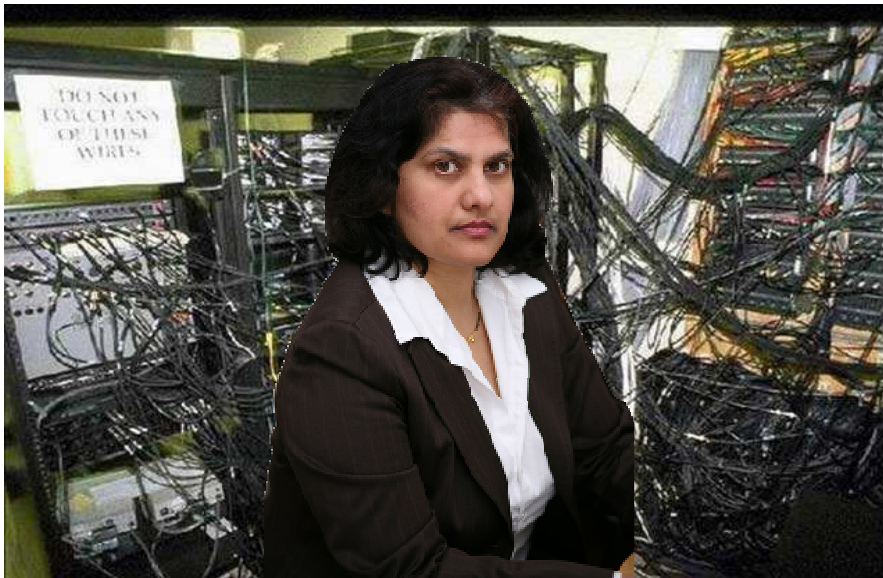# zEnterprise –
The Ideal Platform For
Smarter Computing

Consolidating Server Infrastructure

A Quick Look At The Problem Of Sprawl

Simplifying Hardware Infrastructure Dramatically Reduces The Cost Per Workload

Eliminate Sprawl With zEnterprise Multi-Architecture Environment

Intranet

Internet

Platforms Optimized for Different Workloads

z/OS	Linux on System z	AIX	Linux on System x	Windows	DataPower

Best Fit for Workload

Standalone

SPRAWL!

Consolidate with zEnterprise!
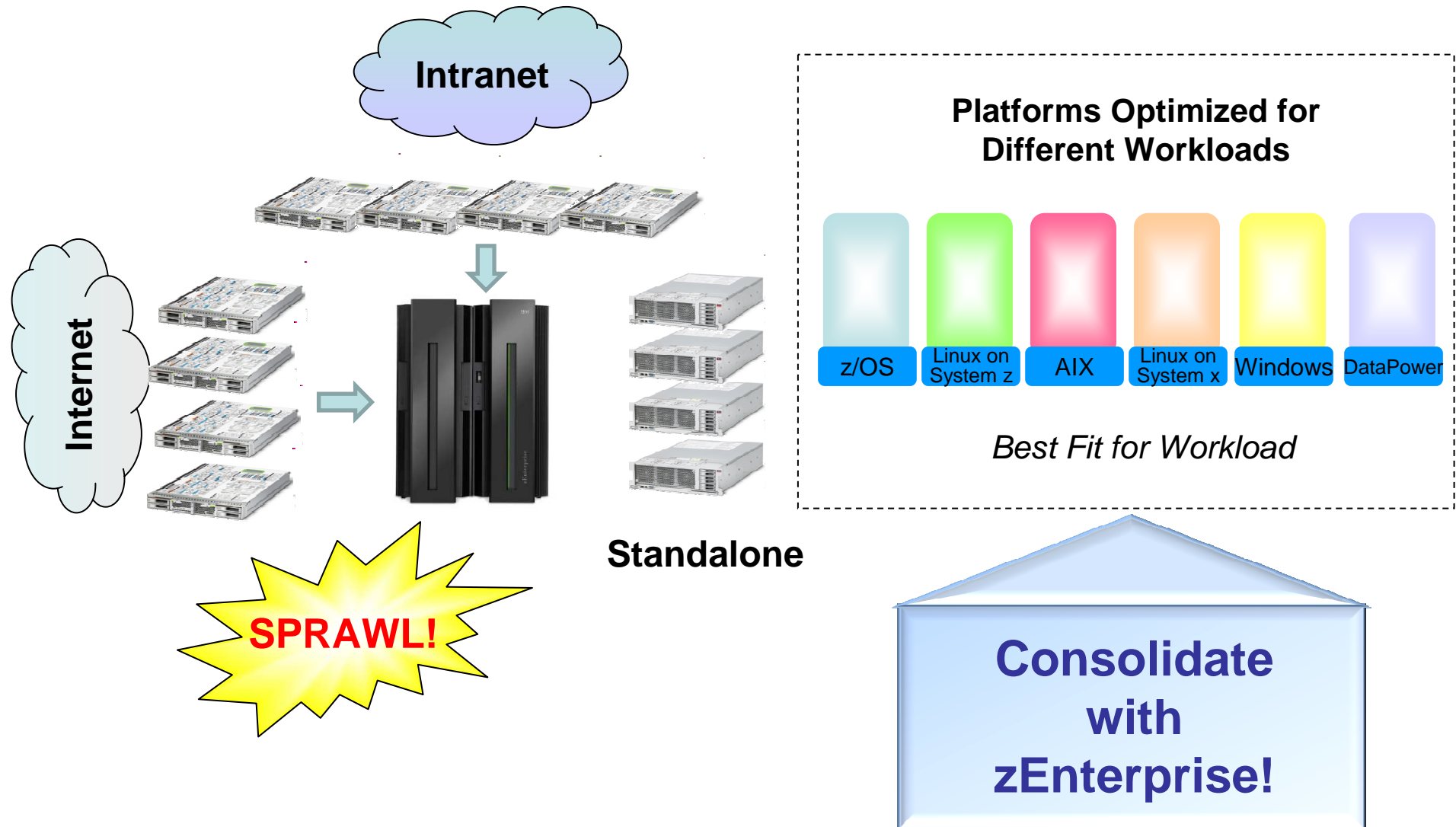
Run Web Front End Workloads On zEnterprise Platform

Web facing front-end | Message hub | CICS/DB2 core system

WAS — AIX

DataPower XI50z

DB2 CICS — z/OS

zEnterprise BladeCenter Extension (zBX)

zEnterprise z114 / z196
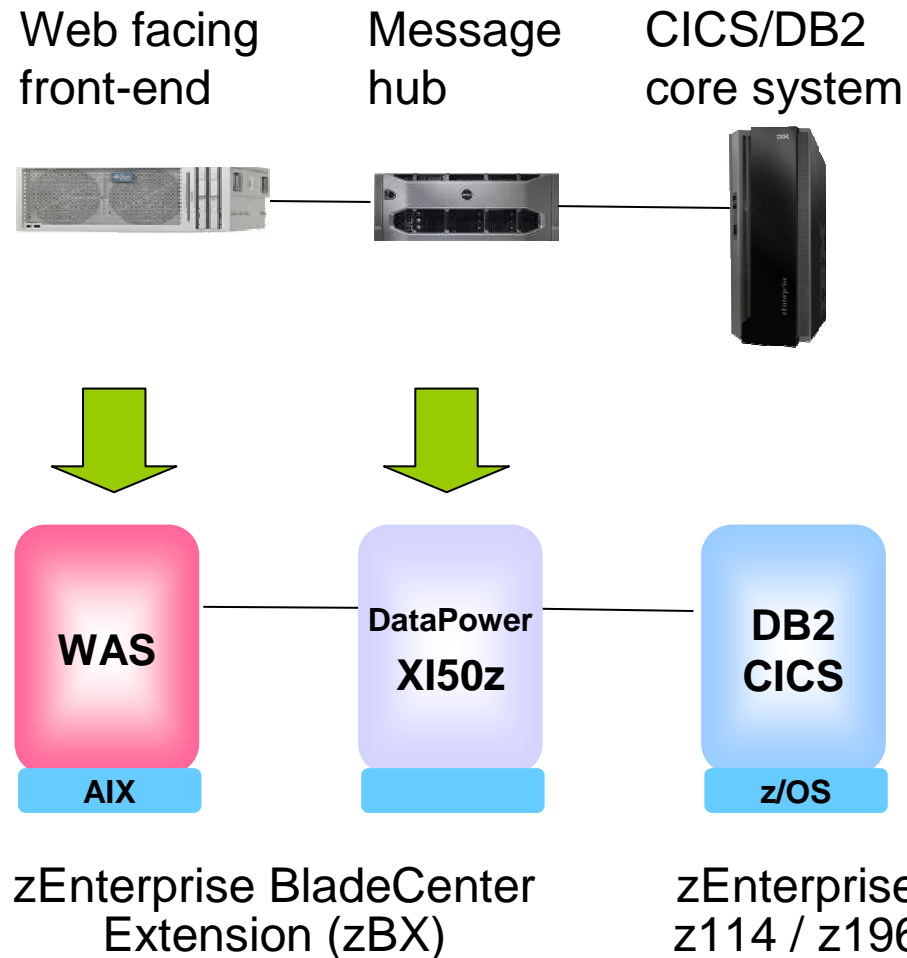
- Extends mission critical quality of service to hybrid environments

