zEnterprise – The Ideal Platform For Smarter Computing

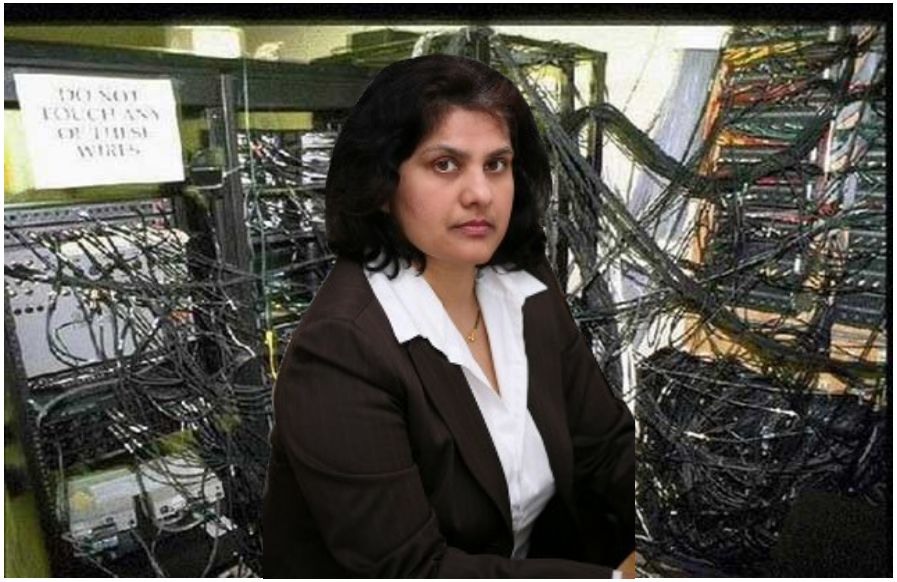
Consolidating Server Infrastructure

A Quick Look At The Problem Of Sprawl

This is your data center with SPRAWL!

Simplifying Hardware Infrastructure Dramatically Reduces The Cost Per Workload

Our front end infrastructure is too complex…

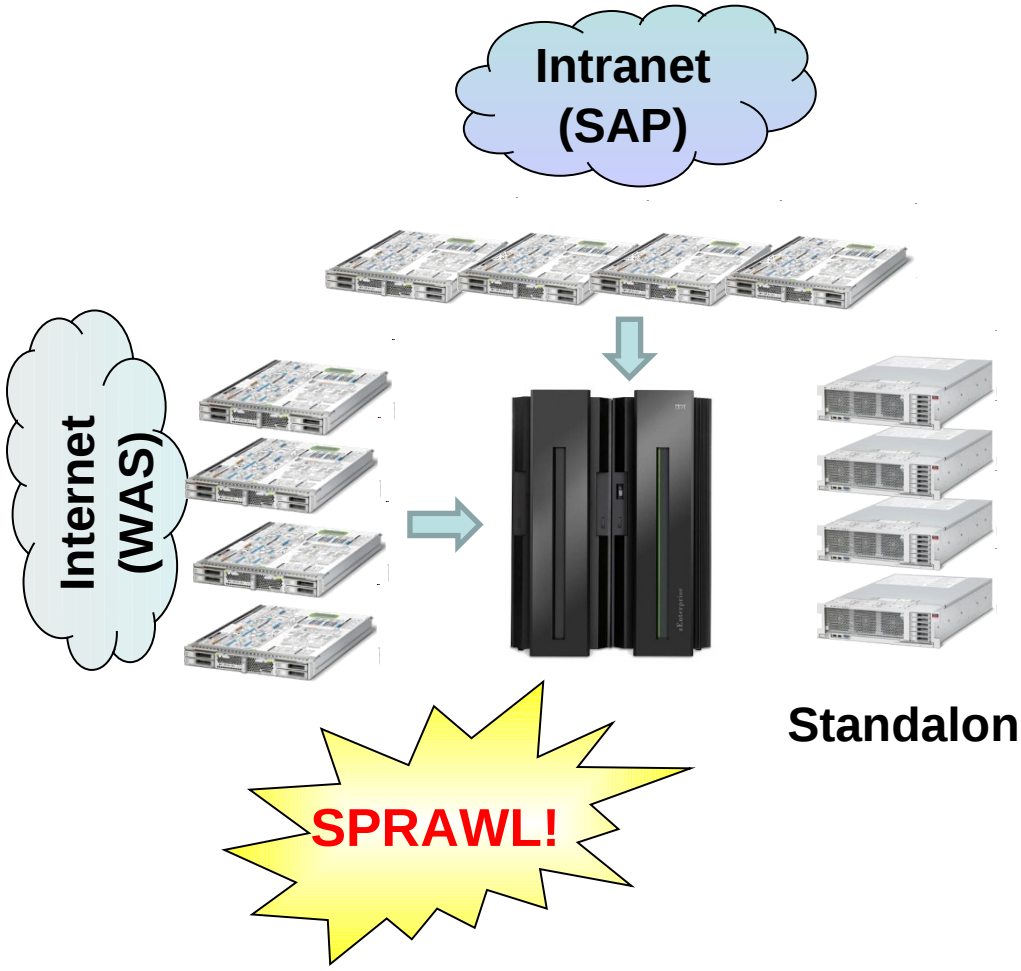


CIO

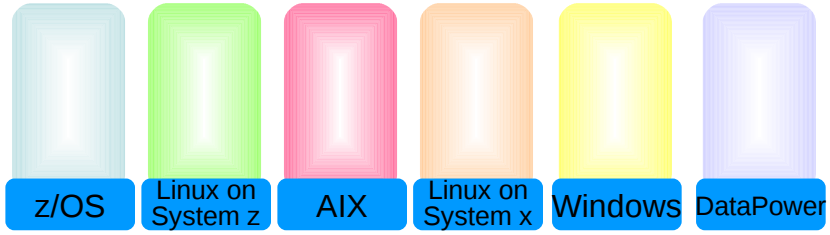
You can simplify by consolidating everything on a single platform!

