

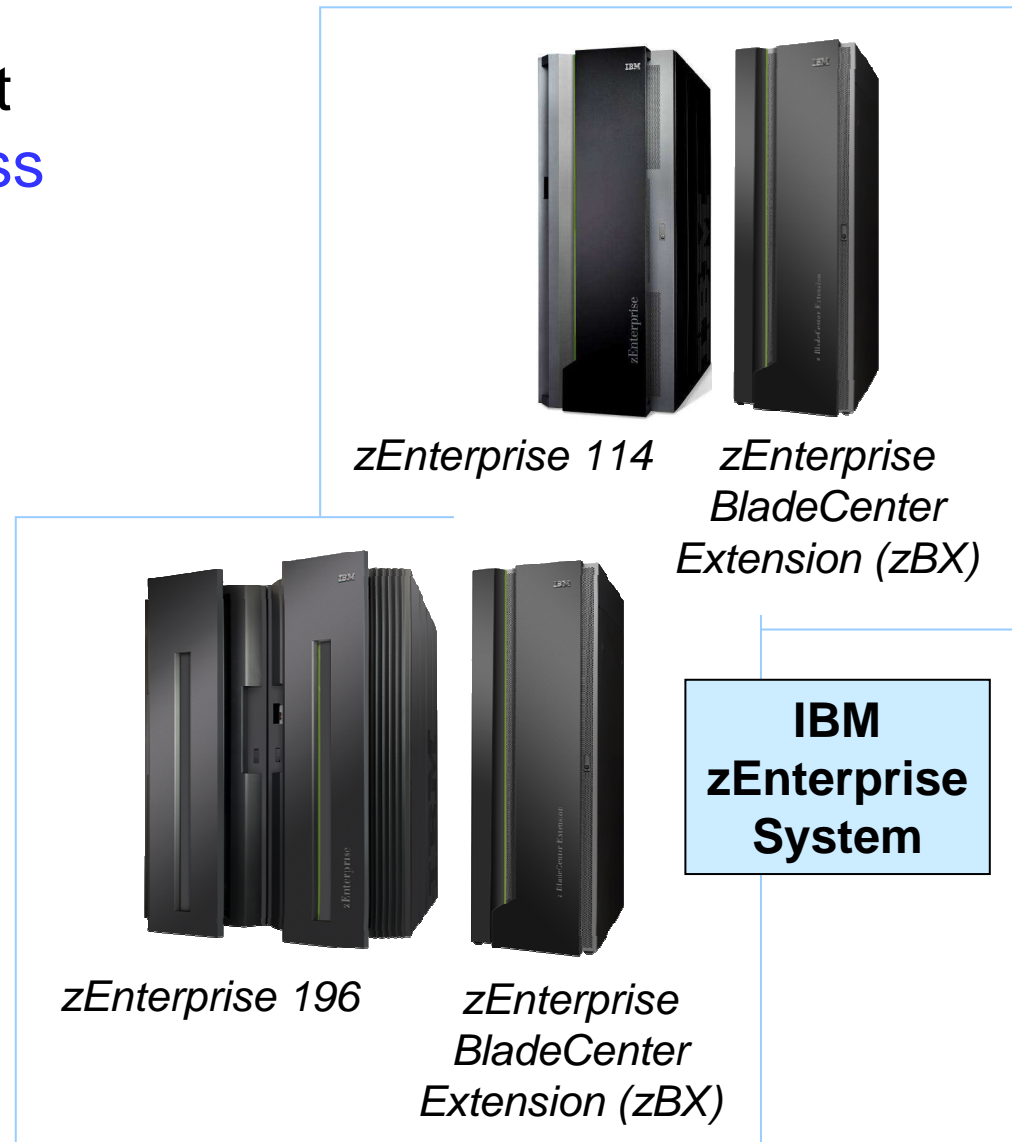


# **zEnterprise – The Ideal Platform For Smarter Computing**

A Closer Look At The Value Of zEnterprise

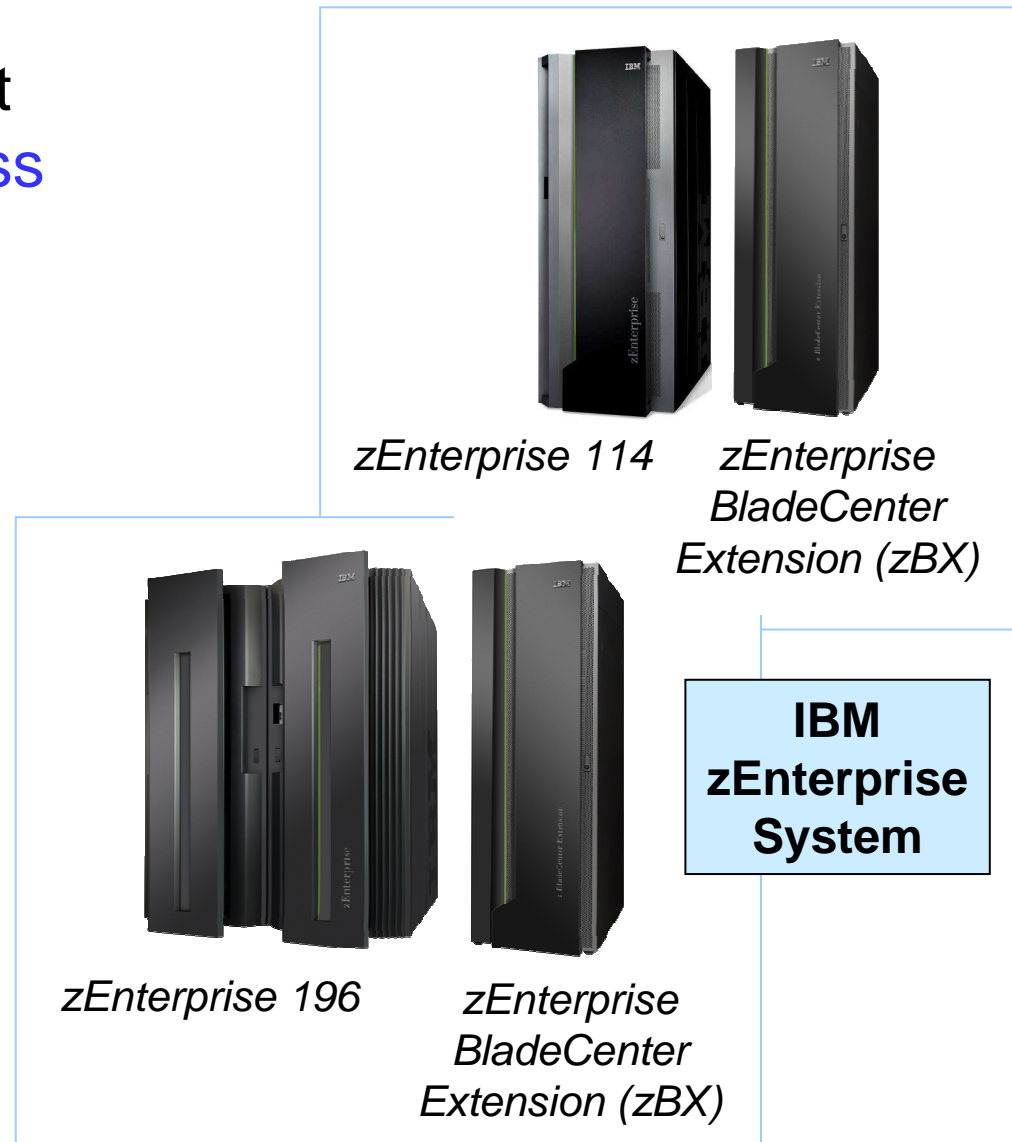
# zEnterprise Value

- zEnterprise is STILL best for handling **core business workloads**
- zEnterprise is more than a mainframe – it's a **complete multi-architecture platform**
- zEnterprise continues a tradition of **unmatched reliability** and **superior qualities of service**



# zEnterprise Value

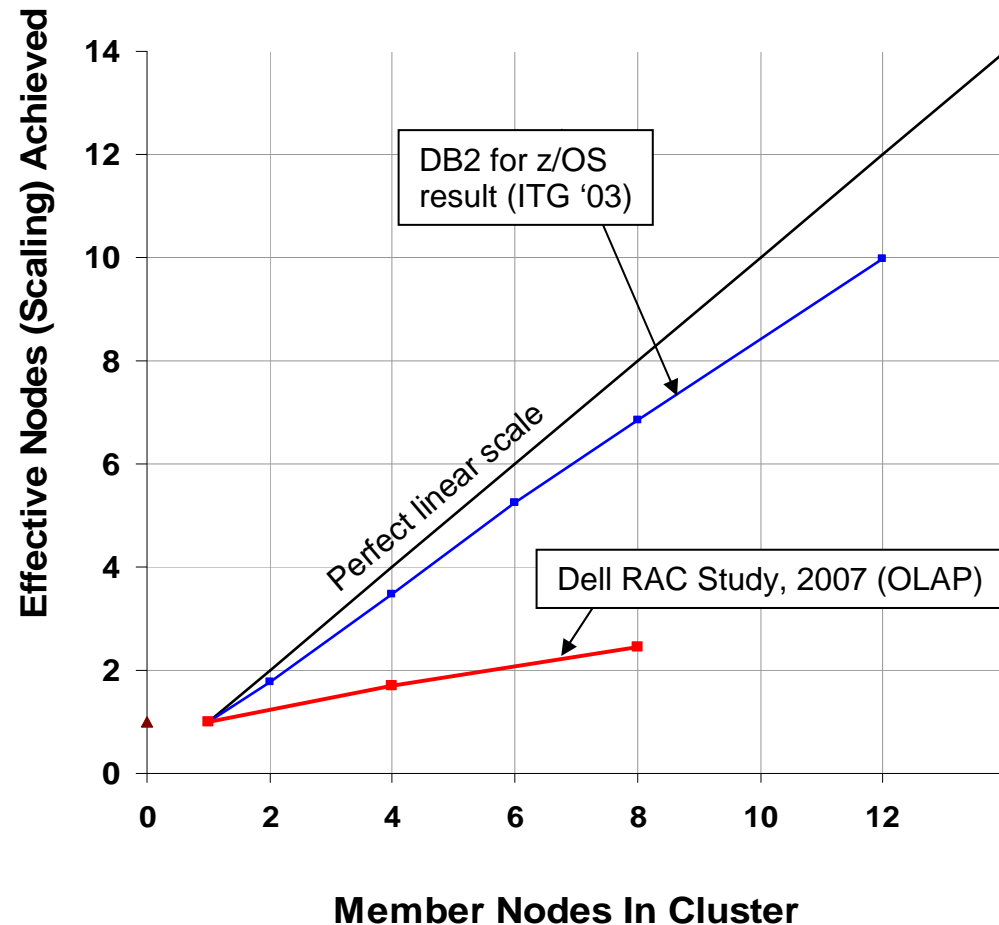
- zEnterprise is **STILL** best for handling **core business workloads**
- zEnterprise is more than a mainframe – it's a complete multi-architecture platform
- zEnterprise continues a tradition of unmatched reliability and superior qualities of service



# System z Is Uniquely Architected To Support Very Large Scalability Rates

- More processors, memory and cache than other enterprise servers
- I/O offloaded to dedicated processors for extreme efficiency
- Up to 32 can be clustered in a parallel sysplex
- Result:
  - ▶ Potential sysplex scale to over 1,300 BIPS
  - ▶ Near-linear
  - ▶ Optimized for heavy I/O workloads

## Example of near-linear scalability:



# System z Is Ideal For High Transaction Workloads And Databases

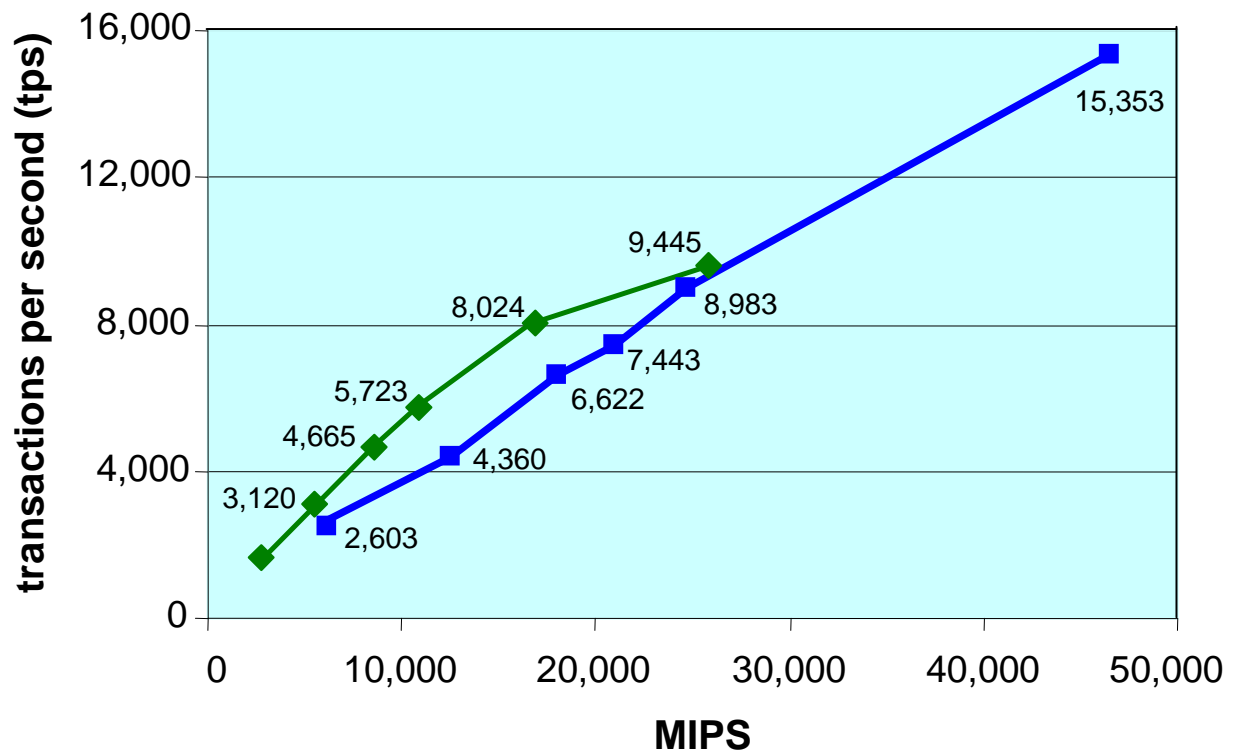
## ■ Kookmin Bank

- ▶ IBM System z and DB2
- ▶ TCS BaNCS
- ▶ 15,353 Transactions/second
- ▶ 50 Million Accounts
- ▶ IBM benchmark for customer
- ▶ DB2 V9, CICS 3.1, z/OS V1.8

