The IBM Enterprise Linux Server – A solution to your IT challenges

The Right Solution: IBM's Enterprise Linux Server

IBM

What's the right solution to address today's IT challenges?

Is this what
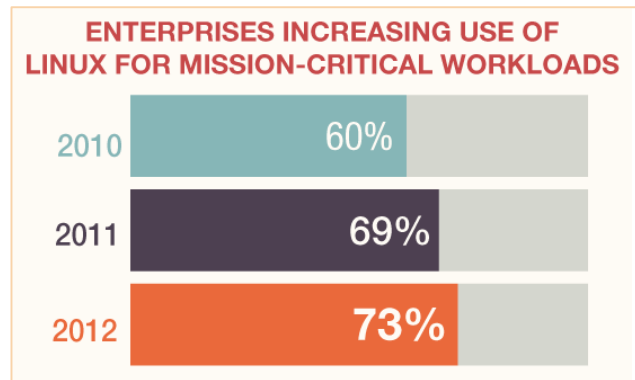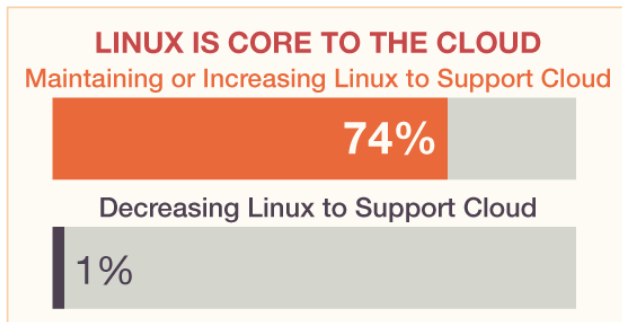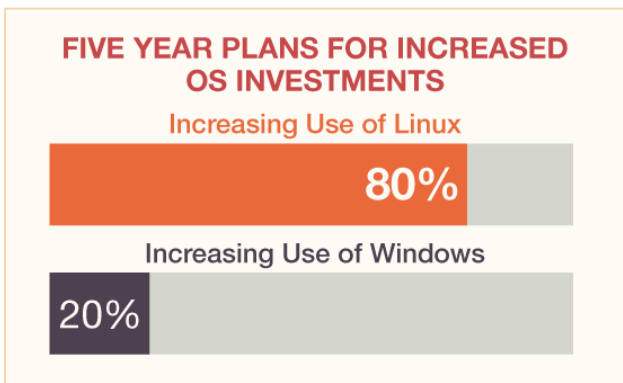your data center
looks like?

Is this where
you'd like to be?

- Currently running lots of x86 or UNIX servers

- Have serious concerns about
  - Downtime
  - Data security
  - Data center floor space and energy usage
  - Growth and scalability

- Strategically committed to Linux
  and open source

- Improved efficiency
  - Fewer servers, less networking
  - Fewer software licenses
  - Growth within the box
  - Better utilization of compute resources

- Reduced risk, better security, higher availability

- Reduced costs, reduced staff, simplification

Competitive Project Office

IBM

Linux adoption is growing to support cloud and mission-critical workloads

FIVE YEAR PLANS FOR INCREASED
OS INVESTMENTS

Increasing Use of Linux
80%

Increasing Use of Windows
20%

THE
LINUX
FOUNDATION

ENTERPRISES INCREASING USE OF
LINUX FOR MISSION-CRITICAL WORKLOADS

2010 — 60%
2011 — **69%**
2012 — **73%**

LINUX IS CORE TO THE CLOUD
Maintaining or Increasing Linux to Support Cloud
74%

Decreasing Linux to Support Cloud
1%

Competitive Project Office

IBM

Introducing the IBM Enterprise Linux Server

- An excellent platform for large scale consolidation

- Highly virtualized, and designed to run at very high CPU utilization rates

- Fast, very high-capacity processors; extreme scalability and elasticity; ultimate levels of reliability, availability and security

- Simplified administration, efficient IT operations

- Low comparable total cost of ownership (TCO)

- Ideal Linux platform for today and the future

Competitive Project Office

2. The Right Solution.pptx

Statistics models show how consolidating workloads drives up CPU utilization
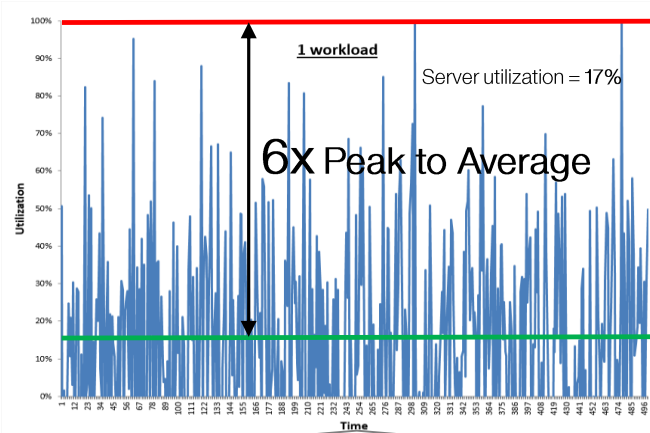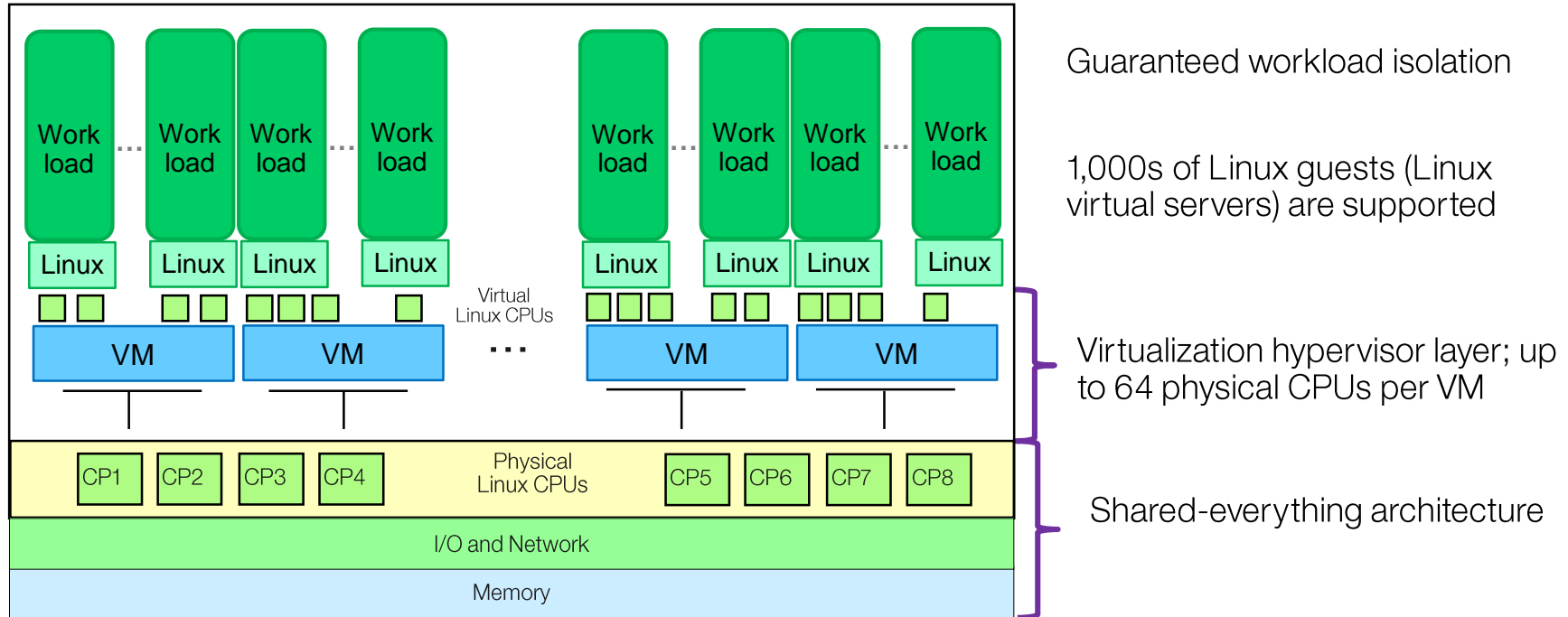

1 variable workload:
   Machine capacity (red) =
   6x average demand (green)
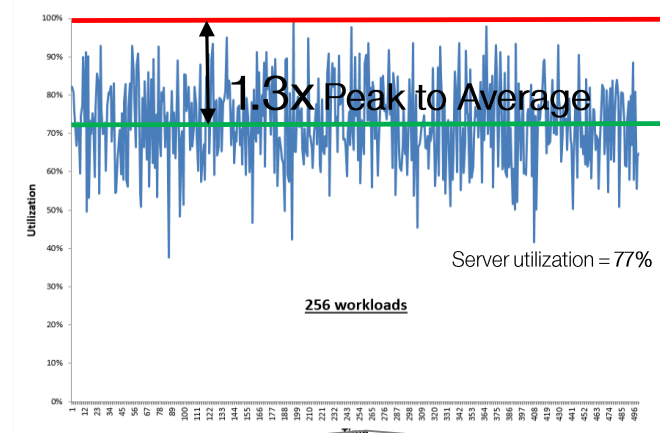
256 variable workloads:
   Machine capacity (red) =
   1.3x average demand (green)

- Consolidating large numbers of variable workloads reduces the overall variance (statistical multiplexing)

- Larger servers with capacity to run more workloads can be driven to higher average utilization levels without violating service level agreements

2. The Right Solution.pptx

IBM

ELS virtualization is built-in (not added-on) to give the best workload isolation