- Virtualization for workload isolation

- Run as ensemble of virtual servers

- Unified management of virtual machines

- Manage ensemble as a single workload with service goals

- Assign best fit to Power blade and XI50z for lowest cost per workload

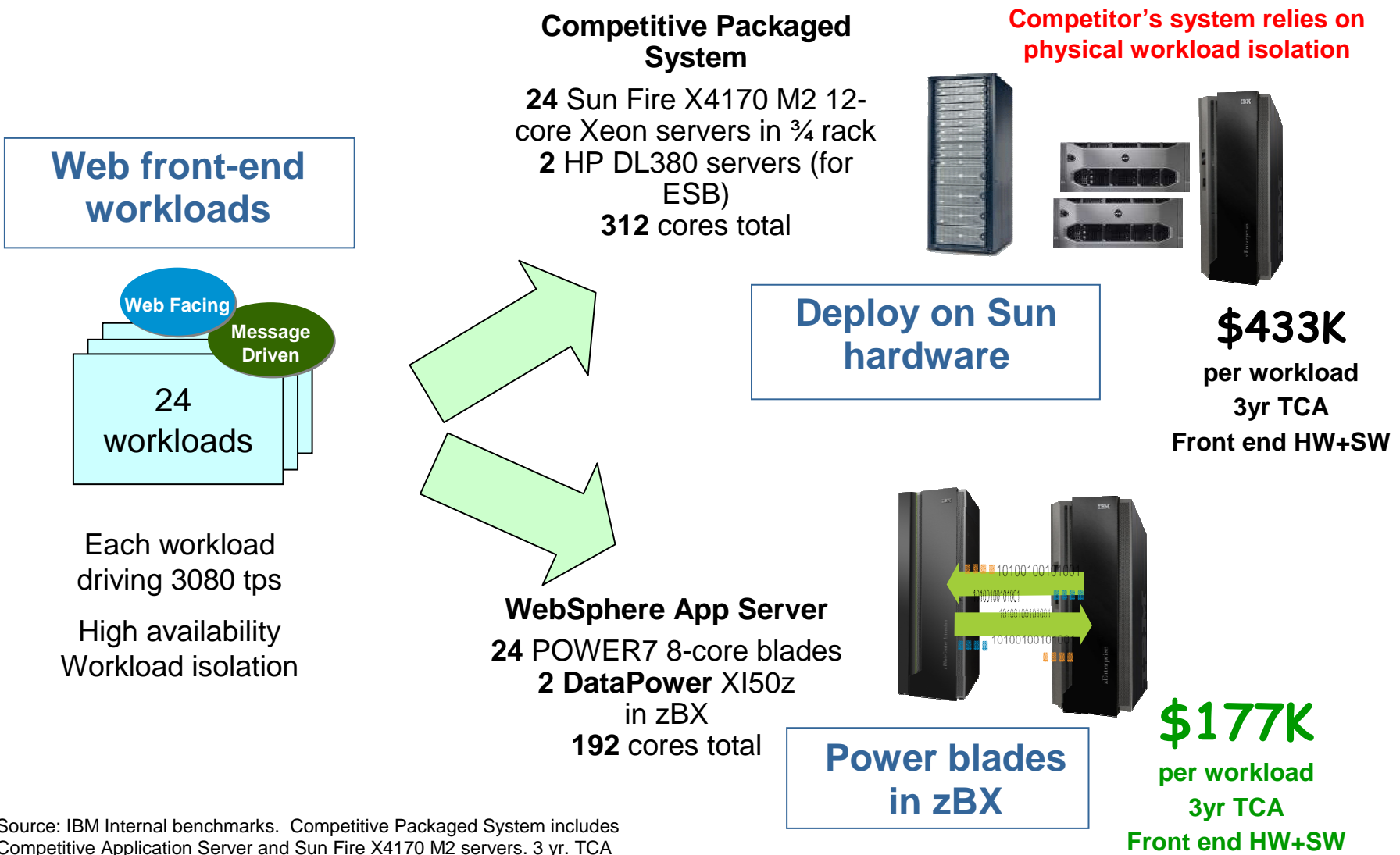- Embedded pre-configured data network

DataPower XI50z – Built For Purpose Appliance

Enterprise Service Bus benchmark comparison

BizTalk Server

Windows

OSB

Linux

messages

messages

DataPower XI50z

Microsoft BizTalk Server
Windows on Intel Server

4 sockets, 32 cores

128 GB

492 messages per sec
$764 per mps

Competitive Service Bus
Oracle Linux on HP DL380

2 sockets, 12 cores

128 GB

5,839 messages per sec
$120 per mps

DataPower
XI50z in zBX

HS 22, 8 cores
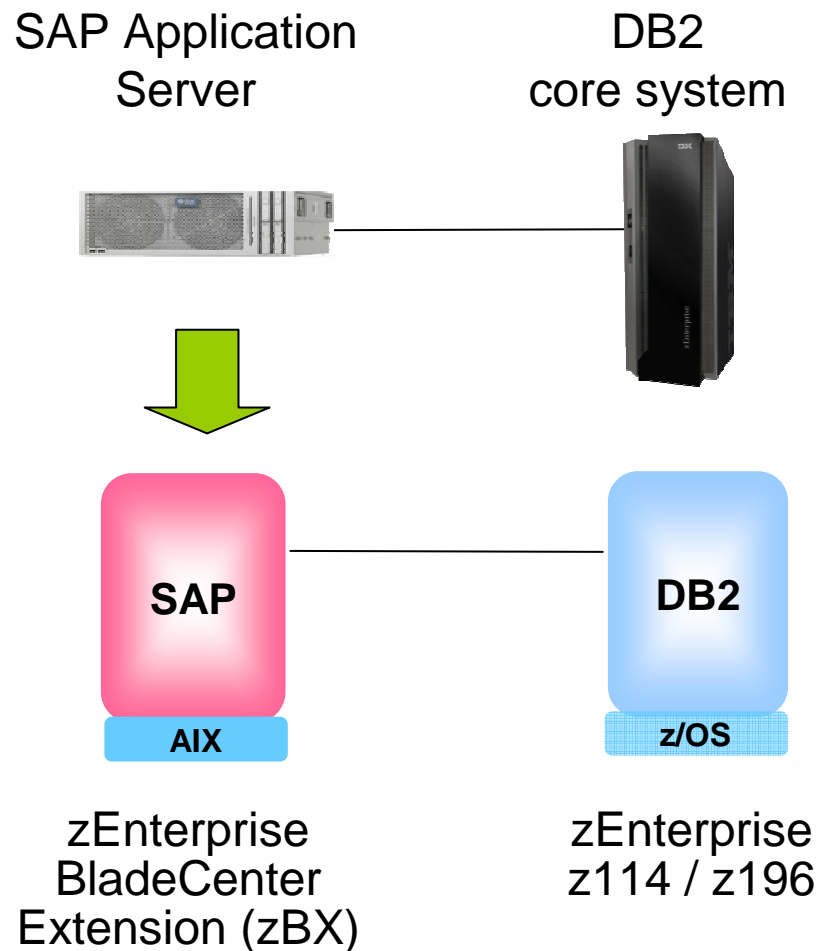
5,117 messages per sec

$33 per mps
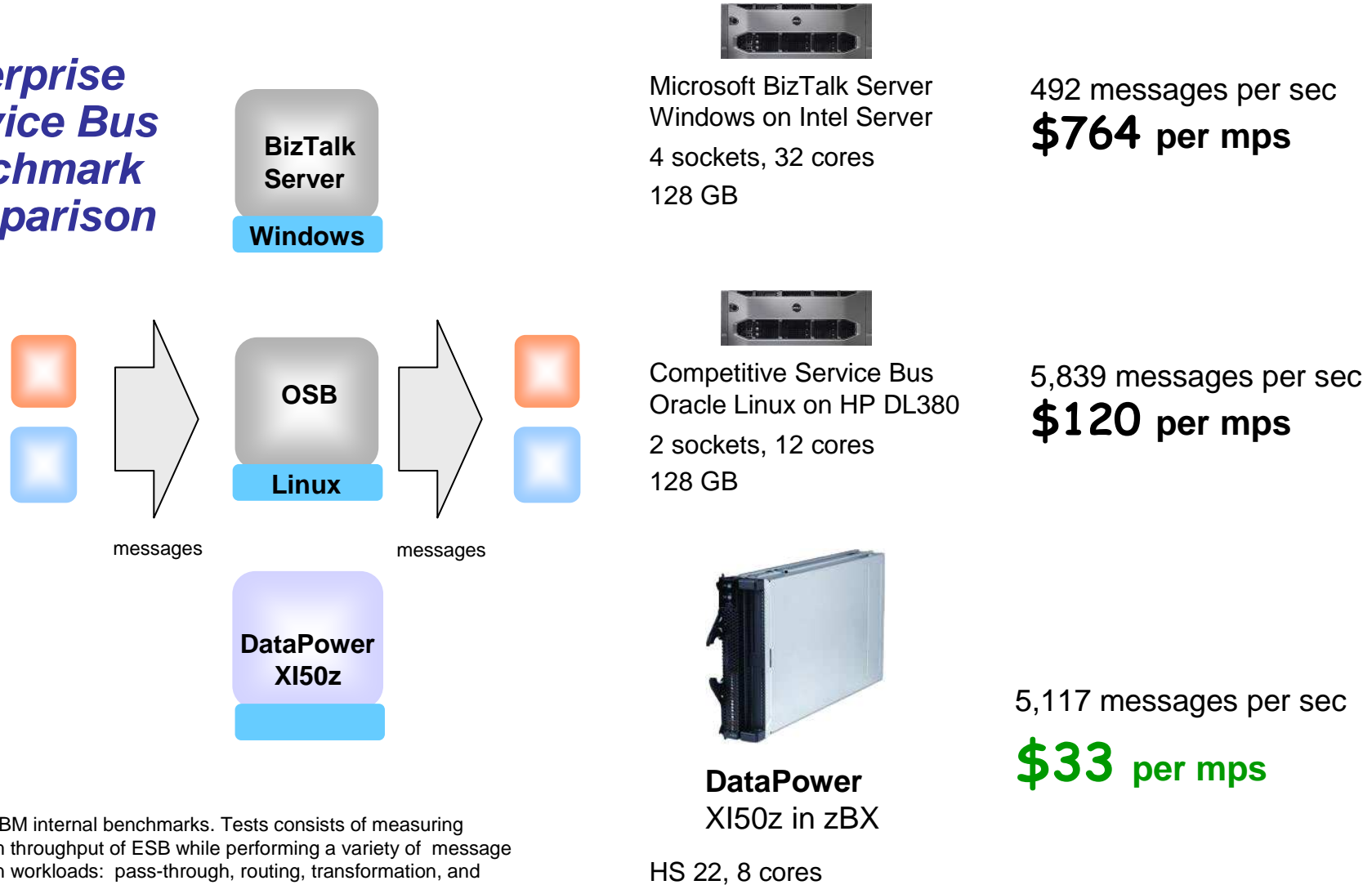
Source: IBM internal benchmarks. Tests consists of measuring maximum throughput of ESB while performing a variety of message mediation workloads: pass-through, routing, transformation, and schema validation. 3 yr. TCA includes hardware acquisition, maintenance, software acquisition and S&S. US list prices used. Prices may vary by country.