IBM

Eliminate Sprawl With zEnterprise Multi-Architecture Environment



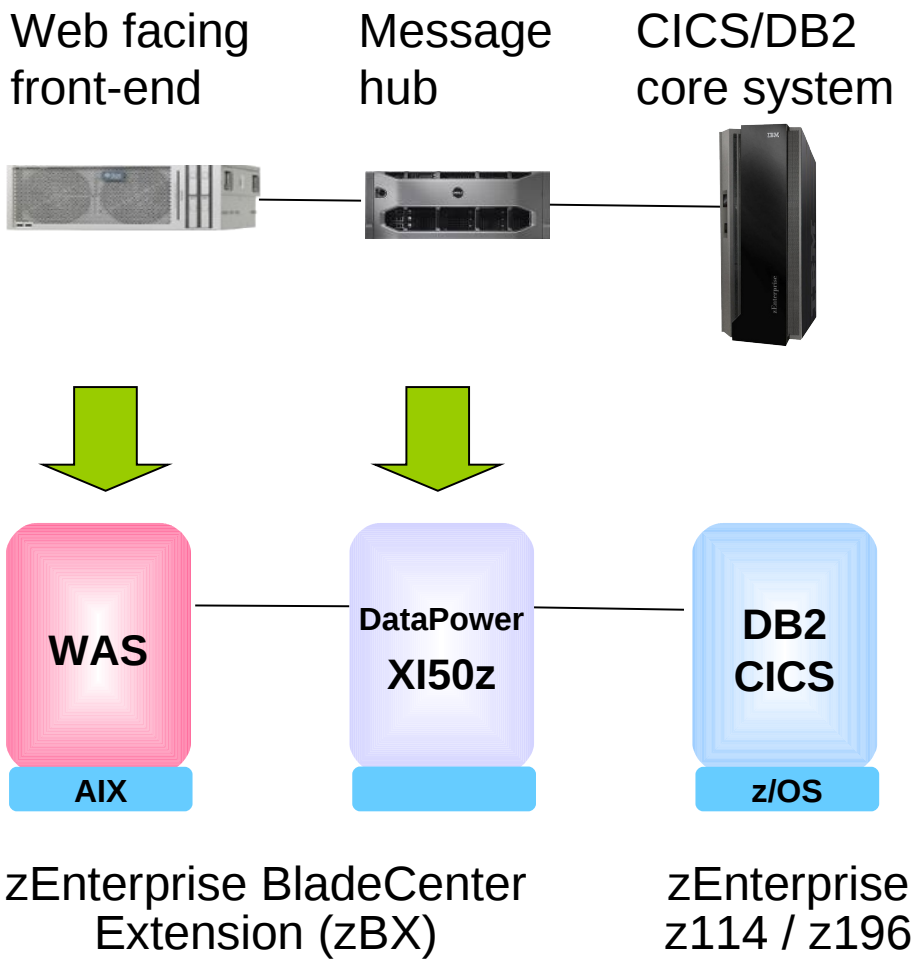
Platforms Optimized for Different Workloads



Best Fit for Workload

Consolidate with zEnterprise!

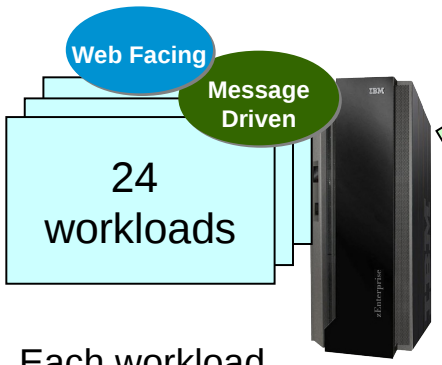
Run Web Front End Workloads On zEnterprise Platform



- Run as ensemble of virtual servers
- Unified management of virtual machines
- Manage ensemble as a single workload with service goals
- Dynamic adjustment of CPU resources drives 10% higher utilization
- Assign best fit to Power blade and XI50z for lowest cost per workload
- Embedded pre-configured data network

Web Front Ends Cost 59% Less On zEnterprise

Web front-end workloads



Each workload driving 3080 tps

High availability
Workload isolation

Competitive Packaged System

24 Sun Fire X4170 M2 12-core Xeon servers in ¾ rack
2 HP DL380 servers (for ESB)
312 cores total

Deploy on Sun hardware

Competitor's system relies on physical workload isolation

$433K
per workload
3yr TCA
Front end HW+SW

WebSphere App Server

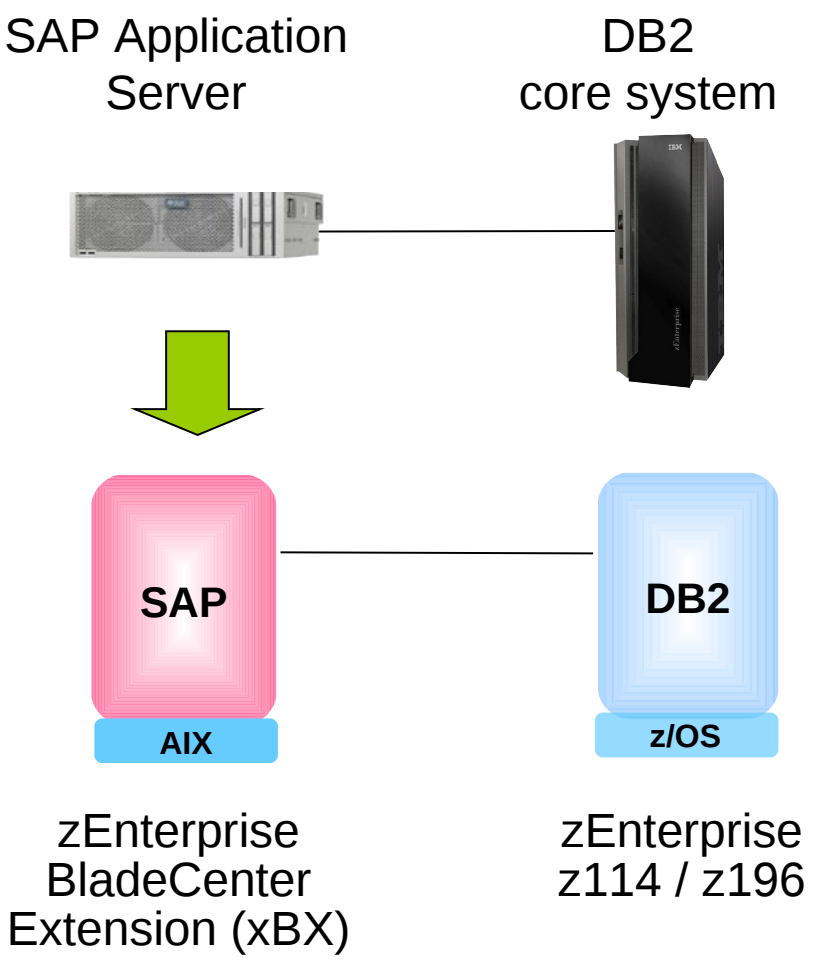
24 POWER7 8-core blades
2 DataPower XI50z in zBX
192 cores total

Power blades in zBX

$177K
per workload
3yr TCA
Front end HW+SW

Source: IBM Internal benchmarks. Competitive Packaged System includes Competitive Application Server and Sun Fire X4170 M2 servers. 3 yr. TCA calculation includes hardware acquisition, maintenance, software acquisition and S&S. US list prices. Prices may vary by country.

Run SAP Front End Applications On zEnterprise Platform

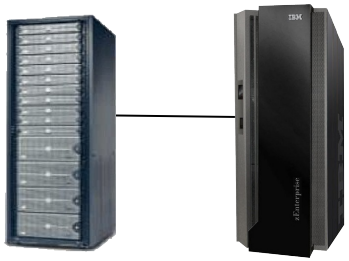


- Run as ensemble of virtual servers
- Unified management of virtual machines
- Manage ensemble as a single workload with service goals
- Dynamic adjustment of CPU resources drives 10% higher utilization
- Assign best fit to Power blade for lowest cost per workload
- Embedded pre-configured data network