Guaranteed workload isolation

1,000s of Linux guests (Linux virtual servers) are supported

Virtualization hypervisor layer; up to 64 physical CPUs per VM

Shared-everything architecture

Diagram labels: Work load, Linux, Virtual Linux CPUs, VM, Physical Linux CPUs, CP1, CP2, CP3, CP4, CP5, CP6, CP7, CP8, I/O and Network, Memory

Hardware-enforced isolation: 10% of circuits support virtualization

2. The Right Solution.pptx

Enterprise Linux Server has superior virtualization compared to distributed servers

Enterprise Linux Server

- Most sophisticated and functionally complete hypervisors
- Virtualization can simulate devices not physically present
- Highly granular resource sharing (<1%)
- Deploy Linux virtual servers (guests) in seconds
- Add physical resources without taking system down
- Extensive built-in facilities for virtual server life-cycle management
- Hardware-enforced isolation

Enterprise Linux Server is designed to run 1,000s of Linux virtual servers at nearly 100% utilization nearly 100% of the time

Distributed Platforms

- Limited per-core virtual server scalability
- Physical server sprawl is needed to scale
- Operational complexity increases as virtual server images grow
- VMware tools only support VMware hypervisor (ESX)

Competitive Project Office
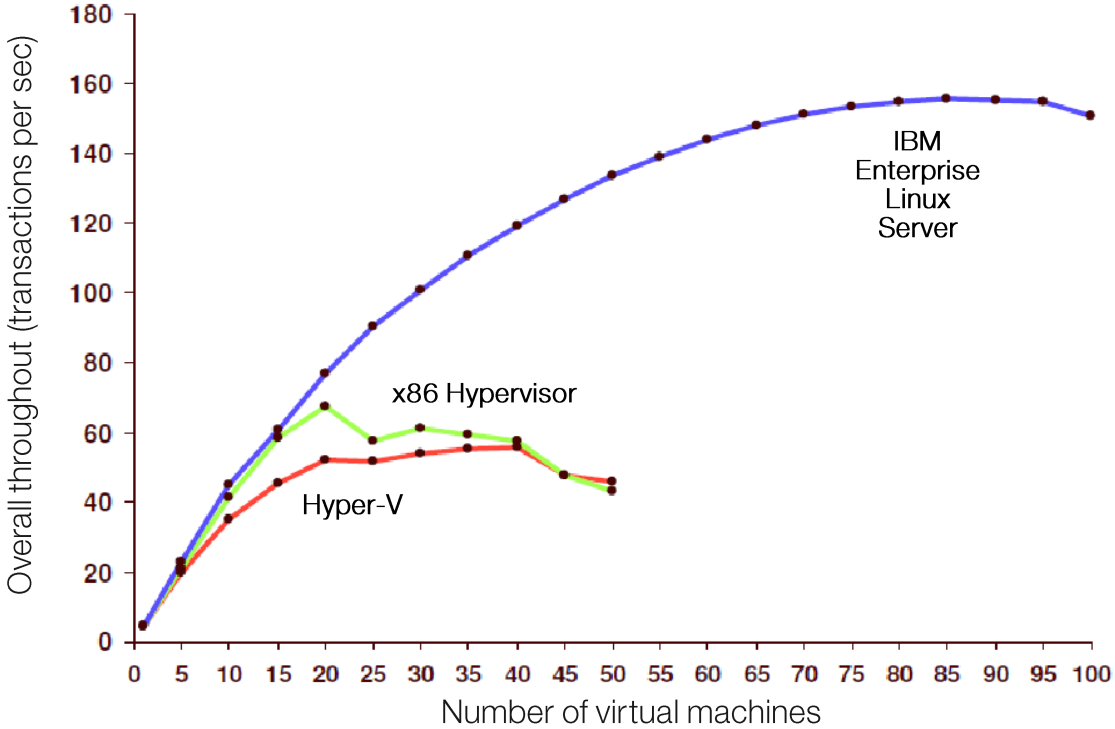
2. The Right Solution.pptx

IBM

A key strength to ELS virtualization is the ability to over-commit resources

- Hosted environment can support considerably more virtual CPU and memory, in aggregate, than what is configured for the VM instance

  - Translates directly into cost savings for hardware and software

  - Reduces overhead for administration, power and cooling, and space
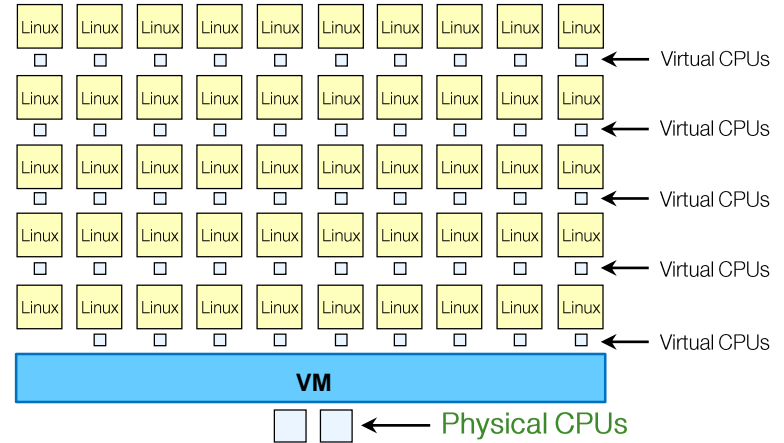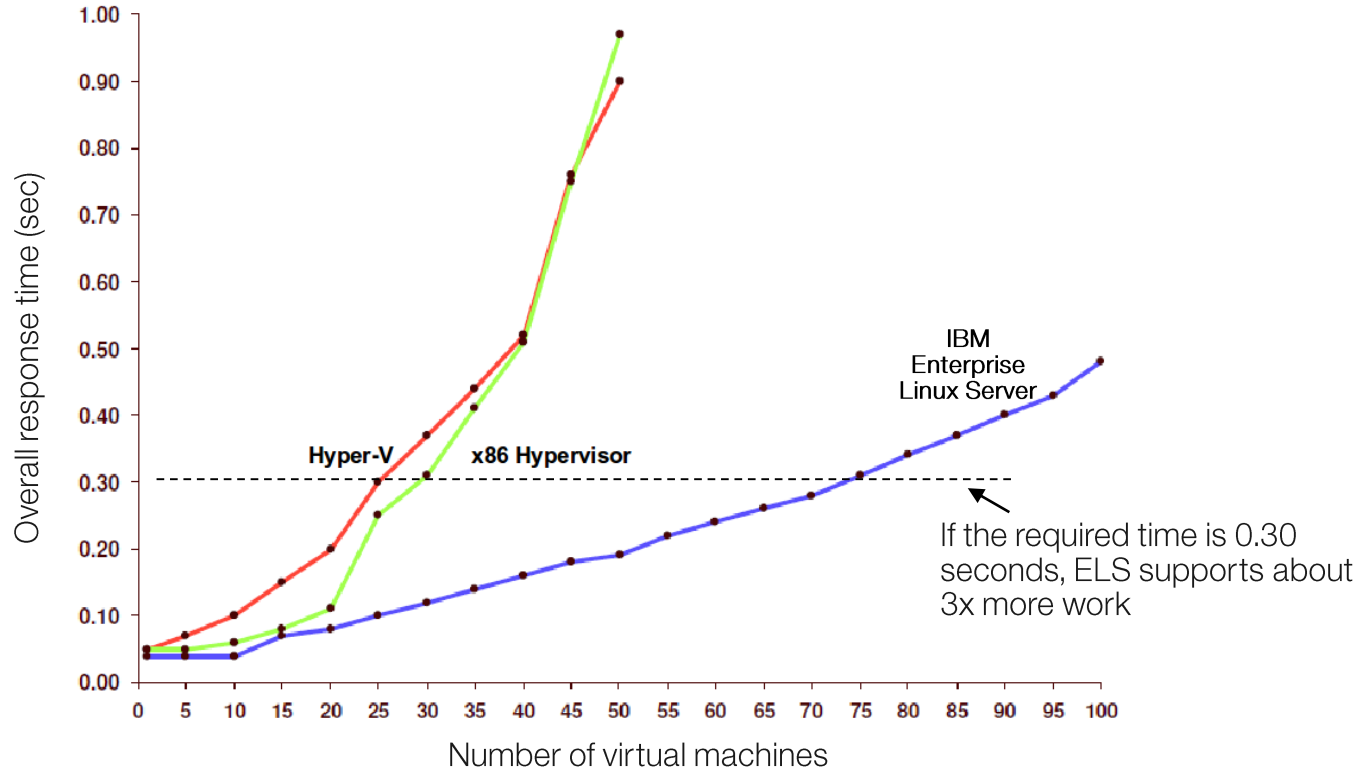

Example: Software is licensed for
two physical CPUs,
but runs on 50 virtual Linux CPUs

IBM

Throughput comparison for different virtualization platforms

Competitive Project Office

Response time comparison for different virtualization platforms

2. The Right Solution.pptx © 2015 IBM Corporation

IBM Enterprise Linux Server has many unique virtualization advantages

Hypervisor recursion!