## ■ Bank of China<sup>1</sup>

- ▶ IBM System z and DB2
- ▶ TCS BaNCS
- ▶ 9,445<sup>2</sup> Transactions/second
- ▶ 380 Million Accounts
- ▶ IBM benchmark for customer

## System z and BaNCS Online Banking Benchmarks



<sup>1</sup>Source: <http://www.enterprisenetworksandservers.com/monthly/art.php?2976> and *InfoSizing FNS BaNCS Scalability on IBM System z – Report Date: September 20, 2006*  
Standard benchmark configuration reached 8,024 tps, a modified prototype reached 9,445 tps

# z/OS Beats The Best HP Benchmark

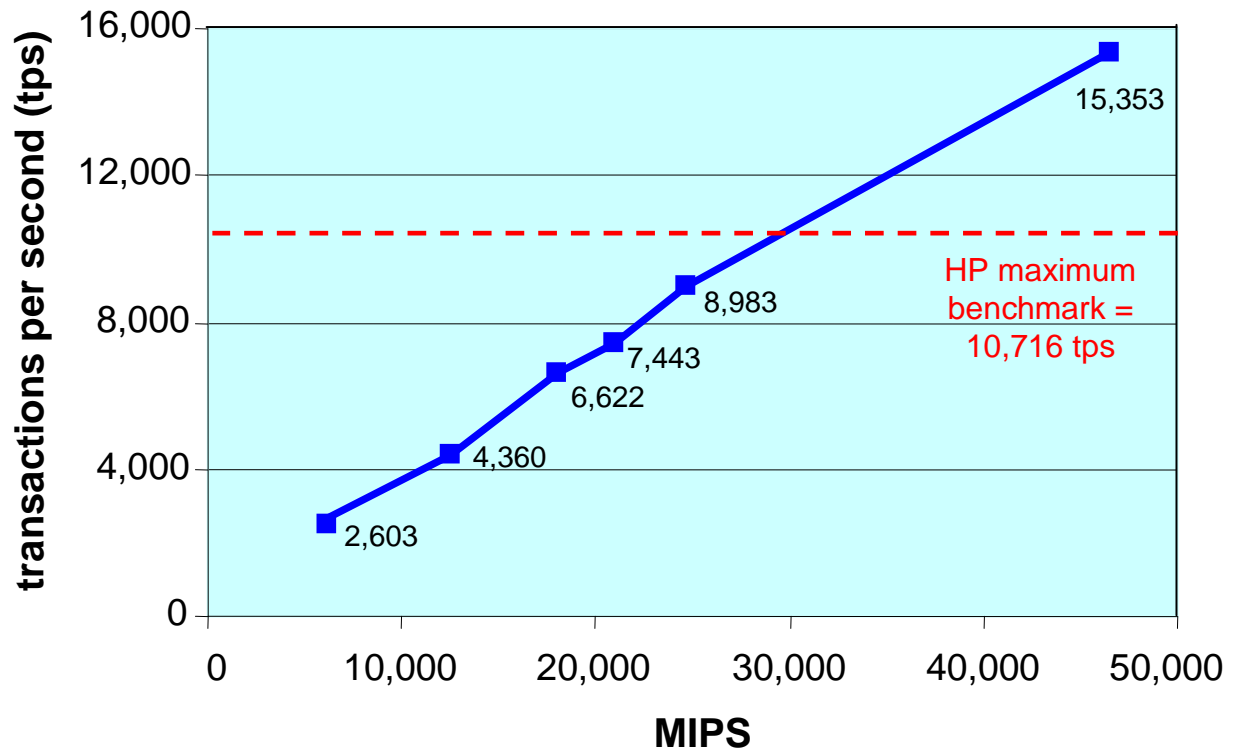
## ■ Kookmin Bank

- ▶ IBM System z and DB2
- ▶ TCS BaNCS
- ▶ 15,353 Transactions/second
- ▶ 50 Million Accounts
- ▶ IBM benchmark for customer
- ▶ DB2 V9, CICS 3.1, z/OS V1.8

## ■ State Bank of India

- ▶ HP Superdome
- ▶ TCS BaNCS
- ▶ 10,716 Transactions/second
- ▶ 500 Million Accounts
- ▶ Largest banking benchmark performance claimed by HP

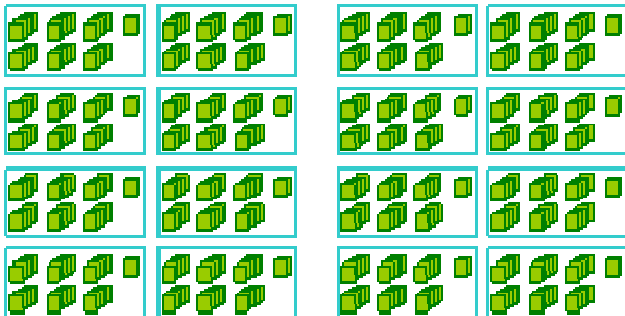
## System z and BaNCS Online Banking Benchmarks



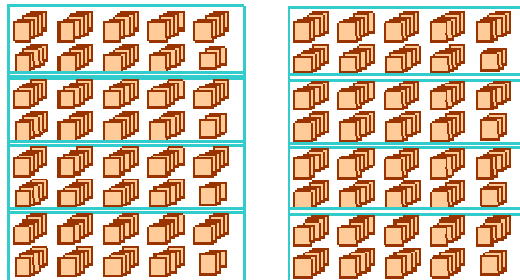
Source: <http://www.enterprisenetworksandservers.com/monthly/art.php?2976> and *InfoSizing FNS BANCS Scalability on IBM System z – Report Date: September 20, 2006*  
 Standard benchmark configuration reached 8,024 tps, a modified prototype reached 9,445 tps  
 SOURCE:\*\*Clement Report; <http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA1-4027ENW.pdf> Feb 2010

# Compare Processors Needed To Achieve Same Throughput (10,716 tps)

**BaNCS Application Servers:**  
16x HP Superdome (16ch/32co)



**BaNCS Database Servers:**  
8x HP Superdome (24ch/48co)



**Oracle on HP-UX**

**49 Processors**  
**(41 GPs + 8 zIIPs)**  
**38,270 MIPS**



**TCS BaNCS**  
**1x z196-741**



**DB2 on z/OS**

**896 processors**  
**3,668,608**  
**Performance Units**

**NOTE:**

- Updated to current z196 from original benchmark. Benchmarks configurations were for production only. To cover DEV/QA capacity, 100% capacity was added to distributed server configuration, and 25% MIPS were added to System z for a total of 38,270 MIPS.

# Compare The 5-Year Platform Acquisition Costs



HP-UX, Oracle

## HP Superdome Servers

**Total** (5yr TCO) **\$195M**

Hardware	\$113,215,984
Software	\$78,185,950
Networking	\$948,000
Space	\$1,061,710
Energy	\$1,522,488

**Scalability Not Demonstrated**  
**Energy (kWh) 3,045K per yr**



z/OS, DB2

## IBM z196

**Total** (5yr TCO) **\$99M**

Hardware	\$54,159,840
Software	\$44,277,400
Networking	\$39,500
Space	\$78,067
Energy	\$131,400

**Excellent Scalability**  
**Energy (kWh) 263K per yr**

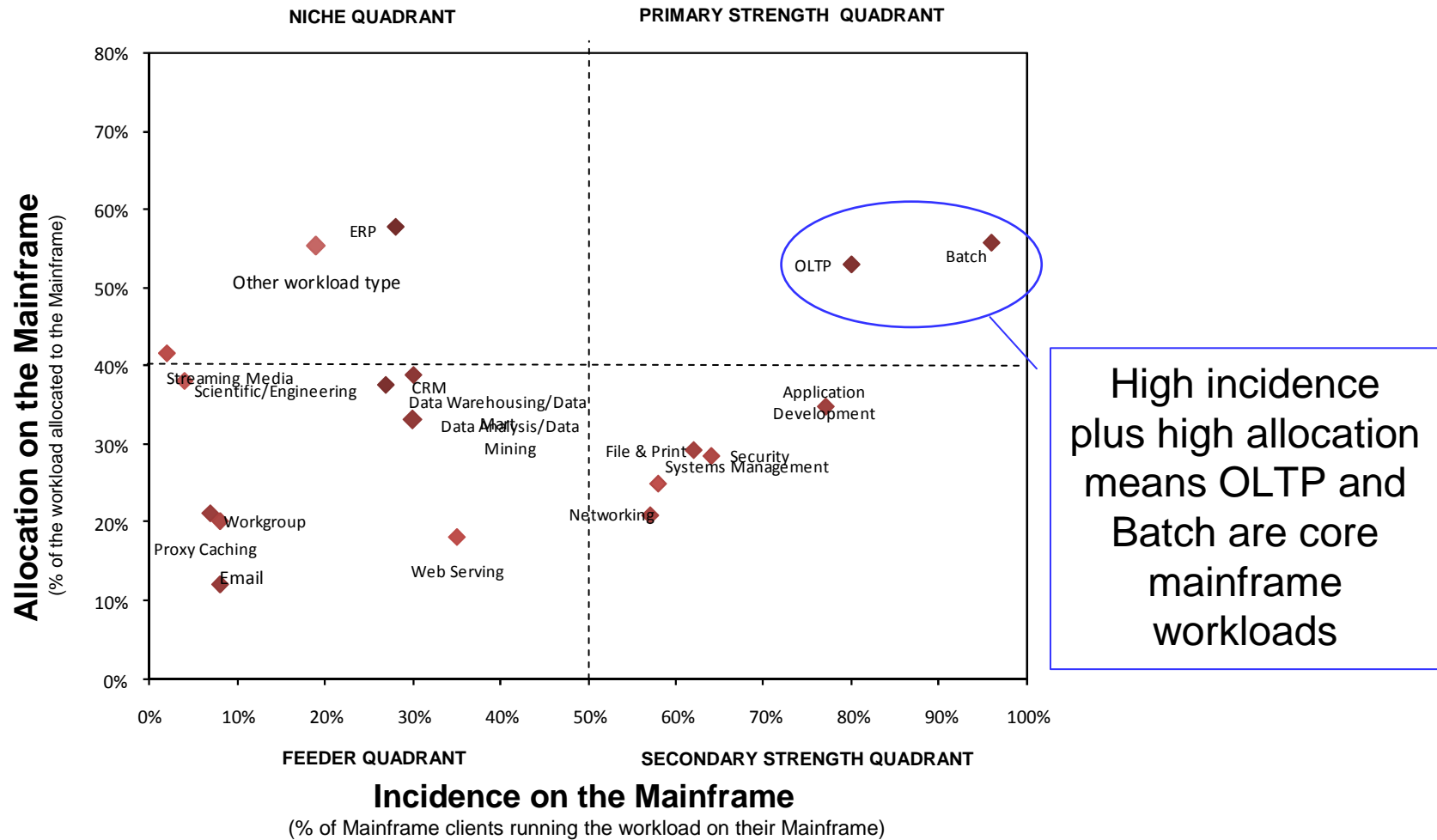
**49% less**

**Note:** Cost of platform infrastructure for production. Cost of packaged application software not included. List prices used.



