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 114

zEnterprise BladeCenter Extension (zBX)

zEnterprise 196

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IBM zEnterprise System

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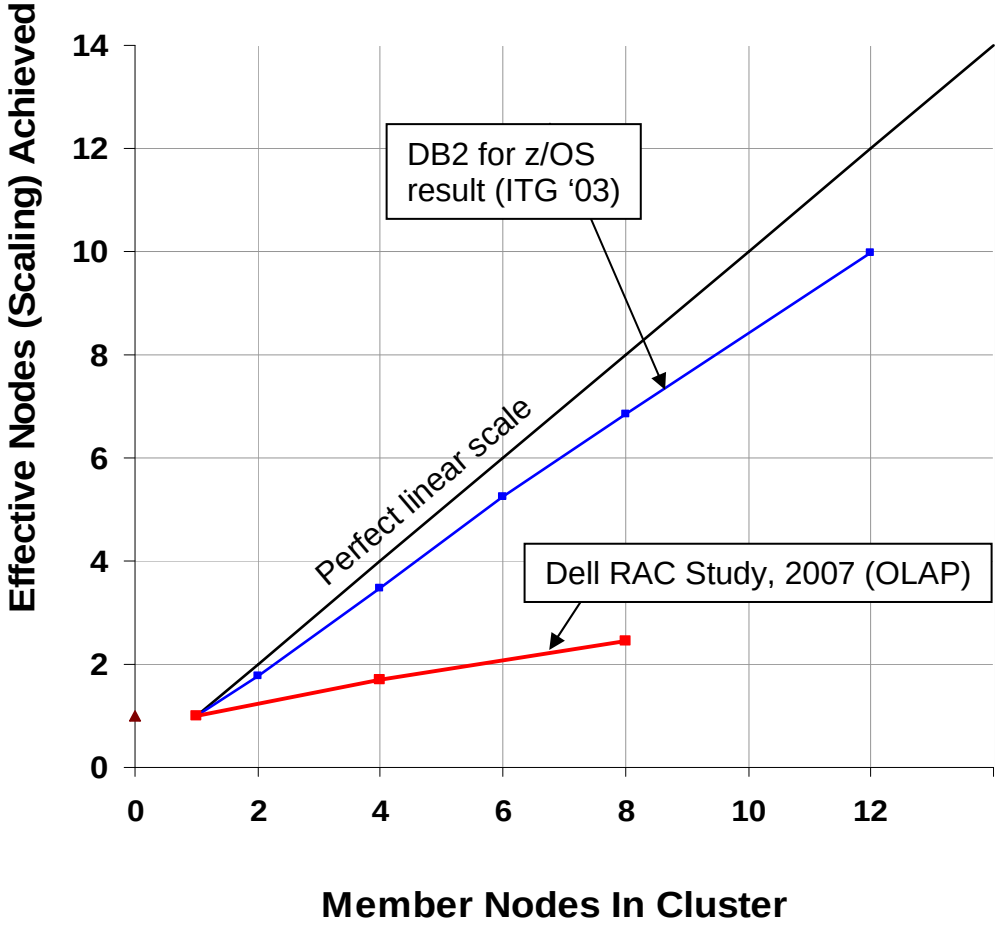
IBM zEnterprise System

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:

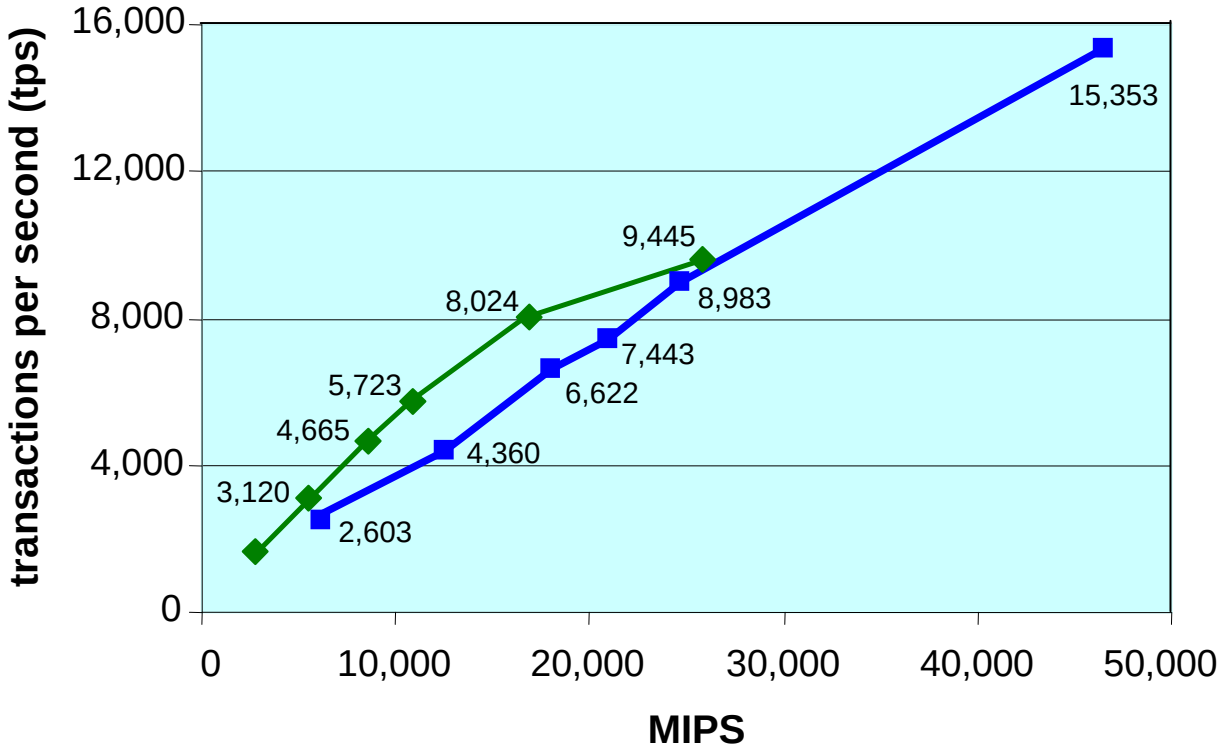


System z Is Ideal For High Transaction Workloads And Databases

- **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**[1]
  - **IBM System z and DB2**
  - **TCS BaNCS**
  - **9,445**[2] Transactions/second
  - **380** Million Accounts
  - IBM benchmark for customer