Web Front Ends Cost 59% Less On zEnterprise

Web front-end workloads

Web Facing

Message Driven

24 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

Competitor's system relies on physical workload isolation

Deploy on Sun hardware

$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

10100100101001
10100100101001
10100100101001
10100100101001

Power blades in zBX

$177K

per workload
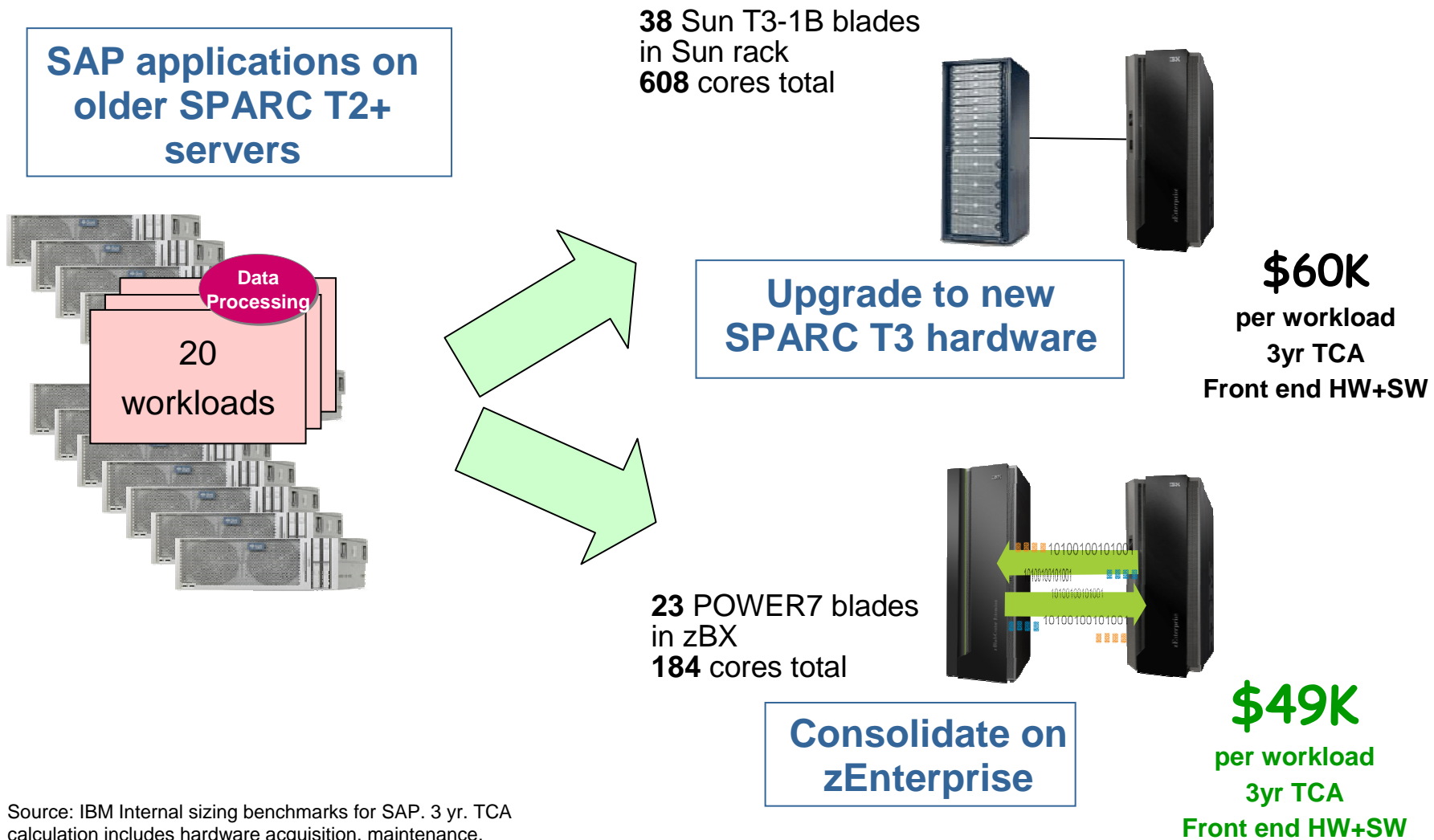**3yr TCA**
Front end HW+SW

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

SAP Application Server

DB2 core system

SAP
AIX

DB2
z/OS

zEnterprise BladeCenter Extension (zBX)

zEnterprise z114 / z196

- Run as ensemble of virtual servers

- Unified management of virtual machines

- Manage ensemble as a single workload with service goals

- 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 on older SPARC T2+ servers

Data Processing

20 workloads

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

10100100101001
10100100101001
10100100101001
10100100101001

Consolidate on zEnterprise

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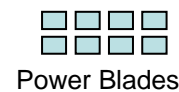**per workload**
3yr TCA
Front end HW+SW

Source: IBM Internal sizing benchmarks for SAP. 3 yr. TCA calculation includes hardware acquisition, maintenance, software acquisition and S&S. US list prices. Prices may vary by country.
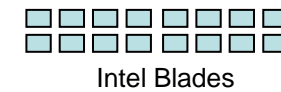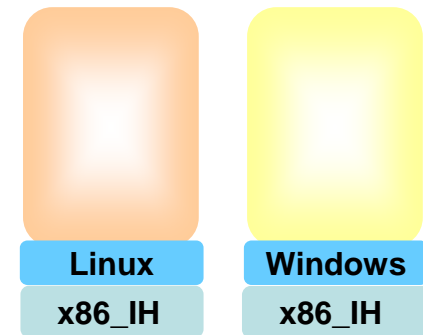
A Closer Look At Fit-For-Purpose Workload Assignment

Linux

z/OS | **z/VM**

PR/SM
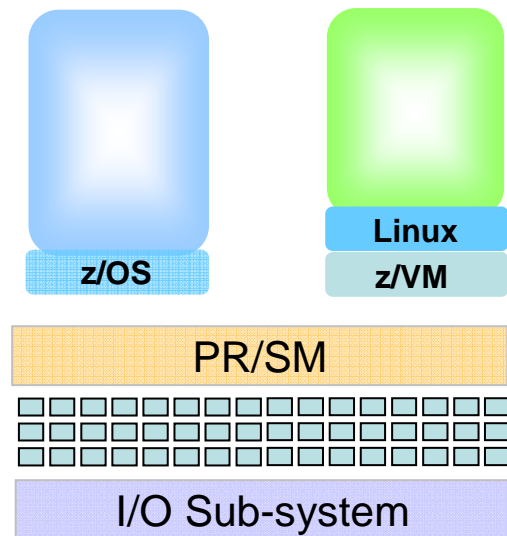
I/O Sub-system

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

AIX

PowerVM
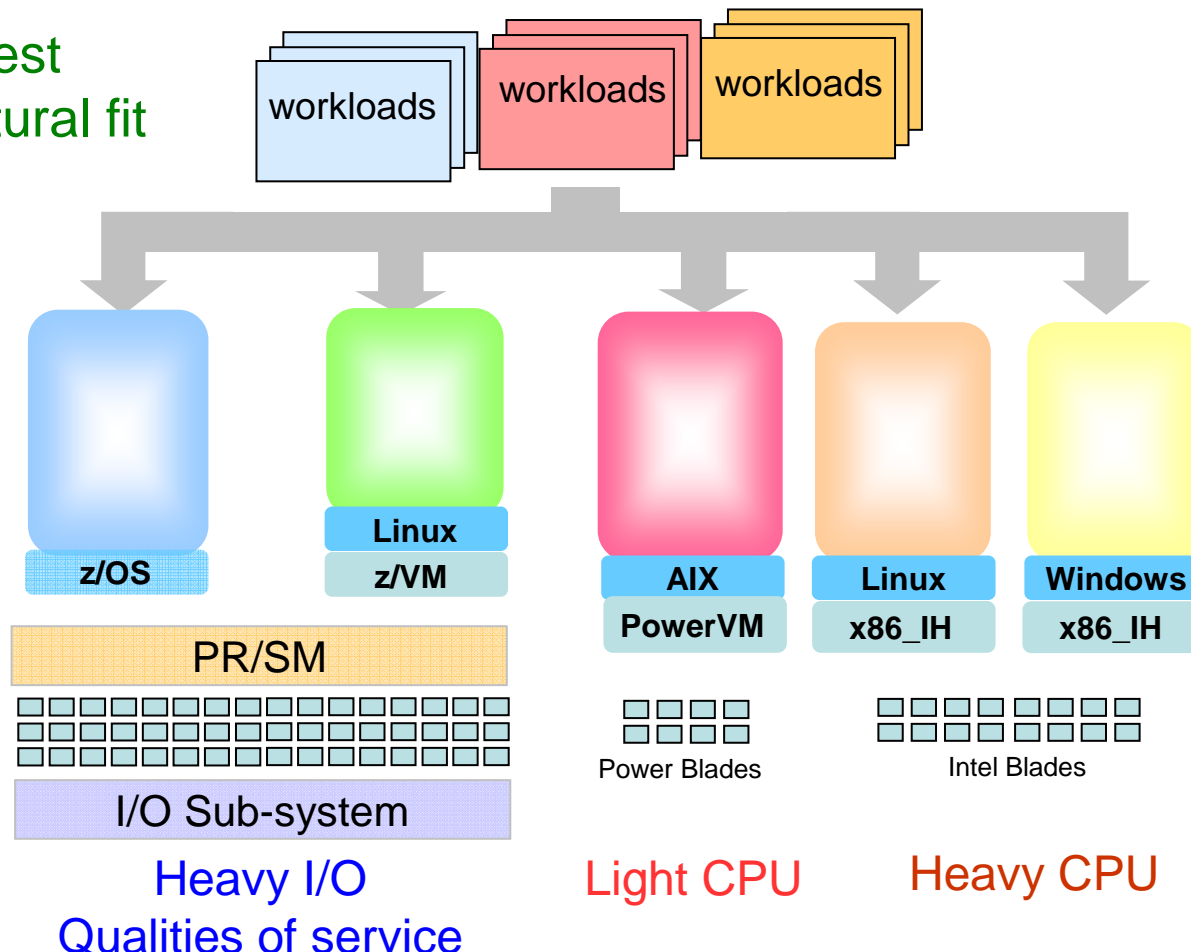
Power Blades

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

Linux | **Windows**

x86_IH | **x86_IH**

Intel Blades

- 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

workloads workloads workloads

	Linux	**AIX**	**Linux**	**Windows**
z/OS	**z/VM**	**PowerVM**	**x86_IH**	**x86_IH**

PR/SM

I/O Sub-system

Power Blades

Intel Blades

Heavy I/O
Qualities of service

Light CPU

Heavy CPU

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
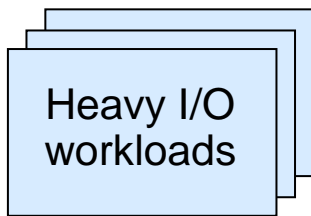
Heavy I/O workloads

- **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**
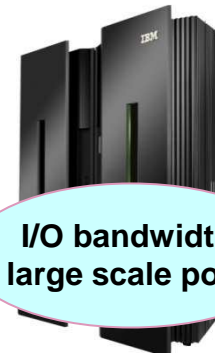
1 workload per Intel blade

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
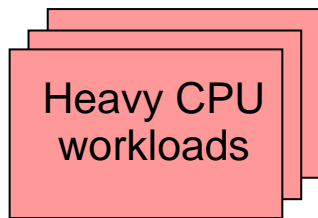
40 workloads per 32-way z/VM

I/O bandwidth large scale pool

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

Scale to 16 cores

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
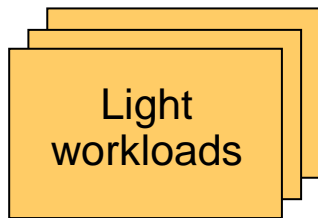
Best Fit