SAP Applications Cost 18% Less On zEnterprise

SAP applications

38 Sun T3-1B blades
in Sun rack
608 cores total



Upgrade to new SPARC T3 hardware

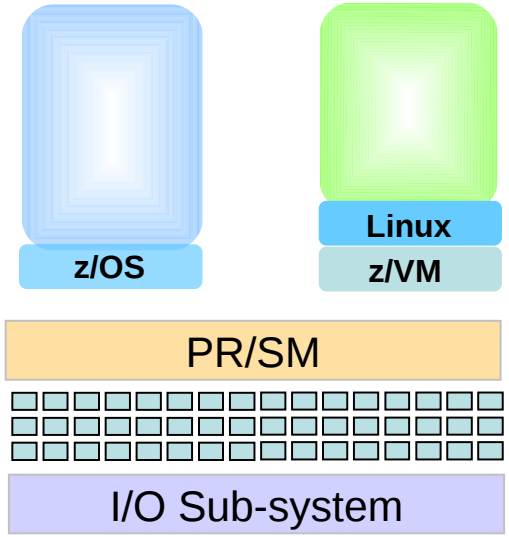
$60K
per workload
3yr TCA
Front end HW+SW

23 POWER7 blades
in zBX
184 cores total

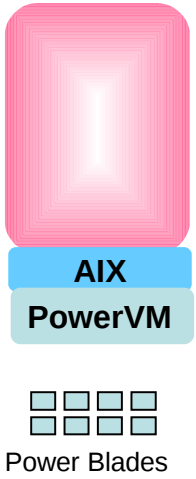
Consolidate on zEnterprise

$49K
per workload
3yr TCA
Front end HW+SW

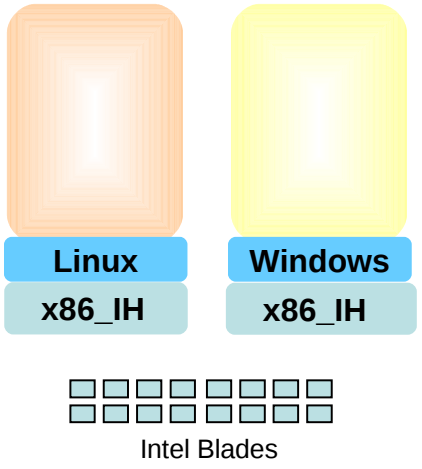
A Closer Look At Fit-For-Purpose Workload Assignment



- Scale up to 80 cores in a frame (z/OS clusters with sysplex)
- Dedicated I/O sub-system
- Superior qualities of service



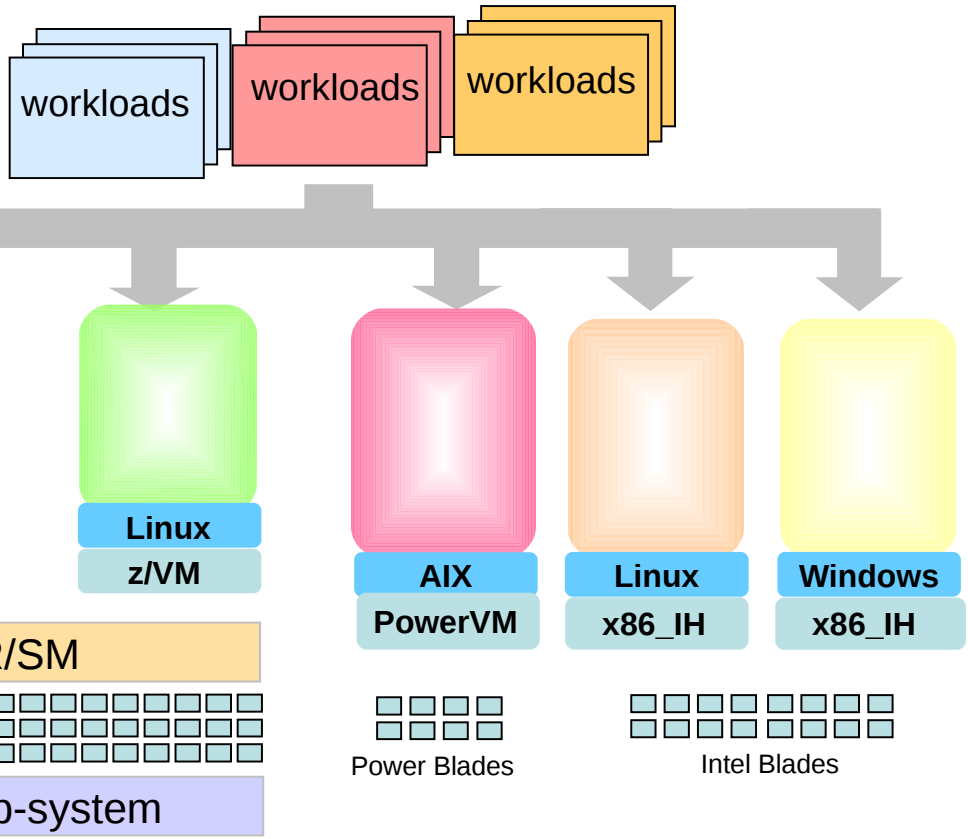
- Scales to 8 cores per blade
- 4 fast processing threads per core
- Floating point accelerators



- Scales to 16 cores per blade
- 2 fast processing threads per core
- Commodity I/O
- Modest qualities of service

Workload Characteristics Influence The Best Fit Deployment Decision

Easiest architectural fit



Deploy or consolidate workloads on the environment best suited for each workload to yield lowest cost

Deploying Stand Alone Workloads With Heavy I/O Requirements

Benchmark to determine which platform provides the lowest TCA over 3 years

Heavy I/O workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 4 core "Older" Intel**

Online banking workloads, each driving **22** transactions per second, with **1 MB I/O per transaction**

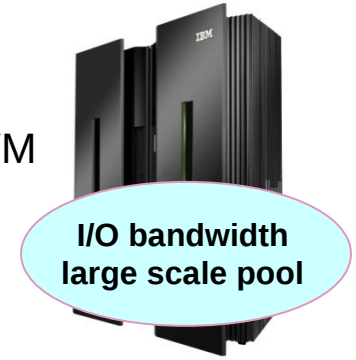
1 workload per Intel blade

Virtualized on Intel
16 core HX5 Blade
$380,046 per workload

1 workload per POWER7 blade

PowerVM on PS701
8 core POWER7 Blade
$204,036 per workload

40 workloads per 32-way z/VM



z/VM on z196 CPC
32 IFLs
$84,985 per workload
Best Fit

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

Deploying Stand Alone Workloads With Heavy CPU Requirements

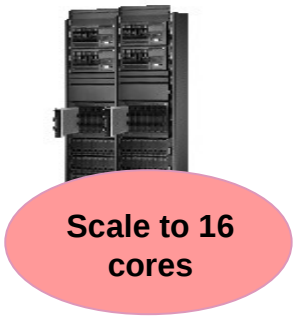
Benchmark to determine which platform provides the lowest TCA over 3 years

Heavy CPU workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 8 core Nehalem servers**

Online banking workloads, each driving **460** transactions per second with light I/O

2 workloads per Intel blade



Virtualized on Intel
16 core HX5 Blade
$190,023 per workload
Best Fit

1 workload per POWER7 blade

PowerVM on PS701
8 core POWER7 Blade
$204,036 per workload

10 workloads per 32-way z/VM

z/VM on z196 CPC
32 IFLs
$339,939 per workload

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

Deploying Stand Alone Workloads With Light CPU Requirements

Benchmark to determine which platform provides the lowest TCA over 3 years

Light workloads

- **IBM WebSphere ND**
- **Monitoring software**
- **On 4 core "Older" Intel**

Online banking workloads, each driving **22** transactions per second with light I/O

47 workloads per Intel blade

Virtualized on Intel
16 core HX5 Blade
$8,086 per workload

28 workload per POWER7 blade

Fast low cost threads

PowerVM on PS701
8 core POWER7 Blade
$7,287 per workload

Best Fit

155 workloads per 32-way z/VM

z/VM on z196 CPC
32 IFLs

$21,932 per workload

Consolidation ratios derived from IBM internal studies. HX5 2.13GHz 2ch/16co performance projected from x3550 2.66GHz 2ch/12co measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics. Prices will vary by country.