# Batch And OLTP Are Prime Workloads For System z

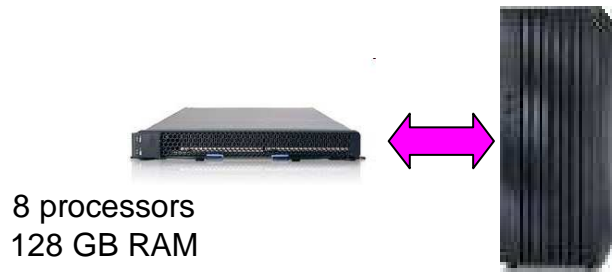
Incidence of workload on the Mainframe vs. allocation on the Mainframe



High incidence plus high allocation means OLTP and Batch are core mainframe workloads

# System z Is Optimized For Batch Processing And Heavy I/O Workloads

## Power PS701 + DS8300



## zEnterprise + DS8300



### **SORT** Job: Sort a 3 GB transaction file – Repetitions: 300

Sorting Total Elapsed 6,900 secs  
 Concurrency 20  
 Bytes Per Sec **280 MB**

Sorting Total Elapsed 860 secs  
 Concurrency 45  
 Bytes Per Sec **2.25 GB**

### **MERGE** Job: Merge 30 sorted files into a 90 GB master file – Repetitions: 10

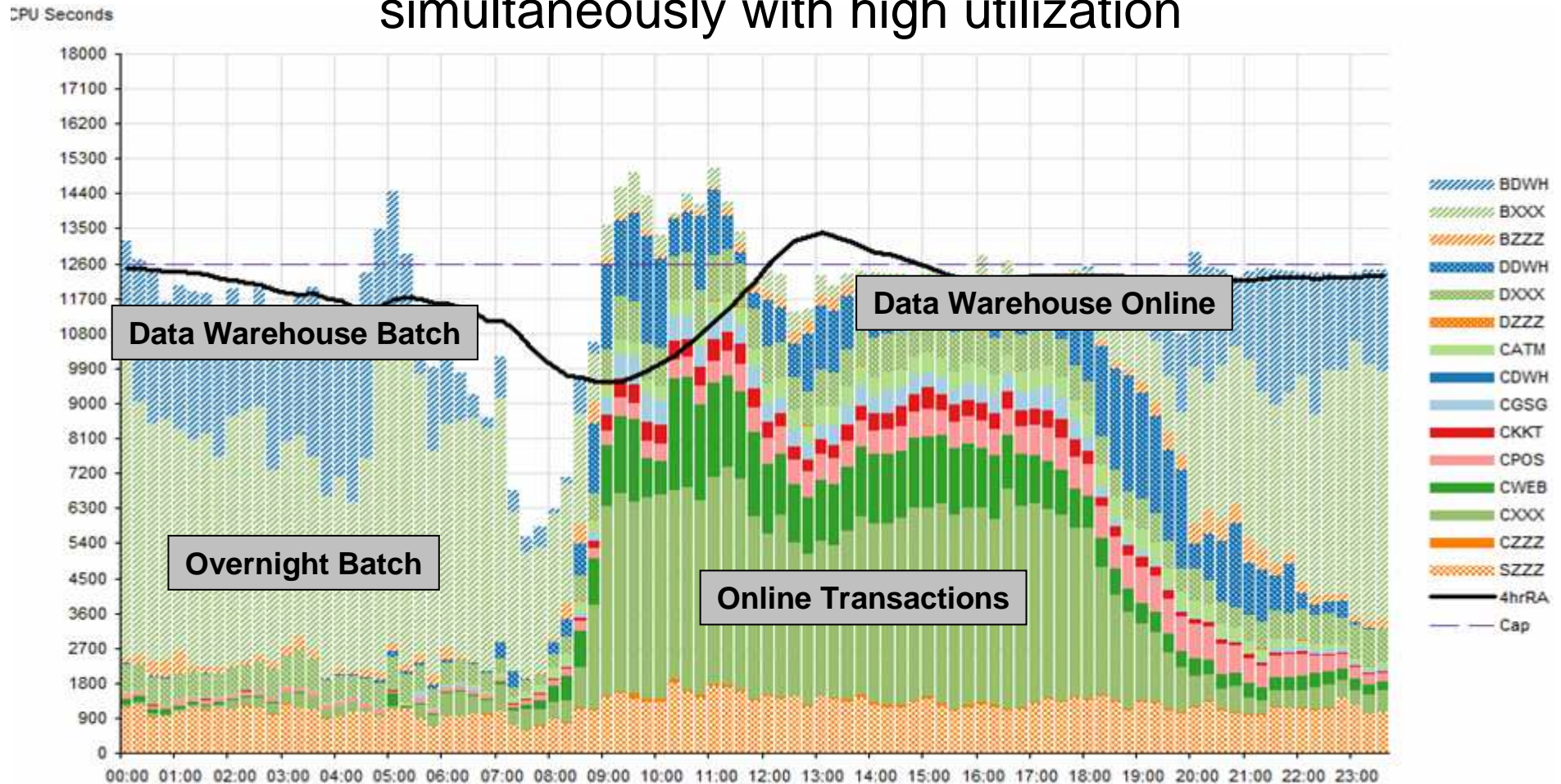
Merging Total Elapsed 7,920 secs  
 Concurrency 10  
 Bytes Per Sec **244 MB**

Merging Total Elapsed 1,218 secs  
 Concurrency 10  
 Bytes Per Sec **1.58 GB**

**Batch window reduced by 89% on zEnterprise**

# System z Platform Easily Handles Workload Peaks

Example: Core banking workloads running simultaneously with high utilization

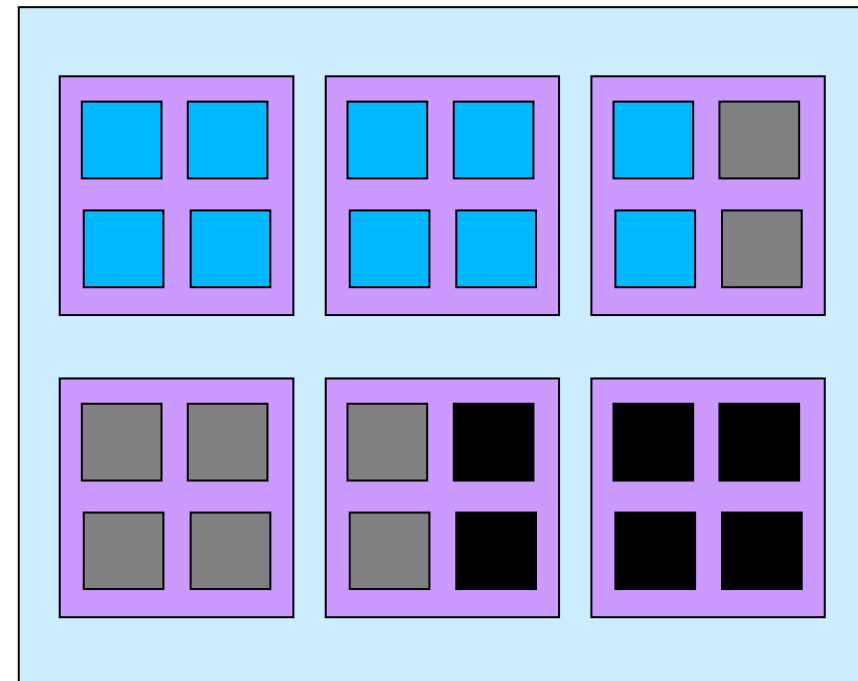


# System z Capacity On Demand Provides Elasticity To Handle Unexpected Peaks

- On/Off Capacity on Demand (On/Off CoD)
  - ▶ Flexible, easy, non-disruptive temporary additional capacity
  - ▶ Self-managed
  - ▶ Total flexibility within number of books installed

- Can be automated

One z196 Book with 6 Sockets



- Active processors – pay full price
- Inactive processors (On/Off CoD) – pay only 2% of full price
- Dark processors (unused) – no charge

# Customer Data Shows Most Mainframe Workloads Are Already Best Fit

- IBM Eagle Team performs total cost of ownership (TCO) studies for customers
- With over 225 customers evaluated, Eagle Team has shown **System z offers better TCO** than a distributed alternative... with very few exceptions
- Contact Craig Bender ([csbender@us.ibm.com](mailto:csbender@us.ibm.com))



# Moving Large Scale Transaction Processing Off z/OS Rarely Reduces Cost

## 4 HP Proliant DL 980 G7 servers



256 cores total

Hardware	\$1,594,801
Software	\$80,617,966
Labor (additional)	\$8,250,000
Power and cooling	\$43,756
Space	\$79,385
Disaster Recovery	\$4,210,728
Migration Labor	\$24,000,000
Parallel Mainframe costs	\$31,474,052
<b>Total (5yr TCO)</b>	<b>\$150,270,688</b>

## System z Sysplex



2760 MIPS

Hardware	\$1,408,185
Software	\$49,687,845
Labor	Baseline
Power and cooling	\$31,339
Space	\$79,385
Disaster recovery	\$1,250,000
<b>Total (5yr TCO)</b>	<b>\$52,456,754</b>

**65% less**

**IBM Confidential**



# Data Shows Mainframe-Biased Businesses Have Reduced Costs

IT cost of goods per industry:

Industry	Measure	Avg IT Cost of			%Improve
		Goods	MF Biased	Server Biased	
Airlines	Per Passenger Mile	\$ 0.007	\$ 0.0061	\$ 0.0076	-20%
Automotive	Per Vehicle	\$ 333	\$ 275	\$ 370	-26%
Chemicals	Per Patent	\$ 57,717	\$ 55,800	\$ 59,552	-6%
Consulting	Per Consultant	\$ 53,060	\$ 48,900	\$ 62,344	-22%
Hospitals	Per Bed per Day	\$ 64.30	\$ 54.4000	\$ 71.7000	-24%
Railroads	Per Ton Mile	\$ 0.0014	\$ 0.0012	\$ 0.0018	-29%
Retail	Per Store (Door)	\$ 494,818	\$ 421,346	\$ 560,300	-25%
Web Sites	Per Search	\$ 0.042	\$ 0.046	\$ 0.041	12%
Trucking	Per Road Mile	\$ 0.177	\$ 0.1550	\$ 0.1940	-20%
Armed Service	Per Person	\$ 8,036.00	\$ 6,871.00	\$ 9,839	-30%
Utilities	Per MegaWatt Hour	\$ 2.63	\$ 2.21	\$ 2.94	-25%
Oil & Gas	Per Barrel of Oil	\$ 2.10	\$ 1.78	\$ 2.32	-23%

*From Rubin Worldwide analysis of Gartner Research customer data and costs*

**Compared to average platform costs for all industries, mainframe-biased businesses spent 14% less, and distributed-biased businesses spent 33% more**

# Now With zEnterprise, System z Is Better Than Ever

**zEnterprise 196  
continues a tradition of  
mainframe innovation**



*z10 Enterprise Class*



*zEnterprise 196 (z196)*

<i>Clock speed</i>	4.4 GHz	➔	<b>5.2 GHz</b>
<i>Sockets per MCM</i>	5	➔	<b>6</b>
<i>Total processors</i>	77 (64 configurable)	➔	<b>96 (80 configurable)</b>
<i>Total Memory</i>	1.5 TB	➔	<b>3TB</b>
<i>Performance**</i>	920 MIPS	➔	<b>1,202 MIPS</b>
<i>Total Capacity*</i>	30,657 MIPS	➔	<b>52,286 MIPS</b>
<i>Power</i>	1,800 W per MCM	➔	<b>1,800 W per MCM</b>

• Based on LSPR ratings for fully configured system

\*\* Single process performance

MCM = Multi-chip module



# Introducing zEnterprise 114

**zEnterprise 114 is uniquely designed for mid-range customers**



*z10 Business Class*



*zEnterprise 114 (z114)*

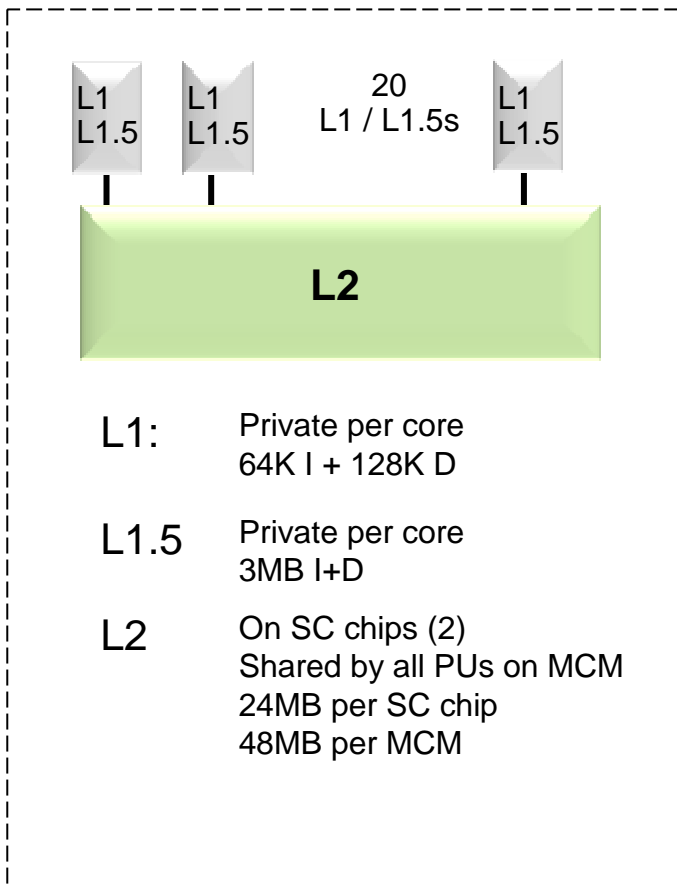
<i>Clock speed</i>	3.5 GHz	➔	<b>3.8 GHz</b>
<i>Total Processors</i>	10 (0 spare)	➔	<b>M05: 5 (0 spare) M10:10 (2 spare)</b>
<i>Total Memory</i>	256 GB	➔	<b>M05: 128 GB M10: 256 GB</b>
<i>Performance**</i>	673 MIPS	➔	<b>782 MIPS</b>
<i>Total Capacity*</i>	2,760 MIPS	➔	<b>3,139 MIPS</b>