System z and BaNCS Online Banking Benchmarks



[1]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

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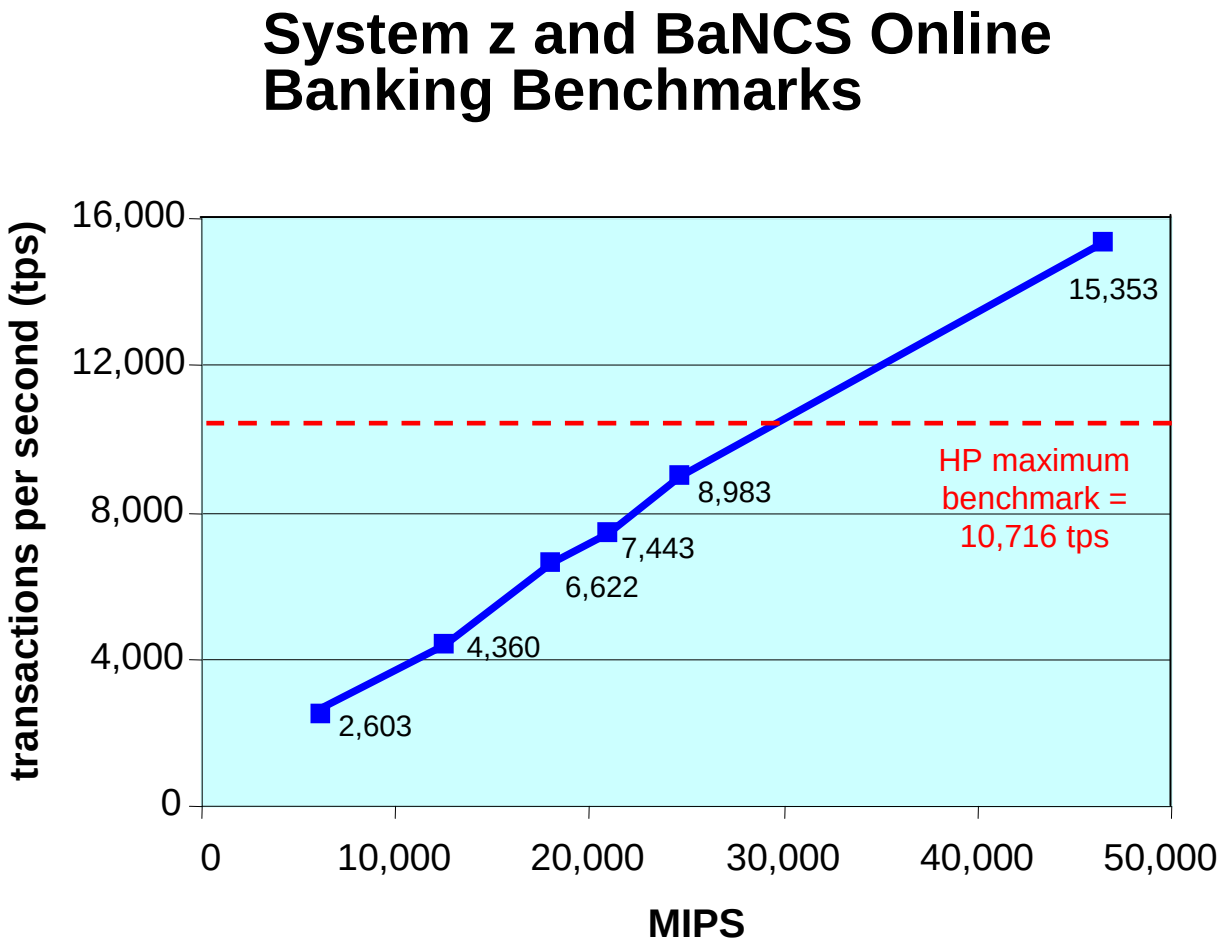
State Bank of India
- **HP Superdome**
- **TCS BaNCS**
- **10,716** Transactions/second
- **500** Million Accounts
- Largest banking benchmark performance claimed by HP



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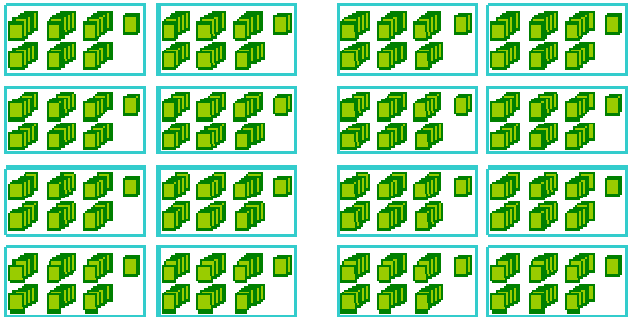
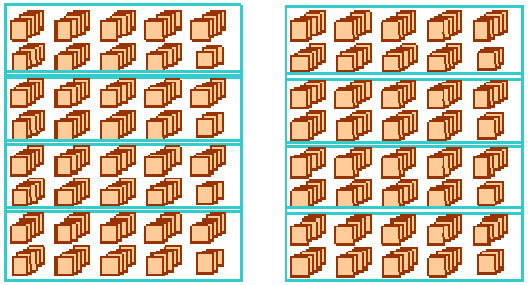
SOURCE:**Clement Report; http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA1-4027ENW.pdf Feb 2010