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
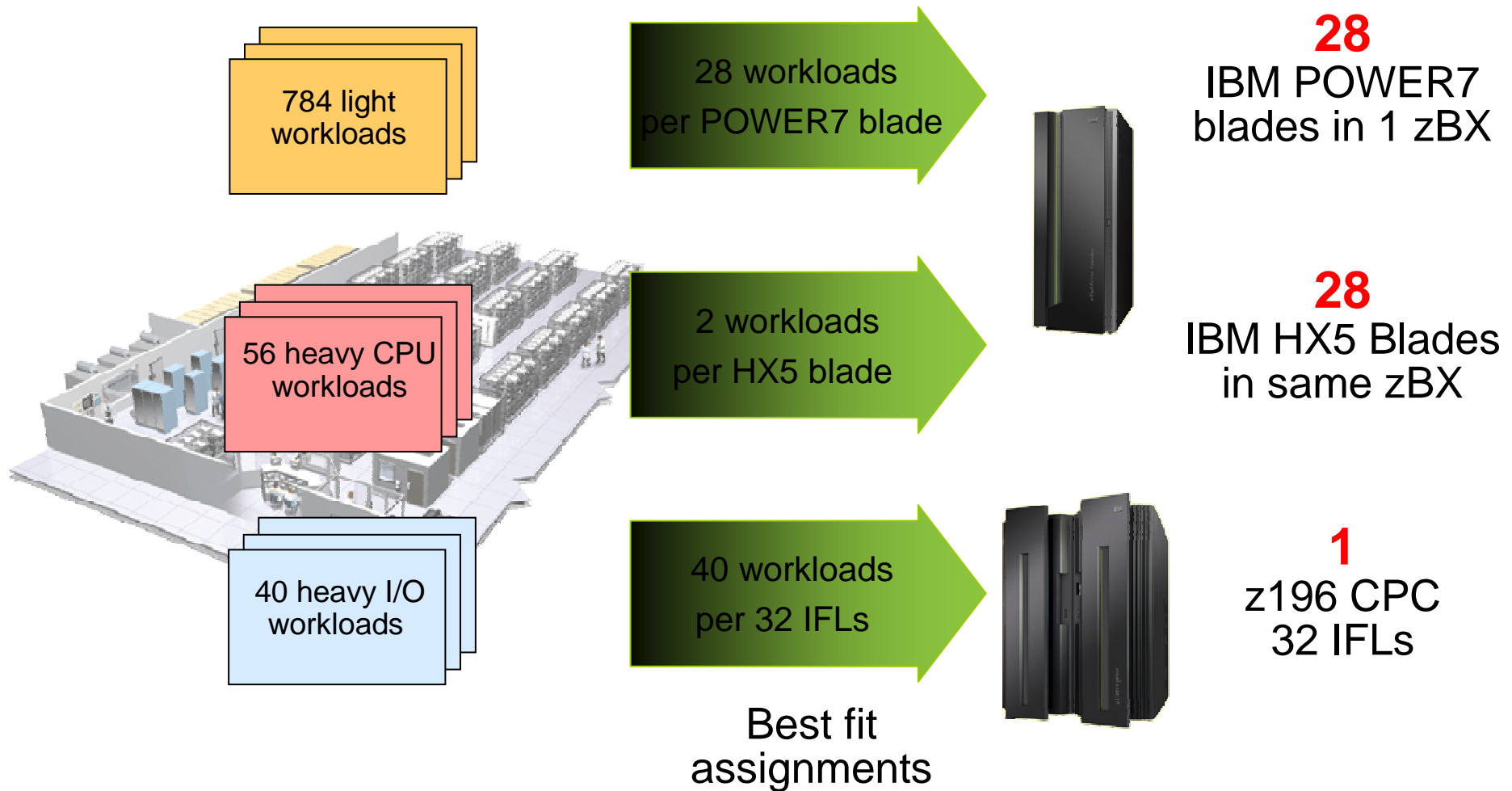
784 light workloads

56 heavy CPU workloads

40 heavy I/O workloads

28 workloads per POWER7 blade

2 workloads per HX5 blade

40 workloads per 32 IFLs

Best fit assignments

28 IBM POWER7 blades in 1 zBX

28 IBM HX5 Blades in same zBX

1 z196 CPC 32 IFLs

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
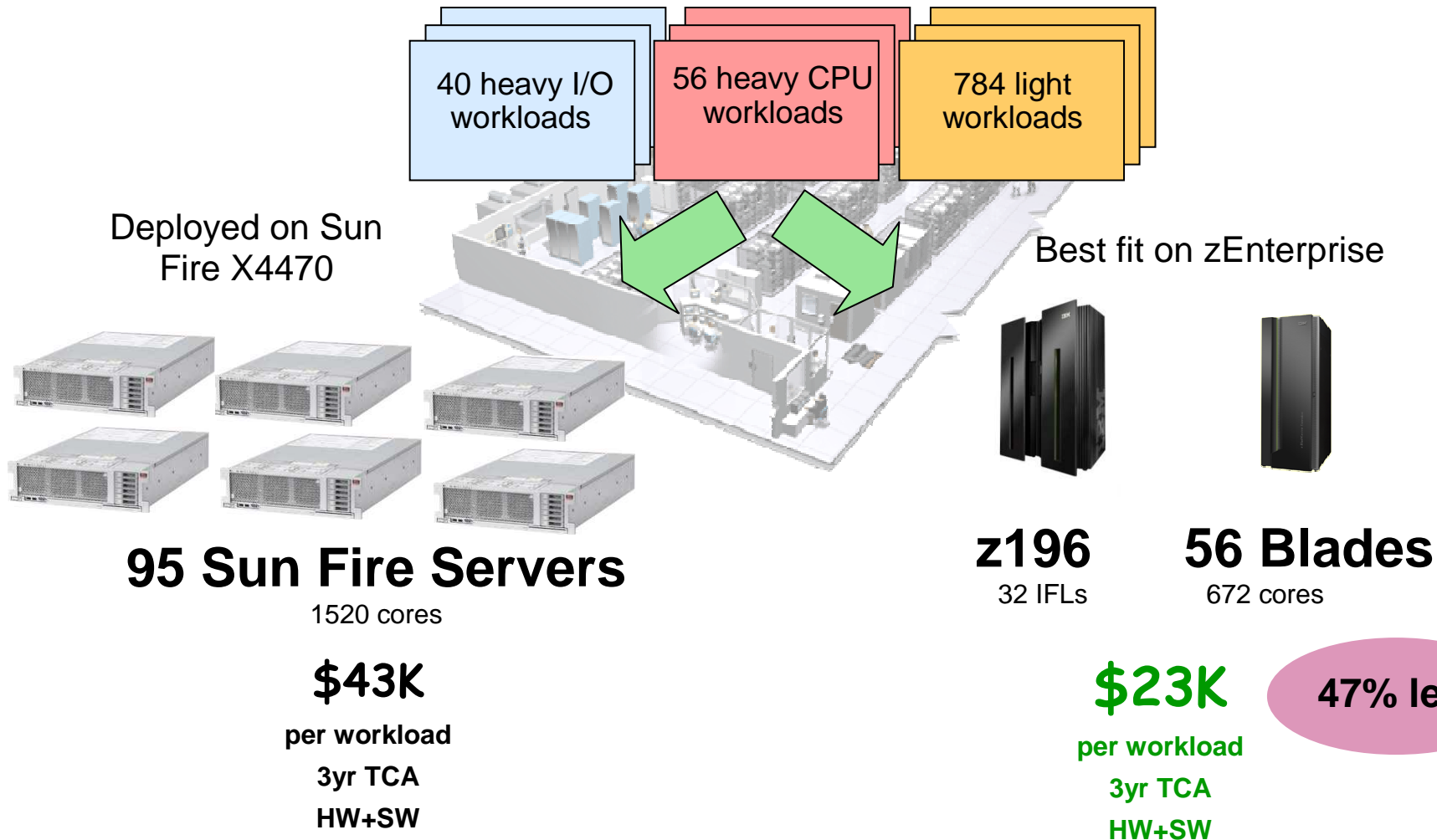
40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