• Based on LSPR ratings for fully configured system

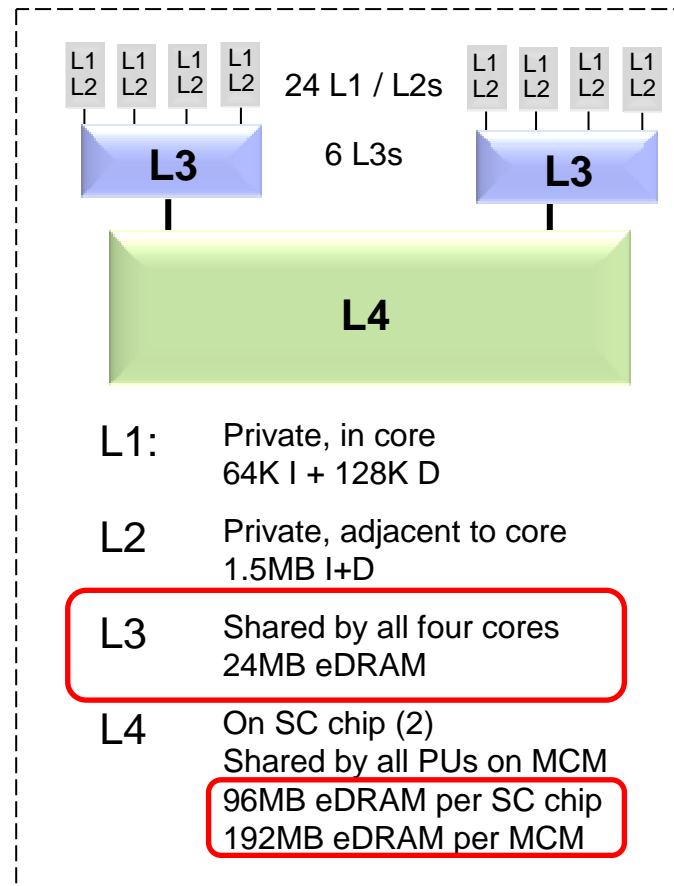
\*\* Single process performance

# z196 Also Has 2.4x More On-Chip Cache As z10 EC

## One z10 EC MCM



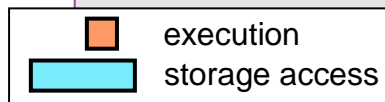
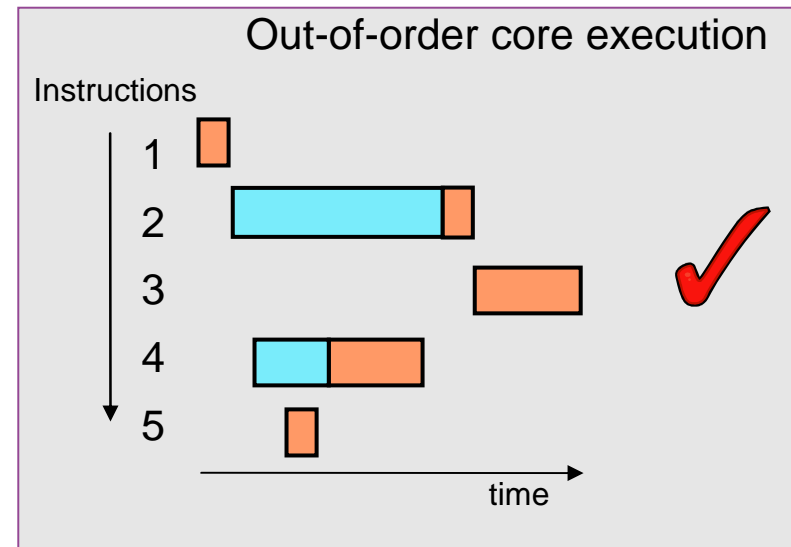
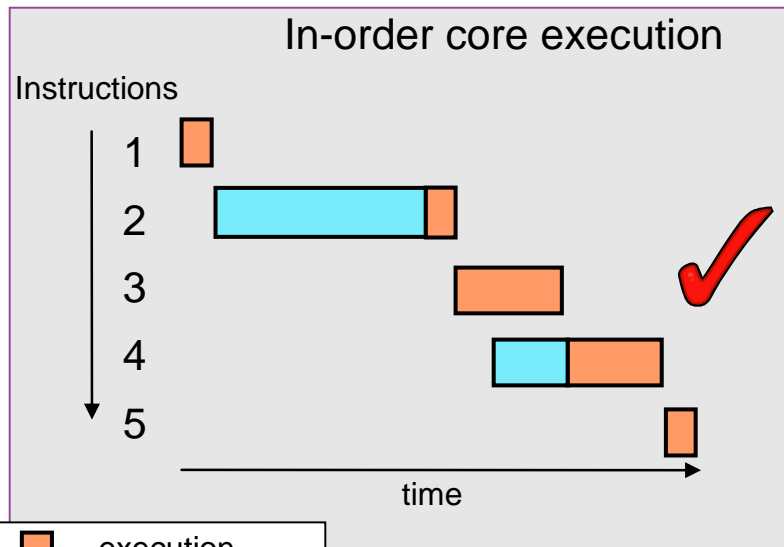
## One z196 MCM



**More cache leads to reduced latency times**

# z114 And z196 Add Out-Of-Order Processing

- Superscalar architecture enhancements:
  - ▶ Decodes up to 3 instructions per cycle (up from 2 on z10)
  - ▶ Executes up to 5 instructions per cycle (up from 2 on z10)
- >100 new instructions added
  - ▶ In particular, Instruction Cracking and Register Renaming which enable Out-of-Order (OOO) instruction execution
- Reduces instruction wait times, and benefits compute-intensive apps



# How Does This Add Up?

## z196 Significantly Outperforms z10 EC

	Performance Ratio (z196 : z10 EC)
<b>LSPR with z/OS V1R11</b>	
z196 708 and z10 708*	1.37
z196 780 and z10 764**	1.64
<b>CPO Banking Benchmark</b>	
CICS – 3270 version	1.37
WAS on z/OS	1.32
WAS on Linux on System z	1.47
<b>CPO COBOL Benchmark</b>	
z/OS V1R11 Enterprise COBOL 4.1	1.41

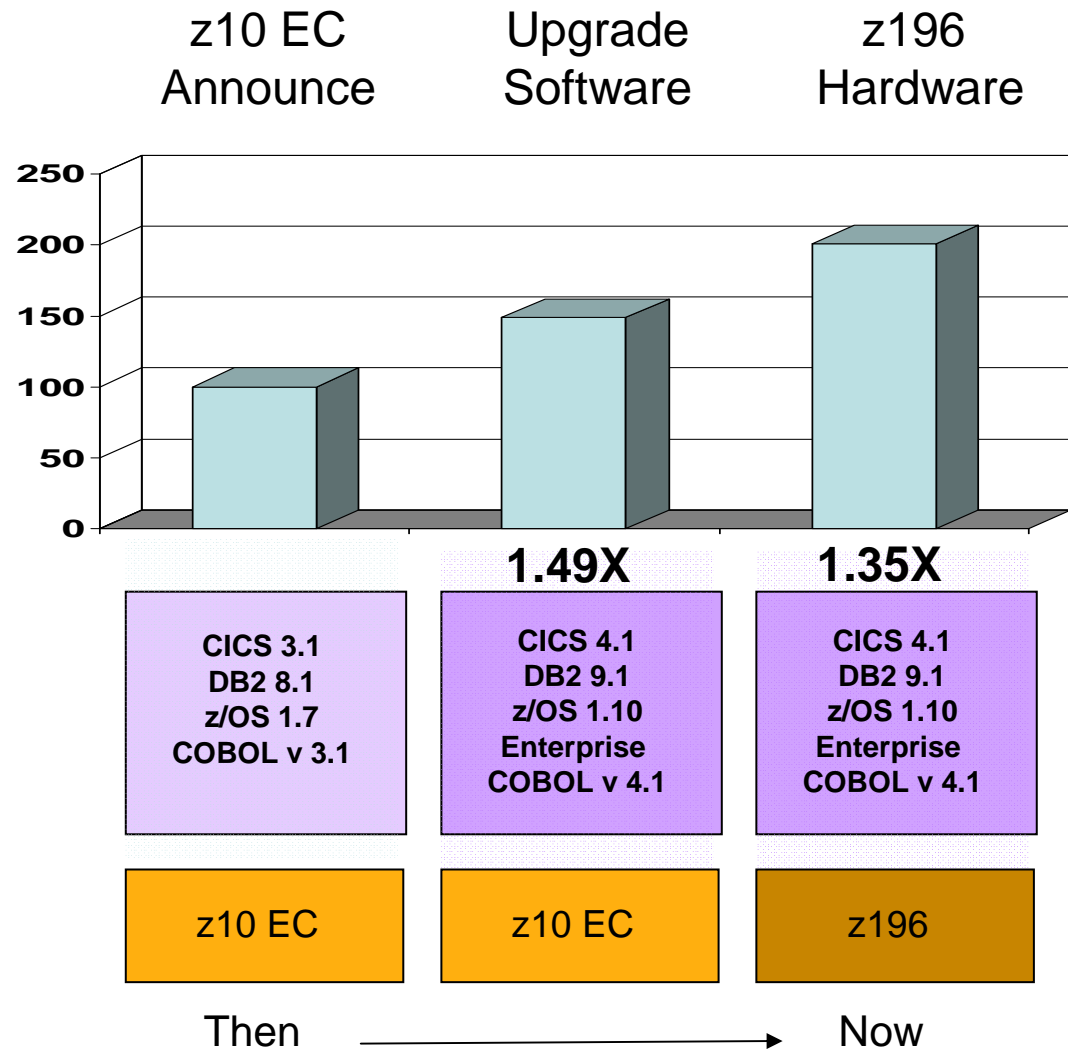
\* Customer average for z10 EC CEC is 9 GP processors

\*\* Each as fully-configured systems

# CICS/DB2 Optimizations For z/OS – From Then To Now

Continued investment to optimize key software for z/OS environment

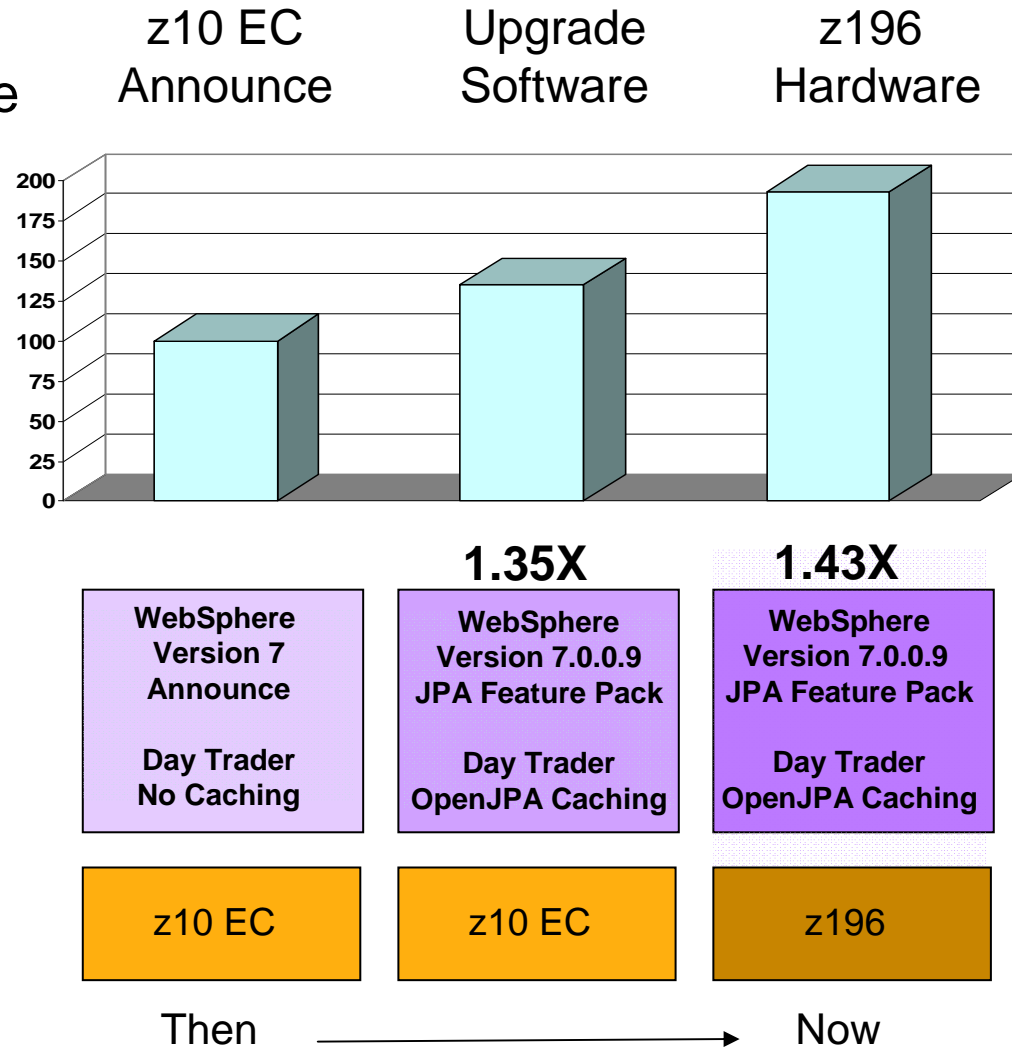
- Upgrade CICS/DB2 stack produces 1.49 times performance improvement on same z10 hardware
- Move to z196 hardware produces 1.35 times performance improvement
- From then to now – **2.01** times performance improvement