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

896 processors
3,668,608
Performance Units

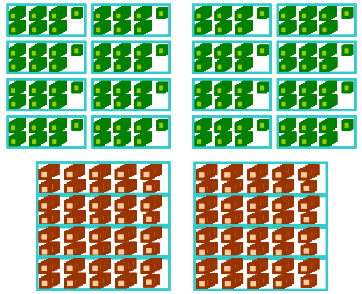
49 Processors
(41 GPs + 8 zIIPs)
38,270 MIPS

TCS BaNCS
1x z196-741

DB2 on z/OS

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

49% less

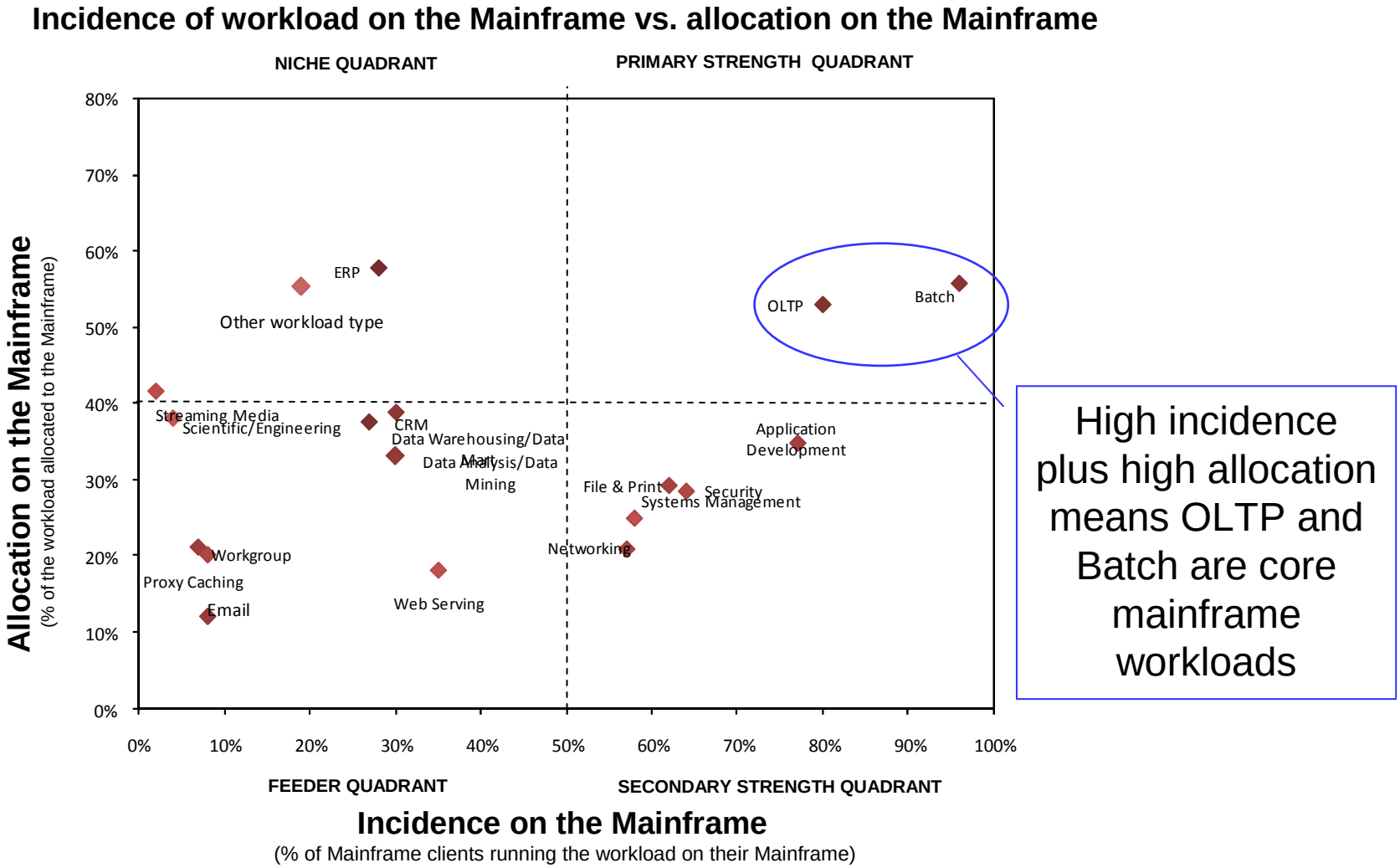
Total (5yr TCO) **$99M**

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

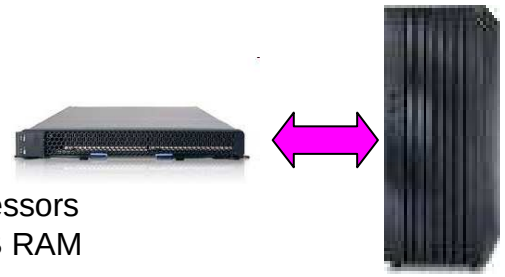
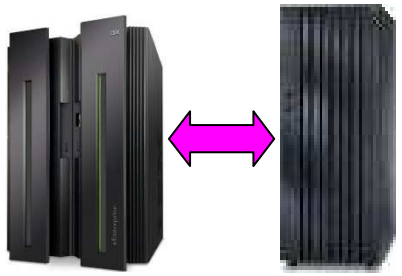
Excellent Scalability
Energy (kWh) 263K per yr