Multiple application instances per Linux guest

Easy partitioning and virtual server cloning enables high availability

Partition-to-Partition communication via very fast in-memory TCP/IP

Competitive Project Office

Tests compare Enterprise Linux Server virtualization to a common x86 hypervisor

- High priority workloads had defined demand over time
  - Service Level Agreement (SLA) requires that response time not degrade over time

- Low Priority workloads had unlimited demand
  - Allowed to "soak up" any unused CPU resource

Web Workloads (10)
VM 1
High Priority

Web Workloads (14)
VM 2
Low Priority

Enterprise Linux Server
32 cores

Web Workloads (10)
High share

Web Workloads (14)
Low share

Common Intel Hypervisor

Intel Westmere EX
40 cores

Competitive Project Office

2. The Right Solution.pptx

IBM
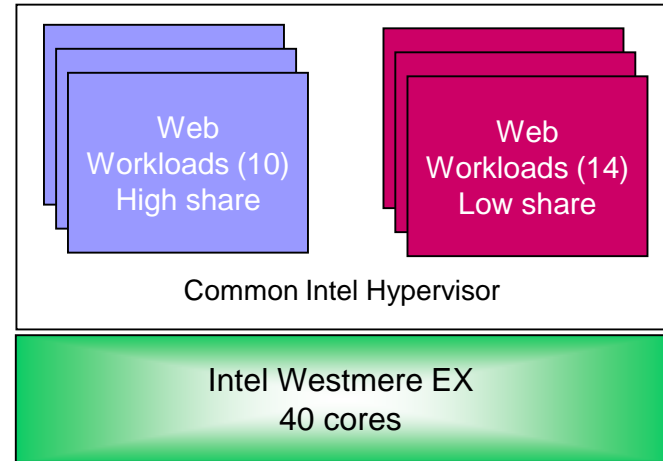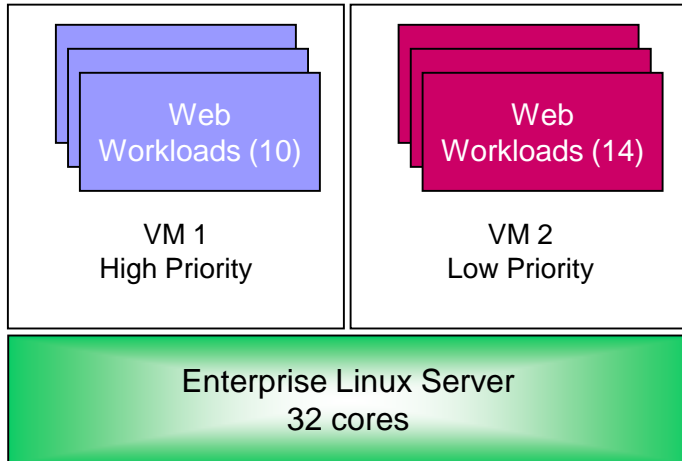
ELS has exceptional workload management, guaranteeing service delivery for workloads

High and low priority workloads

High and low priority workloads

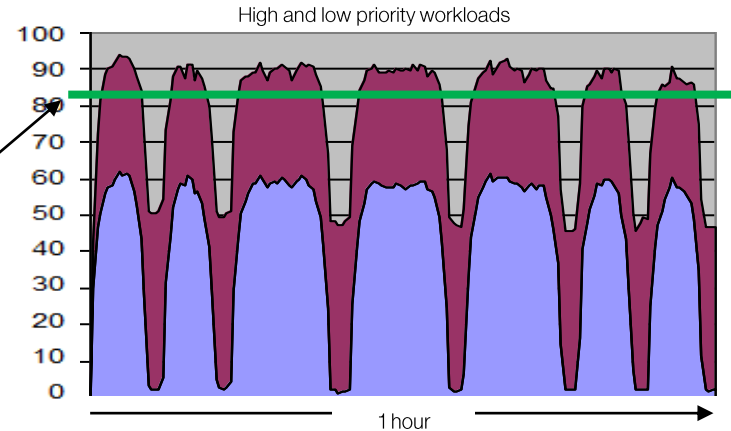Utilization levels for high priority workloads alone

1 hour

1 hour
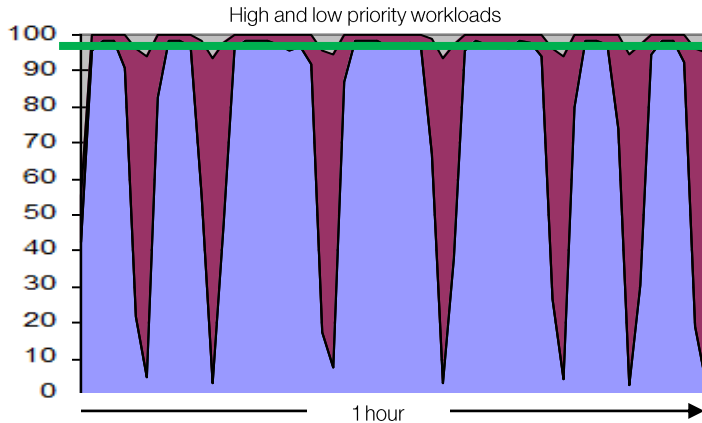
Enterprise Linux Server

High priority workloads (blue) run at very high utilization and do not degrade when low priority workloads added

Low priority workloads (maroon) consume all but 2% of remaining resources (gray)

Intel server with common x86 hypervisor

High priority workloads (blue) run at *lower* utilization and *degrade* when low priority workloads (maroon) added

Too much resource (gray) *remains unused* (22%)

Competitive Project Office

2. The Right Solution.pptx

IBM

Result: Enterprise Linux Server easily manages mixed priority workloads at lower cost

Which platform provides the lowest TCA over 3 years?

High priority workloads

Low priority workloads
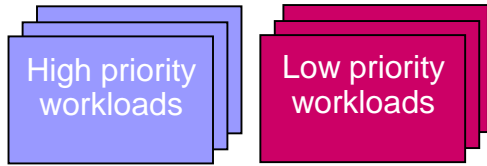
High priority online banking workloads driving a total of 9.1M transactions per hour and low priority discretionary workloads driving 2.8M transactions per hour

VMs

VMs

VMs
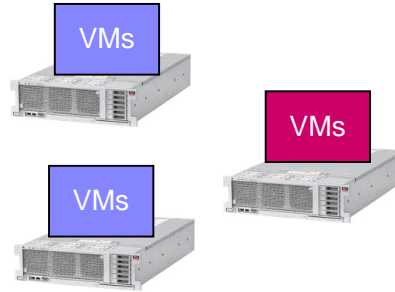
Virtualized on 3 Intel 40 core servers

$15.9M (3 yr. TCA)

VMs

VMs

Linux

Linux

VM

VM
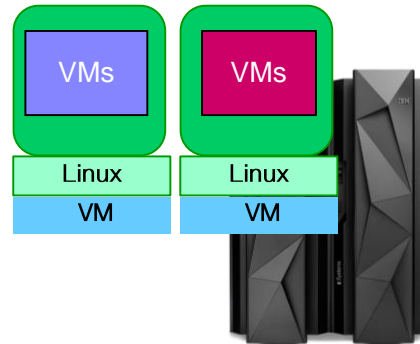
Enterprise Linux Server with 32 processors

$6.5M (3 yr. TCA)

59% lower cost!

Consolidation ratios derived from IBM internal studies. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

Competitive Project Office

IBM

Compared to other virtualization platforms, ELS demonstrates real economies of scale

Efficiency of Scale – TCO

Deployment Size and Complexity
- Medium
- Large
- Very Large

Lower is Better

Cost comparison (normalized)

x86   ELS

0.4 0.2 0.0 0.2 0.4 0.6
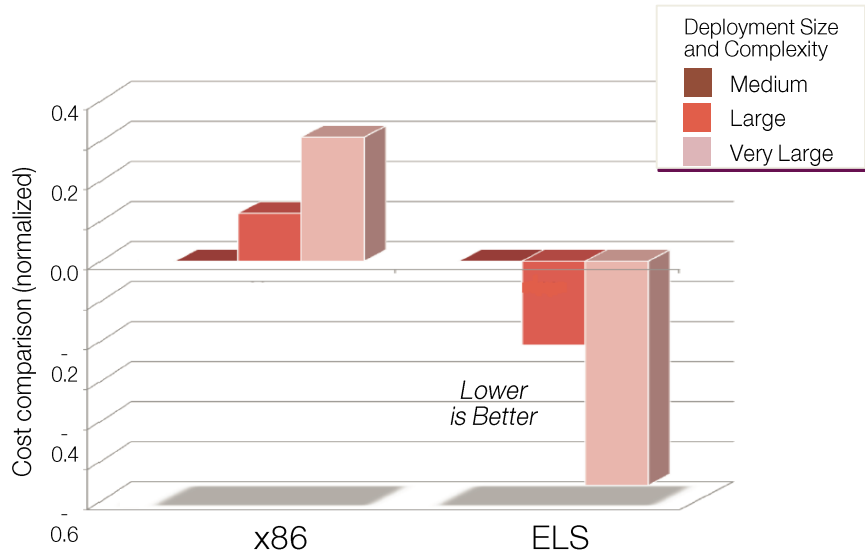
When going from Medium to Large Deployments:

- x86 – 135% *increase* in cost per VM
- ELS – 68% *reduction* in cost per VM

Better efficiency leads to savings of millions of dollars in deployment and operational costs

Competitive Project Office

Better economies of scale leads directly to reduced administration staffing levels
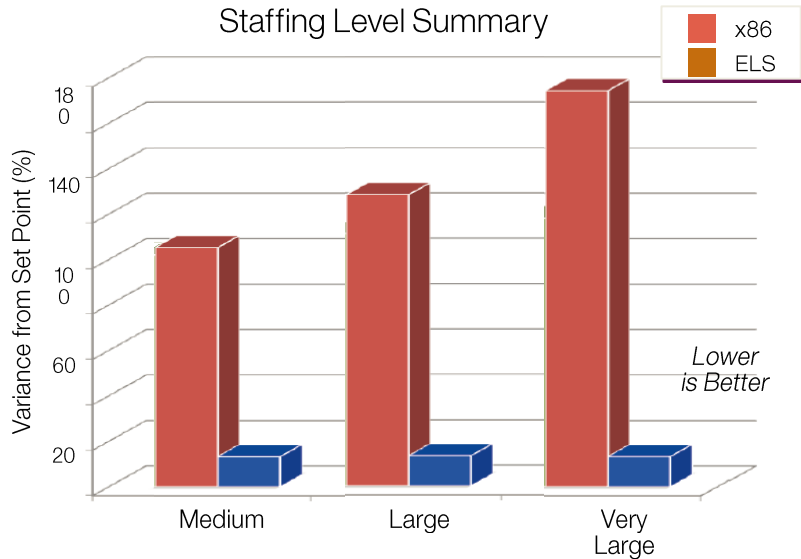
Staffing Level Summary

