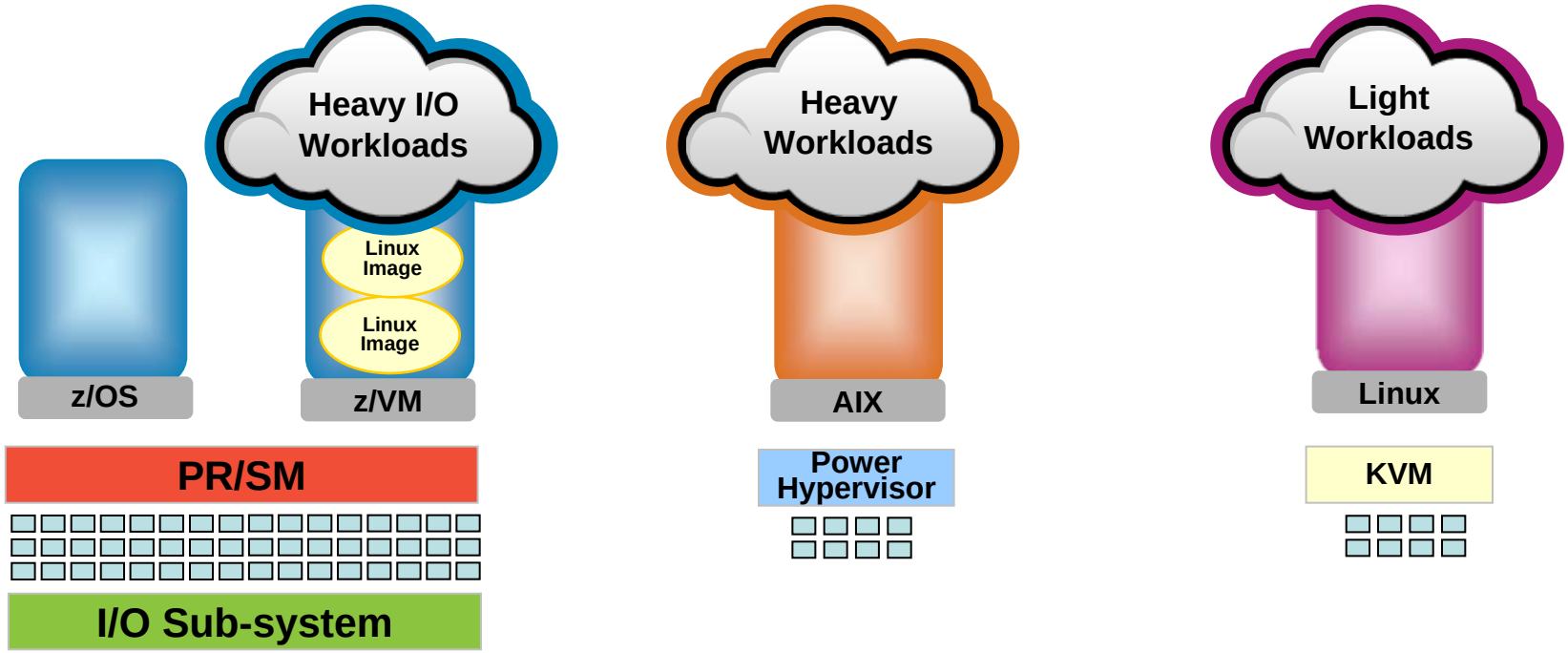
The New zEnterprise – A Smarter System For A Smart Planet

Virtualization & Consolidation
On zEnterprise

A Deeper Look At Some Topics

- How was “fit for purpose” determined?
- Why was Linux on z/VM best for the heavy I/O workloads?
- Network simplification with zEnterprise
- Storage simplification with zEnterprise

zEnterprise Extends Cost Advantages To A Broader Range Of Workloads

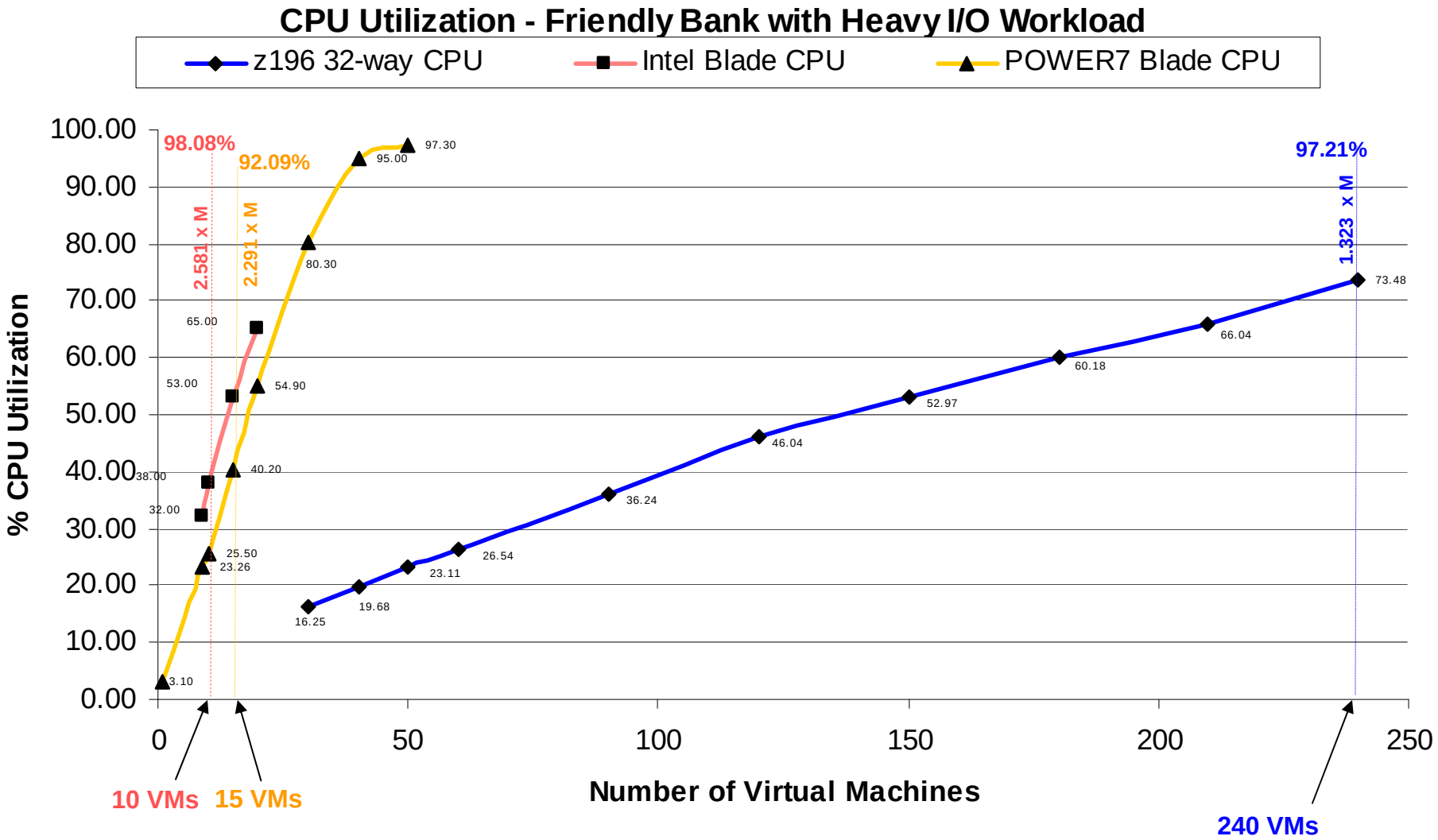


- Scale up to 96 cores in a frame (z/OS clusters with Sysplex)
- Dedicated I/O Sub System with up to 336 I/O processors
- Superior qualities of service

- Scales to 8 cores per blade
- Larger number of fast processing threads
- Floating point accelerators

- Scales to 8-12 cores per blade
- Fast processing threads
- Commodity I/O
- Modest qualities of service

Consolidation Ratios for Distributed Workloads with Heavy I/O



Consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way measurements. zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics.