Deployed on Sun Fire X4470

Best fit on zEnterprise

95 Sun Fire Servers
1520 cores

z196
32 IFLs

56 Blades
672 cores

$43K

per workload

3yr TCA

HW+SW

$23K

per workload

3yr TCA

HW+SW

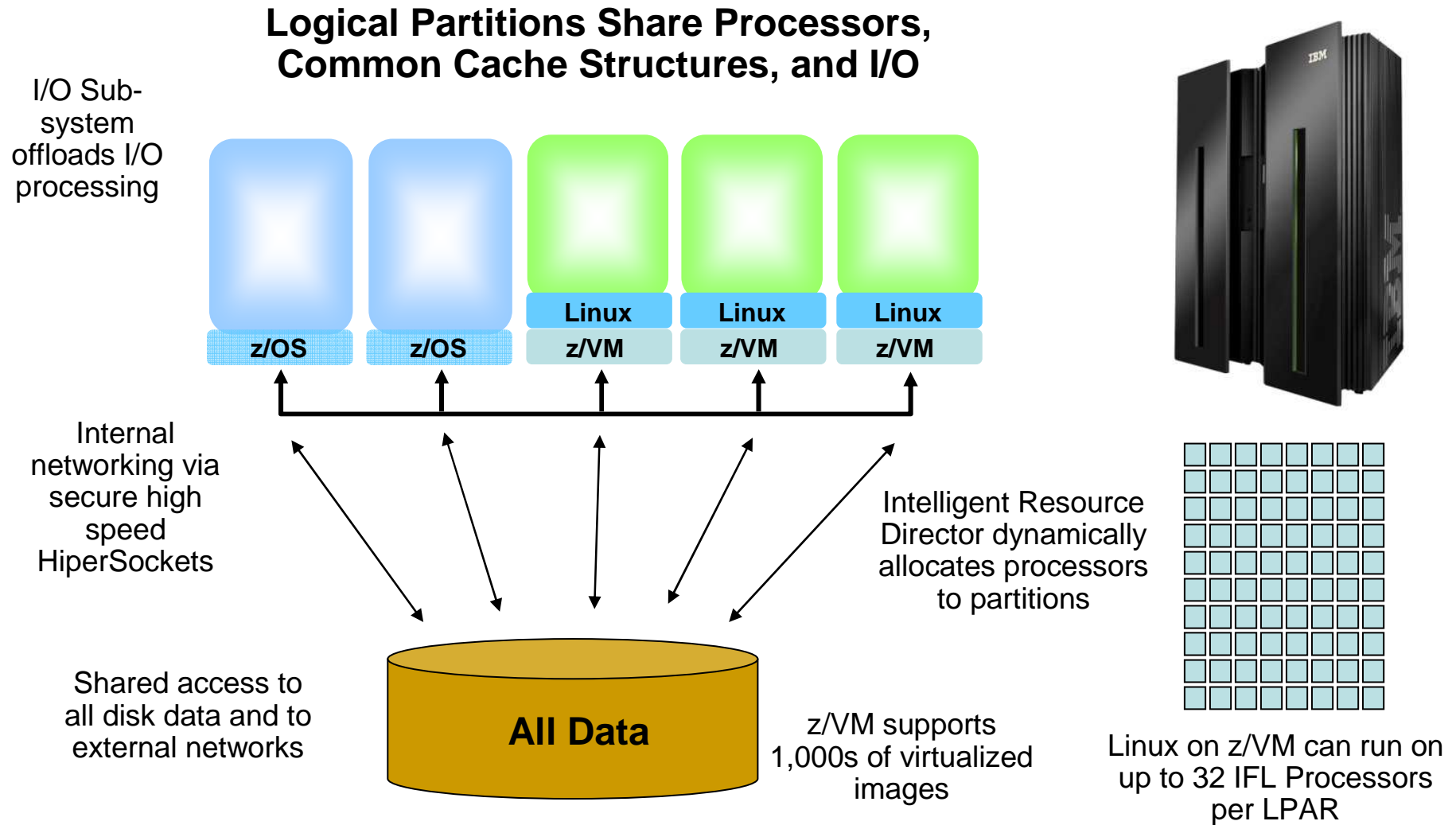**47% less**

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 IFLs

- Cost benefit of software pricing for IFLs

- 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

Logical Partitions Share Processors, Common Cache Structures, and I/O

I/O Sub-system offloads I/O processing

		Linux	Linux	Linux
z/OS	z/OS	z/VM	z/VM	z/VM

Internal networking via secure high speed HiperSockets

Intelligent Resource Director dynamically allocates processors to partitions

All Data

Shared access to all disk data and to external networks

z/VM supports 1,000s of virtualized images

Linux on z/VM can run on up to 32 IFL Processors per LPAR

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

GPs

SAPs

FICON Express8 card

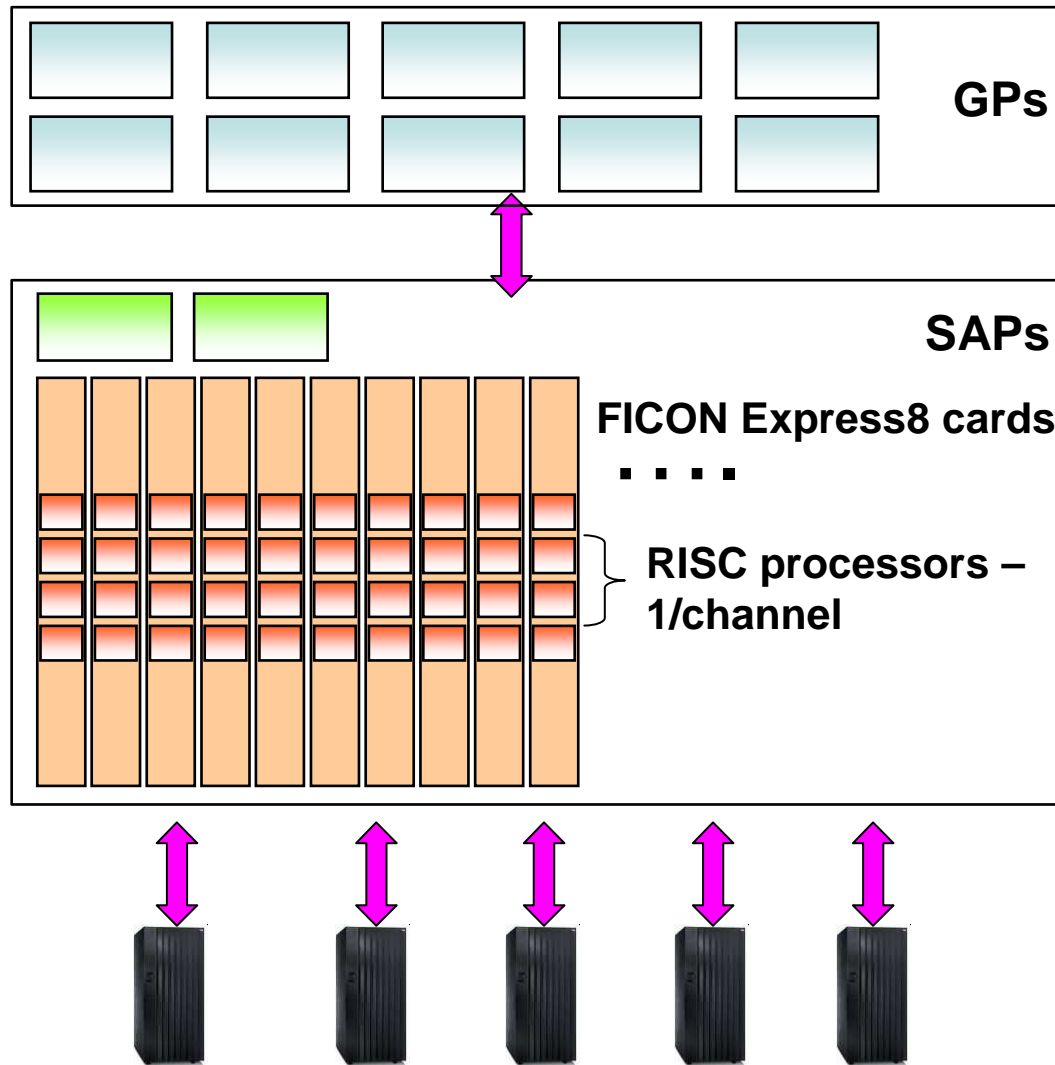**RISC processors – 1/channel**
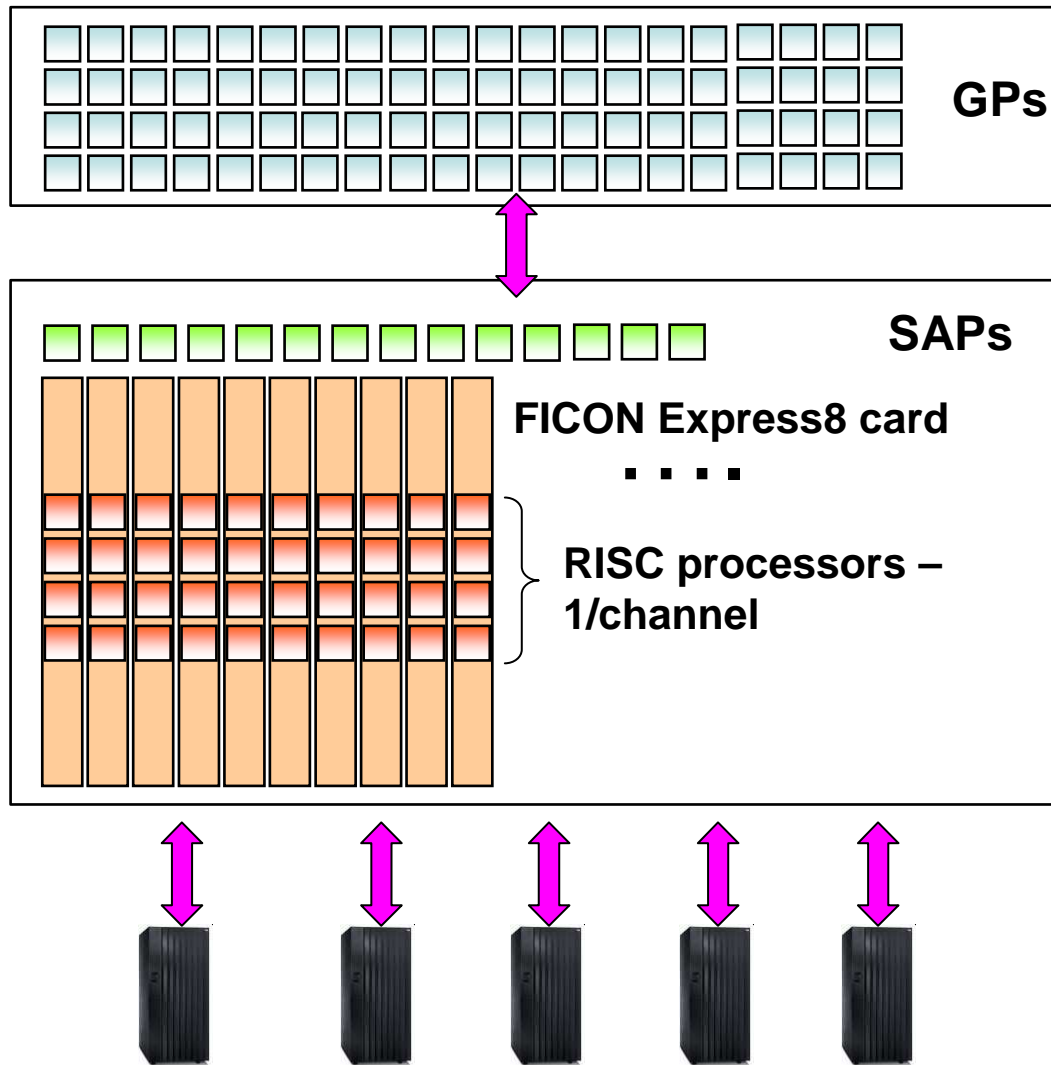
- Up to 80 General Purpose (GP) or Specialty Engine processors
  - ▶ Execute business logic

- 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

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

GPs

SAPs

FICON Express8 cards

RISC processors – 1/channel

- 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**

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

z196

Logical Channel Sub-system 1

Logical Channel Sub-system 2

Logical Channel Sub-system 3

Logical Channel Sub-system 4

System z Physical Channel Sub-system

Physical hardware virtualized and shared via logical channel architecture

FICON Channel Path Transparently Shared by All Logical Partitions

OSA Transparently Shared By Logical Partitions Configured to Logical Channel Sub-system 4

FICON Switch, CU, Devices, etc

Switches, Network Links, etc.

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
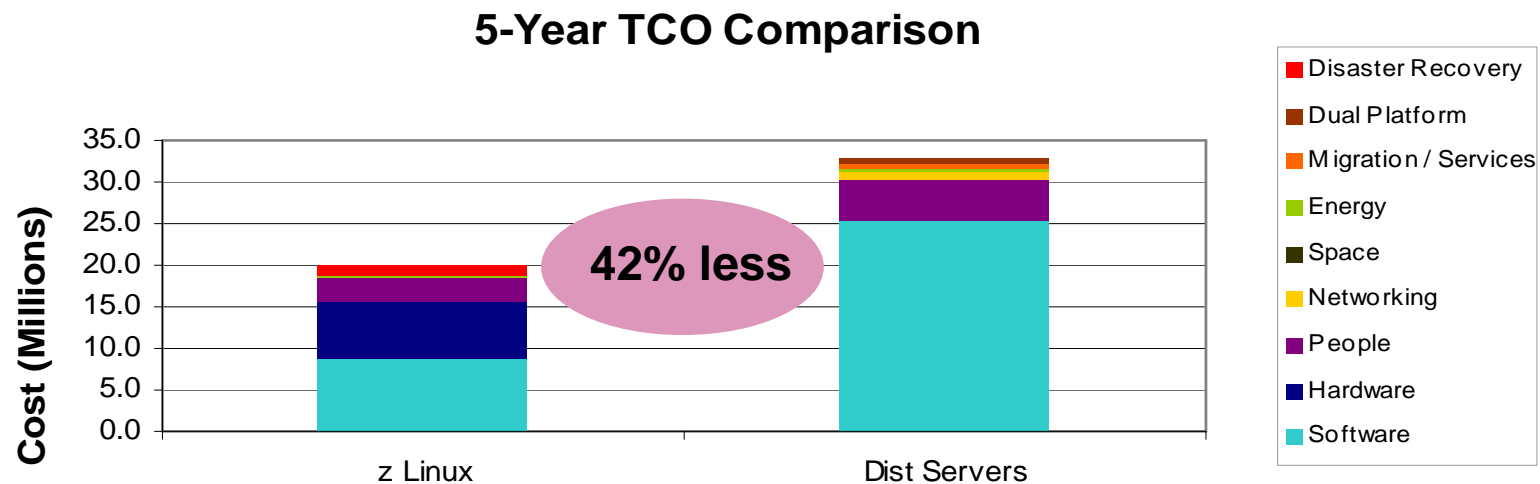
   ▶ Without disruption in service
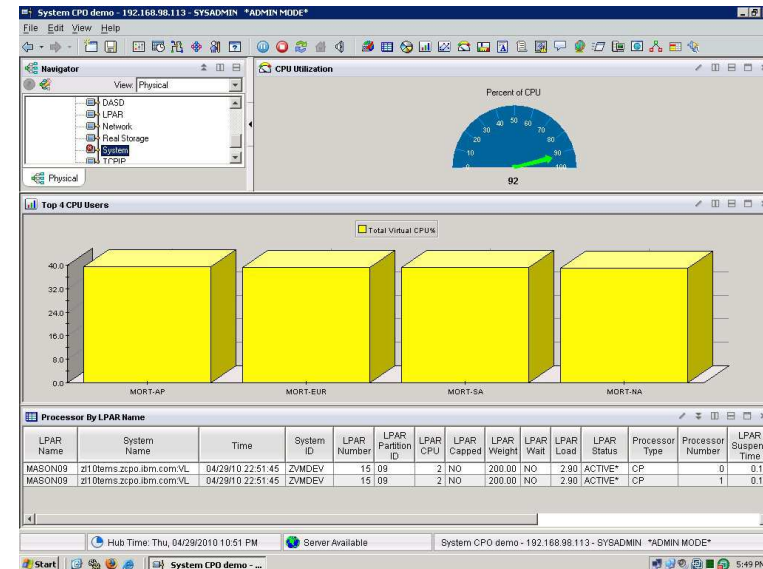
VMware can't recognize and take advantage of additional physical processors without bringing down and rebooting the system