Case Study – Consolidate 880 Standalone Workloads On zEnterprise

- Distributed workload profile is a mix of
  - **784 light**
  - **56 heavy CPU**
  - **40 heavy I/O**

- What is the most cost effective way to consolidate/deploy all these workloads?

Sun Fire X4470

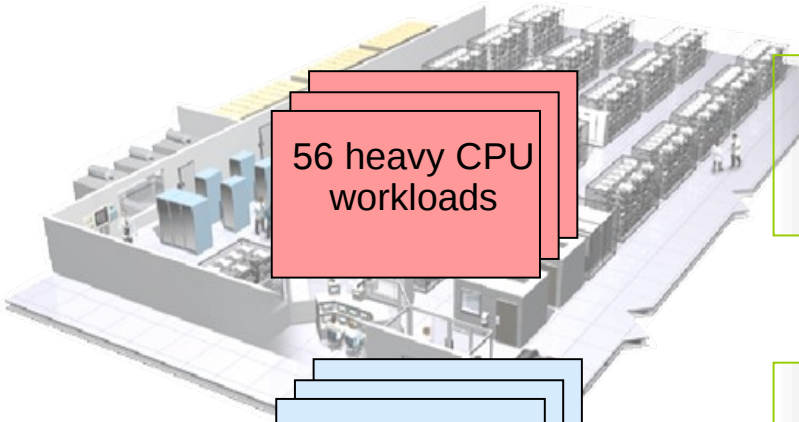
zEnterprise

A Best Fit Assignment Of 880 Standalone Workloads On zEnterprise

784 light workloads

28 workloads per POWER7 blade

28 IBM POWER7 blades in 1 zBX



56 heavy CPU workloads

2 workloads per HX5 blade

28 IBM HX5 Blades in same zBX

40 heavy I/O workloads

40 workloads per 32 IFLs

1 z196 CPC 32 IFLs

Best fit assignments

Server configurations are based on consolidation ratios derived from IBM internal studies. Projected Sun Fire X4470 2.0GHz 2ch/16co from x3550 2.66GHz 2ch/12co measurements. Prices are in US currency, prices will vary by country

Standalone Workloads Cost 47% Less On zEnterprise

40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

Deployed on Sun Fire X4470

95 Sun Fire Servers

1140 cores

$43K

per workload

3yr TCA

HW+SW

Best fit on zEnterprise

z196

32 IFLs

56 Blades

672 cores

$23K

per workload

3yr TCA

HW+SW

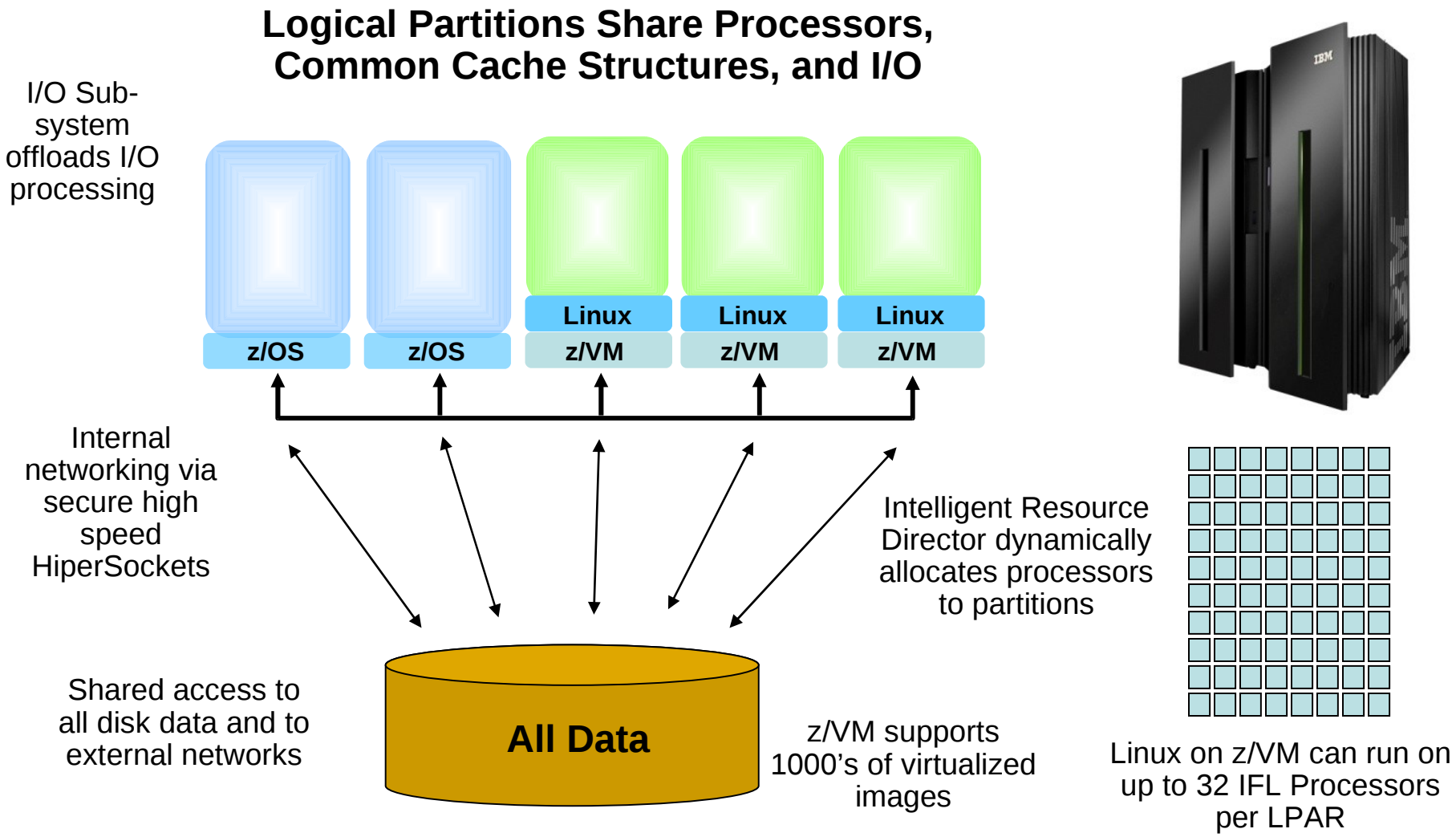
47% less

Server configurations are based on consolidation ratios derived from IBM internal studies. Projected Sun Fire X4470 2.0GHz 2ch/16co from x3550 2.66GHz 2ch/12co measurements. Prices are in US currency, prices will vary by country