# WebSphere Optimizations For z/OS – From Then To Now

Continued investment to optimize WebSphere software for z/OS environment

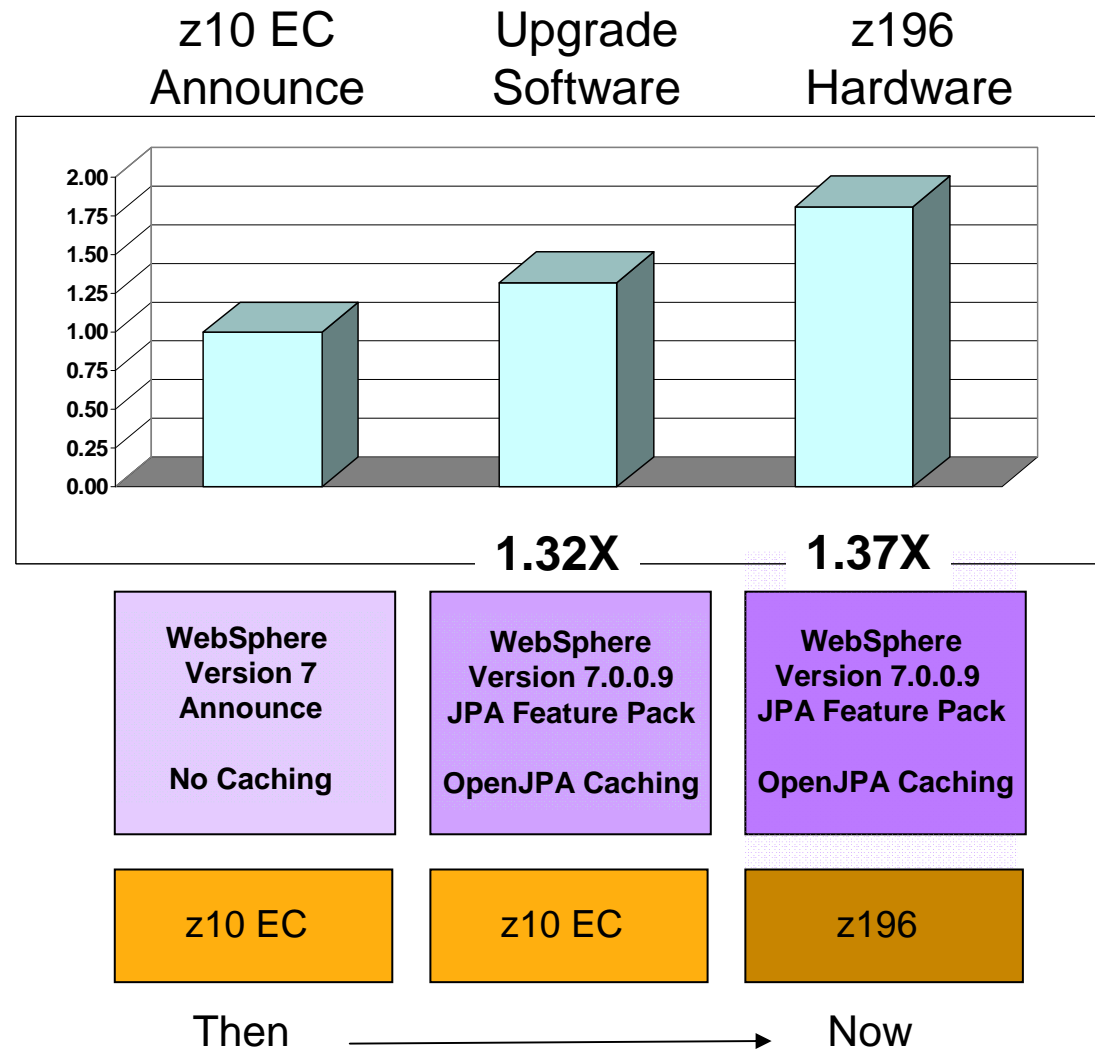
- 1.35 times performance improvement for JPA 2.0 applications that exploit the OpenJPA caching facilities available in the WebSphere Version 7 JPA Feature Pack.
- Move to z196 hardware produces 1.43 times performance improvement
- From then to now – **1.93** times performance improvement



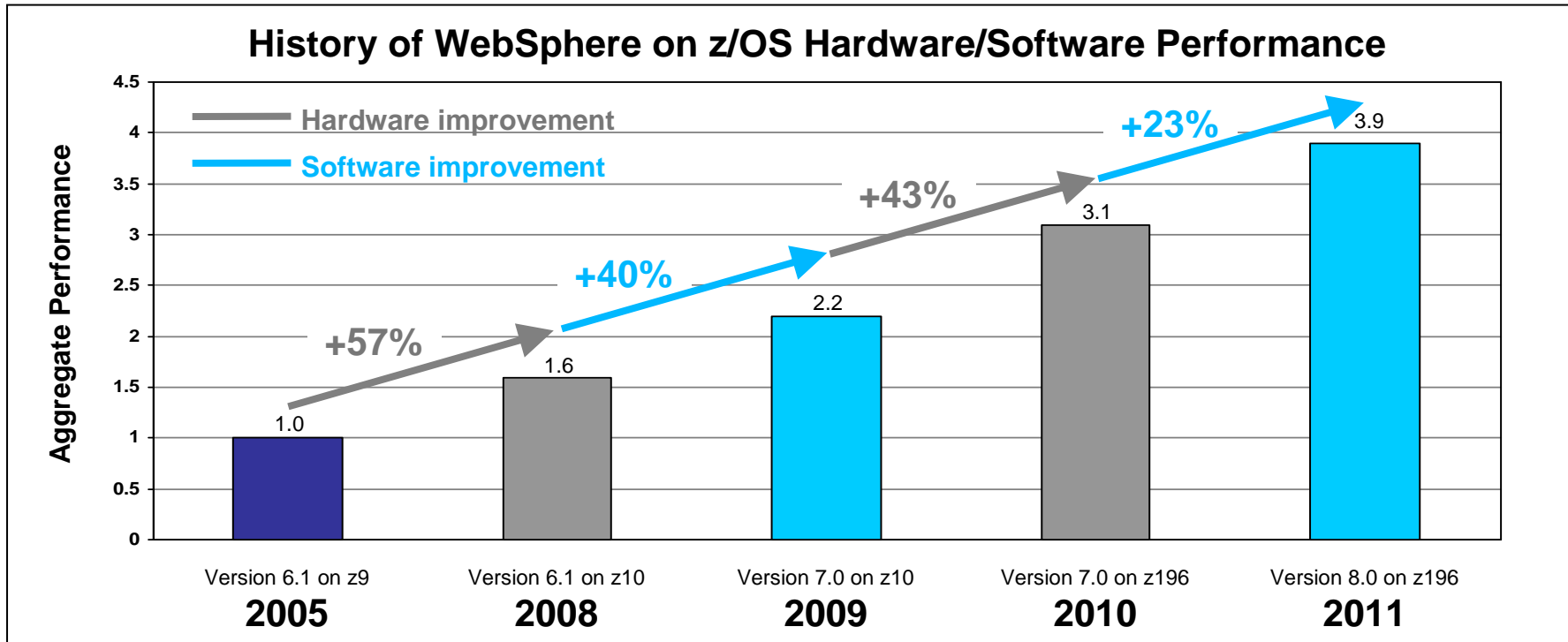
# WebSphere Optimizations For Linux

Similar results are achieved for WebSphere software in a Linux for System z environment

- 1.32 times performance improvement for JPA 2.0 applications that exploit the OpenJPA Caching facilities available in the WebSphere Version 7 JPA Feature Pack.
- Move to z196 hardware produces 1.37 times performance improvement
- Combined hardware and software - **1.81** times performance improvement



# Continual HW And SW Innovations Yield Continuous Performance Improvements

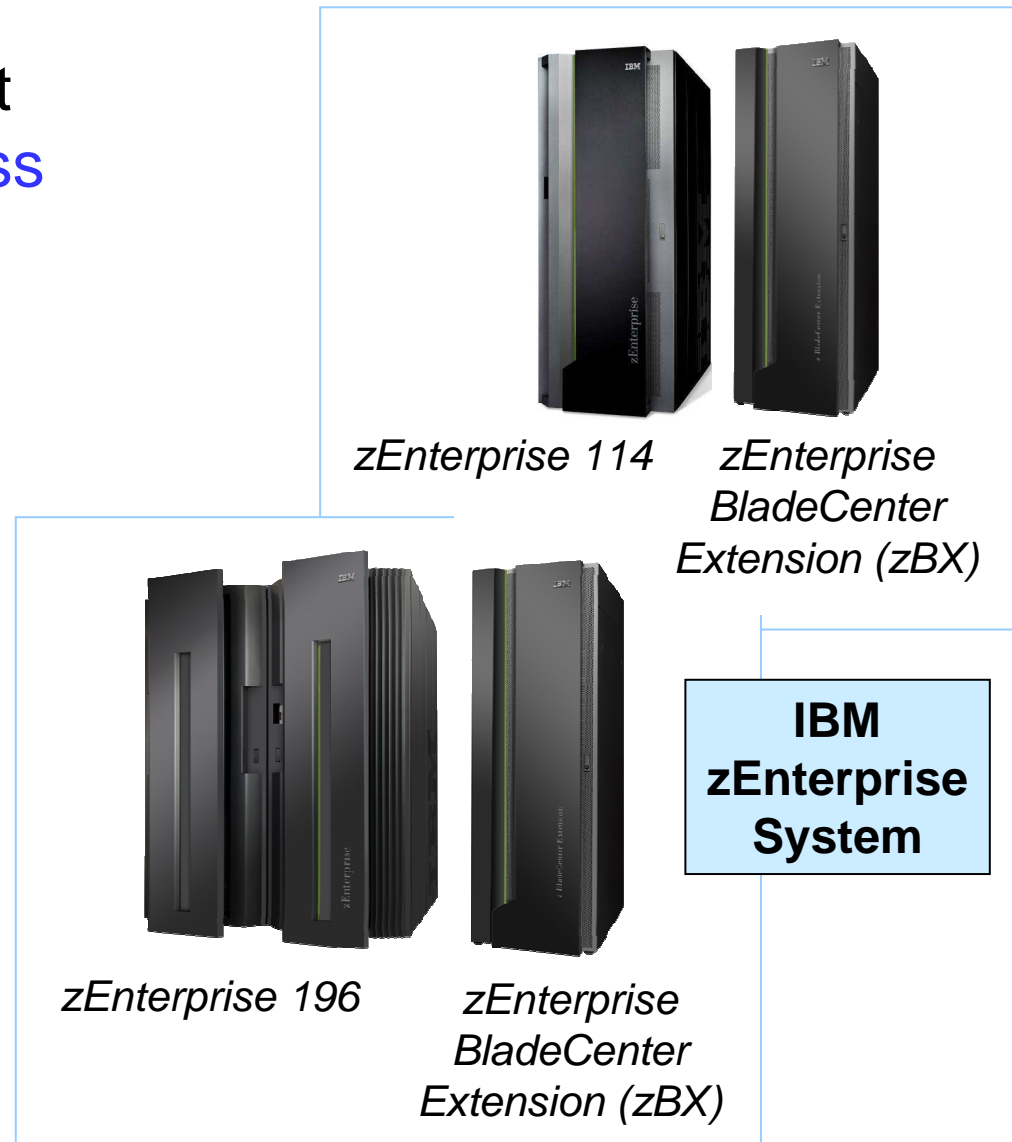


- Hardware component increase of about 2.25x (1.57 x 1.43)
- Software component increase of about 1.72x (1.40 x 1.23)
- Aggregate performance improvement of almost 4x from WAS V6.1 on a z9 to WAS V8.0 on a z196
- Similar improvements have been measured for CICS, DB2, and IMS

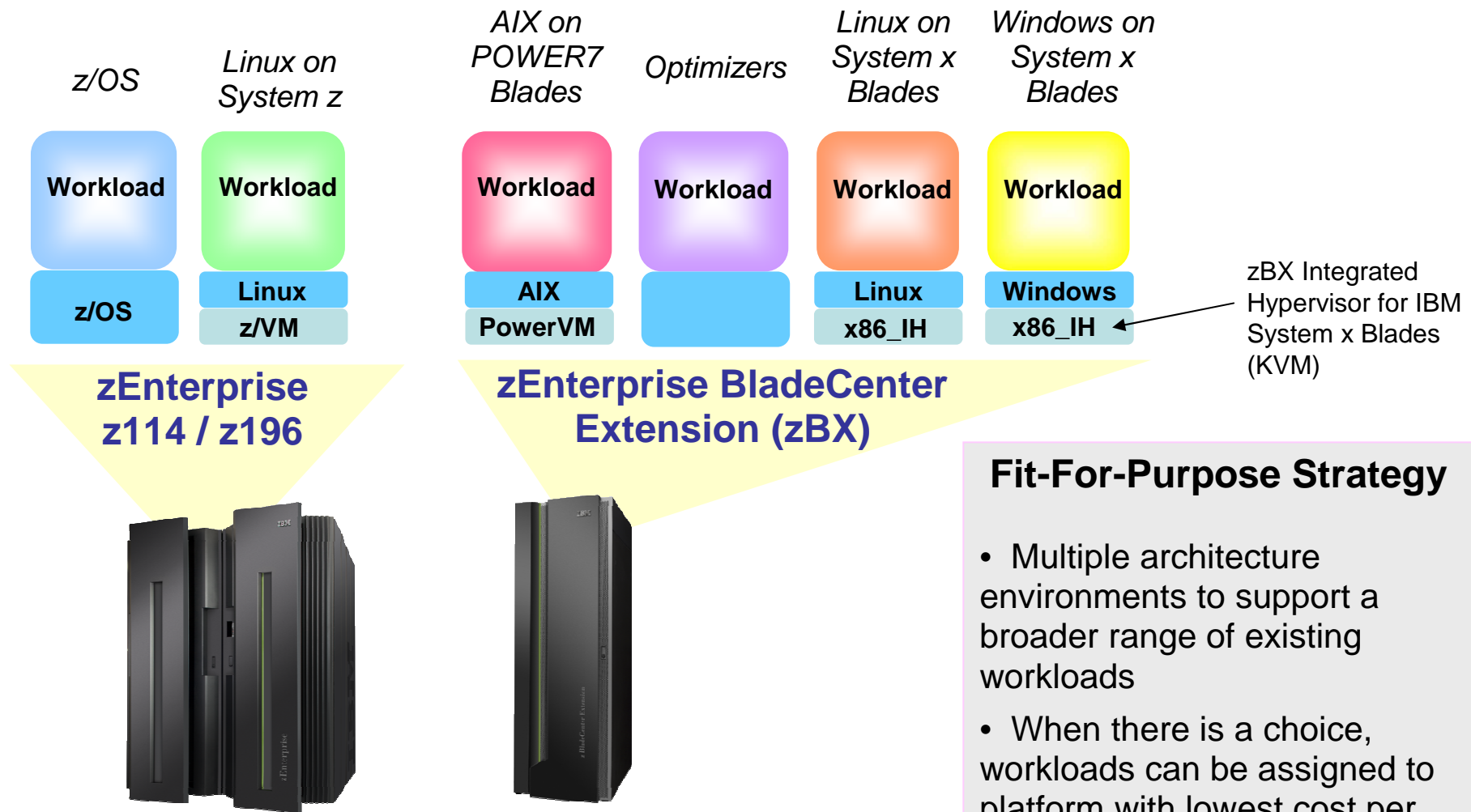


# zEnterprise Value

- zEnterprise is STILL best for handling **core business workloads**
- zEnterprise is more than a mainframe – it's a **complete multi-architecture platform**
- zEnterprise continues a tradition of unmatched reliability and superior qualities of service



# zEnterprise Has Different Environments For Different Workload Requirements



# zEnterprise BladeCenter Extension (zBX) Adds New Platforms To System z

- zBX ordered and installed as one fully built and tested System z “part”
  - ▶ Includes all necessary components – switches, chassis, power, and cabling
  - ▶ Blades and optimizers purchased separately
- Built from standard IBM Certified Components
- Full redundancy insures highest reliability
- System z product support for problem reporting, hardware and firmware updates



#### One zBX rack:

- Up to 14 single-width blades per chassis
- Up to 2 chassis per rack



#### One fully loaded zBX is:

- 4 racks
- 112 blades\*



#### Selected IBM blades supported:

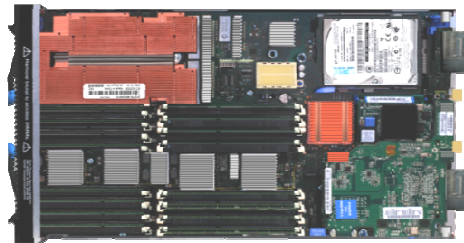
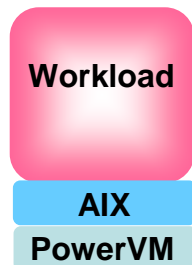
- IBM POWER7 blades
- IBM System x blades
- Specialty Optimizer
- Most can be mixed



\* Blade capacity per rack varies with blade type. Max number of blades per zBX is as follows: 112 Power blades, 28 x blades, 28 DataPower blades, 56 ISAO blades. Power, x and DP blades can be mixed in same chassis, ISAO blades require own chassis, but can share a rack.