Note: Assumes available processors on installed books

Large Pharmaceutical Company Virtualizes Key Application On Linux Under z/VM
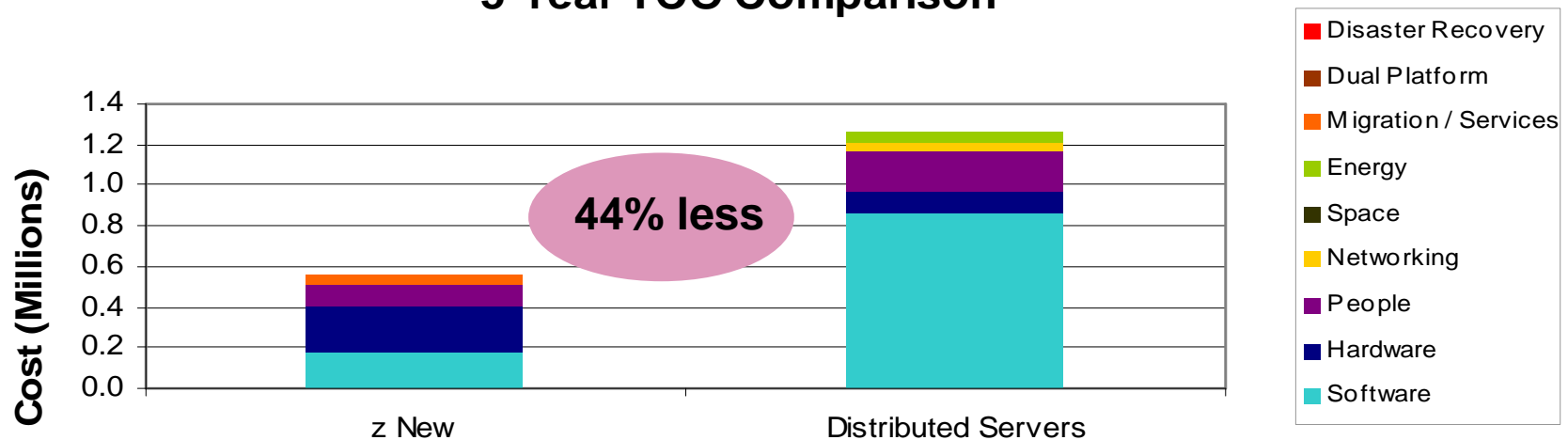
- **z/VM offers lower cost and higher DR resiliency than VMware**
  - ▶ WebSphere based mission critical workload
  - ▶ DR required. System z simplifies DR.
  - ▶ Cost effective scaling required - 4X user growth by 2014
  - ▶ 3 MIPS per user on a z10 IFL
  - ▶ 1 IFL to 7 Nehalem core ratio by 2014 (60 IFLs : 424 x86 cores)

- **Correct virtualization environment for the given requirements**

5-Year TCO Comparison

Chart legend:
- Disaster Recovery
- Dual Platform
- Migration / Services
- Energy
- Space
- Networking
- People
- Hardware
- Software

Y-axis: Cost (Millions), scale 0.0 to 35.0

Categories: z Linux, Dist Servers

42% less

Large Technology Company Virtualizes Manufacturing Application On Linux Under z/VM

■ **z/VM offers 7 to 1* footprint reduction over x86 Virtualization**

  ▶ 100 Low CPU, High I/O mission critical workloads

  ▶ Continuous operation required

  ▶ Once-a-year scheduled maintenance

    – Any downtime very painful

  ▶ Consolidate to 2 IFLs or 56 Nehalem cores

  ▶ Distributed hypervisor costs exceed entire System z incremental costs

5-Year TCO Comparison

44% less

Legend:
- Disaster Recovery
- Dual Platform
- Migration / Services
- Energy
- Space
- Networking
- People
- Hardware
- Software

Y-axis: Cost (Millions), 0.0 to 1.4
X-axis: z New, Distributed Servers

*IFLs added to existing z footprint.

Case in Point:
## A Real Life Case Study On Disaster Recovery

The Customer: A major US specialty retailer has two data centers across the continent, with critical business applications running on 5 z9s and 200+ UNIX servers. The company runs disaster recovery test twice annually to ensure business continuity.

Disaster Recovery Test Result:
- Mainframe recover within 1 hour
- UNIX servers failed to recover after 3 days!

What is the potential impact to customer?
- Assuming 3 days of business outage
- WW average of similar companies:
  - $32B annual revenue   => $260M revenue loss
  - $1.5B annual profit   => $13M direct profit loss
- ITG estimation of hourly impact for retailer $1.11M/hour, with assumption of 12 hours per day for business operation   => $39M business impact

Disaster Recovery Time
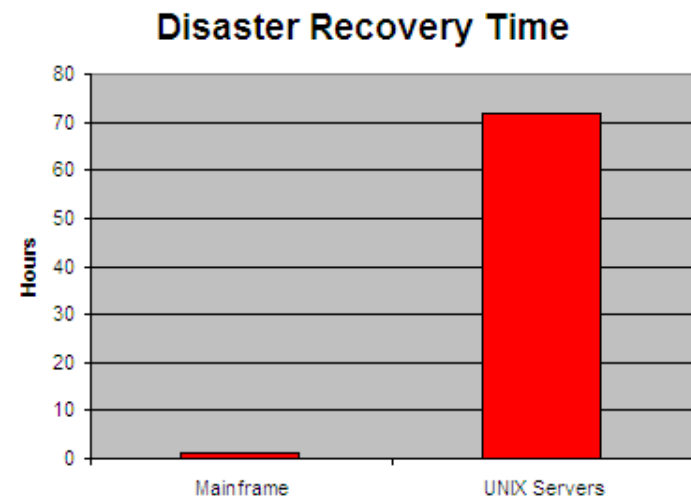
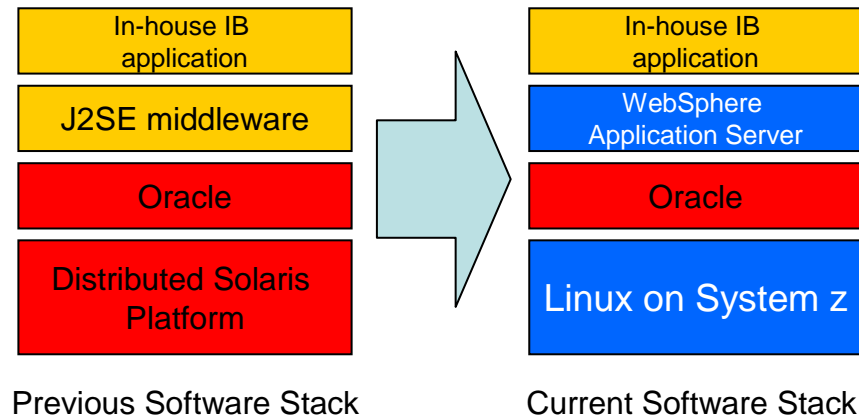# BNZ Replaced Solaris With Linux On System z – Reduced HW And Achieved Systematic DR Plan

bnz Bank of New Zealand

Transformed their Internet Banking (IB) front end application from a distributed Solaris platform to Linux on System z
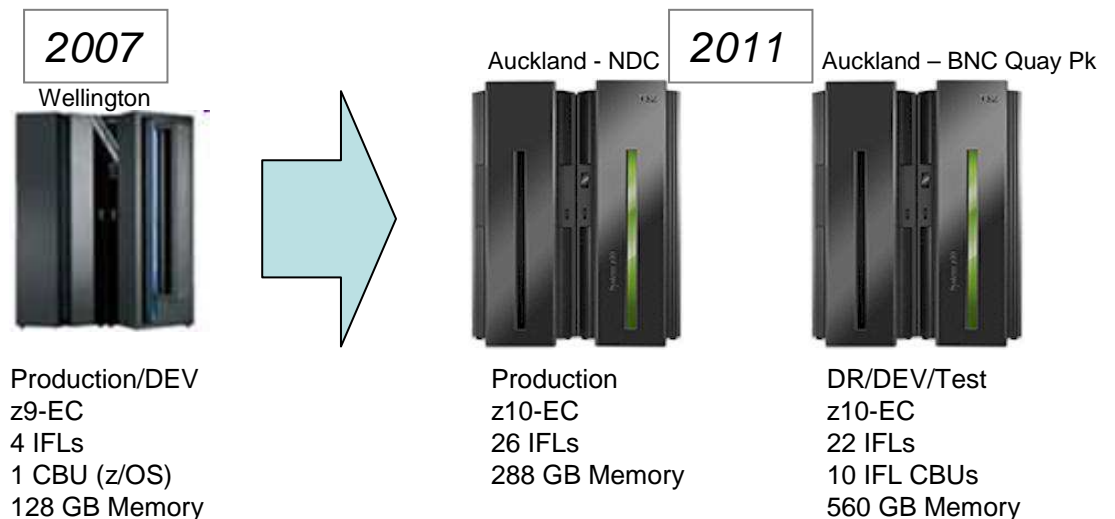
Result
- *Physical x86 servers reduced by 75%*
- *Linux on System z yielded lowest costs for software priced per core*

Previous Software Stack
In-house IB application
J2SE middleware
Oracle
Distributed Solaris Platform

Current Software Stack
In-house IB application
WebSphere Application Server
Oracle
Linux on System z

Implemented a second z10 EC mainframe at a separate site to support DR / Dev / Test

Result
- *"Simple, consistent and reliable DR" plan in place protecting data and workloads*

2007
Wellington

Production/DEV
z9-EC
4 IFLs
1 CBU (z/OS)
128 GB Memory

2011
Auckland - NDC

Production
z10-EC
26 IFLs
288 GB Memory

Auckland – BNC Quay Pk

DR/DEV/Test
z10-EC
22 IFLs
10 IFL CBUs
560 GB Memory

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

Installed Linux MIPS
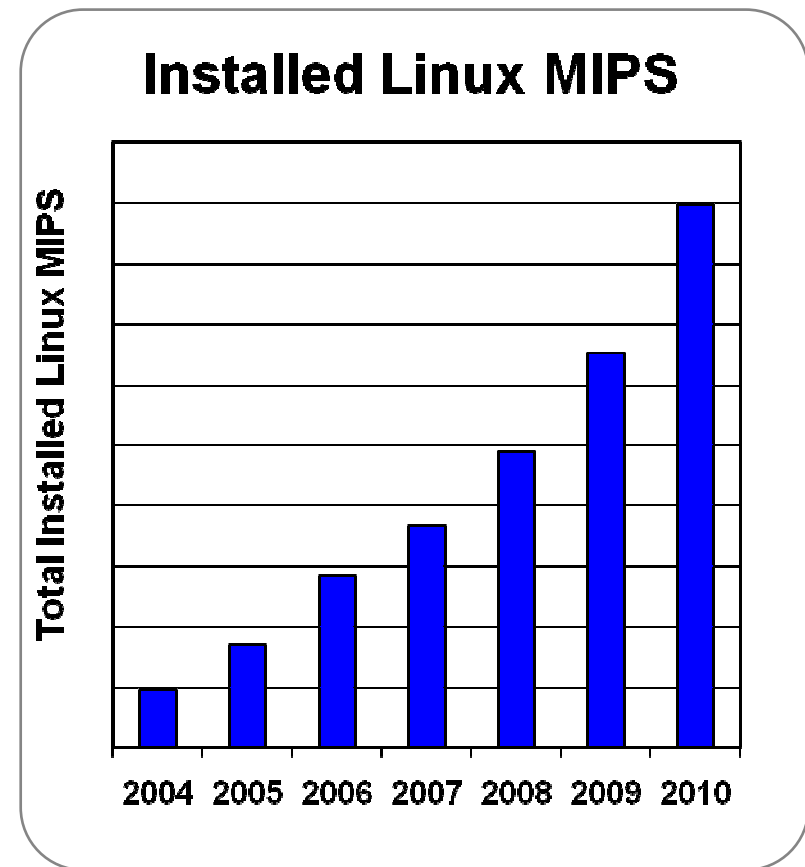
Blue Cross Blue Shield Of Minnesota Saves Up To 50% By Reducing Their Hardware Footprint