A Deeper Look At Linux On z/VM Capabilities

- Cost benefit of Enterprise Linux Server Solution Edition pricing
  - Cost of IFL’s
- Cost benefit of software pricing for IFL’s
- Dedicated I/O Sub-system offloads I/O processing
- Greater I/O bandwidth
- Virtualization of I/O processing resources
- Superior Reliability, Serviceability, and Security
- Achieves lowest TCA for heavy I/O workloads

Linux On z/VM Is Designed For Efficient Virtualization And Consolidation

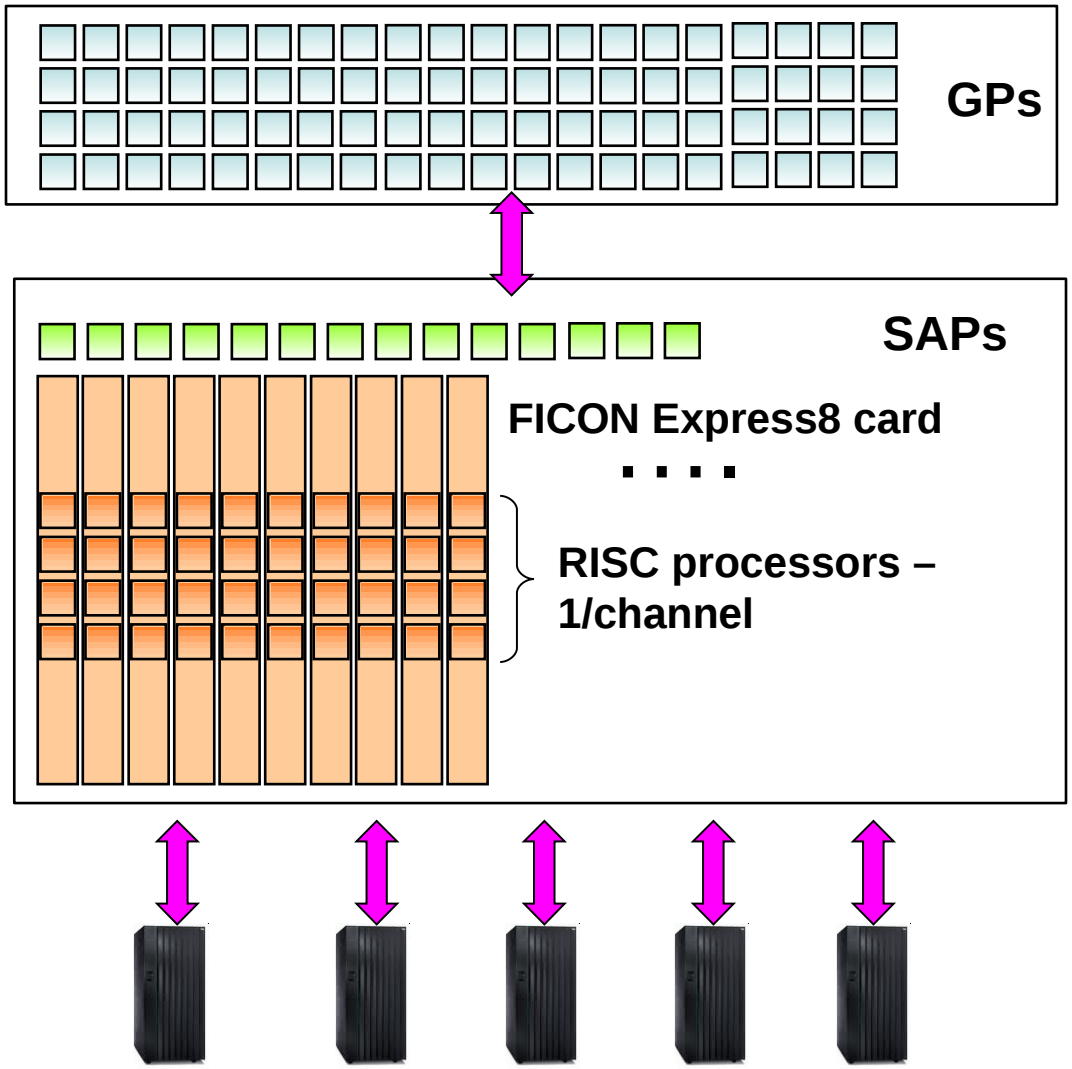


System z Solution Editions For Linux Offer Significant Cost Reductions

Special Package Prices

- System z Solution Edition for Enterprise Linux
  - **Add** Integrated Facility for Linux (IFL) processors, memory and z/VM to an existing mainframe
  - Hardware and software maintenance for three or five years
- Enterprise Linux Server
  - **Standalone** System zEnterprise server with IFLs, memory, I/O connectivity, and z/VM
  - Hardware and software maintenance for three or five years
- Linux on System z available from distribution partners

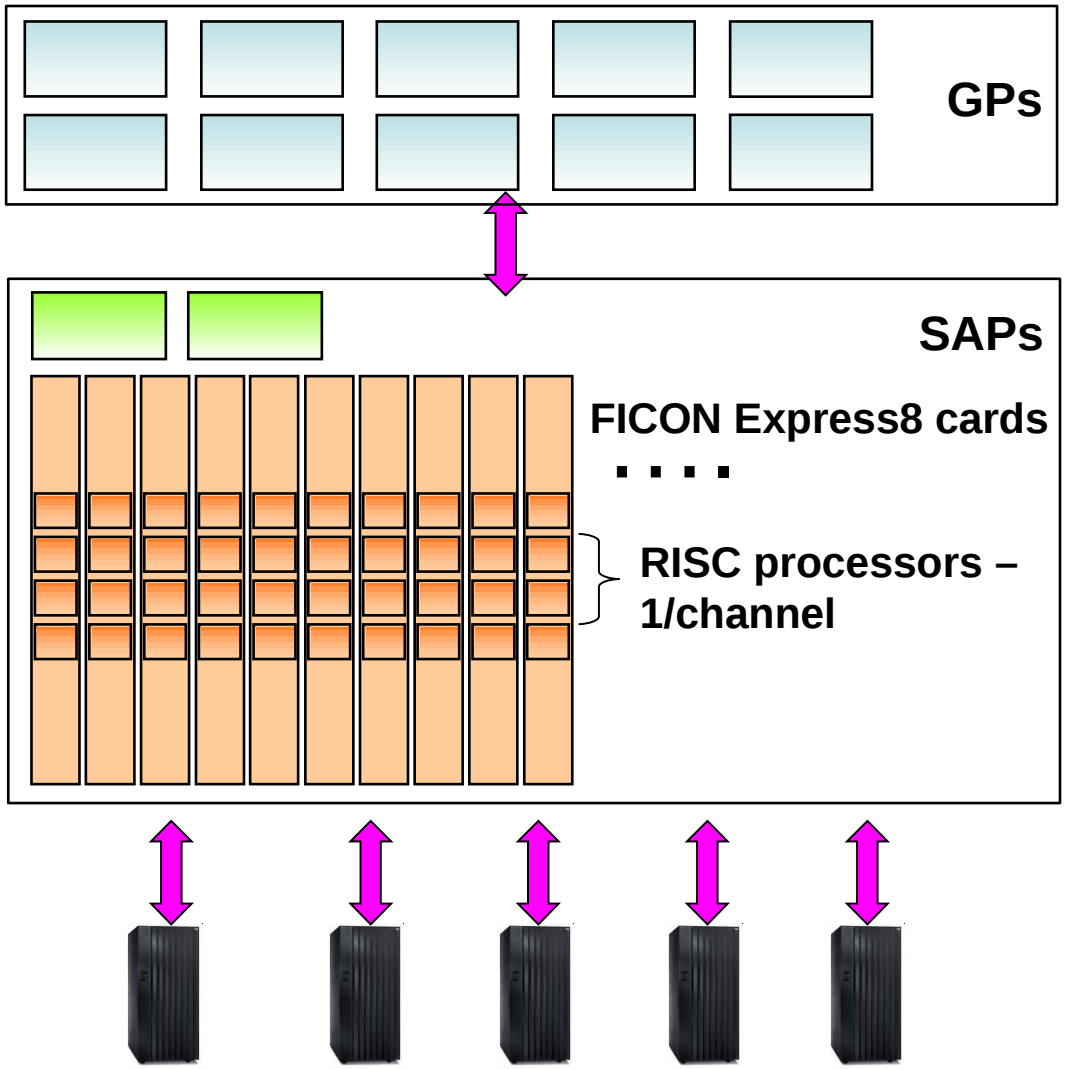
Linux On z/VM Benefits From High I/O Bandwidth Provided By z196