Deploying Workloads With Heavy I/O Requirements

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

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**

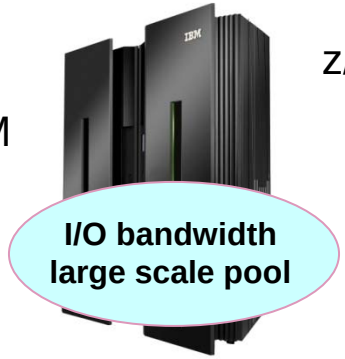
10 workloads
per Intel blade

Virtualized on Intel
8 core Blade
$23,621 per workload

15 workloads
per POWER7 blade

PowerVM on PS701
8 core Blade
$15,614 per workload

240 workloads
per 32-way z/VM



z/VM on zEnterprise CPF
32 IFLs
$13,599 per workload

Consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way 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 Heavy Workloads

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

Workloads

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

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

1 workload per Intel blade

Virtualized on Intel
8 core Blade
$236,208 per workload

2 workloads per POWER7 blade

more parallel threads

PowerVM on PS701
8 core Blade
$117,108 per workload

23 workloads per 32-way z/VM

z/VM on zEnterprise CEC
32 IFLs
$141,900 per workload

Consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way 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 Light Workloads

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

Workloads

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

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

36 workloads per Intel blade

Fast low cost threads

Virtualized on Intel
8 core Blade
$6,561 per workload

34 workloads per POWER7 blade

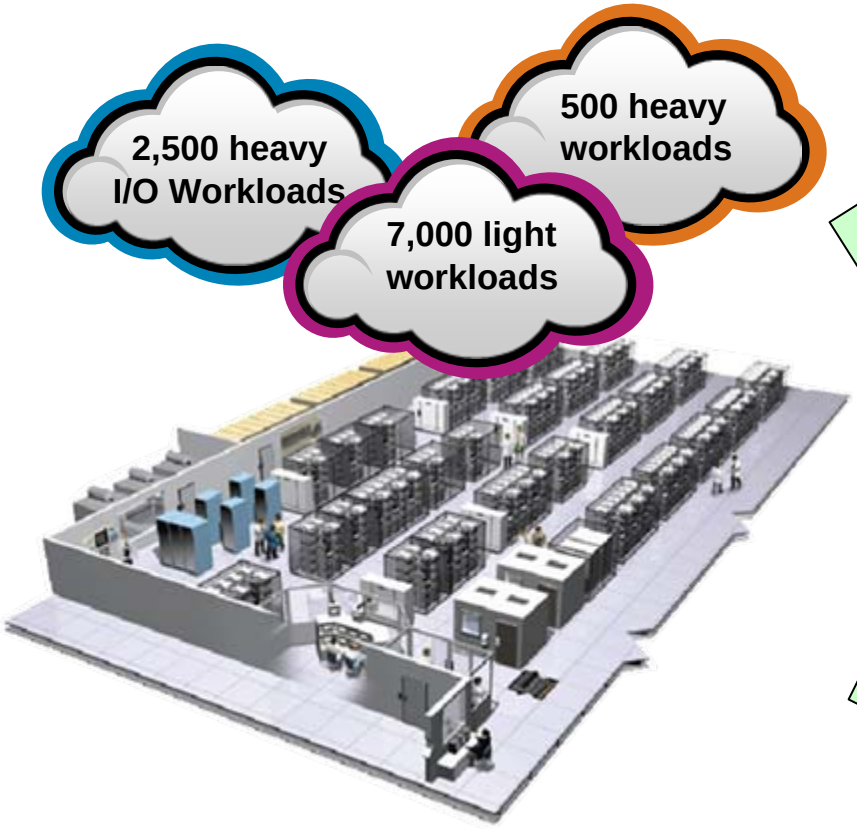
PowerVM on PS701
8 core Blade
$6,889 per workload

270 workloads per 32-way z/VM

z/VM on zEnterprise CEC
32 IFLs
$12,088 per workload

Consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way 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.

Options For Deploying Distributed Workloads –
Best Fit Strategy On zEnterprise Produces Lowest Cost



Deploy all distributed workloads on x blades

$223 M

Deploy all distributed workloads on p blades

$145 M

Deploy all distributed workloads on Linux on System z

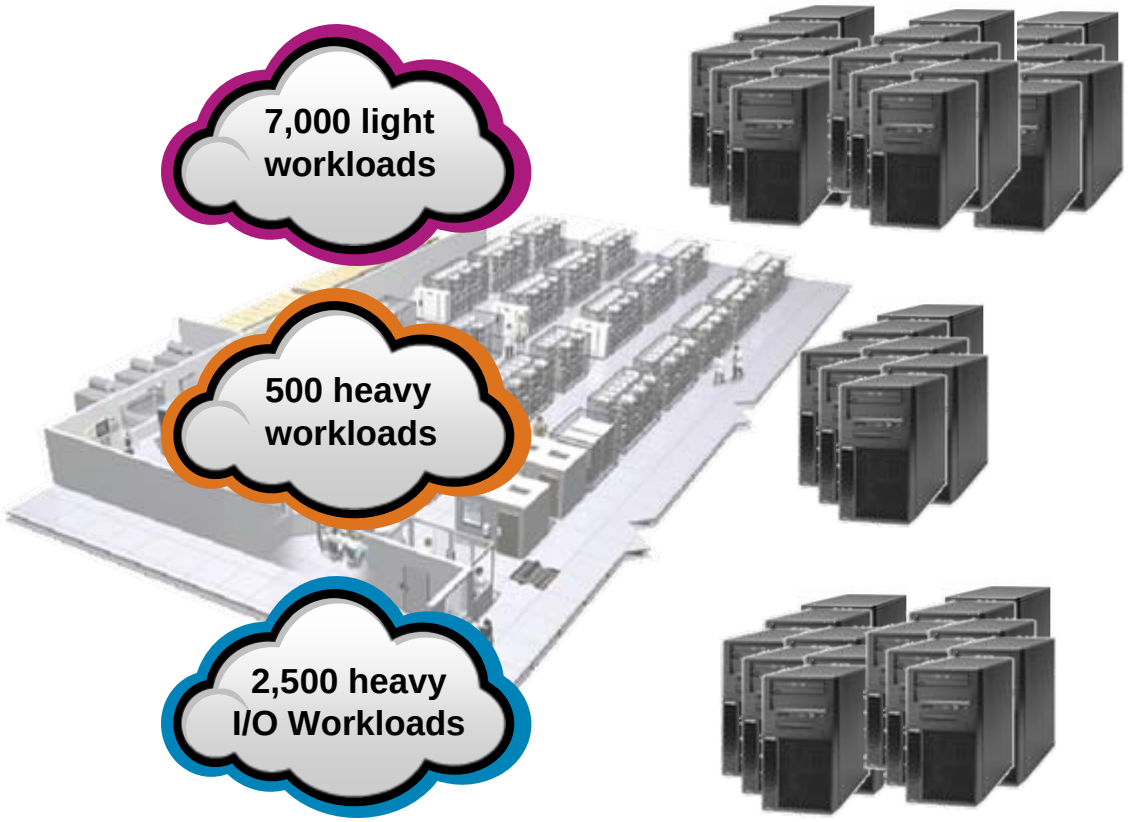
$189 M

Best Fit deployment on zEnterprise (Linux on System z, x blade, p blade)

$138 M

Consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way 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.

Large Data Center – What Did It Cost To Deploy 10,000 Workloads On Virtualized Intel Servers?



