoring: Gabriel Consulting's Vendor Preference Index (VPI)

Scores > 100 are great  
 Scores = 100 are par  
 Scores < 100 are not so good

Based on survey of 277 enterprise Unix customers in 4Q '06; one-third standardized on IBM, HP, Sun; 75% have two or more Unix variants.

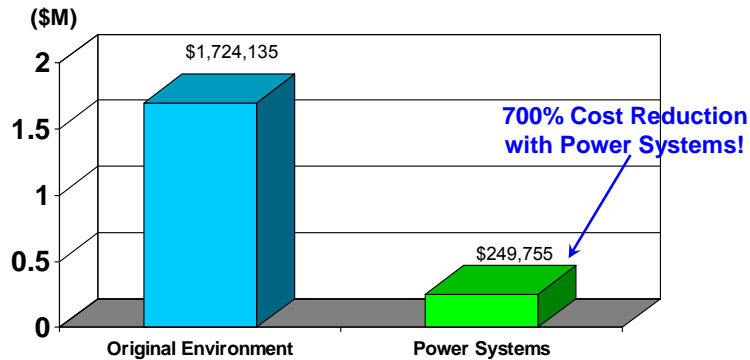
Source: Unix Vendor Preference Survey 4Q'06, Gabriel Consulting Group, December 2006.

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## Alinean Inc. Consolidation on Power Systems Reduced Annual Downtime Cost by \$1.47M

### Alinean Inc. Downtime Costs, Before and After Consolidation



Source: IBM System p5: Lower TCO Through Server Consolidation\*, Alinean Inc., September 2006.

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## IBM Factories Get You Started on the Road To Consolidation

- Free Proof of Concept and cost/benefit analysis
- Includes high level architecture
- Consolidation Discovery and Analysis Tool (CDAT) now available as a free download for IBM Sales and Business Partners

Our teams conduct data center interviews and run analysis tools to assess current efficiency and make consolidation recommendations.



IBM



- Migration Factory
- Server Consolidation Factory
- Availability Factory
- x86 Server Consolidation Factory on POWER Systems

IBM: [http://w3-1.ibm.com/sales/systems/portal/\\_s.155/254?navID=f220s380&qeolD=All&prodID=IBM%20Systems&docID=spschdatool](http://w3-1.ibm.com/sales/systems/portal/_s.155/254?navID=f220s380&qeolD=All&prodID=IBM%20Systems&docID=spschdatool)  
BPs: PartnerWorld

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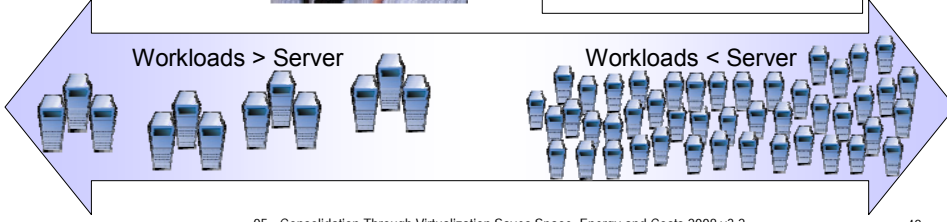
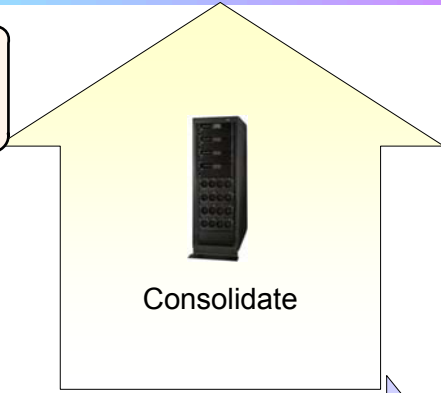
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# Service Oriented Finance Consolidated Their Servers onto Power Systems

You saved a lot of money by consolidating our servers.



And simplified my environment!



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## URLs and References

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- [Web Tier Consolidation](#)
  - ▶ [http://www-03.ibm.com/systems/p/hardware/annnc\\_0213/index.html?ca=p5&met=annnc\\_0213&me=W&P\\_Site=p5hero](http://www-03.ibm.com/systems/p/hardware/annnc_0213/index.html?ca=p5&met=annnc_0213&me=W&P_Site=p5hero)
- [Workload Manager Redbook](#)
  - ▶ <https://www.redbooks.ibm.com/redbooks/pdfs/sq245977.pdf>
- [Migration Factory](#)
  - ▶ <http://www-03.ibm.com/systems/migratetoibm/factory/>
- [System P Expert Corner](#)
  - ▶ <http://www-941.ibm.com/collaboration/wiki/display/Wikip5/Home>
- [IBM Systems Magazine – Virtualization Explained](#)
  - ▶ <http://www.ibmsystemsmag.com/opensystems/februarymarch05/coverstory/6793p1.aspx>