- Up to 80 General Purpose (GP) or Specialty Engine processors
  - Execute business logic
- Up to 14 System Assist Processors (SAP) to manage I/O requests
  - Logical Channel Sub-systems virtualize I/O
  - Can sustain up to **2.2M IOPS***
- Up to 84 physical FICON cards for I/O transfers
  - Up to **336 RISC channel I/O processors**
  - High Performance FICON connections (zHPF)
- IBM DS8800 Storage System
  - Up to **440K IOPS capability** with zHPF
- Benefits both z/OS and z/VM workloads

* Recommend 70% max utilization – 1.5M IOPS

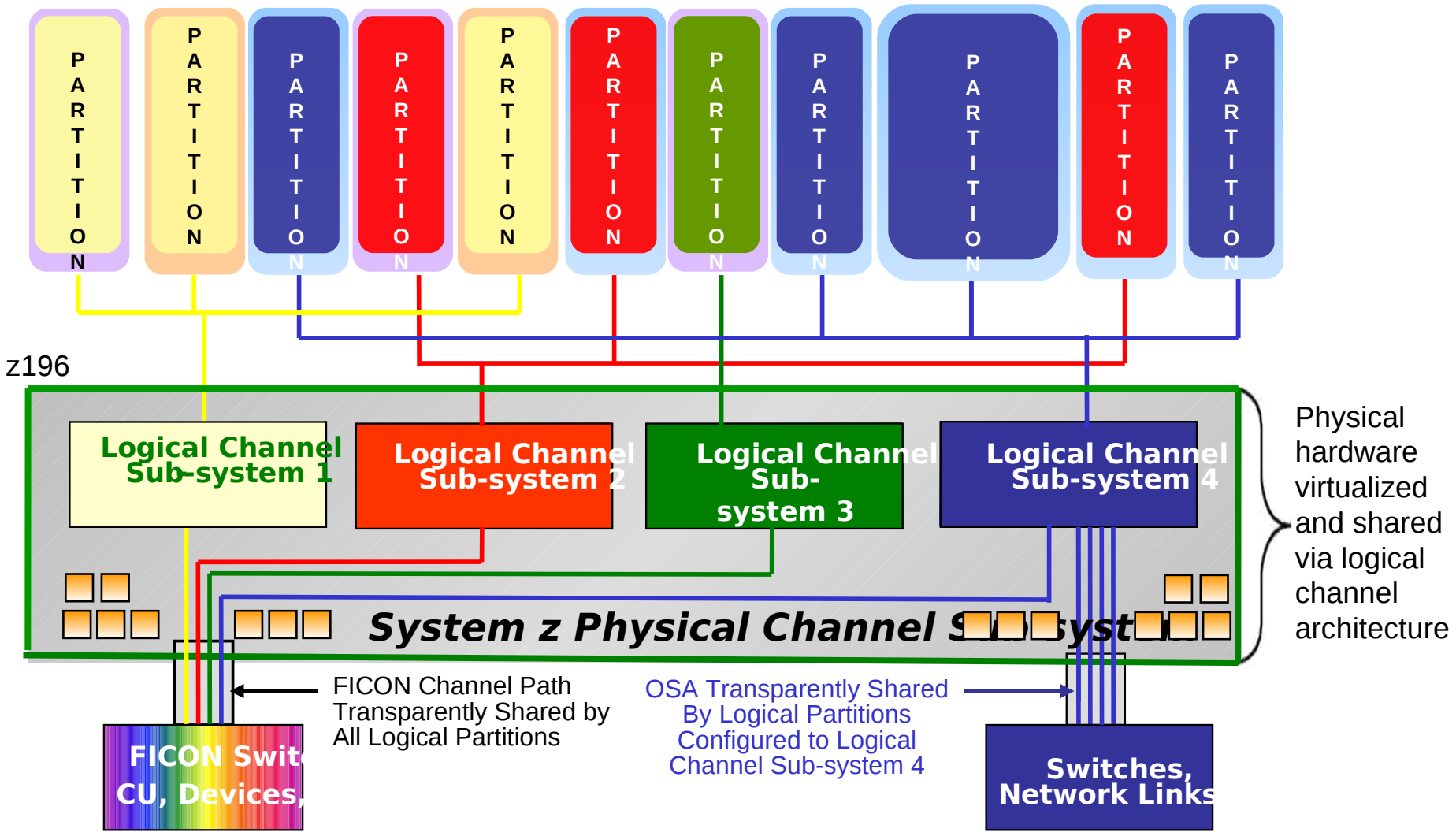
Linux On z/VM Also Benefits From High I/O Bandwidth Provided By z114



- Up to 10 General Purpose (GP) or Specialty Engine processors
  - Execute business logic
- Up to 2 System Assist Processors (SAP) to manage I/O requests
  - Can sustain up to **230K IOPS***
- Up to 64 physical FICON cards for I/O transfers
  - Up to **128 RISC channel I/O processors**

* Recommend 70% max utilization – 161K IOPS

Linux On z/VM Benefits From Virtualized Logical Channel Sub System – Sharing And Failover



z/VM Security For Linux Workloads

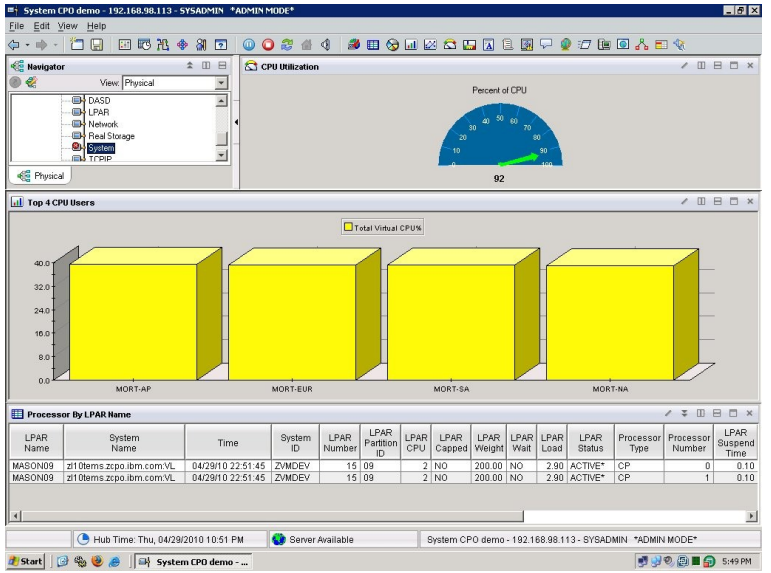
- Protects Linux virtual machines from each other
  - Operates without interference/harm from guest virtual machines
  - Virtual machines cannot circumvent system security features
  - z/VM certified at Common Criteria EAL4+
  - LPAR certified Common Criteria EAL5
- RACF Ensures that a user only has access to resources specifically permitted
  - Tracks who is accessing all system resources
- HiperSockets for highly secure internal networking
- Access to System z Crypto features
  - CPACF, CryptoExpress3