Deployed on **875** Intel Xeon Servers using VMware
(8 cores each)

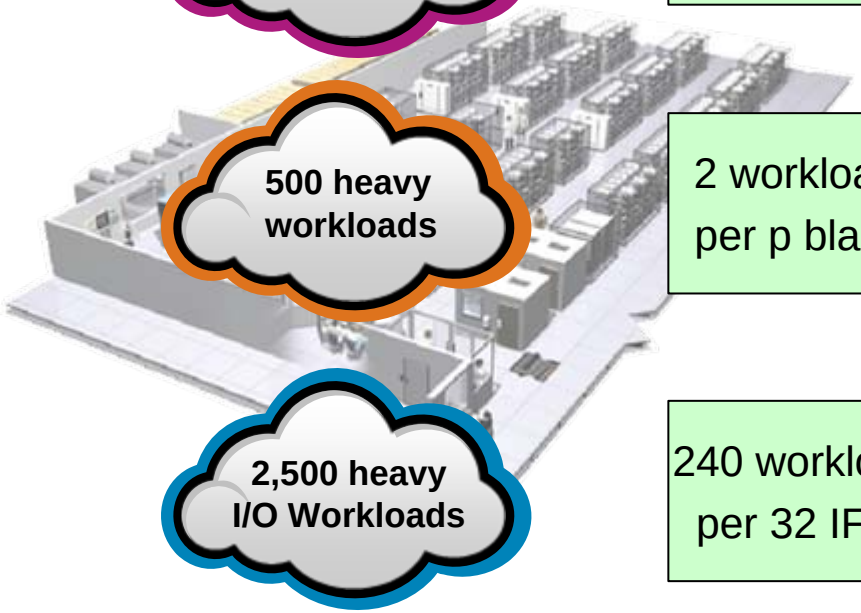
Deployed on **500** Intel Nehalem Servers
(8 cores each, non-virtualized)

Deployed on **228** Intel Nehalem Servers using VMware
(8 cores each)

10,000 workloads **1603 servers**

IBM analysis of a customer scenario with 10,000 distributed workloads. Deployment configuration is based on consolidation ratios derived from IBM internal studies.

Large Data Center – What Does It Cost To Deploy 10,000 Workloads On zEnterprise?



7,000 light workloads

36 workloads per x blade

7 zBX racks 195 x blades total

500 heavy workloads

2 workloads per p blade

9 zBX racks 250 p blades total

2,500 heavy I/O Workloads

240 workloads per 32 IFLs

5 zEnterprise CPFs 334 IFL's

Best fit assignments

Configuration is based on consolidation ratios derived from IBM internal studies. z196 32-way performance projected from z196 8-way and z10 32-way measurements. The zBX with x blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics.

Compare Server Cost of Acquisition

Deployed on Intel

Best fit on zEnterprise

1603 Intel Servers

21 Frames
445 blades
334 IFL's

$314M TCA (3 years)

$138M TCA (3 years)

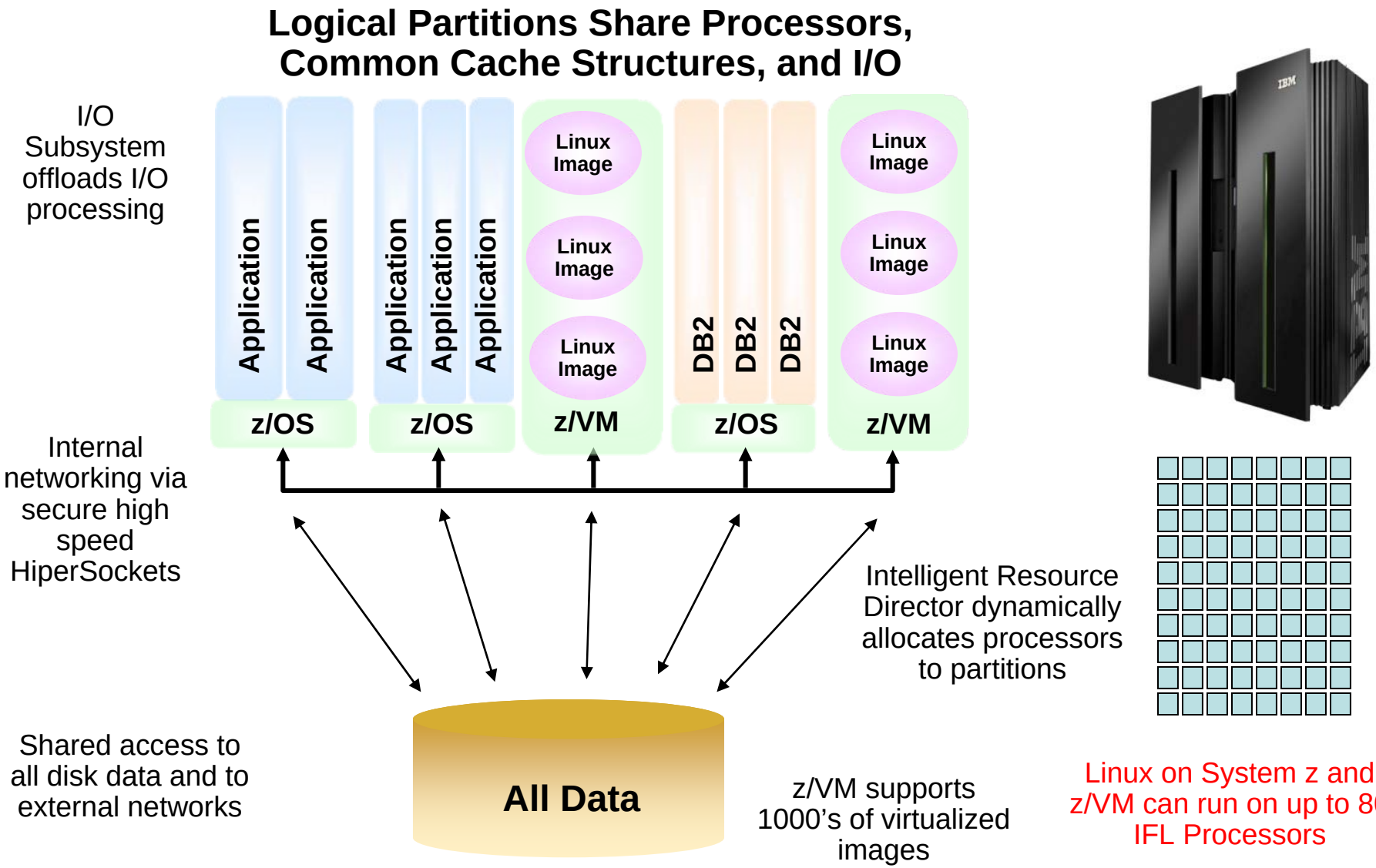
Server configurations are based on consolidation ratios derived from IBM internal studies. Prices are in US currency, prices will vary by country

56% less

Linux On z196 Achieves Lowest TCA For Heavy Processing And I/O Workloads

- Larger scale of shared processor pools (32 cores vs. 8 cores)
- Statistical benefit of sharing a larger pool of processors
- Software priced per core
- Cost benefit of Enterprise Linux Server Solution Edition pricing
- Dedicated I/O Subsystem offloads I/O processing
- Greater I/O bandwidth
- Virtualization of I/O processing resources
- Built-in storage virtualization and switching