Variance from Set Point (%)

Legend: x86 (red), ELS (orange)

y-axis values: 180, 140, 100, 60, 20

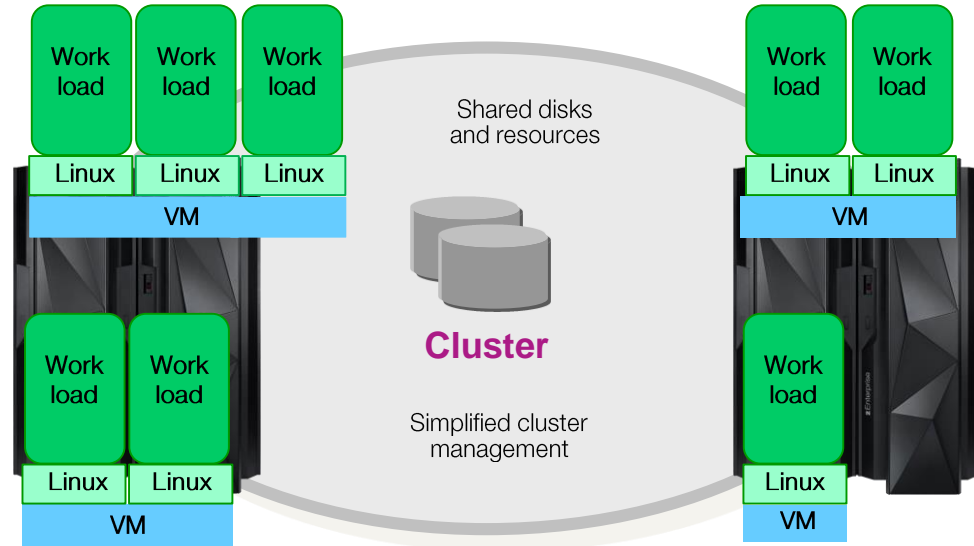x-axis categories: Medium, Large, Very Large

Lower is Better

Staffing levels required to maintain a "gold standard":

- Normalized to VMWare in Medium-sized environment

- Staffing levels for ELS are up to 13x smaller

Source: Solitaire Interglobal Ltd., 2013

2. The Right Solution.pptx

IBM

Enterprise Linux Server has multi-system clustering and virtual server mobility

- Each VM instance can support **thousands** of Linux virtual guests

- **Capacity on Demand** allows addition of Linux cores on a temporary basis if need demands

- For large scale growth, **VM clustering** allows for up to 4 systems to be clustered in a single system image

Work load — Linux

Work load — Linux

Work load — Linux

VM

Work load — Linux

Work load — Linux

VM

Shared disks and resources

Cluster

Simplified cluster management

Work load — Linux

Work load — Linux

VM

Work load — Linux

VM

IBM

Manage the complete virtualized network using a simple, intuitive, rich graphical user interface

- Intuitive graphical workspace with powerful drag-and-drop capability

- Automatically detects all resources in the environment
  - Spans partitions, servers, sites, geographies
  - Supports SSI clustering and Live Guest Mobility

- Simplifies and automates management
  - Monitor, provision, manage user accounts

- *Significantly reduces administration requirements and costs*

IBM Wave virtualization management software for Enterprise Linux Server systems

2. The Right Solution.pptx

IBM
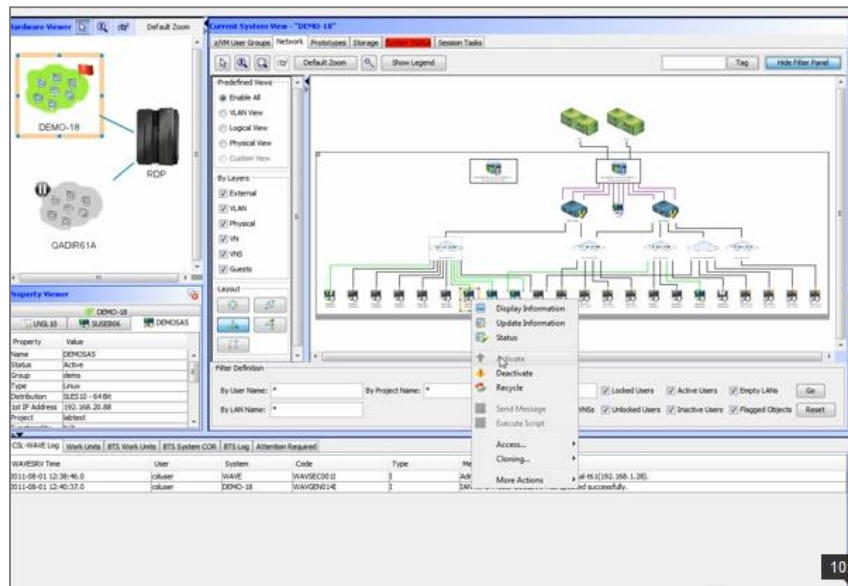
Enterprise Linux Server supports *standard* Linux distributions

- Enterprise Linux Server supports both **SUSE** and **Red Hat** distributions

- Plentiful availability of skills administrators and developers

- Large selection of applications middleware and tooling from IBM, ISVs and Open Source

IBM has been collaborating on innovative Linux solutions for years

Top 10 Linux Kernel Contributors (2013)

Company	Changes	Total
None	12,550	13.6%
Red Hat	9,483	10.2%
Intel	8,108	8.8%
Texas Instruments	3,814	4.1%
Linaro	3,791	4.1%
SUSE	3,212	3.5%
Unknown	3,032	3.3%
IBM	2,858	3.1%
Samsung	2,415	2.6%
Google	2,255	2.4%
Vision Engraving Systems	2,107	2.3%
Consultants	1,529	1.7%
Wolfson Microelectronics	1,516	1.6%
Oracle	1,248	1.3%
Broadcom	1,205	1.3%