Linux On z/VM Workloads Inherit System z Qualities Of Service

- Reliability, availability, serviceability characteristics of System z
- Site failover for disaster recovery
- Capacity on demand upgrades
- Add physical processors to Linux environment without disruption

DEMO: Dynamically Add New Processor To z/VM LPAR To Handle Increased Workload

1. A customer has in-house Risk Analysis program running on Linux on System z
2. Increased workload to all 4 Linux guests is causing z/VM LPAR utilization of 90%+
3. Customer determines this is a long term trend - additional physical capacity needed
4. New capacity made available to LPAR as new Logical CPU, available for work
   - Without disruption in service

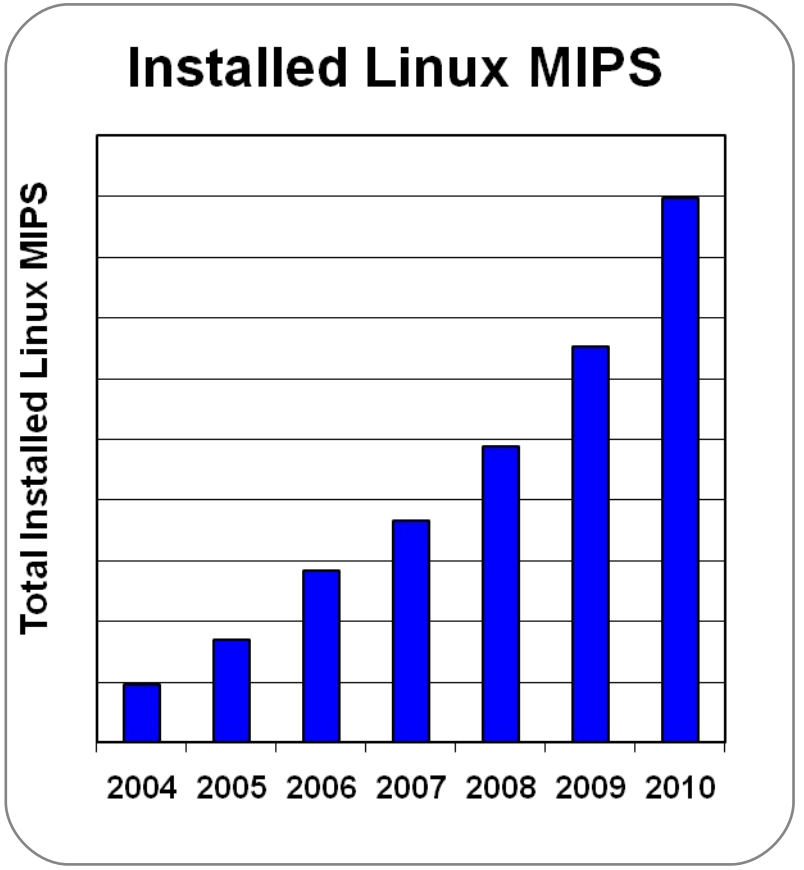


VMware can't recognize and take advantage of additional physical processors without bringing down and rebooting the system

Note: Assumes available processors on installed books

Installed MIPS For Linux on z/VM Are Growing At 45% CAGR

- The momentum continues:
  - **Shipped IFL MIPS increased 84% from YE08 to YE10**
- Linux is 18% of the System z customer install base (MIPS)
- Over 80% of the top 100 System z clients are running Linux on the mainframe
- More than 3,100 applications available for Linux on System z



[1] Based on YE 2004 to YE 2010

Case Study – The Salt River Project*

Migrates to Red Hat Enterprise Linux on IBM Mainframes for Flexibility and Performance

Business need:
Searched for a replacement for proprietary software for its IBM mainframe servers that could provide greater flexibility, manageability, and utilization opportunities. Migration Path: HP–UX to Red Hat Enterprise Linux

Solution:
SRP decided it would prefer to use one reliable Linux distribution in both its mainframe and distributed environments.

Benefits:
Red Hat Enterprise Linux on IBM System z mainframe servers has provided SRP with a very stable and predictable solution that can be easily managed via Red Hat Network Satellite.

"Since we were already leaning toward Red Hat in our distributed environment, choosing Red Hat on the mainframe coincided perfectly with our desire to have one corporate standard for Linux."

- Kevin Masaryk, Senior Linux/UNIX Administrator at SRP

- Achieved
  - Consolidation of multiple workloads
  - Reduced costs
  - A single corporate standard OS across the mainframe and distributed platforms

***Large Arizona Agency & Utility**

From Server Sprawl To Storage Sprawl, The New Era Of CIO Pain

But what about the storage?

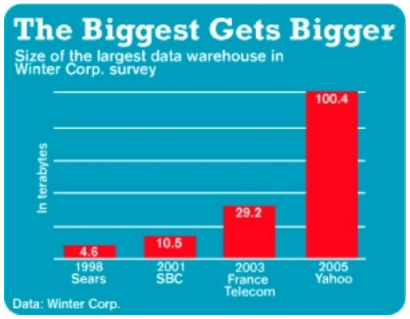
CIO

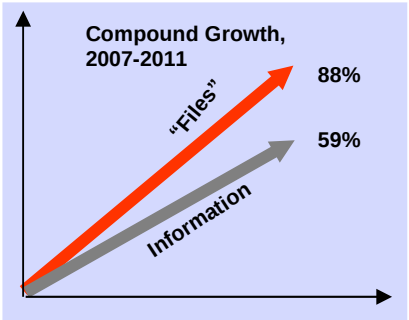
You can virtualize and consolidate it all on DS8000.