z196 Is Designed For Large Scale Virtualization And Consolidation



z/VM on System z – Optimized For Large Scale Virtualization

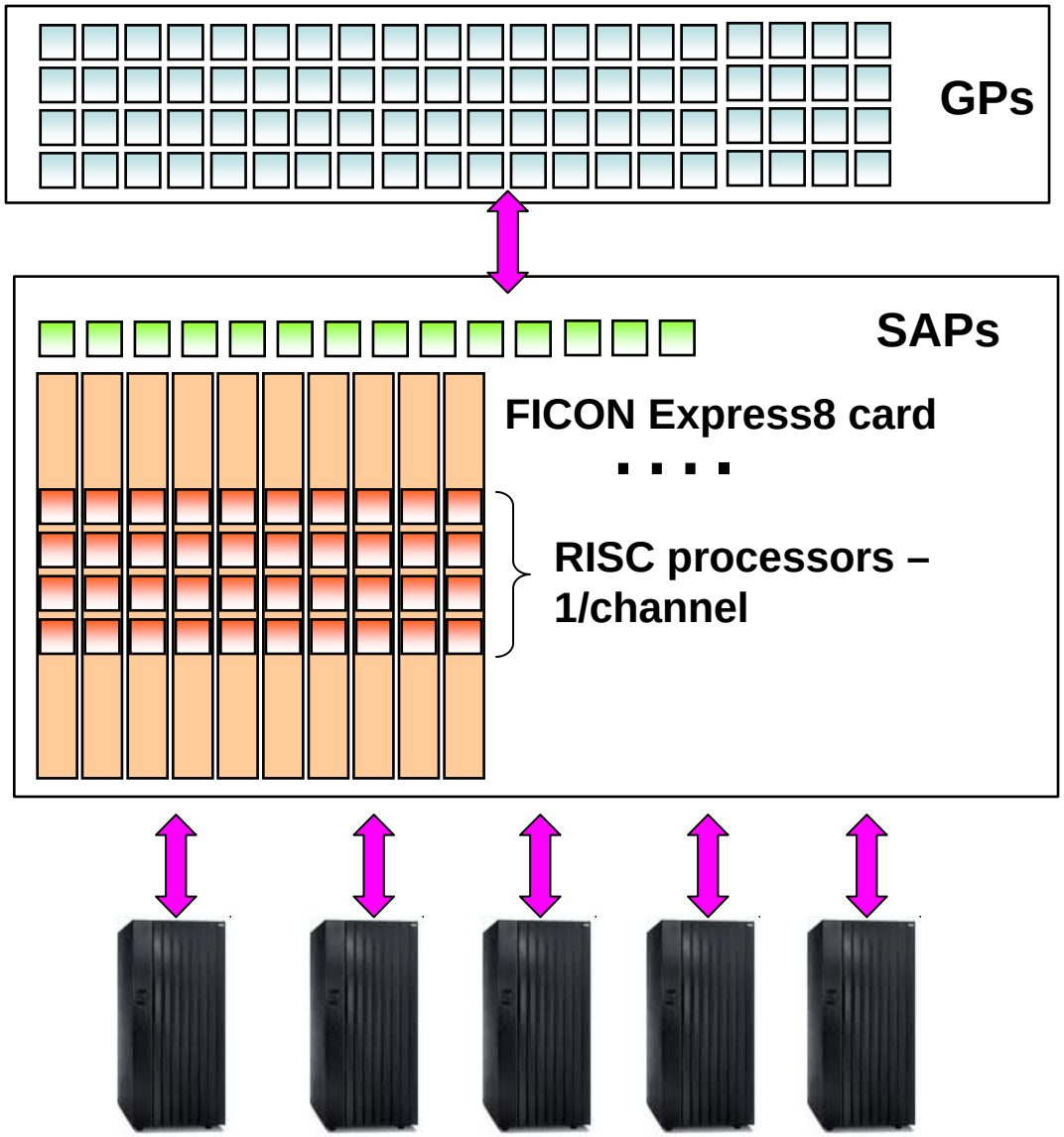
- Large scale virtualization yields pooling benefits
  - Shared processor pool
  - Lower headroom requirement to accommodate variations in workload demand
- On System z, up to 32 IFL processor cores can be supported by a single z/VM LPAR
  - Large scale virtualization platform can support hundreds of virtual machines
- zBX Blades are limited to 8-12 cores (currently)

System z Solution Edition For Enterprise Linux And The Enterprise Linux Server

Transforming the economics of large scale integration at a special packaged price!

- System z Solution Edition for Enterprise Linux
  - Integrated Facility for Linux (IFL) processors, memory and z/VM added 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
  - (Novell SUSE and Red Hat)

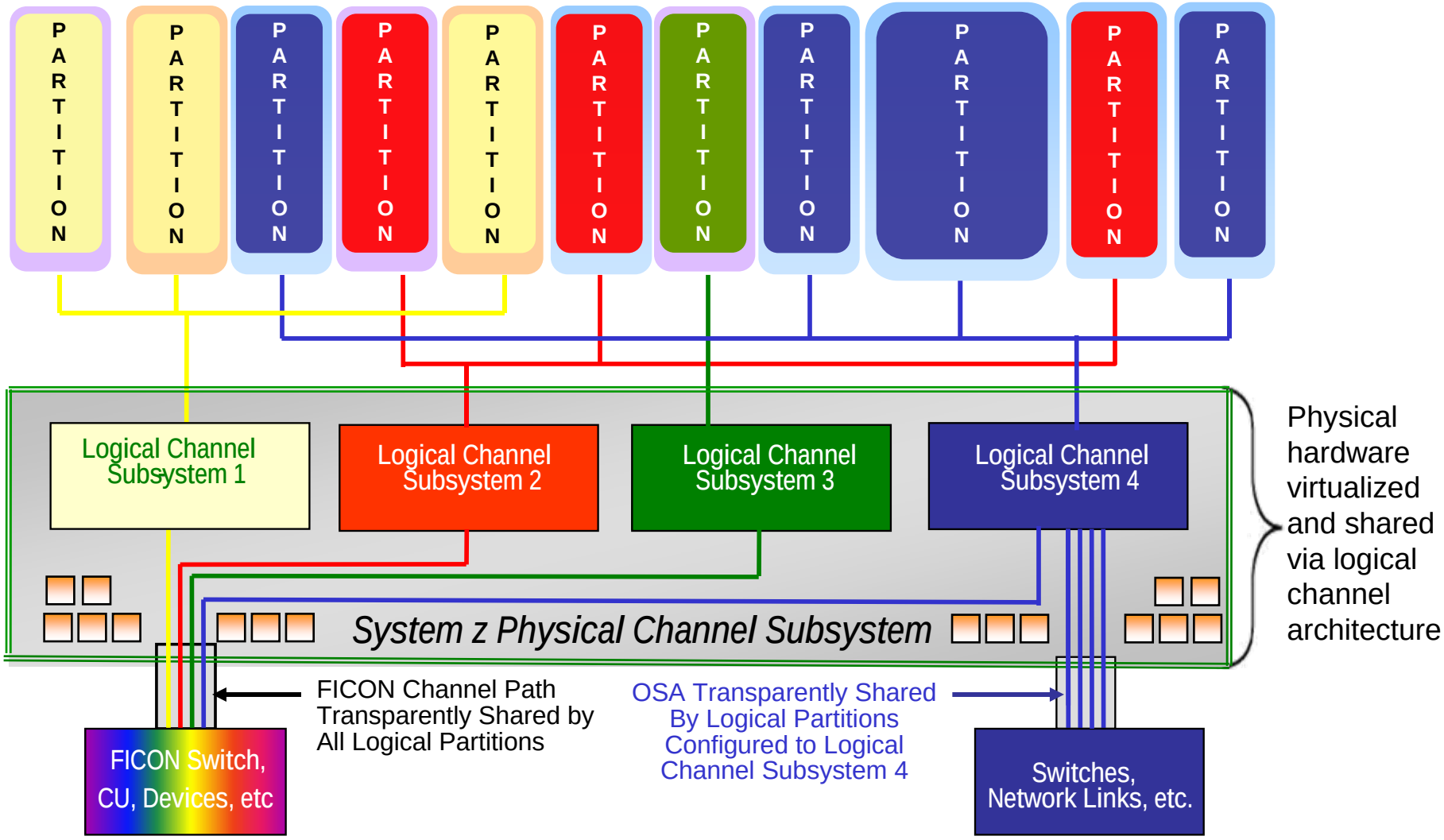
z196 - Optimized For High I/O Bandwidth



- 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
  - Can sustain up to **2.2M IOPS***
- Logical Channel Subsystem virtualizes I/O
  - Up to 1024 logical channels
- Up to 84 physical FICON cards for I/O transfers
  - Up to **336 RISC channel I/O processors**
  - High Performance FICON connections
- IBM DS8700 Storage System
  - Up to **420K IOPS capability** with zHPF
- Benefits both z/OS and z/VM workloads