# zBX-supported POWER And System x Application Server Blades

*AIX on  
POWER7  
Blades*



*Linux on  
System x  
Blades*



*Windows on  
System x  
Blades*



- POWER7 PS701 Express
  - ▶ Single-width, 1ch/8co, 3.0 GHz
    - Up to 4 threads per core
  - ▶ AIX OS 5.3 or greater
  - ▶ PowerVM

- System x HX5 (Westmere-EX)
  - ▶ Single-width, 2ch/16 co, 2.13 GHz
    - Up to 2 threads per core
  - ▶ Windows and Linux
  - ▶ KVM-based integrated hypervisor

# Blades Run Distributed Software Available Through Passport Advantage

## IBM Information Management software

Cognos BI  
 Content Manager  
 DB2 UDB  
 Document Manager  
 Filenet  
 Informix  
 Information Integration  
 Information Server  
 InfoSphere  
 MDM  
 OmniFind  
 OpenPages  
 Optim  
 SPSS  
 ...

## Lotus software

Connections  
 Domino  
 Forms  
 ActiveInsight  
 Quickr  
 Web Content Manager  
 Workflow  
 Mashup Center  
 Sametime  
 ...

- No MIPS or MSU rating for zBX software

## WebSphere software

Application Workload Modeler  
 Communications Server  
 Decision Server  
 MQSeries  
 Process Integration Server  
 Application Server  
 BI Server  
 Business Integration  
 Commerce  
 ESB  
 Lombardi  
 Portal  
 Portlet Factory  
 Translation Server  
 Voice Server  
 ...

## Rational software

Team Concert  
 Requirements Composer  
 Asset Manager  
 BuildForge  
 ClearCase  
 AppScan  
 Quality Manager  
 Functional Test  
 Performance Test  
 ...

## Other

Unica  
 Systems Director  
 Sterling  
 ...

## Tivoli software

Directory Server  
 Maximo  
 Performance Analyzer  
 Composite Application Manager  
 Identity and Access Assurance  
 Access manager  
 Asset Manager  
 Change and Configuration Manager  
 Compliance Insight Manager  
 Directory Integrator  
 Federated Identity Manager  
 Identity and Access Manager  
 License Compliance Manager  
 Monitoring  
 Netcool  
 OMEGAMON  
 Provisioning  
 Security Compliance Manager  
 Service Automation Manager  
 Systems Automation  
 Workload Scheduler  
 ...

# zBX Optimizers Are Built-For-Purpose

- Delivered as Blades for use in zBX
- Fully-integrated, fully-contained – each targeted for specific workload functions
  - ▶ Pre-packaged, self-contained units including hardware, software, memory, etc.
- Designed for integration with and management by zEnterprise
- Optimizer available today:
  - ▶ **IBM WebSphere DataPower XI50 for zEnterprise**

*Optimizers*



But what is so unique about putting a BladeCenter next to a mainframe?



**CIO**

There's more to this than meets the eye!

The Unified Resource Manager – also called zManager – is the “secret sauce”.

It provides extensive management of resources and workloads across all zEnterprise platforms!



**IBM**



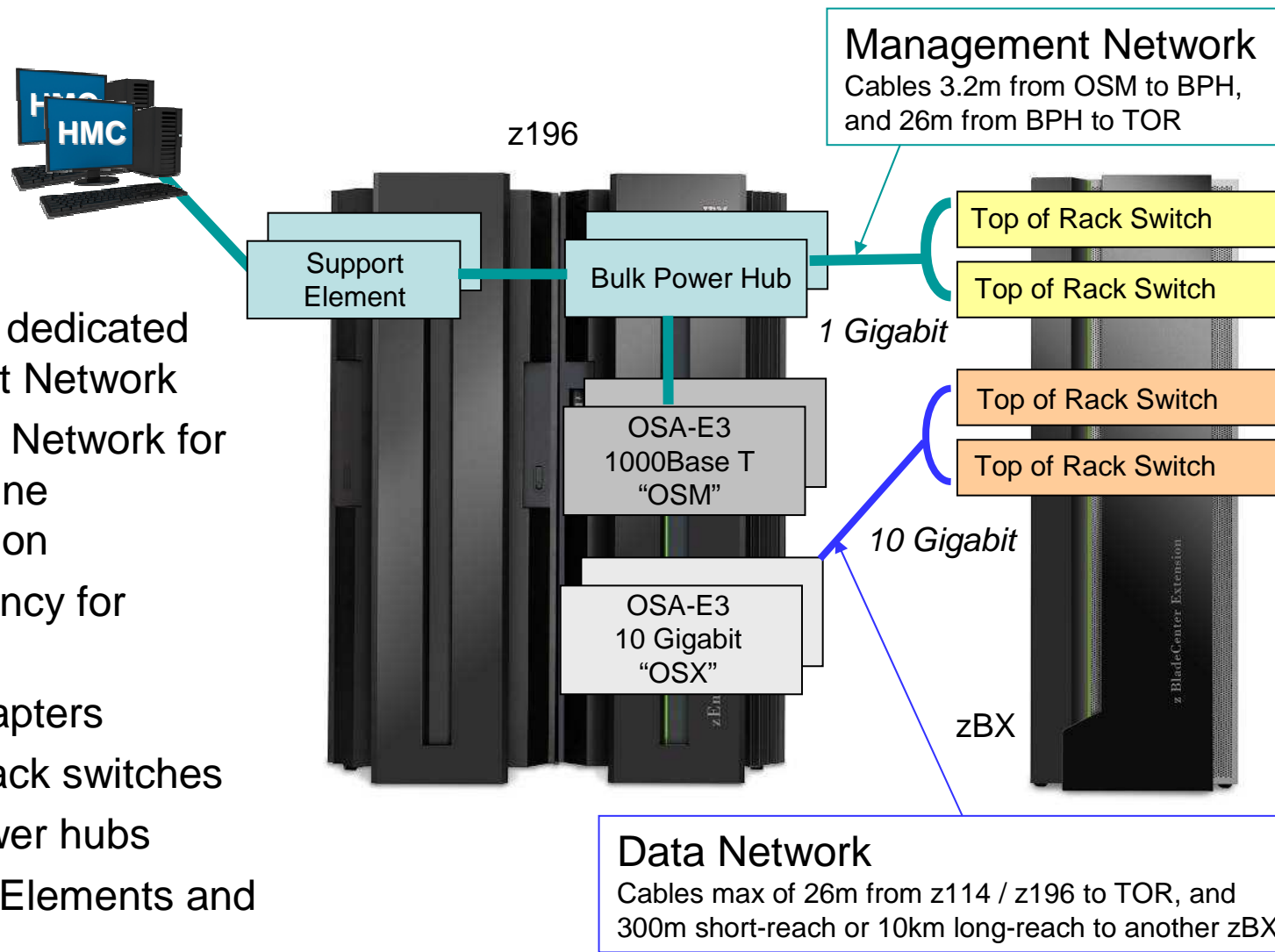
# zManager Provides Platform And Resource Management Across zEnterprise Environments

Process	Typical Distributed Management Practices	zManager
<b>Asset Management</b>	<ul style="list-style-type: none"> <li>Discover assets with ad hoc methods</li> <li>Manual entitlement management</li> </ul>	<ul style="list-style-type: none"> <li>Automated discovery and management of entitlement assets</li> </ul>
<b>Deployment Management</b>	<ul style="list-style-type: none"> <li>Manually configure hypervisor and build networks</li> </ul>	<ul style="list-style-type: none"> <li>Automated deployment of hypervisor and attachment to integrated networks</li> </ul>
<b>Security Management</b>	<ul style="list-style-type: none"> <li>Different ways to manage administrator access</li> </ul>	<ul style="list-style-type: none"> <li>Centralized, fine-grained administrator access management</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>No visibility into impact of changes</li> </ul>	<ul style="list-style-type: none"> <li>Track dependencies for change impact</li> </ul>
<b>Capacity and Performance Management</b>	<ul style="list-style-type: none"> <li>No end-to-end transaction monitoring</li> <li>Manually adjust CPU resources to meet changing workload demands</li> </ul>	<ul style="list-style-type: none"> <li>End-to-end transaction monitoring to isolate issues</li> <li>Automatic CPU resource adjustments to meet changing workload demands</li> </ul>



# z114 / z196 And zBX Are Connected Via Two Internal Networks

- Isolated and dedicated Management Network
- Secure Data Network for virtual machine communication
- Full redundancy for reliability
  - ▶ OSA adapters
  - ▶ Top of rack switches
  - ▶ Bulk power hubs
  - ▶ Support Elements and HMC