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



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

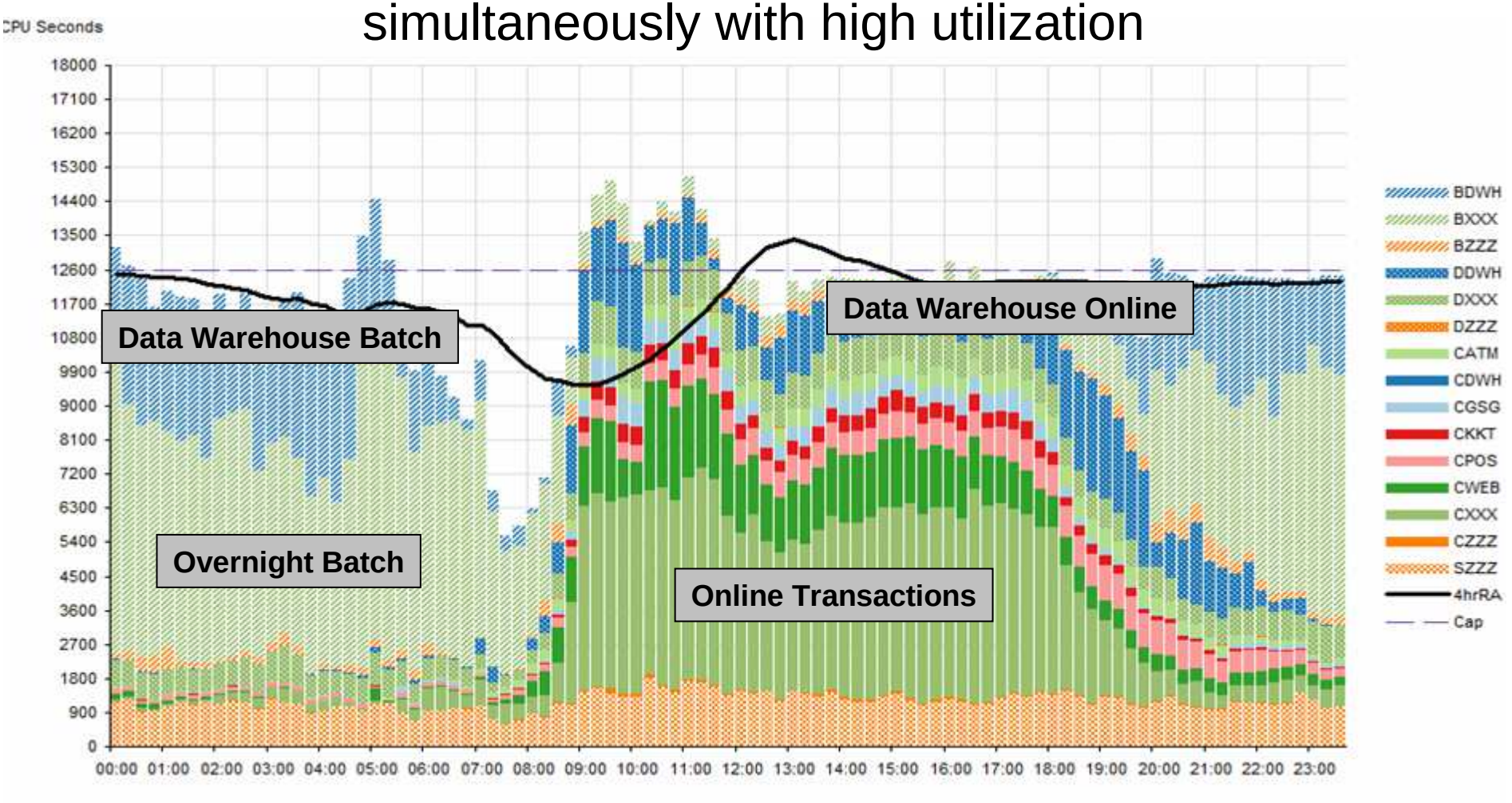
	Power PS701 + DS8300	zEnterprise + DS8300
	 8 processors 128 GB RAM	8 processors 256 GB RAM 
SORT *Job: Sort a 3 GB transaction file – Repetitions: 300*		
Sorting Total Elapsed	6,900 secs	860 secs
Concurrency	20	45
Bytes Per Sec	280 MB	2.25 GB
MERGE *Job: Merge 30 sorted files into a 90 GB master file – Repetitions: 10*		
Merging Total Elapsed	7,920 secs	1,218 secs
Concurrency	10	10
Bytes Per Sec	244 MB	1.58 GB

Batch window reduced by 89% on zEnterprise

Source: IBM Internal Study. Results may vary based on customer workload profiles/characteristics.