- IBM has been an active Linux community member since 1999

- IBM has over 600 full-time developers working with Linux and open source

Source: The Linux Foundation - http://www.linuxfoundation.org/

Competitive Project Office

Virtually all IBM middleware runs on the Enterprise Linux Server

AIM / WebSphere (51)	IM (52)	SCI / Tivoli (57)	BA (15)	Industry Solutions (28)
CICS Transaction Gateway Desktop Edition CICS Transaction Gateway for Multiplatforms Communications Server for Linux HTTP Server for WAS HE Novell SLES IBM Business Monitor IBM Business Process Manager Advanced IBM Business Process Manager Standard IBM Integration Bus IBM Mobile Foundation IBM Runtime Environment, Java Technology IBM Worklight TPF Toolkit WebSphere Adapter for Email WebSphere Adapter for ECM WebSphere Adapter for File Transfer Protocol WebSphere Adapter for Flat Files WebSphere Adapter for IBM i WebSphere Adapter for JDBC WebSphere Adapter for Lotus Domino WebSphere Adapter for Oracle E-Business WebSphere Adapter for PeopleSoft WebSphere Adapter for SAP Runtime WebSphere Adapter for Siebel Business WebSphere Adapters WebSphere Application Server WebSphere Application Server - Express WebSphere Application Server FP Web 2.0 WebSphere Application Server for Developers WebSphere Application Server Hypervisor WAS HE for Novell SLES on System z (2) WAS HE for Red Hat Enterprise Linux Server WAS HE Intelligent Management Pack WAS HE V7.0 on RHEL for System z (2) WebSphere Application Server Liberty Core WebSphere Application Server ND WebSphere Enterprise Service Bus WebSphere Extended Deployment WebSphere Extended Deployment CG WebSphere eXtreme Scale WebSphere Lombardi Edition WebSphere Message Broker WebSphere MB Connectivity for Healthcare WebSphere MQ, FTE, Low Latency (3) WebSphere Service Registry and Repository WebSphere SSR Advanced Lifecycle Edition WebSphere SSR Client WebSphere Virtual Enterprise	Cúram Social Program Management Database Enterprise Developer Edition DB2 Advanced Enterprise Server Edition DB2 Advanced Workgroup Server Edition DB2 Connect Application Server Advanced DB2 Connect Application Server Edition DB2 Connect Enterprise Edition DB2 Connect Unlimited Advanced z, I (3) DB2 Enterprise Server Edition DB2 for Linux, UNIX and Windows for SAP DB2 Merge Backup for Linux UNIX, Win DB2 Recovery Expert for Linux, UNIX, Win IBM Data Studio IBM InfoSphere Business Info. Exchange IBM InfoSphere Foundation Tools IBM InfoSphere Identity Insight IBM InfoSphere QualityStage Module US Cert IBM Metadata Workbench IBM solidDB Information Server Bus. Glossary Anywhere Informix Client Software Development Kit Informix Connect Runtime Informix Dynamic Server Enterprise Edition InfoSphere Business Glossary InfoSphere Change Data Capture InfoSphere Change Data Delivery InfoSphere Data Replication InfoSphere Federation Server InfoSphere Guardium InfoSphere Information Analyzer InfoSphere Information Server, SAP (2) InfoSphere Master Data Management InfoSphere Master Data Management Server InfoSphere Optim Configuration Manager InfoSphere Optim Performance Manager (2) InfoSphere Optim pureQuery Runtime z/OS InfoSphere Optim Query Capture and Replay InfoSphere Warehouse Advanced Depart. InfoSphere Warehouse Advanced Enterprise InfoSphere Warehouse Departmental Edition InfoSphere Warehouse Developer Edition InfoSphere Warehouse Enterprise Base InfoSphere Warehouse Enterprise Edition InfoSphere Warehouse Optim Data Retention Optim High Performance Unload for DB2 Optim Performance Manager (2) Optim Query Tuner for DB2	IBM License Metric Tool IBM SmartCloud Control Desk IBM SmartCloud Cost Management IBM TRIRIGA Application Builder IBM TRIRIGA Application Platform IBM TRIRIGA Connector Business Apps (2) IBM TRIRIGA Connector for Offline Forms Maximo Adapter for Microsoft Project Maximo Adapter for Primavera Maximo Archiving Adapter for Optim Data Gr. Maximo Asset Configuration Manager Maximo Asset Mgmt, Essentials, Schedule (3) Maximo Calibration Maximo Change and Corrective Action Mgr Maximo Enterprise Adapter, SAP (2) Maximo Everyplace Maximo for Government Maximo for Life Sciences Maximo for Nuclear Power Maximo for Oil and Gas Maximo for Service Providers Maximo for Transportation Maximo for Utilities Maximo Health, Safety and Environment Mgr Maximo Linear Asset Manager Maximo Mobile Asset Manager Maximo Mobile Inventory Manager Maximo Mobile Suite Maximo Mobile Work Manager Maximo Spatial Asset Management Tivoli Application Dependency Discovery Mgr Tivoli Asset Discovery for Distributed Tivoli Business Service Manager Tivoli Monitoring, Energy Mgmt, VE (3) Tivoli Netcool/Impact Tivoli Netcool/OMNIbus Tivoli NetView for z/OS Tivoli Network Manager IP Edition Tivoli Provisioning Manager Tivoli Service Automation Manager Tivoli Storage Productivity Center Editions (3) Tivoli System Automation Application Mgr Tivoli System Automation for Multiplatforms Tivoli Usage and Accounting Manager, Ent (2) Tivoli Workload Scheduler, z/OS, Agent (3) TotalStorage SAN Volume Controller	Cognos Business Insight Cognos Business Intelligence & Analysis Cognos Insight Cognos Mobile Cognos Real-time Monitoring IBM SPSS License Authorization Wizard IBM SPSS Modeler Limited SPSS Collaboration and Deployment Services SPSS Decision Management SPSS Modeler & Server (2) SPSS Statistics & Server (2) **ICS / Portal (15)** IBM Connections IBM Connections Mail IBM Customer Experience Suite Rich Media IBM Domino IBM Forms Experience Builder IBM Forms Server IBM Mobile Portal Accelerator IBM Web Content Manager, Rich Media (2) IBM Web Experience Factory Lotus Domino WebSphere Dashboard Framework WebSphere Portal Enable, Extend, Server (3) **Security (7)** IBM Security Access Manager for Web IBM Security Identity Manager Tivoli Access Manager for e-business Tivoli Directory Integrator Tivoli Federated Identity Manager Tivoli Federated Identity Mgr Bus. Gateway Tivoli Key Lifecycle Manager	Case Foundation Case Manager Content Analytics Content Foundation Content Integrator Enterprise Edition Content Manager Enterprise Edition Content Manager OnDemand Multiplatforms Cúram Social Program Management Enterprise Records FileNet Business Process Manager FileNet Content Manager IBM WebSphere Multichannel Bank Toolkit Sterling B2B Integrator Sterling Connect:Direct Sterling Connect:Express Sterling Control Center WebSphere Commerce Enterprise WebSphere Multichannel Bank Toolkit WebSphere Transformation Extender WebSphere Transformation Extender SEPA WebSphere Transformation Extender SAP WebSphere Transformation Extender SWIFT WebSphere Transformation Extender EDI WebSphere Transformation Ext. Financial WebSphere Transformation Ext. Healthcare WebSphere Transformation Ext. NACHA **Rational (19)** Rational Asset Manager Enterprise Edition Rational Asset Manager Standard Edition Rational Automation Framework Rational Build Forge Rational Build Forge Enterprise Edition Rational Build Forge Enterprise Plus Edition Rational Build Forge Standard Edition Rational ClearCase Rational ClearCase MultiSite Rational Collaborative Lifecycle Management Rational Developer for System z Rational Developer for zEnterprise Rational DOORS Rational Host Access Transformation Service Rational Programming Patterns Rational Programming Patterns for System z Rational Quality Manager Rational Requirements Composer Rational Team Concert

2. The Right Solution.pptx

Competitive Project Office

IBM

The ISV ecosystem for the Enterprise Linux Server is strong and continues to grow

Over 3,000 total Linux applications available from hundreds of ISVs
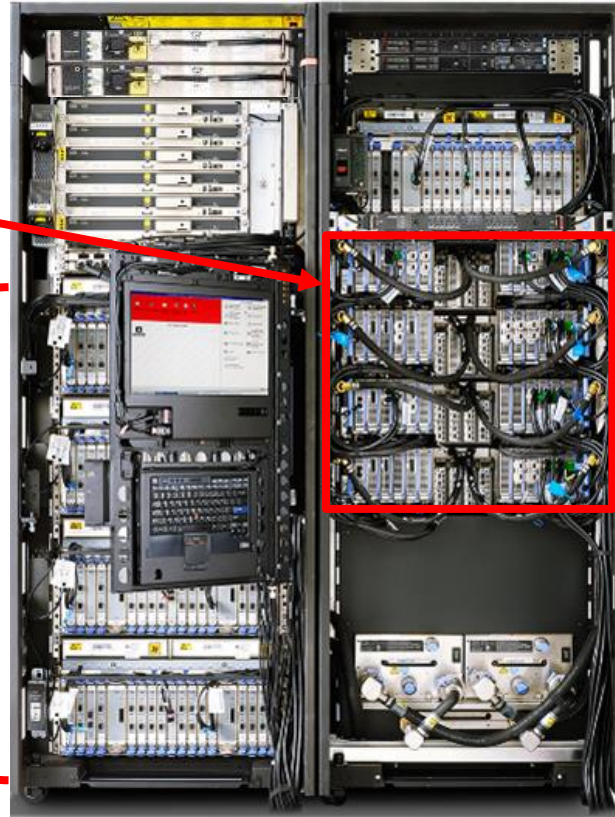
Competitive Project Office

The IBM Enterprise Linux Server is designed for high availability and redundancy

Easy-access, drawer-based design with cables between the drawers

PCIe Gen 3 I/O drawer (5)

PCIe Gen 3 I/O drawers (1-4)

Serviceability options –
Non-raised floor,
Water cooling,
High-voltage DC power, Top exit power,
I/O cabling
– designed to increase flexibility and save space

Two-frame base system (enterprise class model)

Maximum input power of 27.5 kW

Competitive Project Office

IBM

Blade-like processing unit drawers support a balanced, pluggable technology

Cooling connectors

Processing unit chip (uncapped)
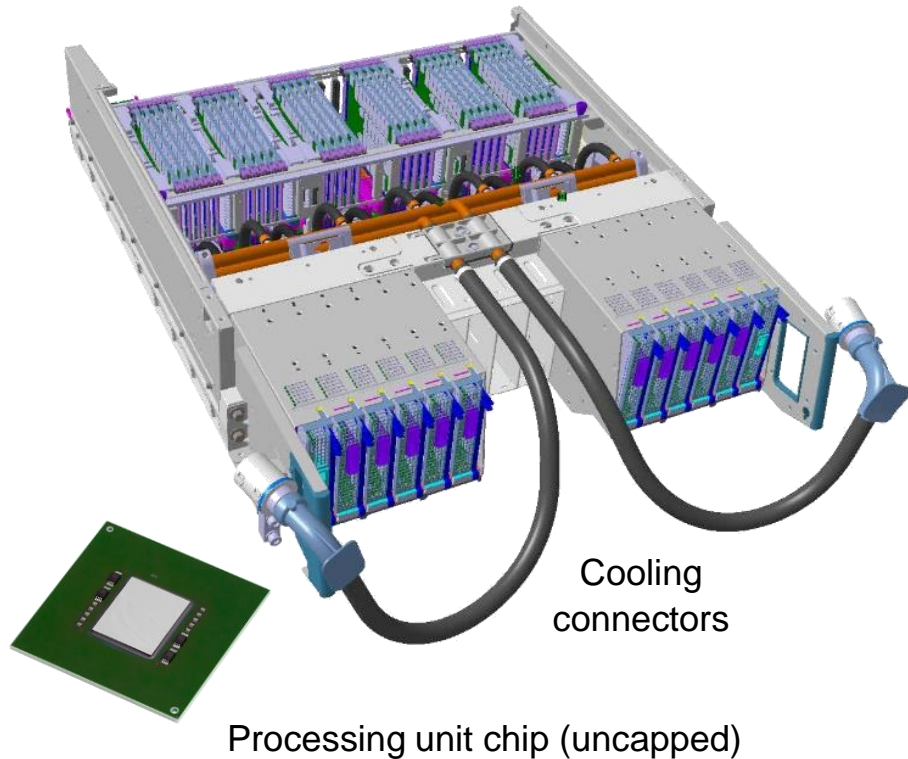
- Single-chip processing unit modules (6 per drawer) contain CPUs, co-processors, memory controllers and cache

- Two L4 cache chips per drawer

- Up to 3,200 GB RAIM memory per drawer

- Drawers support concurrent maintenance

2. The Right Solution.pptx

IBM

ELS yields exceptional processing power from highly advanced processing unit chips

- 22 nm SOI technology – almost 4B transistors!