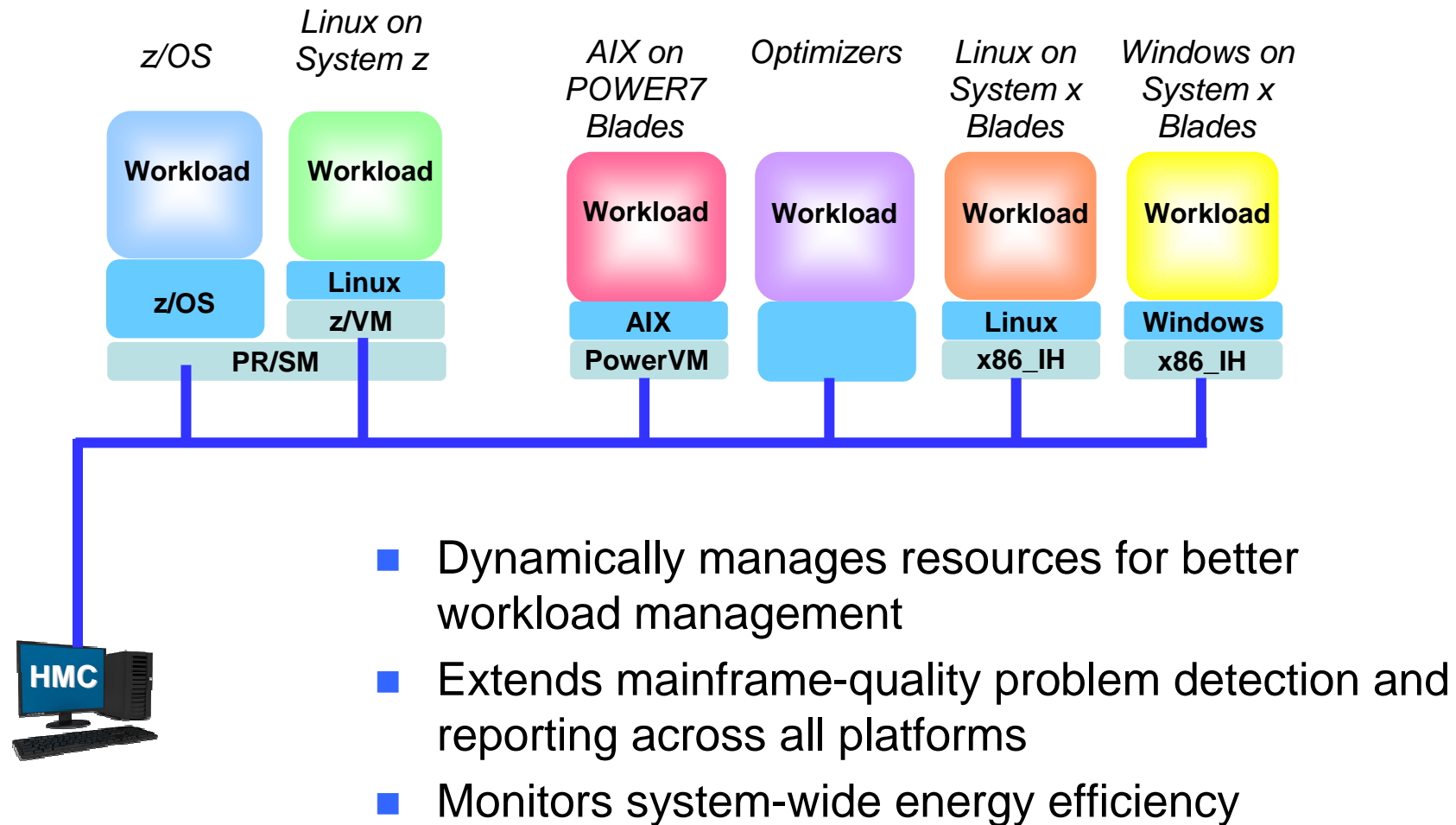


# zEnterprise Network Simplification And Security

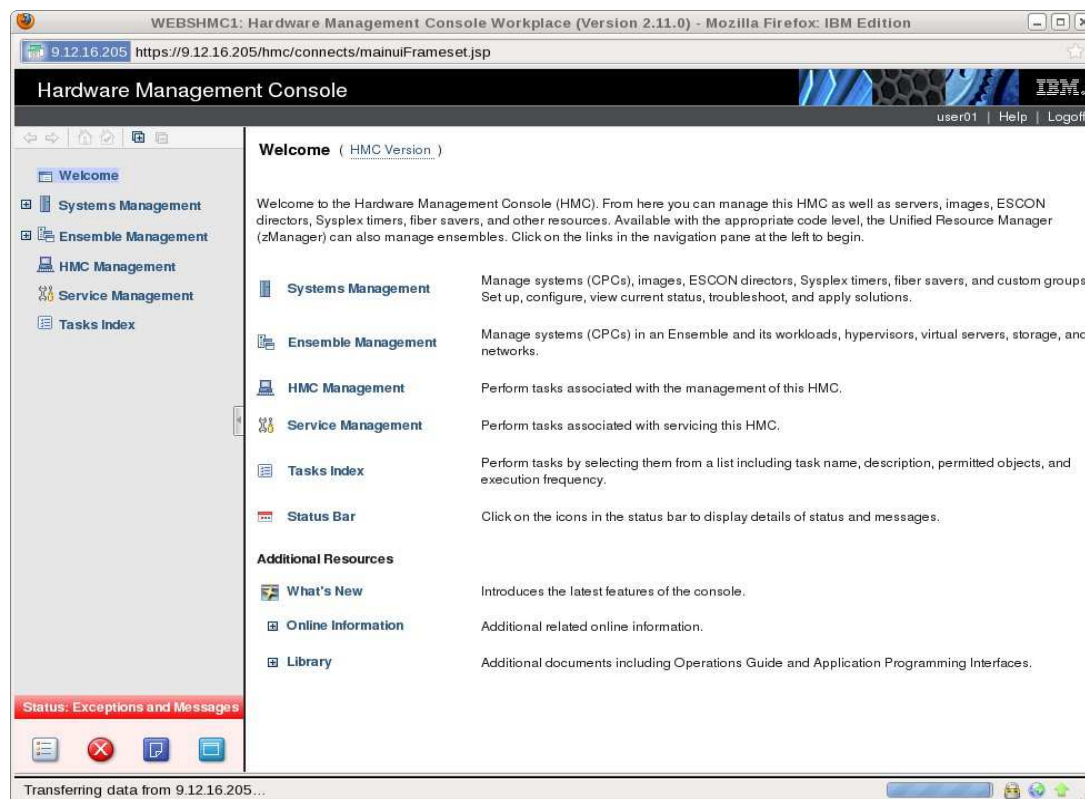
- “Network in a box” limits vulnerability to security breaches
  - ▶ Fully integrated concealed networks
    - No external switches or routers necessary – IBM-only equipment
    - Fully tested, pre-installed and pre-configured
  - ▶ Can reduce latency and the number of “hops”
  
- Security
  - ▶ Management Network:
    - Tightly restricted to zManager use only
  - ▶ Data Network:
    - Accessible only by authorized virtual machines
  - ▶ Logical security via virtualization
  - ▶ zManager includes strict “role-based” access control
  - ▶ No need for additional encryption or firewall



# zManager Owns The Private Management Network For Hypervisor Communications



# DEMO: Manage Resources And Workloads Using zManager



- zManager uses familiar HMC interface
- View and manage all zEnterprise platforms

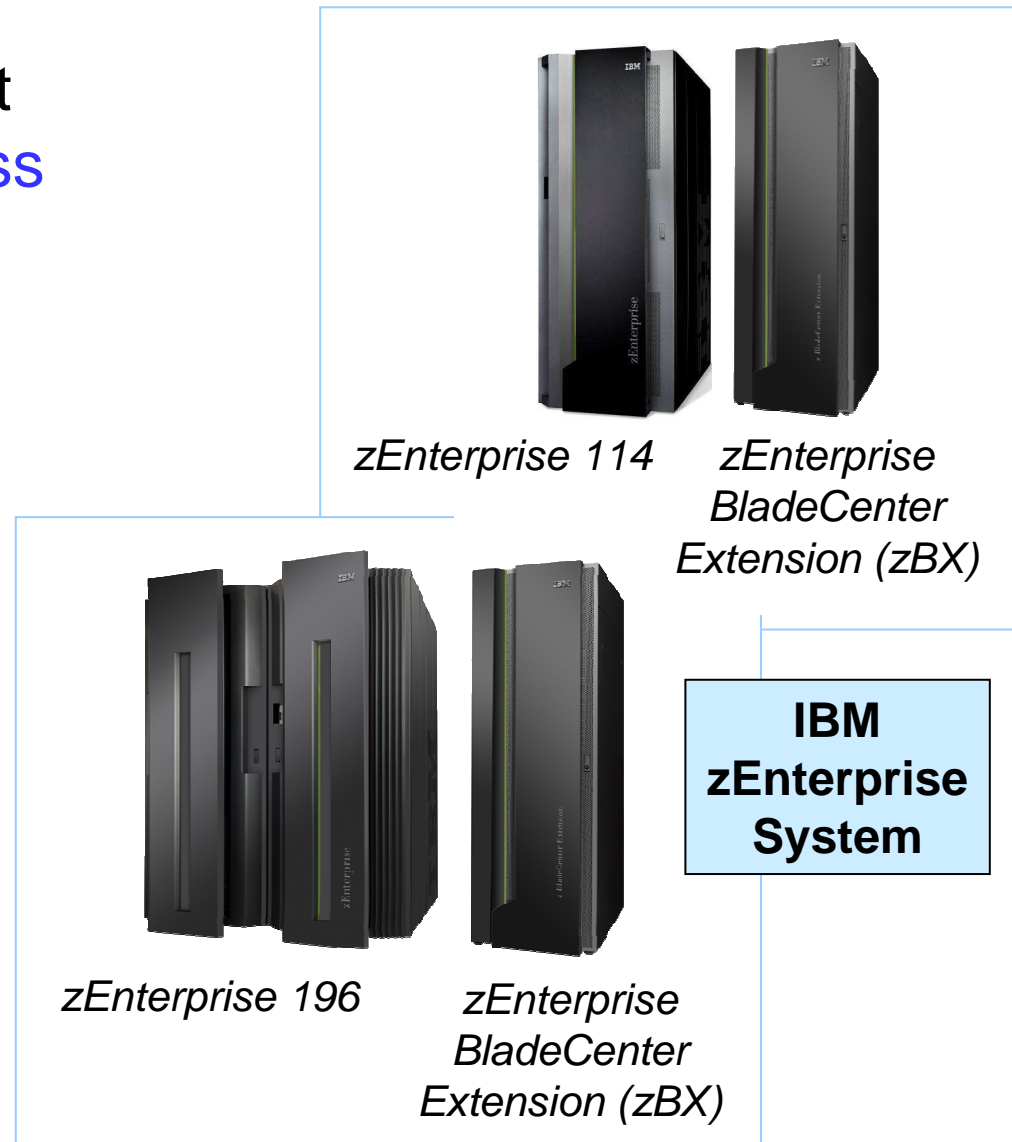
# zManager Can Drive Down Labor Costs

IT Process	zManager	Costs Reduced By*
<b>Asset Management</b>	<ul style="list-style-type: none"> <li>Automated discovery and management of entitlement</li> </ul>	<b>9%</b>
<b>Deployment Management</b>	<ul style="list-style-type: none"> <li>Automated deployment of hypervisors and virtual networks</li> </ul>	<b>33%</b>
<b>Capacity and Performance Management</b>	<ul style="list-style-type: none"> <li>Automatic resource adjustments to meet changing workload demands</li> </ul>	<b>52%</b>
<b>Security Management</b>	<ul style="list-style-type: none"> <li>Centralized, fine-grained administrator access</li> </ul>	<b>20%</b>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>Dependency tracking across platform for change impact</li> </ul>	<b>41%</b>

\*Source: IBM Internal study of 92 hybrid workloads

# zEnterprise Value

- zEnterprise is STILL best for handling **core business workloads**
- zEnterprise is more than a mainframe – it's a **complete multi-architecture platform**
- zEnterprise continues a tradition of **unmatched reliability** and **superior qualities of service**



# A Complex, Distributed-based Scale Out Strategy Has Its Risks

North America	Europe	Asia Pacific		Apr 26	Apr 25	Apr 24	Apr 23	Apr 22	Apr 21	Apr 20
Amazon CloudFront	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon CloudWatch (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon CloudWatch (N. Virginia)	✓	✓	⚠	⚠	⚠	⚠	✓	✓	✓	✓
Amazon EC2 (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon EC2 (N. Virginia)	✓	⚠	⚠	✖	✖	✖	✓	✓	✓	✓
Amazon EMR (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon EMR (N. Virginia)	✓	✓	✓	⚠	⚠	⚠	✓	✓	✓	✓
Amazon Flexible Payments Service	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon Mechanical Turk (Requester)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon Mechanical Turk (Worker)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon RDS (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon RDS (N. Virginia)	✓	⚠	⚠	✖	✖	✖	✓	✓	✓	✓
Amazon Route 53	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon Simple Email Service (N. Virginia)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SNS (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SNS (N. Virginia)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SQS (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SQS (N. Virginia)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon S3 (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon S3 (US Standard)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SimpleDB (N. California)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon SimpleDB (N. Virginia)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Amazon VPC (N. Virginia)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	⚠	⚠	⚠	✓
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Amazon public cloud platform suffered a 3+ day outage in April, 2011

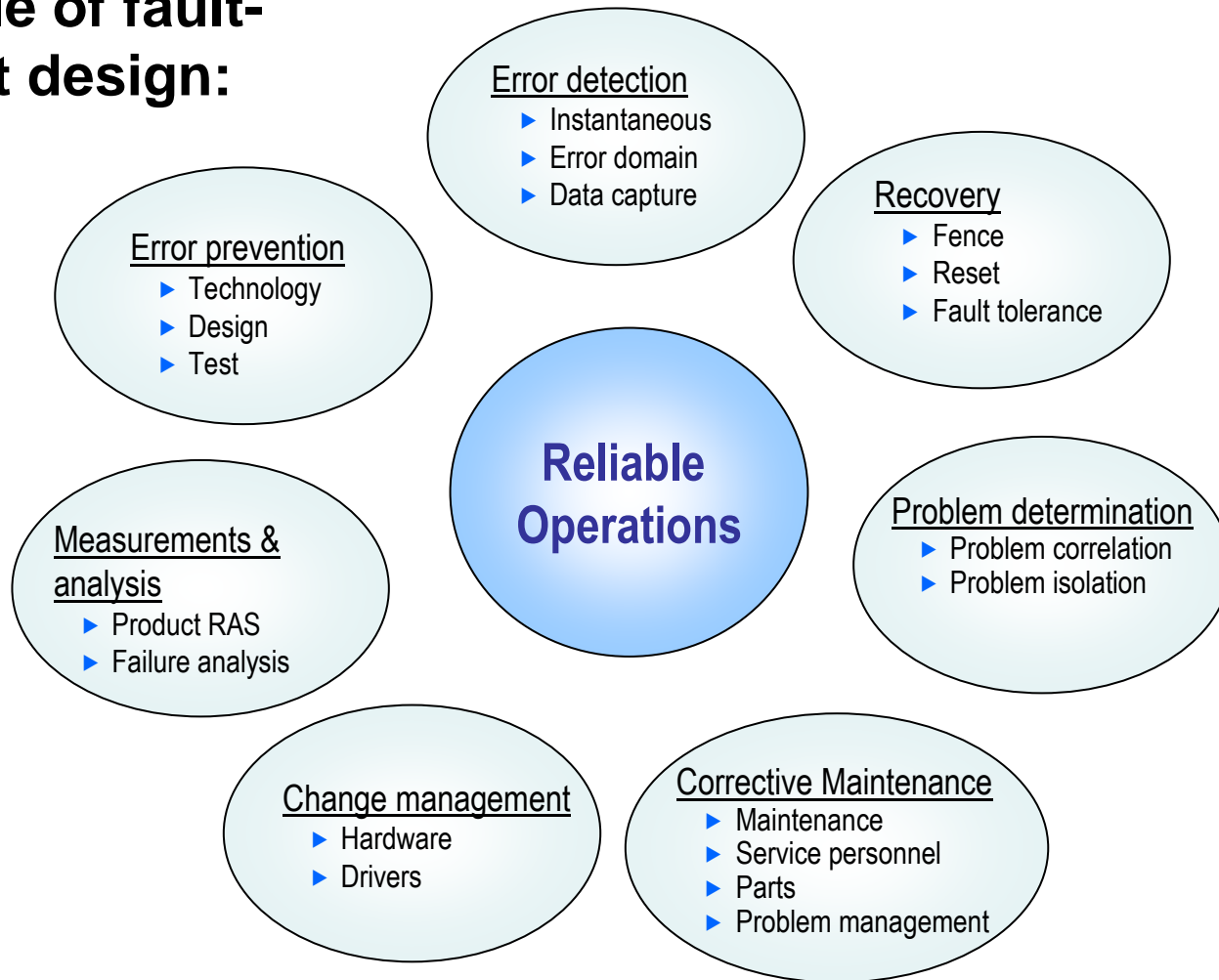
- Distributed architecture designed “for durability and availability”
- Yet a complex *single point of failure* negated the advantage of rapid replacement of failed resources
- Numerous customers suffered significant and unrecoverable data loss