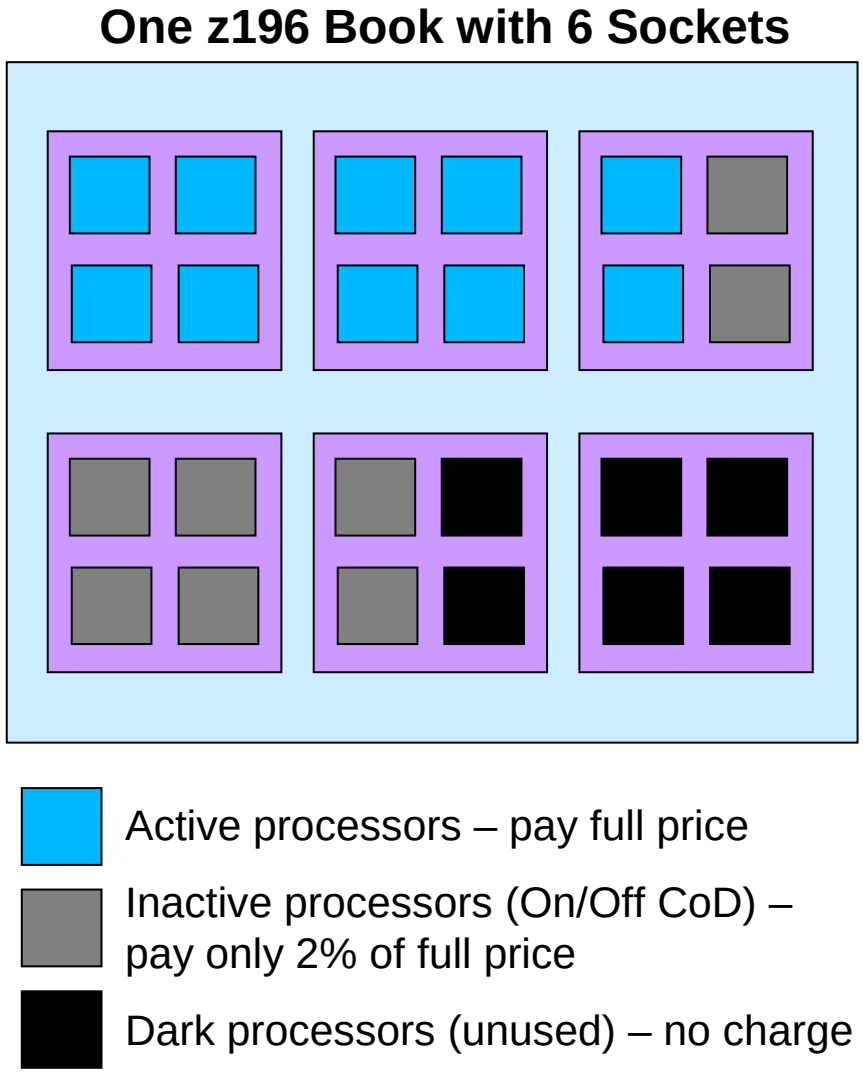
System z Platform Easily Handles Workload Peaks

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



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)

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

4 HP Proliant DL 980 G7 servers

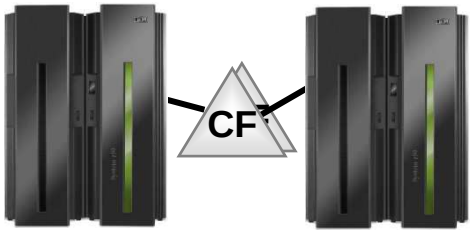
Production

Development

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
Total (5yr TCO)	**$150,270,688**

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
Total (5yr TCO)	**$52,456,754**

65% less

IBM Confidential

Source: Typical IBM Eagle TCO Study
For A Financial Services Customer

Data Shows Mainframe-Biased Businesses Have Reduced Costs

IT cost of goods per industry:

Industry	Measure	Avg IT Cost of Goods	MF Biased	Server Biased	%Improve
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

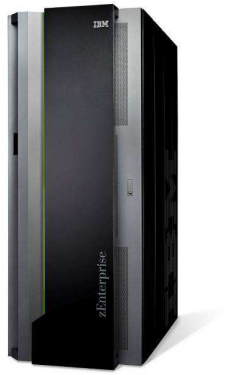
zEnterprise 196 (z196)

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

• 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

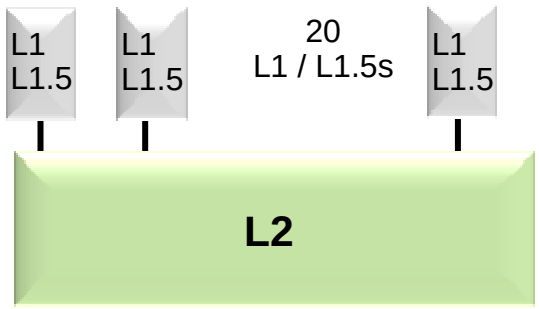


	z10 Business Class		***zEnterprise 114 (z114)***
Clock speed	3.5 GHz	→	**3.8 GHz**
Total Processors	10 (0 spare)	→	**M05: 5 (0 spare)** **M10:10 (2 spare)**
Total Memory	256 GB	→	**M05: 128 GB** **M10: 256 GB**
*Performance***	673 MIPS	→	**782 MIPS**
*Total Capacity**	2,760 MIPS	→	**3,139 MIPS**

• Based on LSPR ratings for fully configured system
** Single process performance

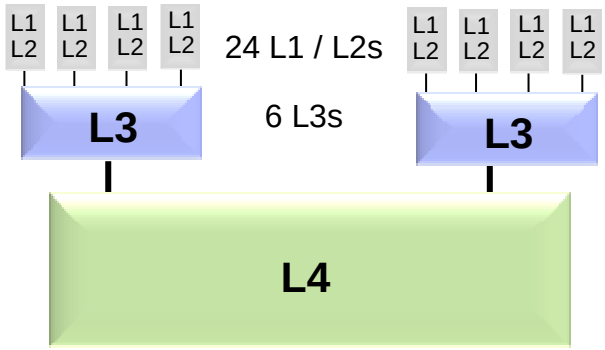
z196 Also Has 2.4x More On-Chip Cache As z10 EC

One z10 EC MCM



L1:	Private per core 64K I + 128K D
L1.5	Private per core 3MB I+D
L2	On SC chips (2) Shared by all PUs on MCM 24MB per SC chip 48MB per MCM