- Up to 8 active cores per chip

- 5.0 GHz clock speed

- Up to 141 total Linux processors
  - Each Linux core can support two threads (Simultaneous Multi-threading)
  - Superscalar design, with advanced pipelining and out-of-order processing

- Each core has dedicated cryptographic and compression coprocessors
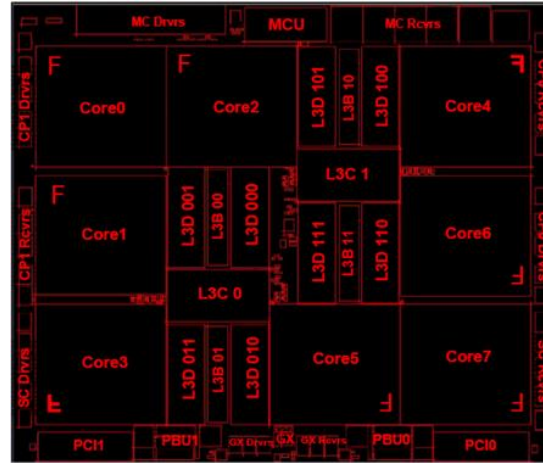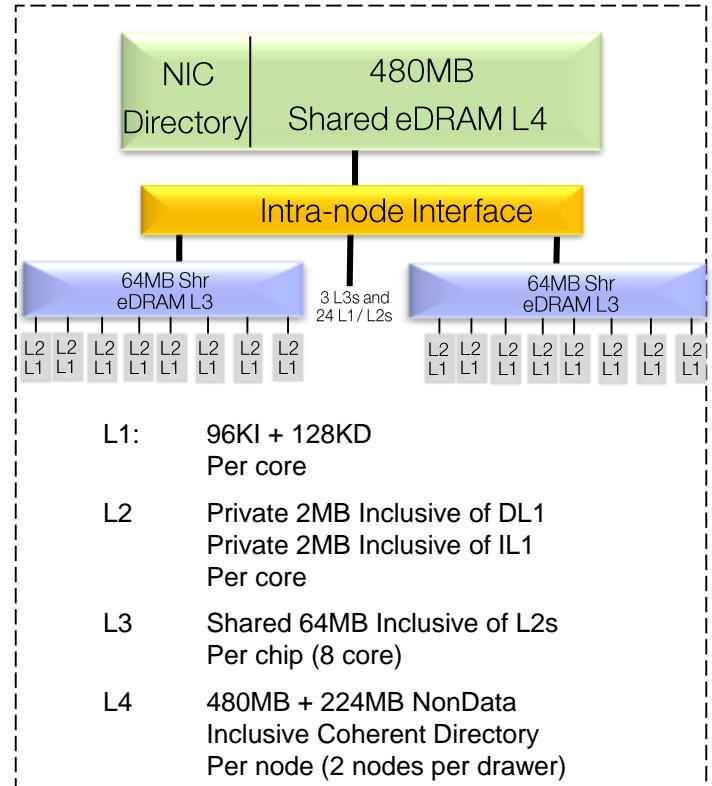

Enterprise Linux Server Processing Unit chip
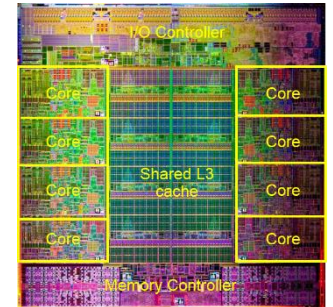
Intel x86 chip

- Typical servers have 3.0-3.3 GHz and 8-24 cores

- Max: 4.0 GHz and 64 cores

2. The Right Solution.pptx

Competitive Project Office

IBM

Enterprise Linux Server includes optimized cache structure

- Continuous advancements in design for optimum performance of large data sets
  - L1 and L2 cache is per core
  - L3 shared across processing unit chip (8 cores)
  - L4 cache shared across all cores

- Todays "performance" x86 systems have only 8MB cache (no L4 cache)

- Enterprise Linux Server also includes a maximum of 10 TB memory (RAIM)

NIC Directory	480MB Shared eDRAM L4

Intra-node Interface

64MB Shr eDRAM L3

3 L3s and 24 L1 / L2s

64MB Shr eDRAM L3

L2 L1 (×8)   L2 L1 (×8)

| L1:	96KI + 128KD Per core
L2	Private 2MB Inclusive of DL1 Private 2MB Inclusive of IL1 Per core
L3	Shared 64MB Inclusive of L2s Per chip (8 core)
L4	480MB + 224MB NonData Inclusive Coherent Directory Per node (2 nodes per drawer)

IBM

More memory yields more sustainable business growth

Research on state-of-the-art usage practices at very large-scale virtualized production data center shows:

- Strong tendency to over-commit CPU – (Some workload slow-down is acceptable)

- Memory was *rarely* over-committed – (Insufficient memory results is significant slow-down, paging, error, and possibly failures!)

Memory is more important than CPU
- Enterprise Linux Server – with very large memory – is more efficient platforms
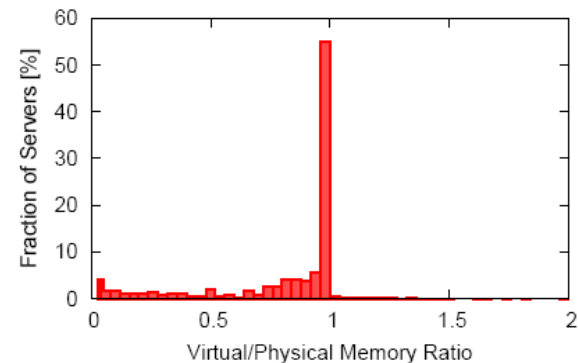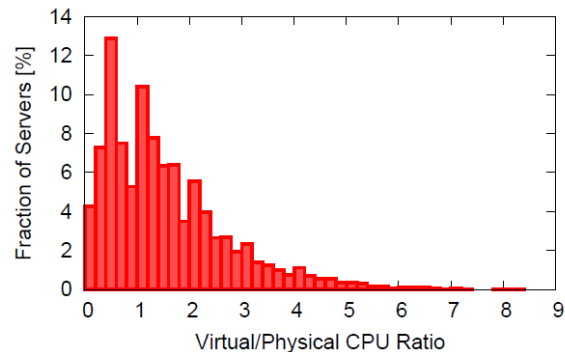
Competitive Project Office

IBM

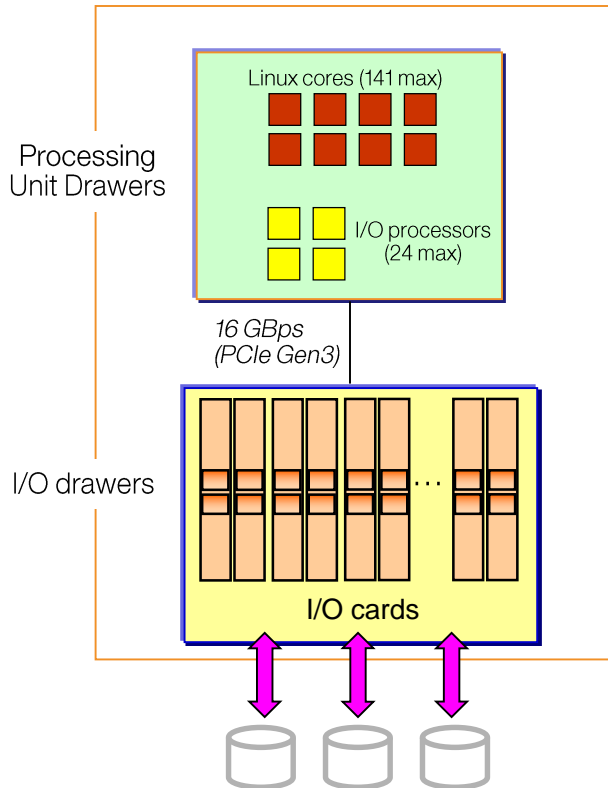# Use Capacity on Demand and pay for only the number of processors needed

- Servers are shipped fully populated
  - Customers purchase (activate) only the number of processors desired

- Customers can also purchase "inactive" processors at reduced price (Capacity on Demand)
  - Activate only as needed
  - Use for temporary or permanent capacity
  - Self-managed on/off