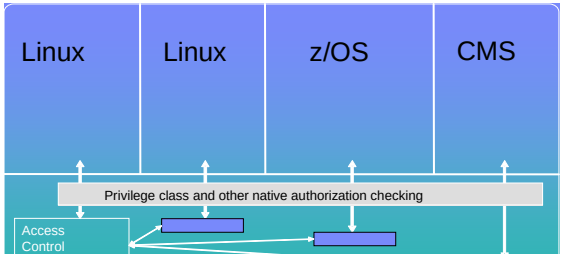
* Recommend 70% max SAP Utilization – 1.5M IOPS

Physical I/O Adapters And Channels Are Virtualized And Shared By The Consolidated Workloads



z/VM Security For Virtualization

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

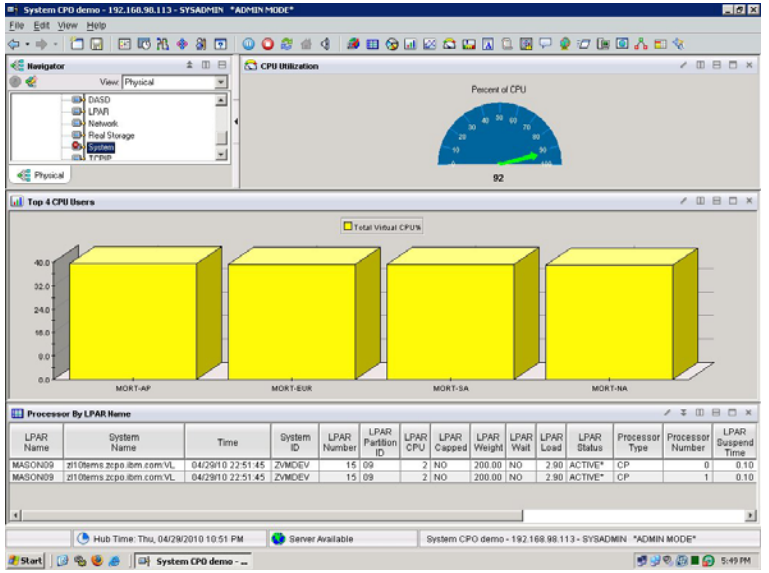


Linux On System z Workloads Inherit System z Qualities Of Service

- 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 Risk Analysis 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

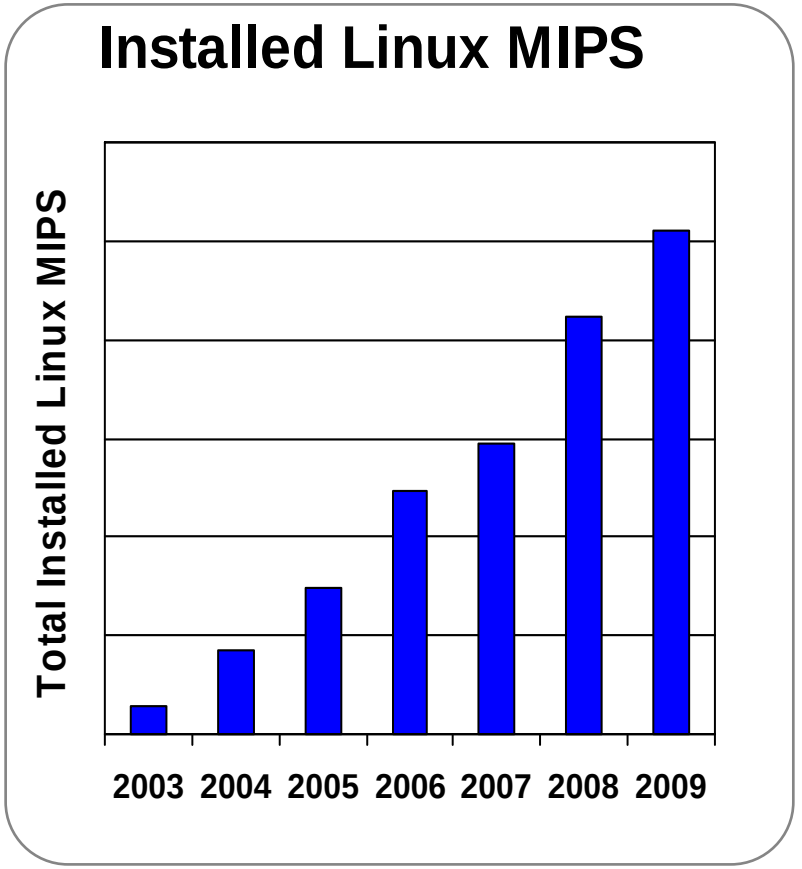


VMware can't recognize and take advantage of additional physical processors without bringing down and rebooting the system

Note: Assumes available processors on installed books

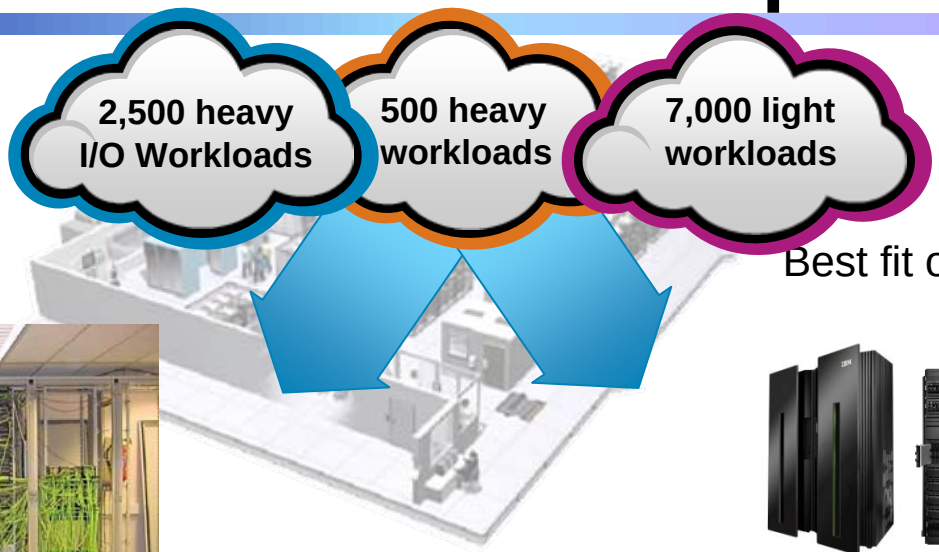
Client Adoption Drives Linux Success
*Installed Linux MIPS At 43% CAGR**

- The momentum continues:
  - **Shipped IFL MIPS increased 65% from YE07 to YE09**
- Linux is 16% of the System z customer install base (MIPS)
- 70% of the top 100 System z clients are running Linux on the mainframe
- >3,100 applications available for Linux on System z