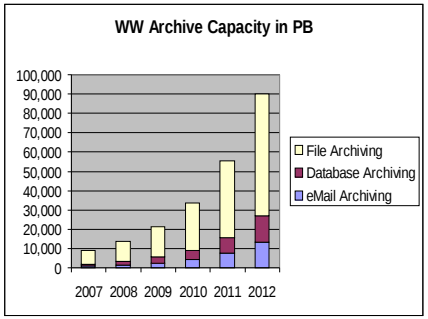
IBM

Storage Administrators Face Problems Similar To Server Administrators

- Insatiable demand for growth
  - Continuous hunger for more storage
  - Both structured
    - Larger databases
    - Bigger data warehouses
  - And unstructured
    - Rich media (web, images, video, email, documents, etc.)
    - Driven by Big Data Analytics
  - Regulatory requirements to maintain more data for longer periods
- Flat IT budgets
  - Little to no growth in budgets
  - Expectation to manage more with the same staff
  - Traditional approaches





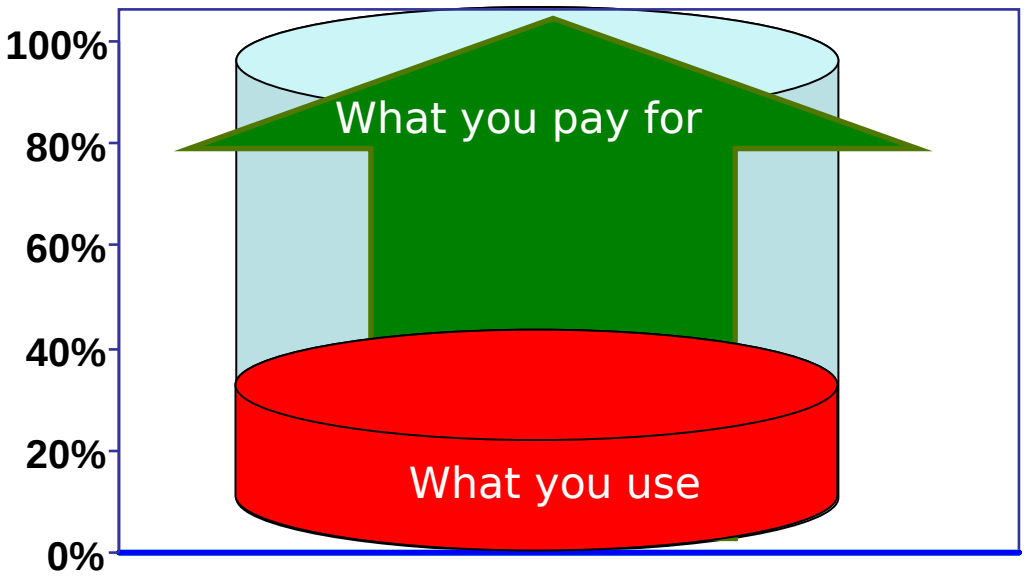


Low Disk Utilization Drives Up Cost

The typical UNIX or x86 disk storage is running at 20-40% utilized

System z disk storage runs as high as 60-80% utilized

- System spins disks that are mostly empty
- Configuration planned for I/O peaks
- Configuration planned for Data growth



Resulting in 60-80% of the hardware, storage software licenses, maintenance, floor space and energy that YOU pay for being wasted

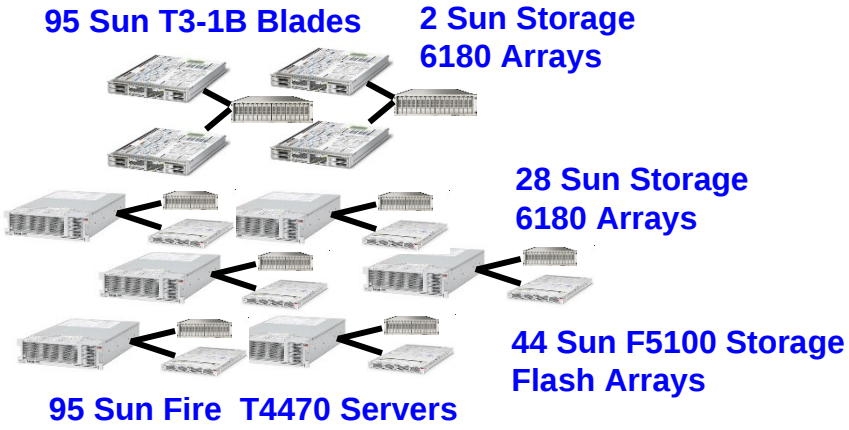
Smart Enhancements To A Superior Design

- In addition to its advanced hardware design, the DS8000 *is* smarter storage
  - Evolution from manual configuration and tuning to automation and efficiency
  - Automation and efficiency are imperatives for multi-tenancy environments, such as cloud computing
  - It all starts with our volume management foundation

- Advanced storage efficiency and quality of service (QoS) capabilities
  - Support for larger volume sizes and new GUI can help increase administrator productivity and lower operating costs
  - Easy Tier enhancements can help clients more effectively optimize performance and capacity management
  - I/O Priority Manager feature can help improve application service levels, enable consolidation, and lower infrastructure costs

Messy Distributed Storage Vs. Clean Centralized Storage With DS8800

Deployed on Sun



- Storage added on a per server basis
- Fragmented Storage Capacity and Storage Cache
- Storage is shared rather than virtualized
- Flash/SSD is over-provisioned and not available to all hosts
- Allocating Flash/SSD is a manual process

Best fit on zEnterprise

Incremental add on DS8800

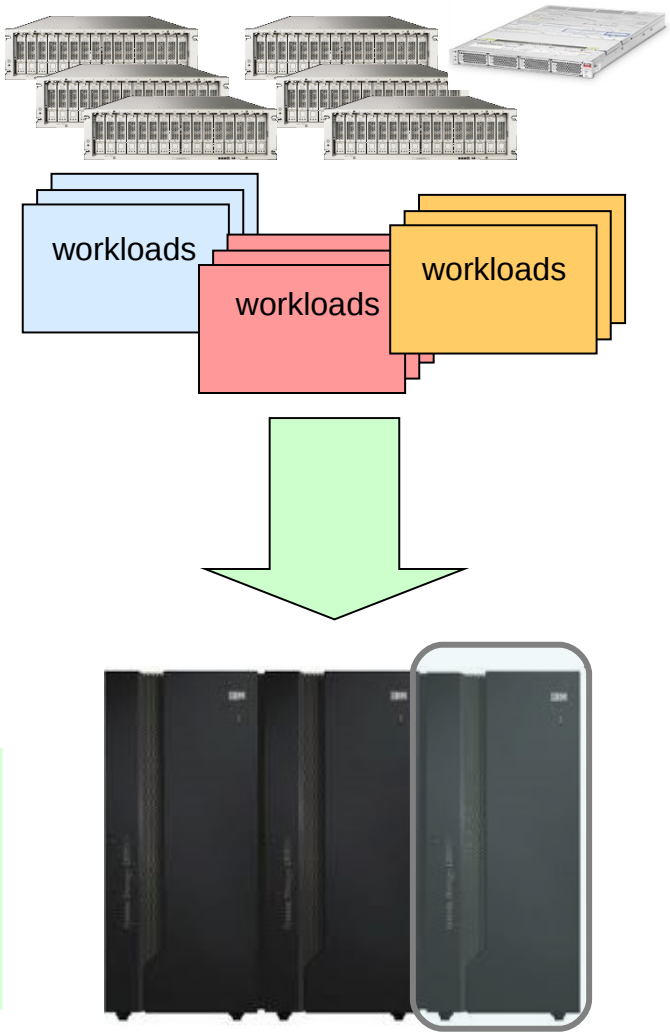
- Enterprise class virtualization
- Storage utilized at 60%
- Use the same storage admin as your zEnterprise storage
- Storage Cache available to all connected hosts
- SSD can be provided to all/any hosts that would benefit

zEnterprise And IBM DS8800 Synergy

Maximize utilization through storage virtualization and consolidation

Efficiently use solid state disk increases performance up to 300% on critical apps

Incremental addition of storage minimizes cost of acquisition



Centralized storage platform and structured practices minimize labor costs

Tivoli management tools improve productivity