- New capacity is immediately available for work without service disruption

Enterprise Linux Server drawer with 48 processors
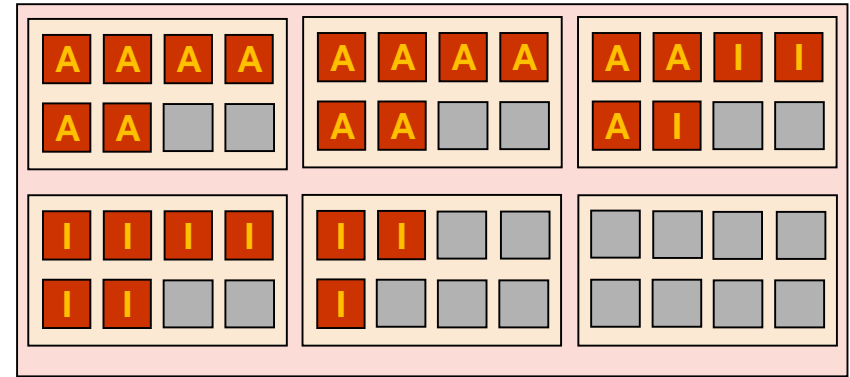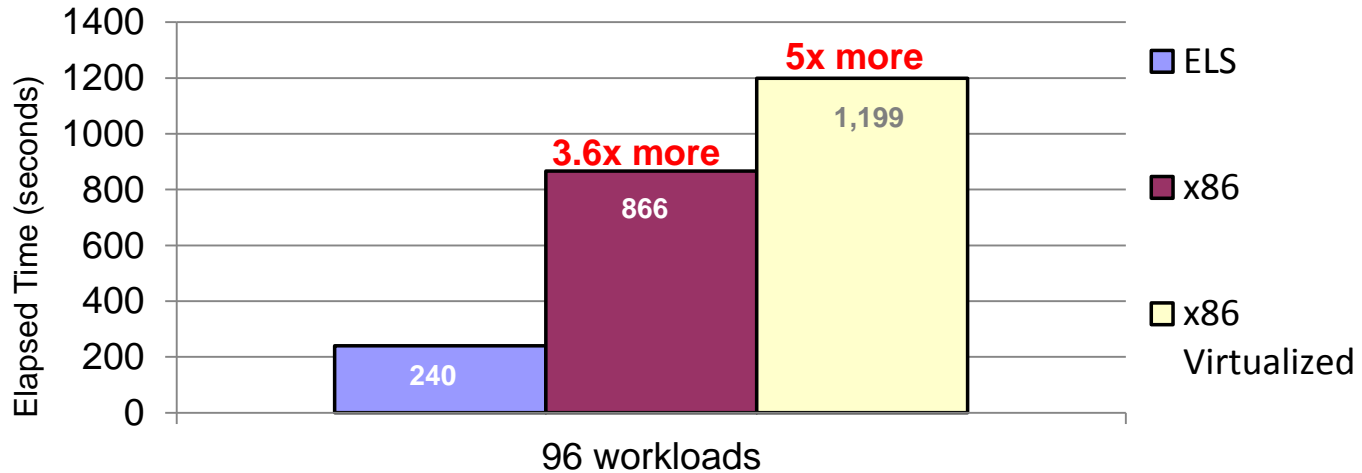

| A | Active processors (15) – pay standard price |

| I | Inactive processors (12) – pay only 2% of full price |

| | Dark processors (21) – no charge |

2. The Right Solution.pptx
© 2015 IBM Corporation

Competitive Project Office

Enterprise Linux Server includes special processors dedicated to driving I/O

Processing Unit Drawers

Linux cores (141 max)

I/O processors (24 max)

16 GBps (PCIe Gen3)

I/O drawers

I/O cards

- I/O processing logic is offloaded to special processors
  - Isolates Linux cores for business logic processing
- I/O processors managed Logical I/O Channel Subsystem
  - Determines optimal physical I/O path to be used
  - Delivers optimized I/O efficiency

- Dedicated I/O subsystem is excellent for high I/O workloads
- Intel servers have no dedicated I/O subsystem

2. The Right Solution.pptx

IBM

In comparison tests of I/O load capacity, Intel times were significantly slower

Elapsed Time (seconds) — 96 workloads

- ELS: 240
- x86: 866 — **3.6x more**
- x86 Virtualized: 1,199 — **5x more**

Performance comparison test of an I/O intensive workload with identical enterprise class storage. Enterprise Linux Server with 8 core. Westmere EX server with 40 core @2.4GHz. Each system connected via 4 x 8Gb links to DS8800. Enterprise Linux Server running against 8 SSD DASD CKD volumes. Intel server running against 8 SSD LUNs FB volumes. Note: Storage limitations came into effect at workload counts greater than 96.
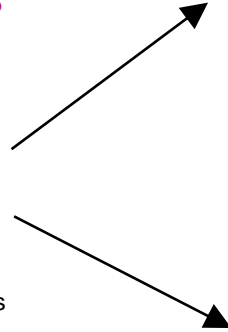
Source: IBM CPO

Competitive Project Office

IBM

Workloads with higher I/O bandwidth requirements benefit from ELS architecture

Which platform provides the lowest TCA over 3 years?
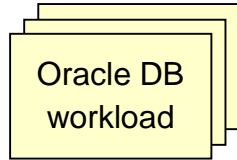
Oracle DB workload

Customer Database Workloads each supporting 4K TPS

Oracle Enterprise Edition
Oracle Real Application Cluster

T5-8 server (128 cores)

3 x 4-node Oracle RAC DB

$8.9M (3 yr. TCA)

ELS with 16 IFLs

3 x 4-node Oracle RAC DB

$3.6M (3 yr. TCA)

60% less cost!

TCA includes hardware, software, maintenance, support and subscription. Workload Equivalence derived from a proof-of-concept study conducted at a large Cooperative Bank and projecting to T5-8 servers using published TPC-C Results normalizing them to Relative Performance Units as available from Ideas International

Competitive Project Office

IBM

Enterprise Linux Server can be configured to support different storage options

If workloads have high I/O, and CPU costs must be kept low:
- Use I/O processors to offload I/O processing
- Connect to direct-attached ECKD storage

Linux cores

I/O processors

I/O cards

If high performance is desired:
- Linux cores directly drive Fibre Channel (SCSI) devices
- But additional Linux cores may be required to drive the workload

IBM DS8xxx

IBM SAN Volume Controller (SVC)

IBM Storwize V7000

IBM XIV

FlashSystem V9000

Competitive Project Office
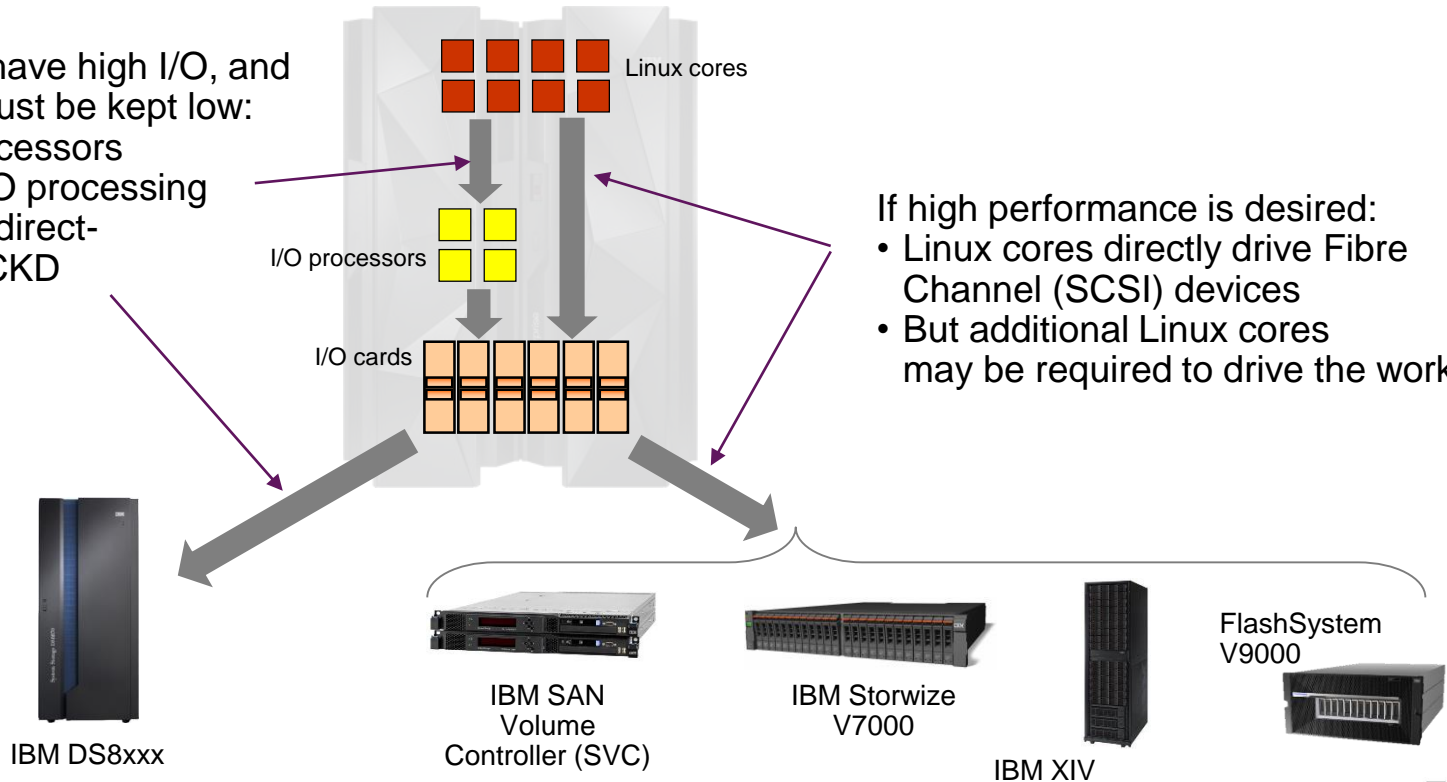
Tests show how ELS with Direct Attached storage can be the right option for certain workloads

- Tests with high transaction workloads confirm:
  Direct attached storage option required less CPU than SCSI to drive the same amount of workload