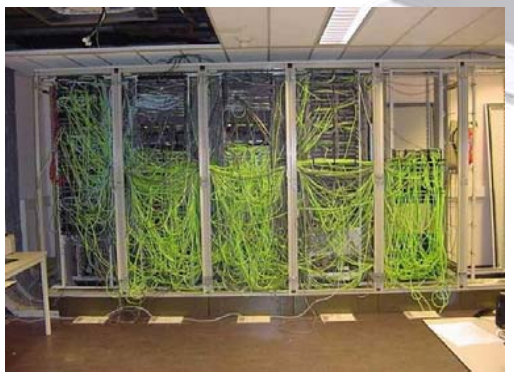


* Based on YE 2004 to YE 2009

Compare Network Cost Of Acquisition



As deployed on Intel



Additional network parts
- 313 switches
- 7038 cables
- 6412 adapters

13,763 total network parts

$3.8M TCA

Best fit on zEnterprise

Additional network parts
- 7 switches
- 142 cables
- 74 adapters

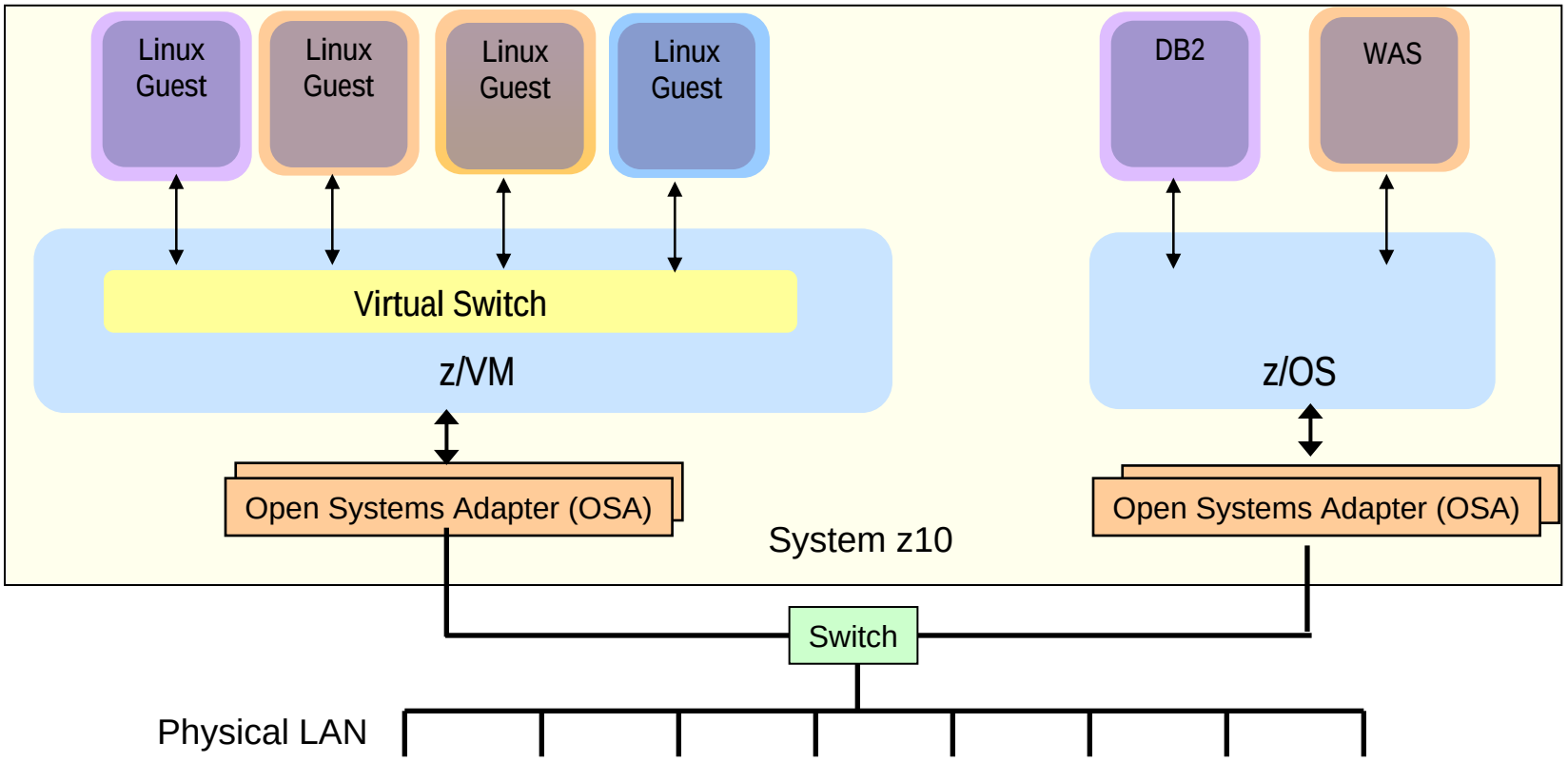
223 total network parts

$197K TCA

95% less

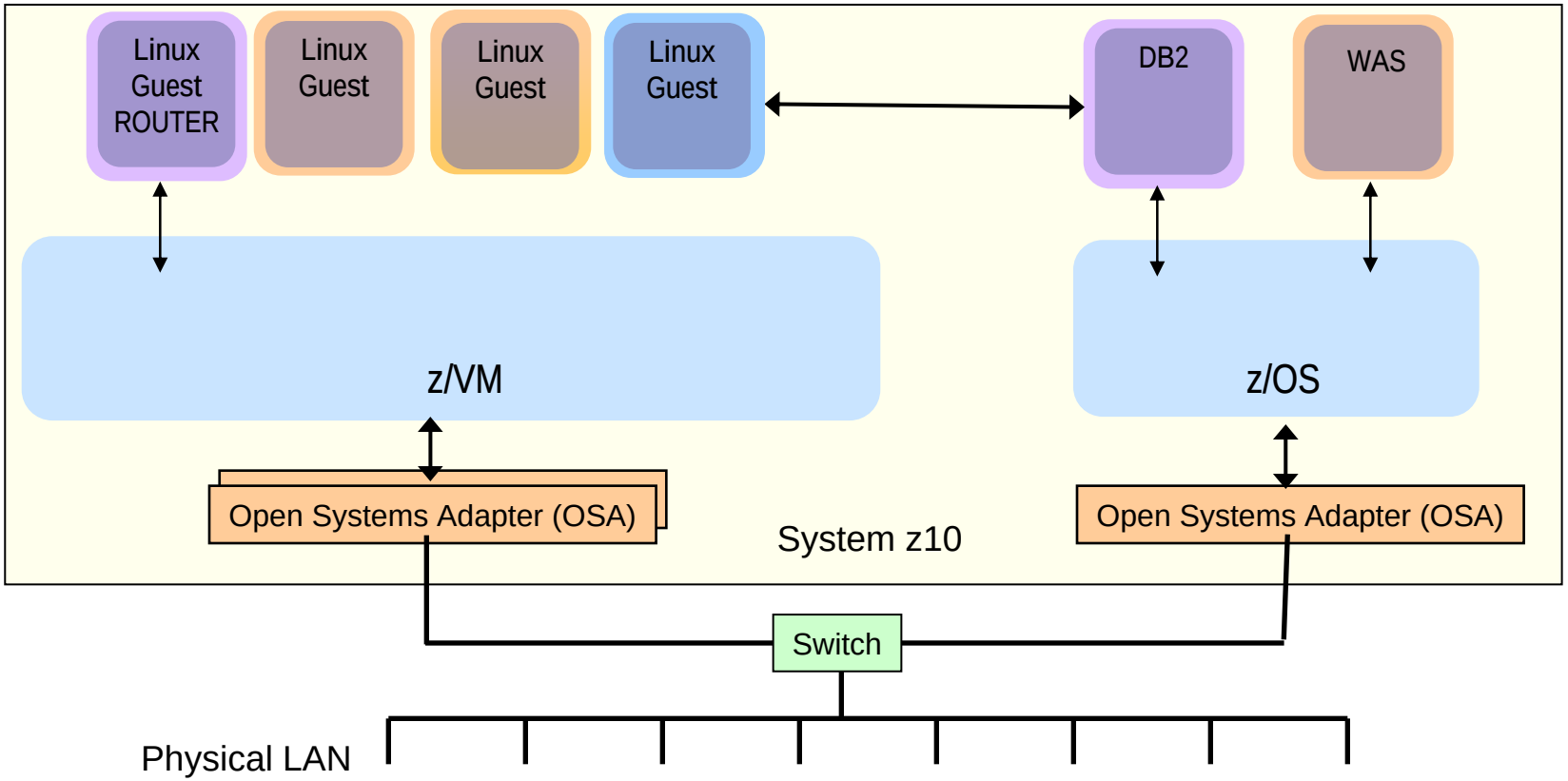
Network configuration is based on IBM internal studies.
Prices are in US currency, prices will vary by country