BlueCross BlueShield of Minnesota

- Lead time for server provisioning reduced to 99%

- IT deploys new Linux Virtual Servers for test and dev within 20 mins

- Not a single incidence of unplanned downtime or underperformance

140 Windows Servers
Inflexible and costly to maintain
Business Problem:
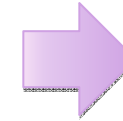
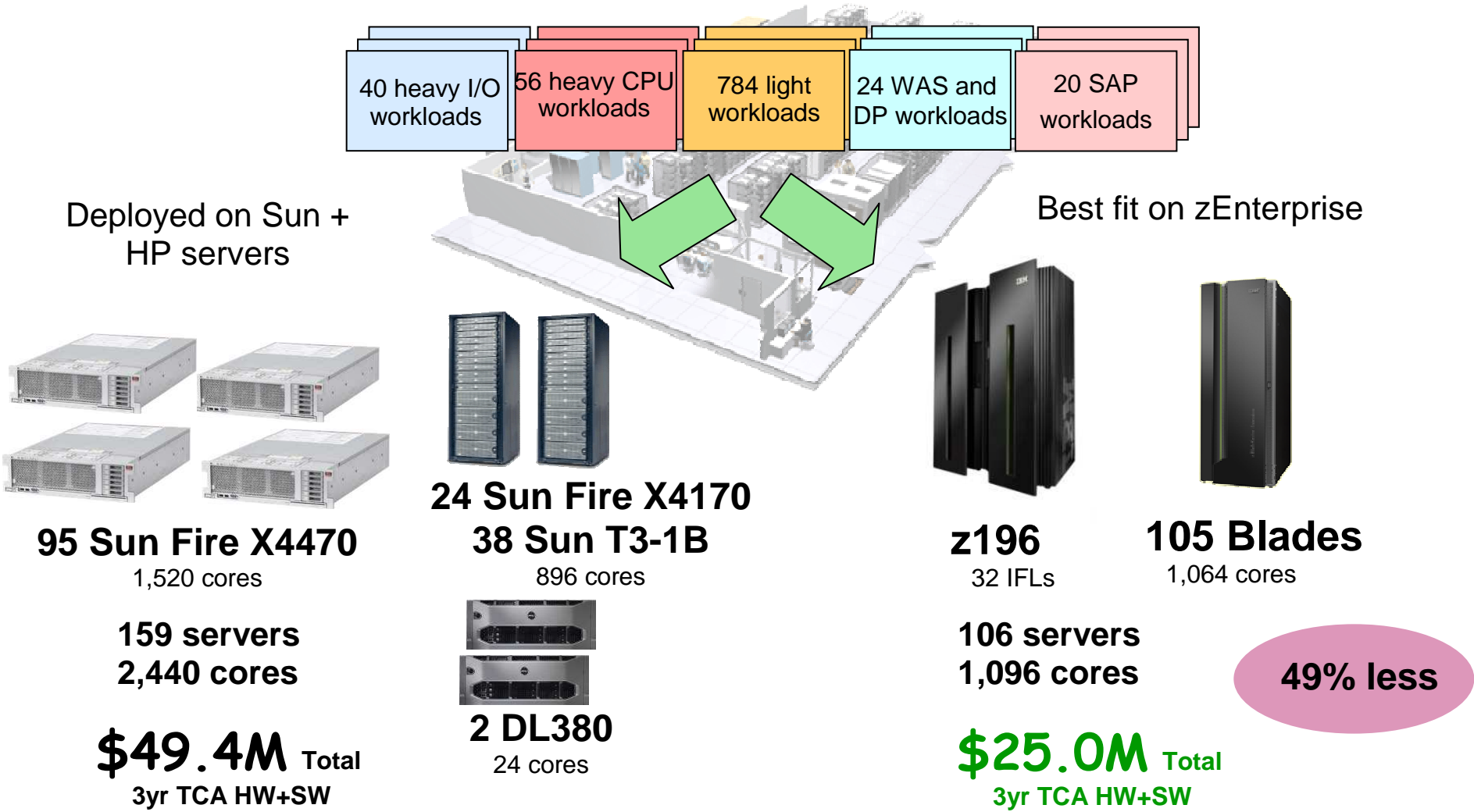**6 IFL processors for**
SUSE applications
DB2 for z/OS

"We found that running a virtualized Linux environment on System z would be somewhere between 30 and 50 percent less expensive than a distributed architecture."

— Ted Mansk, Director of Infrastructure Engineering and Databases at BCBSM

Compare Server Hardware And Software Cost Of Acquisition

40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

24 WAS and DP workloads

20 SAP workloads

Deployed on Sun + HP servers

Best fit on zEnterprise

95 Sun Fire X4470
1,520 cores

24 Sun Fire X4170
38 Sun T3-1B
896 cores

2 DL380
24 cores

z196
32 IFLs

105 Blades
1,064 cores

159 servers
2,440 cores

106 servers
1,096 cores

49% less

$49.4M Total
3yr TCA HW+SW

$25.0M Total
3yr TCA HW+SW

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

Compare Network Cost Of Acquisition

40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

24 WAS and DP workloads

20 SAP workloads

Deployed on Sun + HP servers

Best fit on zEnterprise

Additional network parts
22 switches
480 cables
380 adapters

882 total network parts

$0.32M Total

Additional network parts
1 switch
10 cables
10 adapters

21 total network parts

$0.03M Total

91% less
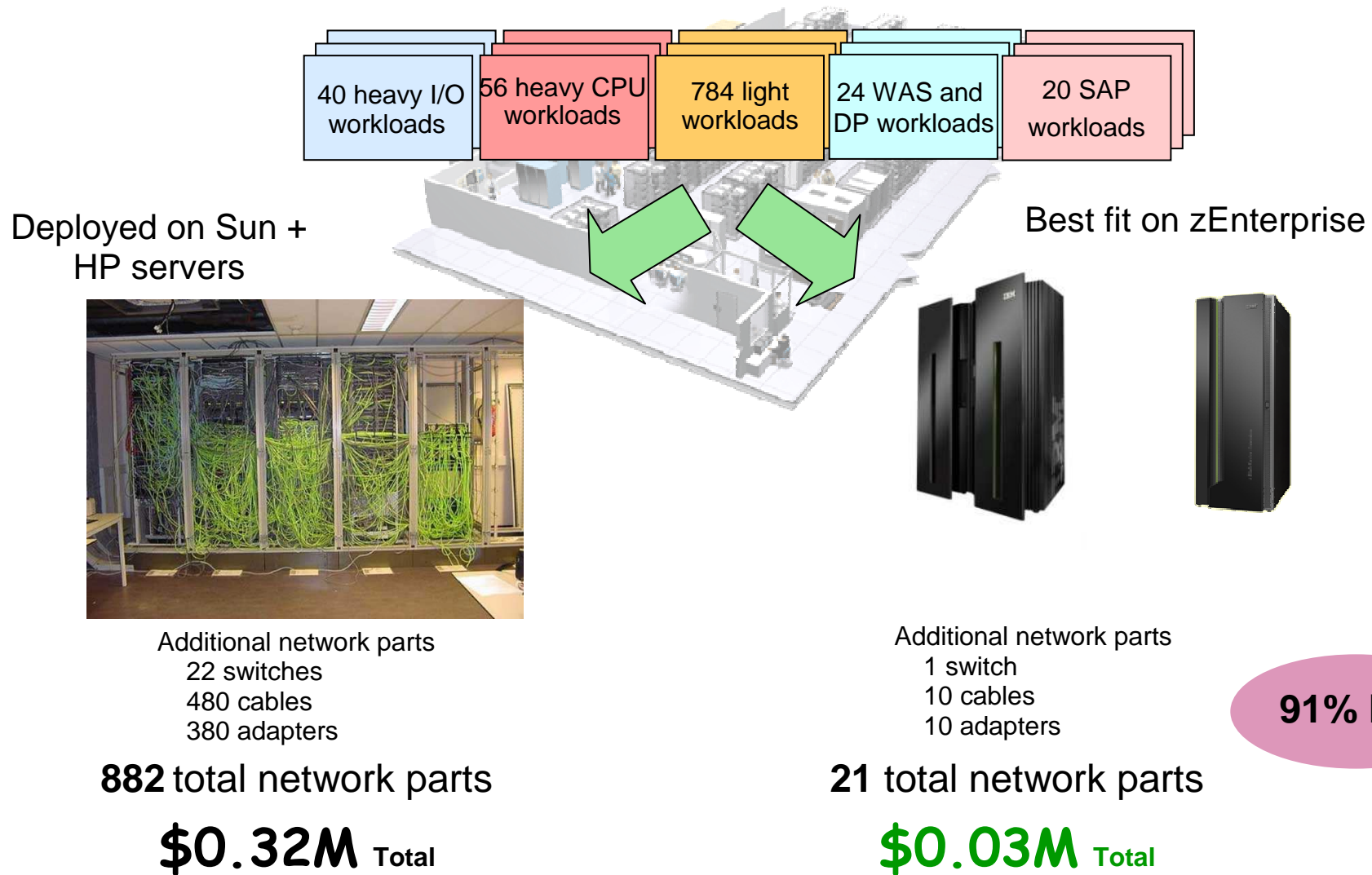
Network configuration is based on IBM internal studies.
Prices are in US currency, prices will vary by country