# System z Has A History Of Continuous Improvements To Reliability And Serviceability

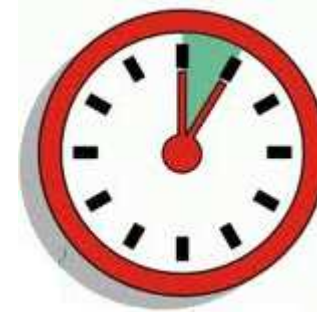
## Example of fault-tolerant design:





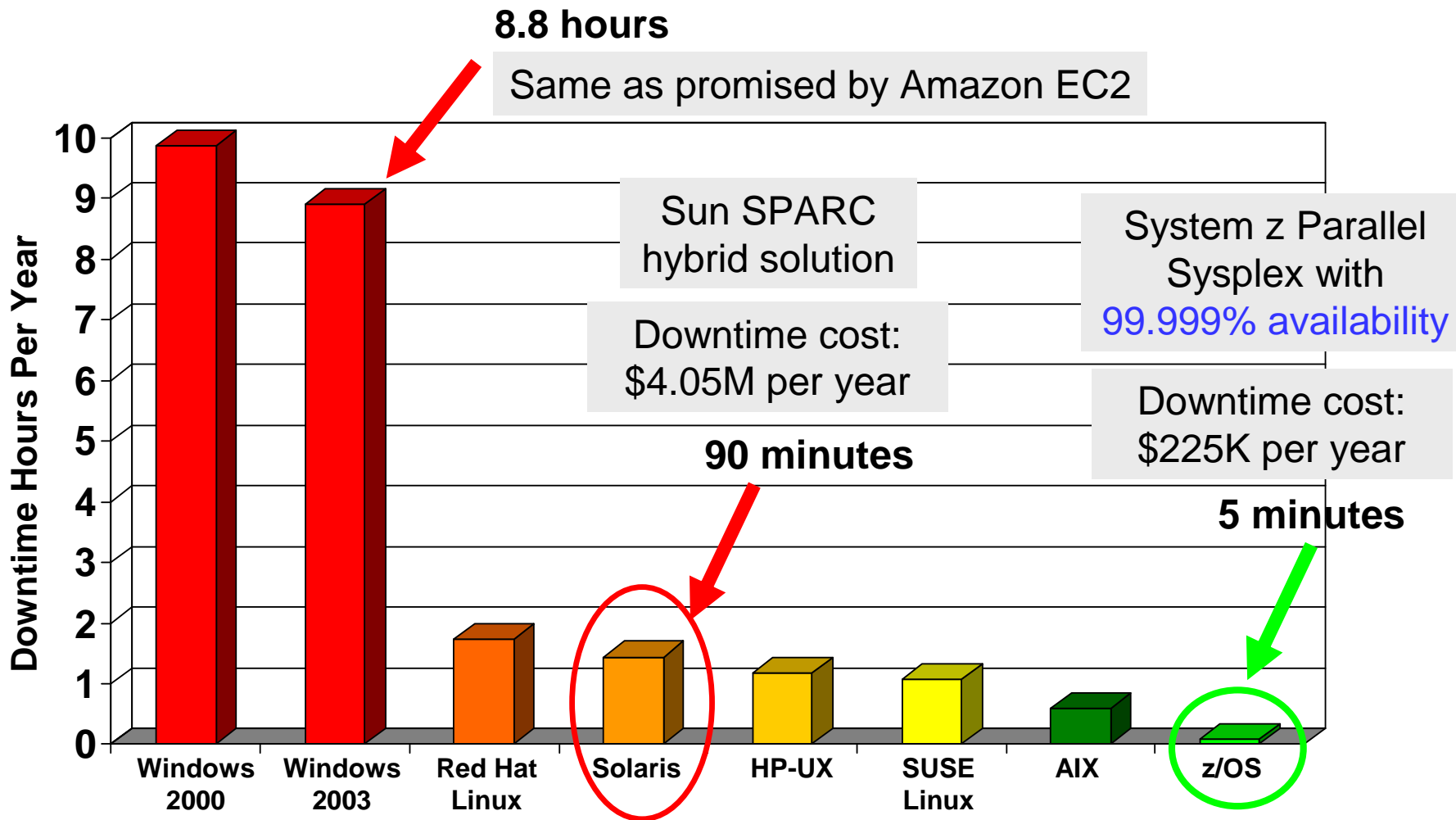
# z/OS Can Support Unprecedented Levels Of Availability

---



- Parallel Sysplex architecture designed for **99.999%** availability
  - ▶ Full redundancy yielding no single points of failure
    - All systems can have concurrent access to all critical applications and data
    - Automatic restart and recovery capabilities
  - ▶ Dynamic workload routing via z/OS Workload Manager and Sysplex Distributor
    - Work flow designed for best response times

# Result: zOS Delivers The Highest Availability And The Lowest Downtime Cost



Source: 2007-2008 Global Server Operating Systems Reliability Survey, Yankee Group, March 2008.

Source: IBM Internal Study

Source: Robert Frances Group, 2006 - Cost based on \$2.7M average revenue lost per hour of downtime

# zEnterprise Continues The Strategy Of Constant Improvements In Availability

---

## ■ RAIM Memory

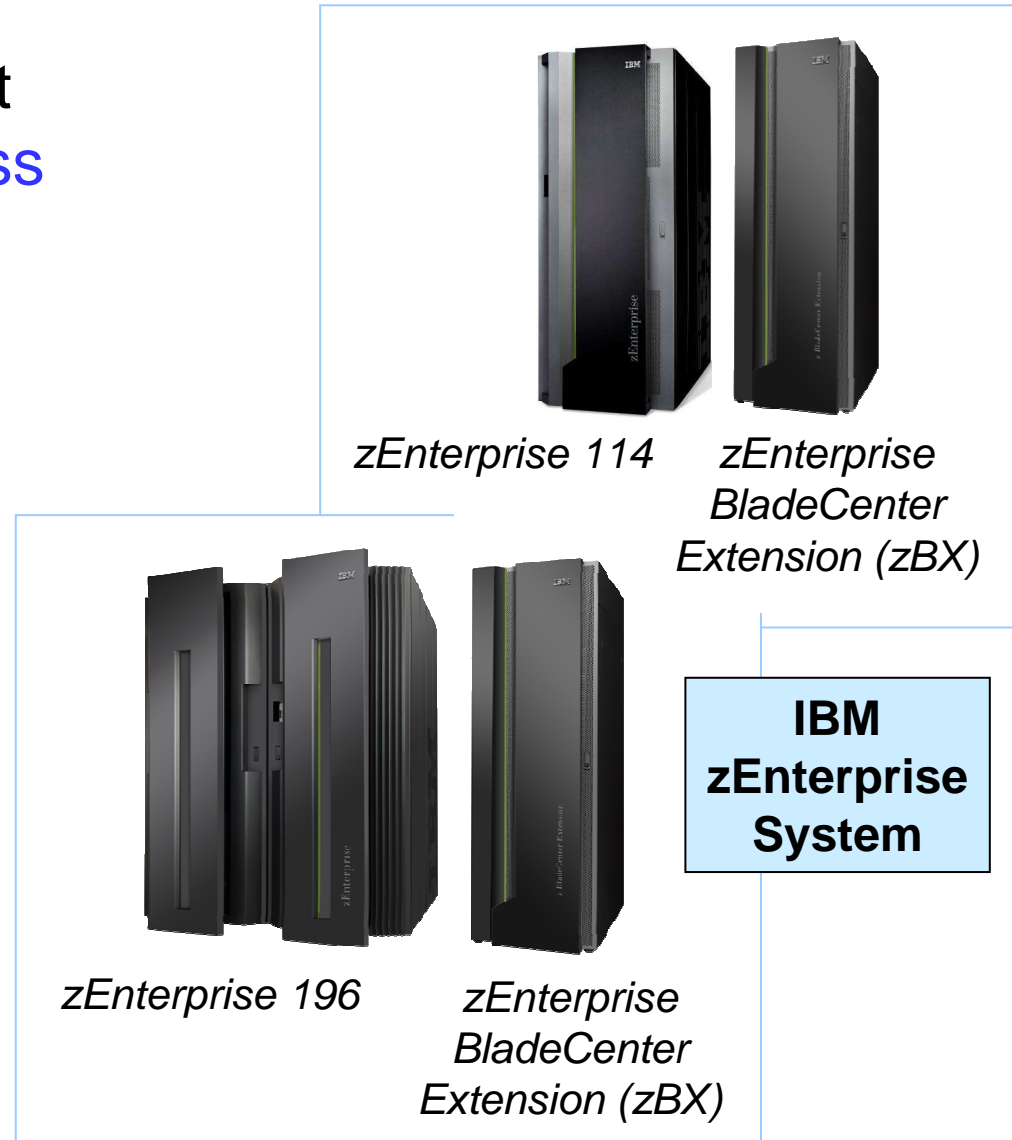
- ▶ Provides more redundancy to protect against additional failure modes
  - Protects DIMM level components such as ASIC, power regulators, clock, and board
  - Protects memory channel failures such as signal lines, control lines, and drivers/receivers on the MCM
  - More robust than ECC, and more cost effective than 100% memory mirroring
  - No performance penalty

## ■ Hot pluggable I/O drawer technology reduces planned down time

- ▶ Perform maintenance while the system keeps running

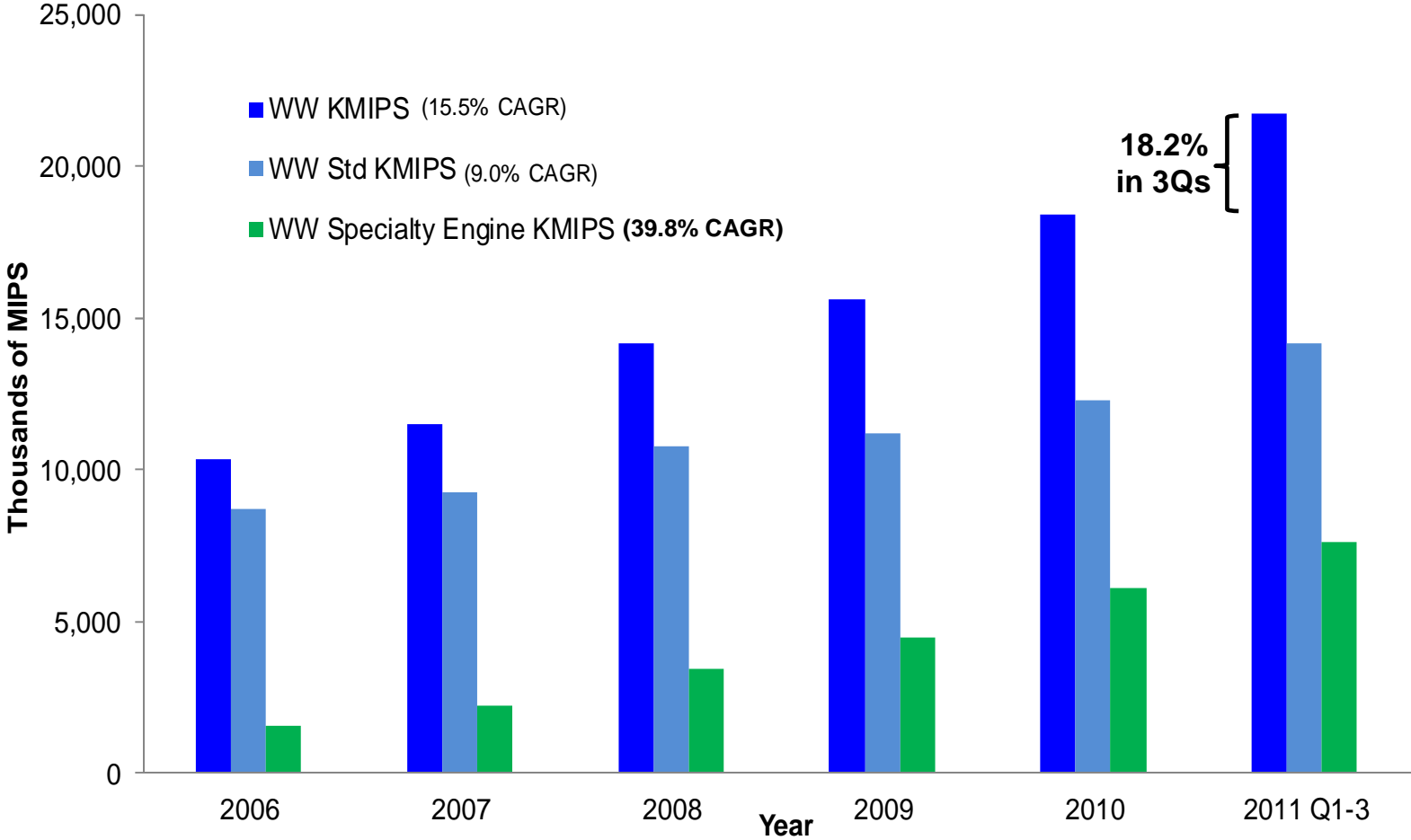
# zEnterprise Value Is Unsurpassed!

- zEnterprise is STILL best for handling **core business workloads**
- zEnterprise is more than a mainframe – it's a **complete multi-architecture platform**
- zEnterprise continues a tradition of **unmatched reliability** and **superior qualities of service**



# System z Continues Robust Growth ...

## WW System z MIPS Growth



# Especially In Growth Markets

## Growth Market System z MIPS Growth