System z Features Enable Network Simplification – z/VM Virtual Switch



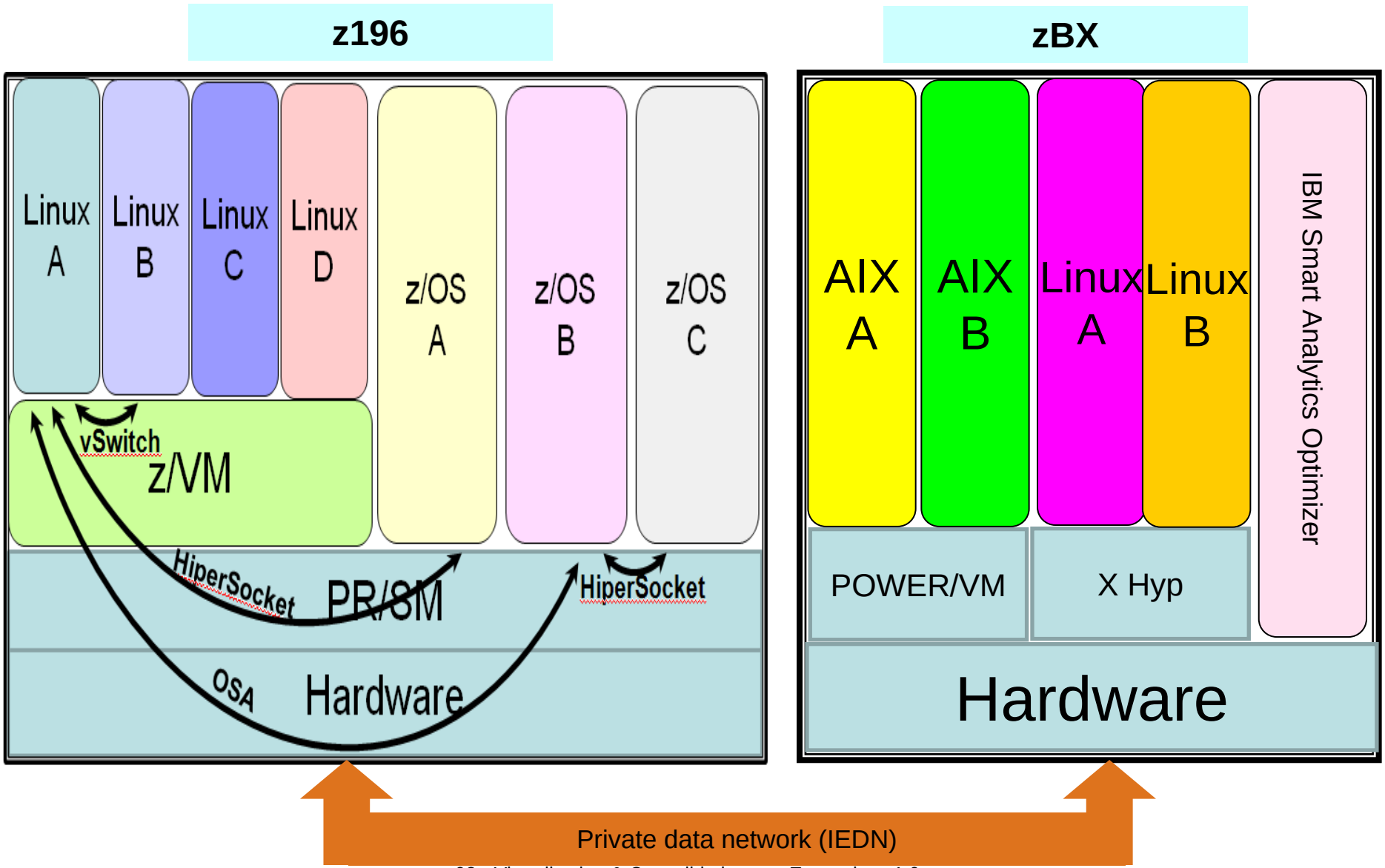
- Linux guests can talk to each other via zVM virtual switch – memory speed
- Linux guests can talk to outside world via z/VM virtual switch connected to shared OSA adapter
- Attach up to 8 physical OSA ports - redundancy, balancing
- Dynamically add new physical OSA to support Linux workload growth

System z Features Enable Network Simplification – HiperSockets

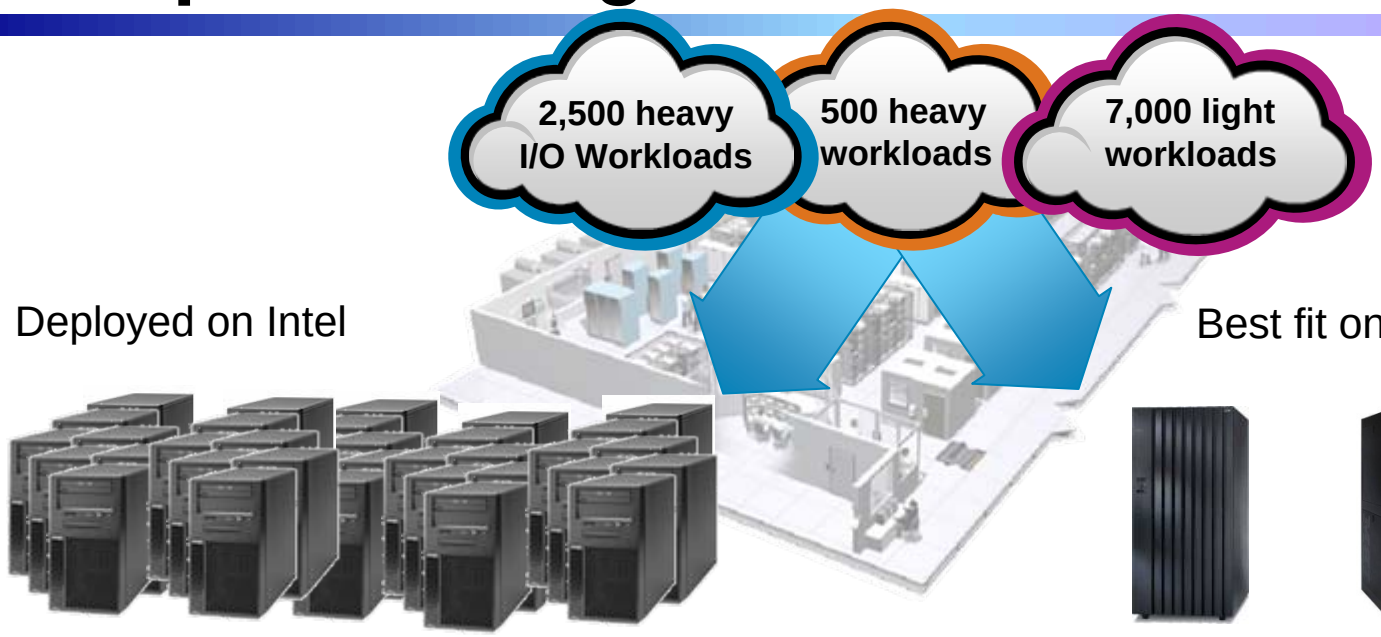


- Linux guests can talk to z/OS applications
- **Secure** IP communication at memory speed
- Close integration of data-intensive applications with database
- Reduces network management and physical assets

Network Simplification Extends To The zBX



Compare Storage Cost



7.7 PB embedded storage
31% utilization
1603 points of admin

$211M TCO(3 years)

240GB active storage required per workload (2.4PB total)

4.5 PB provisioned storage
53% utilization
10 points of admin

$108M TCO (3 years)

49% less

Storage configuration is based on IBM internal studies.
Prices are in US currency, prices will vary by country

IBM System Storage – Optimized For Different Requirements

DS8700

- Mix of random and sequential I/O
- Highest availability and performance with High Performance FICON, large cache, and Easy Tier for SSD's