03 - Consolidating Server Infrastructure V2.6

35

Compare Power Consumption

40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

24 WAS and DP workloads

20 SAP workloads

Deployed on Sun + HP servers

Best fit on zEnterprise

159 servers
115.3 kW

106 servers
47.1 kW

$0.46M Total
3 years
@ $0.10 per kWh

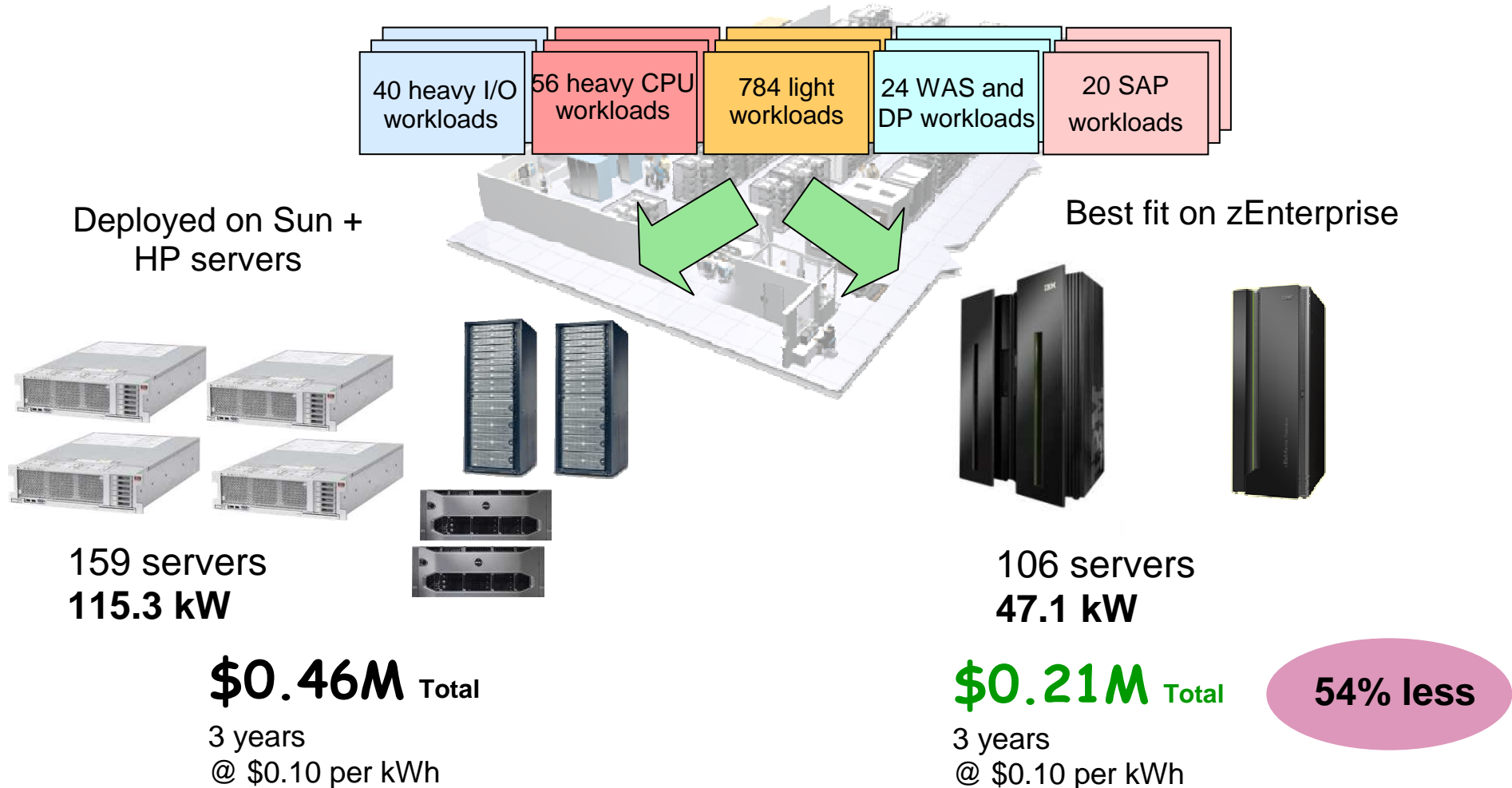**$0.21M** Total
3 years
@ $0.10 per kWh

54% less

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

Compare Server Infrastructure Labor Costs
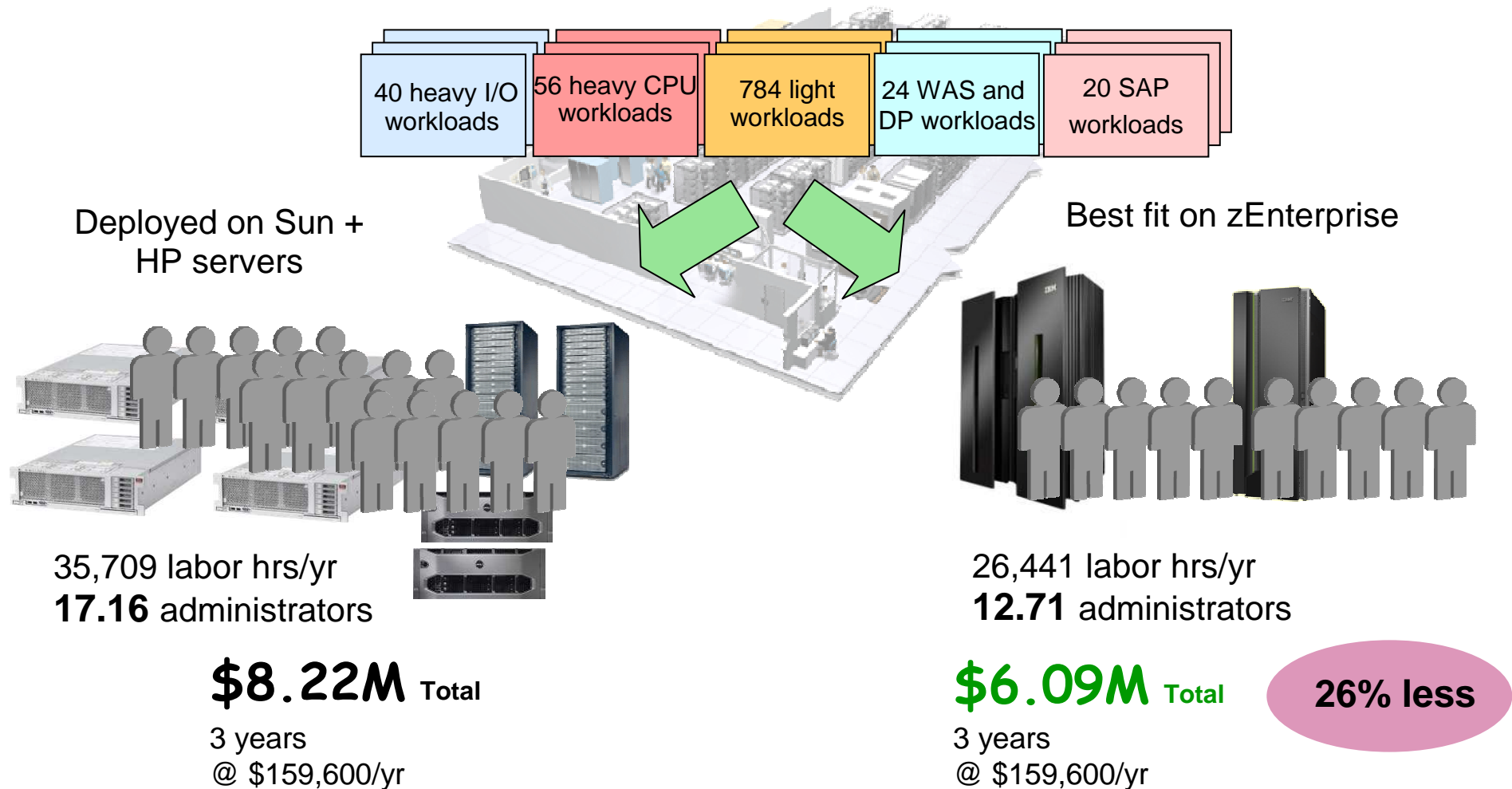
40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

24 WAS and DP workloads

20 SAP workloads

Deployed on Sun + HP servers

Best fit on zEnterprise

35,709 labor hrs/yr
17.16 administrators

26,441 labor hrs/yr
12.71 administrators

$8.22M Total
3 years
@ $159,600/yr

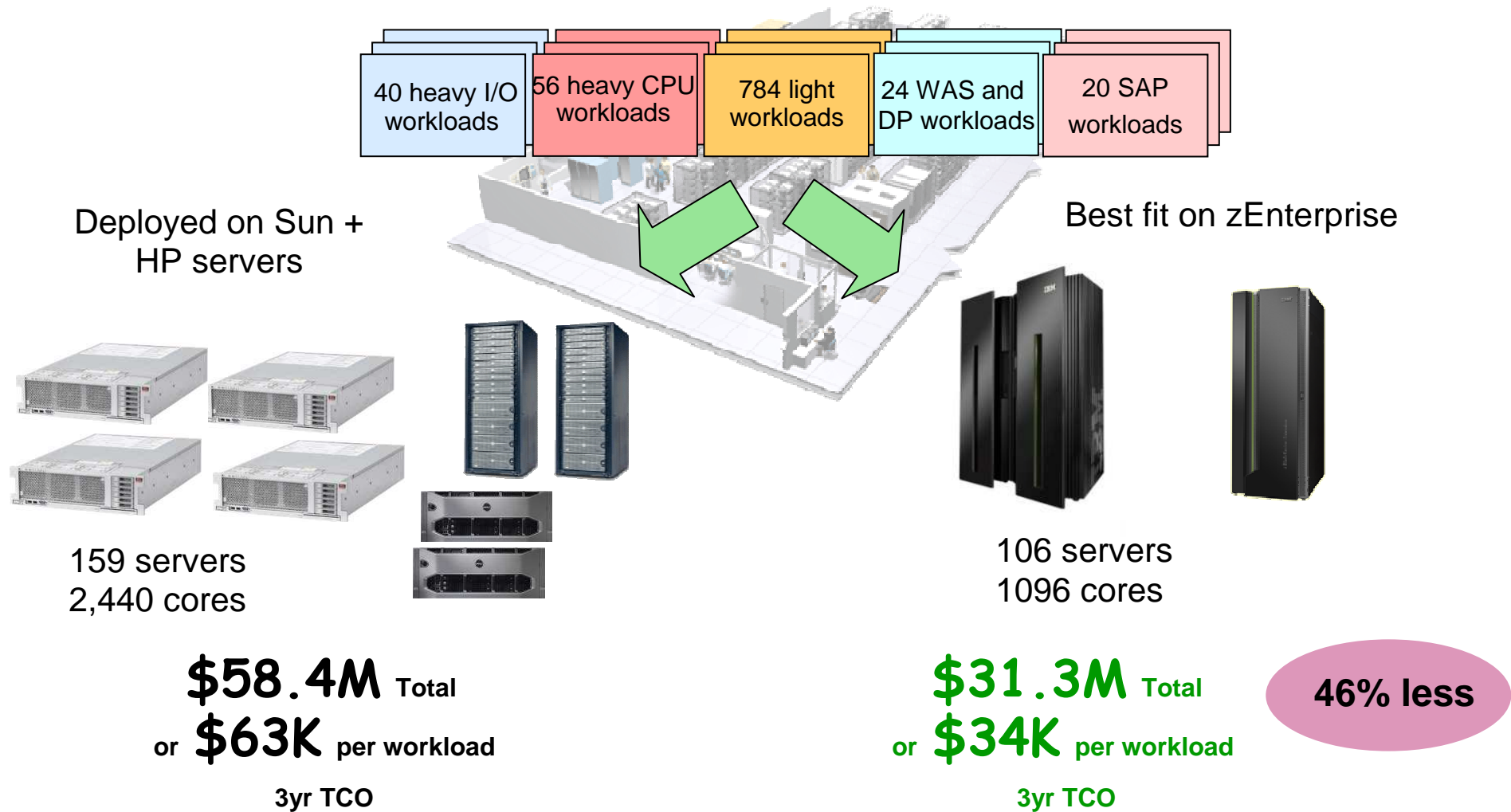**$6.09M** Total
3 years
@ $159,600/yr

26% less

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

Compare Total Cost Of Ownership

40 heavy I/O workloads

56 heavy CPU workloads

784 light workloads

24 WAS and DP workloads

20 SAP workloads

Deployed on Sun + HP servers

Best fit on zEnterprise

159 servers
2,440 cores

106 servers
1096 cores

$58.4M Total

or **$63K** per workload

3yr TCO

$31.3M Total

or **$34K** per workload

3yr TCO

46% less

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