One z196 MCM

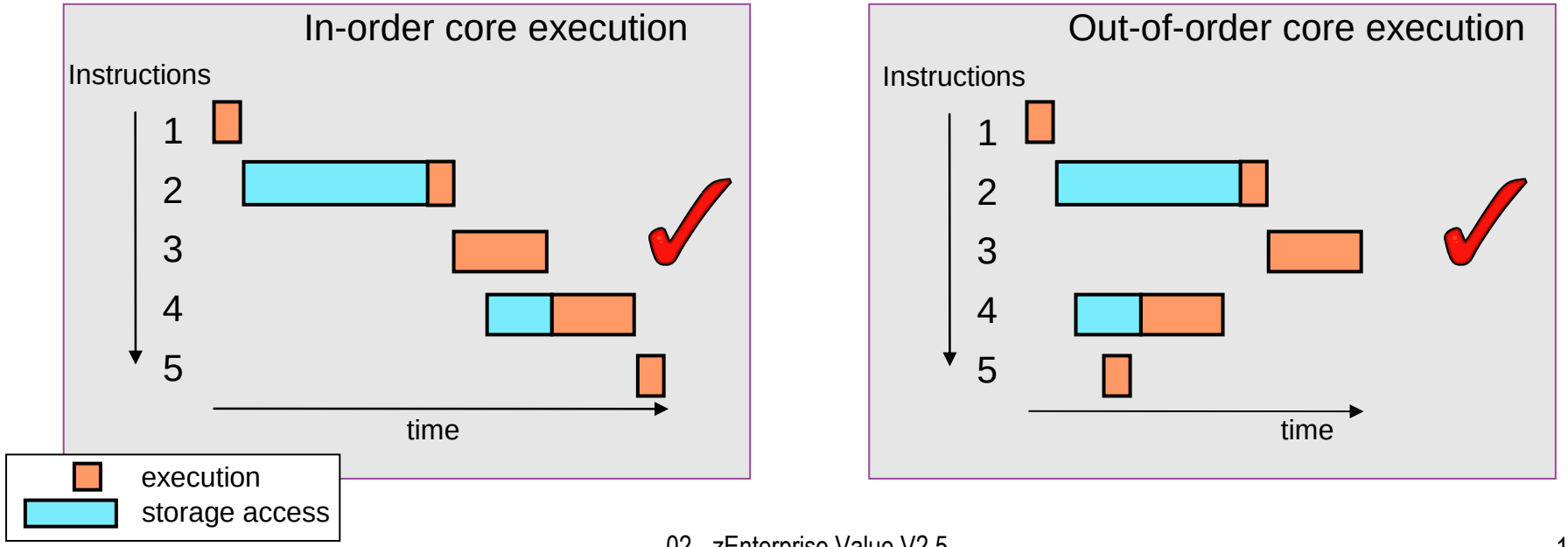


L1:	Private, in core 64K I + 128K D
L2	Private, adjacent to core 1.5MB I+D
L3	Shared by all four cores 24MB eDRAM
L4	On SC chip (2) Shared by all PUs on MCM 96MB eDRAM per SC chip 192MB eDRAM per MCM

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

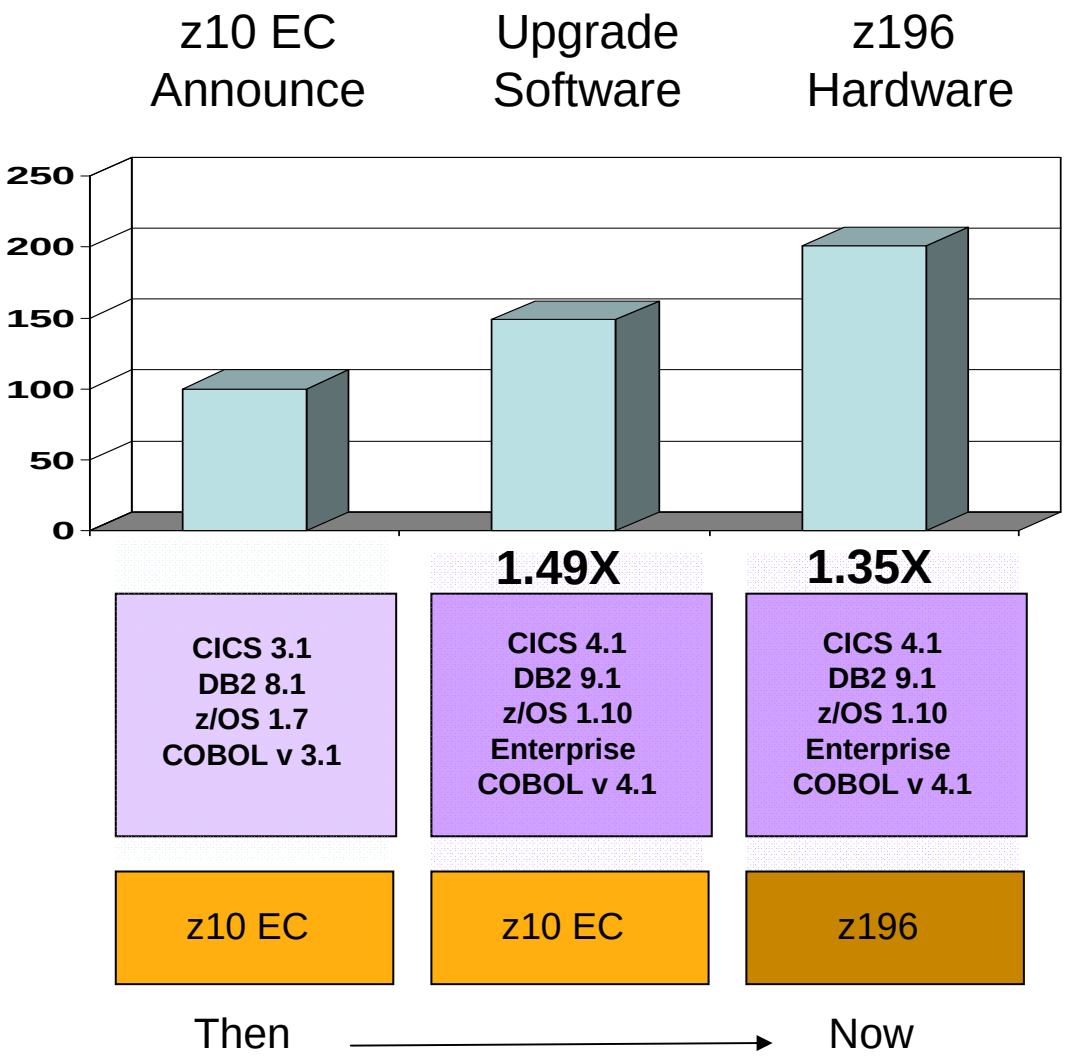
* Customer average for z10 EC CEC is 9 GP processors