XIV

- Mostly random block I/O
- Ideal for distributed apps
- Exceptional ease of use and management productivity

SONAS

- Mostly sequential file server I/O
- Scalable network storage
- Ideal for consolidating distributed filers

Best Fit Storage

Distributed light workload -
240GB active storage
55% block/45% file

7,000 Workloads

924TB to XIV
756TB to SONAS

6 zBX racks with xASB

+

XIV
6 via SAN

SONAS
1

Distributed heavy workload -
240 GB active storage
55% block/45% file

500 Workloads

66TB to XIV
54TB to SONAS

9 zBX racks with pASB

+

XIV
1 via SAN

Distributed light workloads with heavy I/O -
240 GB active storage
100% block

2,500 Workloads

600TB to DS8700

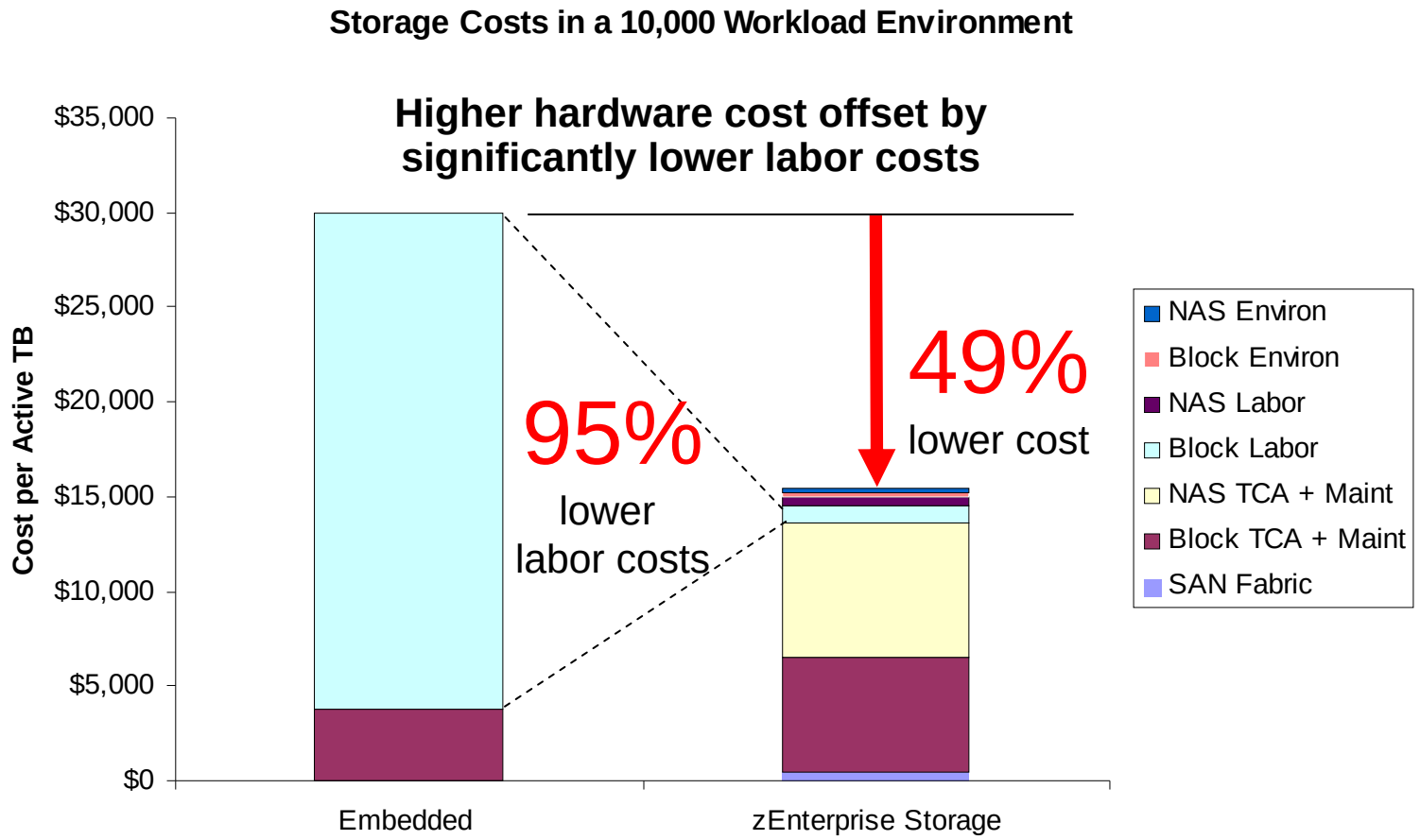
5 zEnterprise CEC's

+

DS8700
3

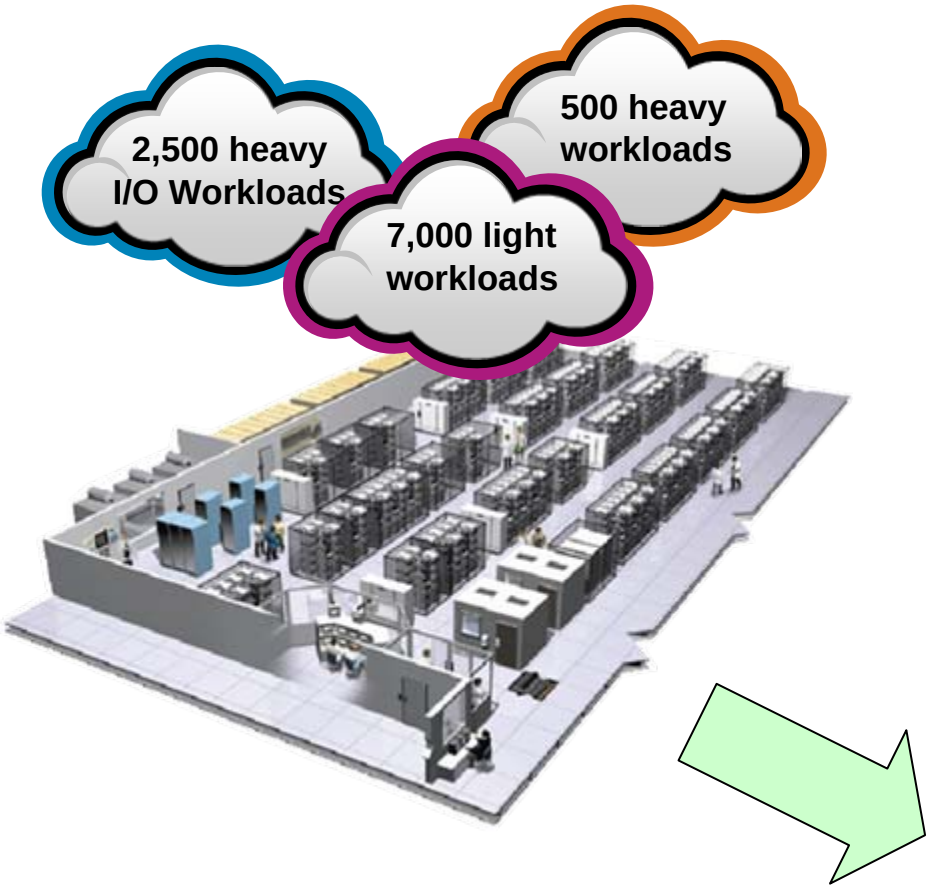
Storage configuration is based on IBM internal studies.
Individual customer configuration will vary

Consolidation Also Reduces Storage Costs



Storage numbers based on IBM study.
Individual customer scenarios will vary.
Prices are in US currency, prices will vary by country

zEnterprise Is A Roadmap To The Data Center Of The Future



- Lower cost per unit of work for large scale workloads
- Revolutionary cost reductions for smaller scale workloads
- Data center simplification
- Improve quality of service
- No other platform can match!

Mainframe workloads
+
distributed workloads
best fit for cost