  - Direct Attached storage costs 12% less with 4 CPUs

  - Increasing SCSI system to 6 CPUs, and Direct Attached option still costs less

CPU Cost per Transactional Throughput

12% less

■ SCSI ■ Direct Attached
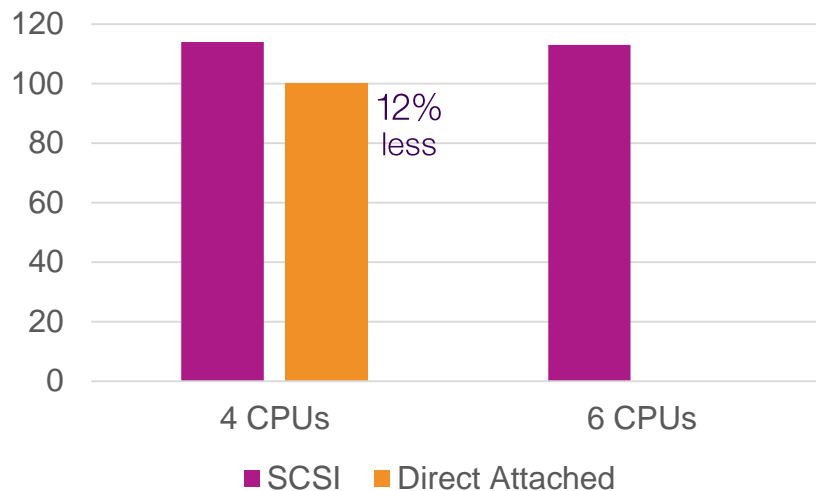
ELS supports Elastic Storage – IBM's shared disk, parallel cluster file system

Based in IBM's General Parallel File System (GPFS)

- **Cluster**: Numerous nodes, fast reliable communication, common admin domain
- **Shared disk**: All data and metadata on storage devices accessible from any node through block I/O interface ("disk": any kind of block storage device)
- **Parallel**: Data and metadata flow from all of the nodes to all of the disks in parallel

Benefits
- Concurrent high-speed, reliable data access from multiple nodes
  - High data availability through data access even at malfunctions of nodes or storage
- Extreme scalability and accelerated performance
  - Elimination of single points of failure and single points of bottleneck
- Smooth, non disruptive capacity expansion and reduction

IBM
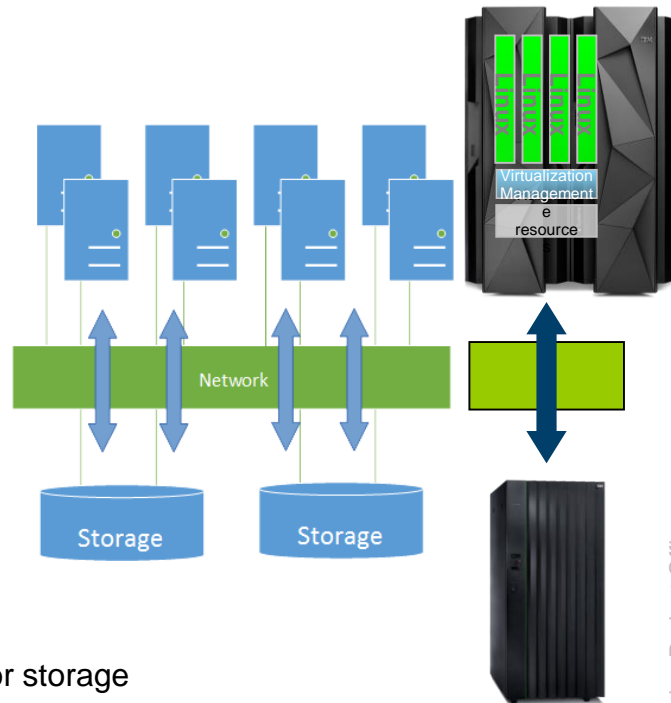
Trusted reliability – comprehensive protection to ensure highest availability

Error Detection
- ▶ Error detection/ correction codes
- ▶ Data capture

Error Prevention
- ▶ Failure analysis
- ▶ Burn-in
- ▶ Shake test

Recovery
- ▶ Scan path
- ▶ Spare CPU
- ▶ Channel

Enterprise Linux Server Reliable Operations

Change Management
- ▶ Non-disruptive
- ▶ Hardware
- ▶ Software

Service Element
- ▶ Problem determination
- ▶ Problem isolation

Maintenance
- ▶ "Phone Home"
- ▶ Local parts depot
- ▶ Local service

Competitive Project Office

IBM
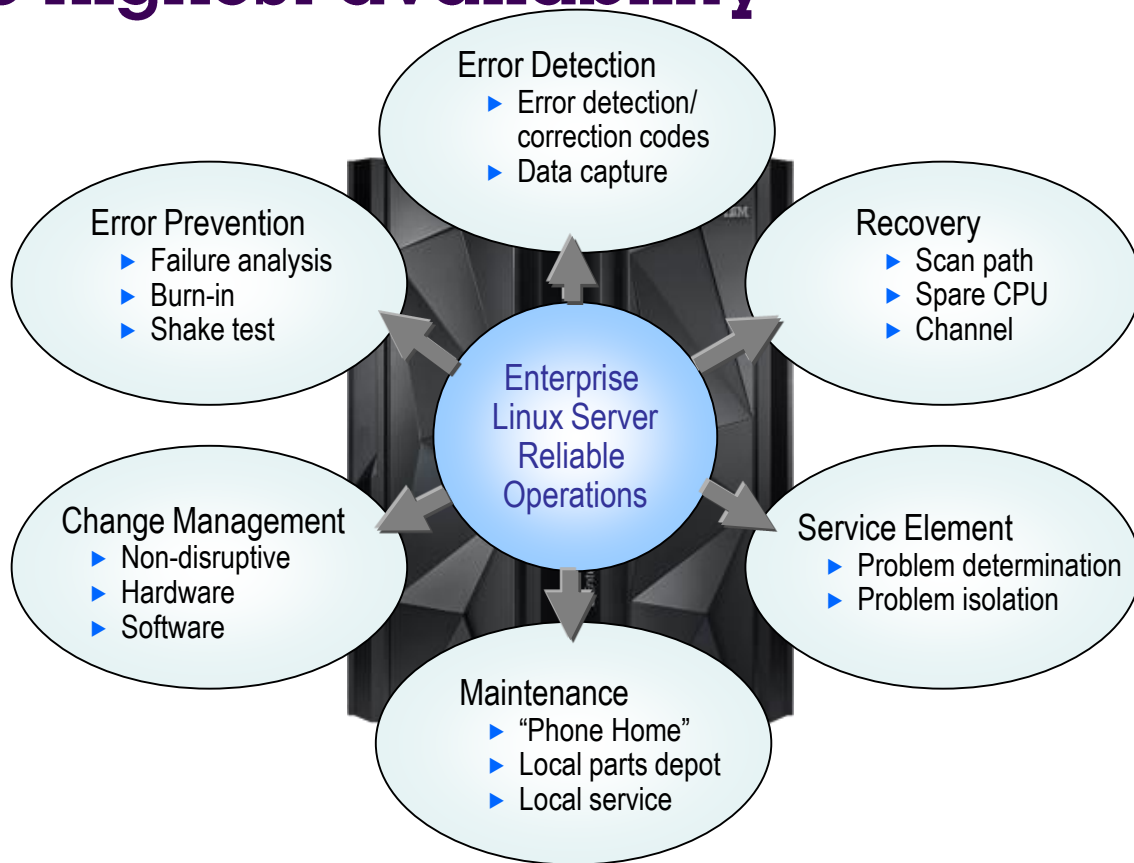
Compared to distributed servers, Enterprise Linux Server has minimal unplanned downtime

- ITIC survey reports IBM's Enterprise system was the only mainstream server offering that had no – *0%* – of unplanned system downtime due to any inherent flaws in the hardware

- On the other end of the spectrum, corporate customers reported that 13% of their Dell PowerEdge x86 machines and 10% of the HP ProLiant systems racked up downtime exceeding four hours per annum/per server downtime.

Enterprise Linux Server hardware platform

Unplanned Downtime of more than four (4) hours on each server hardware platform (2014)

Server	Downtime
Dell PowerEdge x86..	13%
HP ProLiant Servers	10%
Oracle x86	6%
Oracle SPARC	4%
Fujitsu SPARC	4%
Toshiba Magnia	3%
Fujitsu Primequest	3%
HP Integrity	3%
Cisco UCS	2%
Fujitsu Primergy	2%
IBM Power System i, p	1%
IBM System x **	1%
	0%

***NOTE: In January 2014 IBM announced the sale of its System x86 server hardware business to Lenovo. The deal is expected to close in late summer.

Competitive Project Office

2. The Right Solution.pptx

IBM Enterprise Linux Server supports concurrent operations during maintenance

Capability	ELS	x86
ECC on Memory Control Circuitry	Transparent While Running	Can recognize/repair soft errors while running; limited ability with hard errors
Oscillator Failure	Transparent While Running	Must bring server down to replace
Core Sparing	Transparent While Running	Must bring server down to replace
Microcode Driver Updates	While Running	Some OS-level drivers can update while running, not firmware drivers; reboot often required
Book Additions, Replacement	While Running	Must bring server down
Memory Replacement	While Running	Must bring server down
Memory Bus Adaptor Replacement	While Running	Must bring server down
I/O Upgrades	While Running	Must bring server down to replace (limited ability to replace I/O in some servers)
Concurrent Driver Maintenance	While Running	Limited – some drivers replaceable while running
Redundant Service Element	2 per System	"Support processors" can act as poor man's SE, but no redundancy

Single book systems may not support concurrent memory upgrades

2. The Right Solution.pptx

Summary – Advantages of Enterprise Linux Server over distributed server farms

- Exceptional virtualization – complete workload isolation and perfect workload management

- Fast Linux processors, with maximum overcommit of resources – nearly 100% utilization nearly all the time

- Designed for superior reliability, highest availability, and ultimate security

- Low total cost of ownership – reduced costs for software licenses, networking, real estate, power and administration

Competitive Project Office

2. The Right Solution.pptx

IBM