** 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

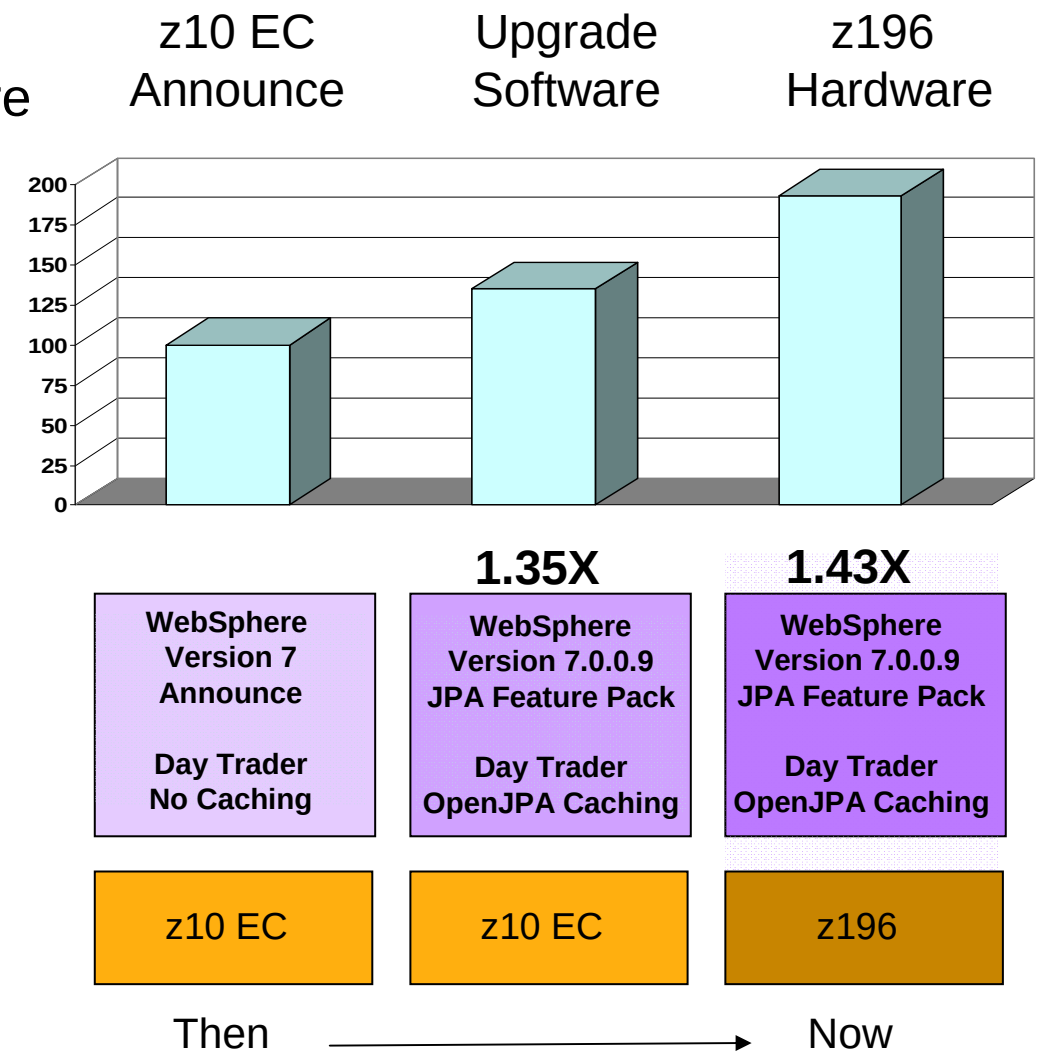
- Upgrade CICS/DB2 stack produces 1.49 times performance improvement on same z10 hardware
- Move to z196 hardware produces 1.35 times performance improvement
- From then to now – **2.01** times performance improvement



WebSphere Optimizations For z/OS – From Then To Now

Continued investment to optimize WebSphere software for z/OS environment

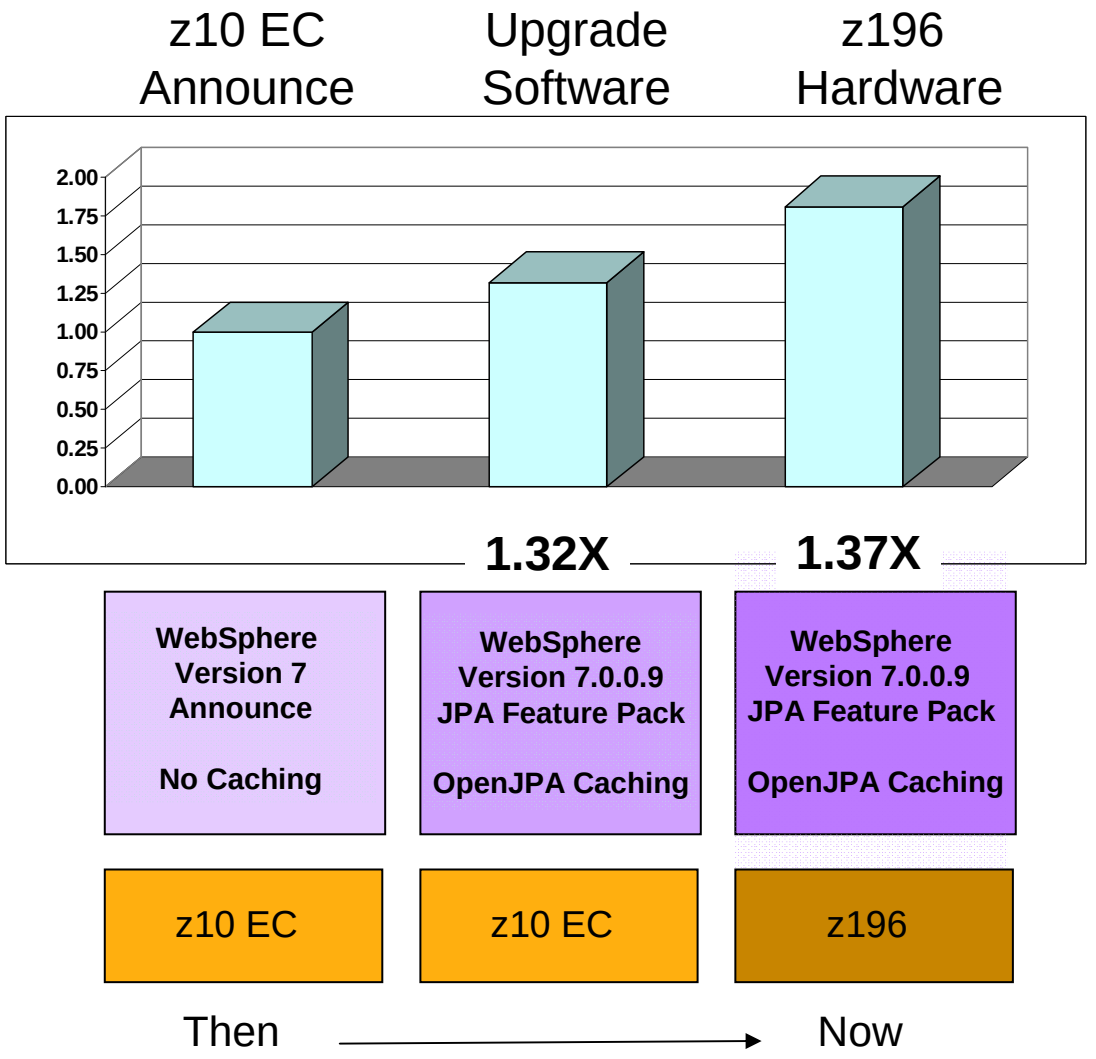
- 1.35 times performance improvement for JPA 2.0 applications that exploit the OpenJPA caching facilities available in the WebSphere Version 7 JPA Feature Pack.
- Move to z196 hardware produces 1.43 times performance improvement
- From then to now – **1.93** times performance improvement



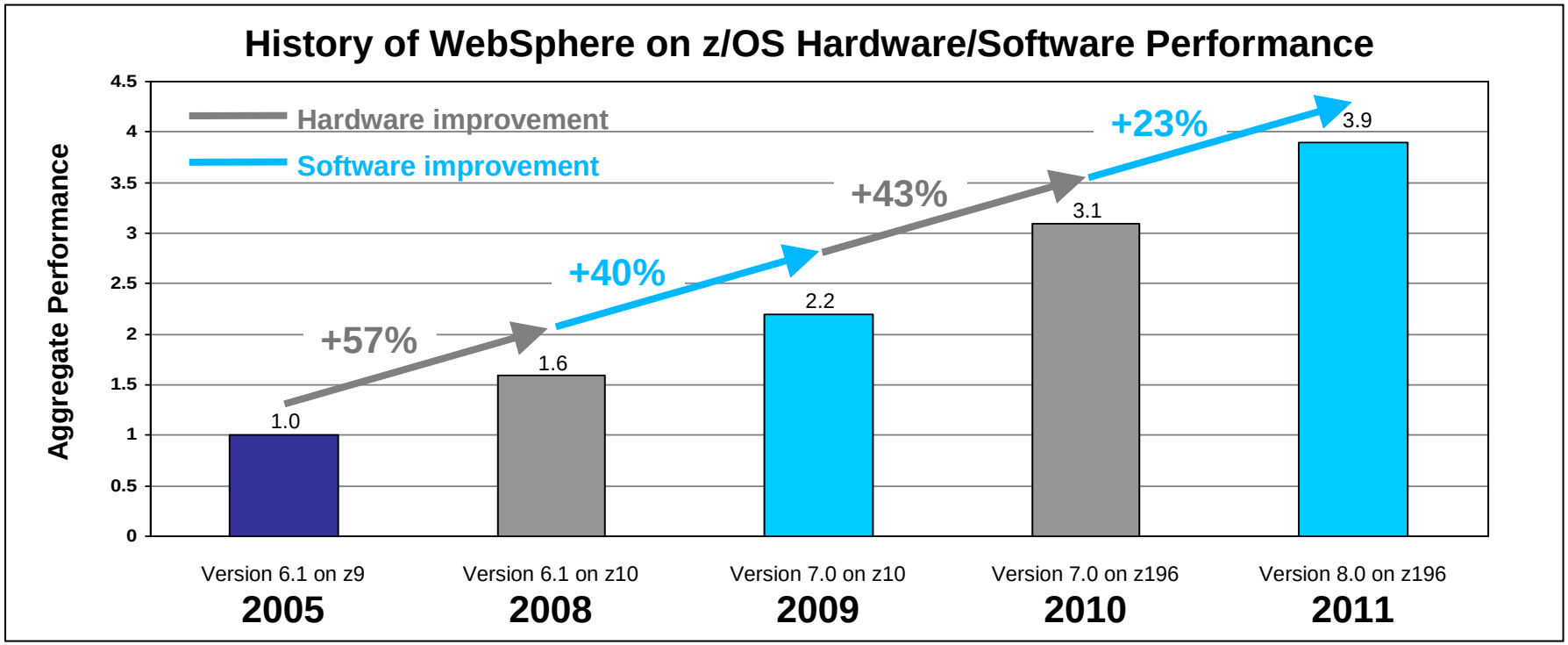
WebSphere Optimizations For Linux

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

Data measurements done using DayTrader EJB workload.

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zEnterprise 114

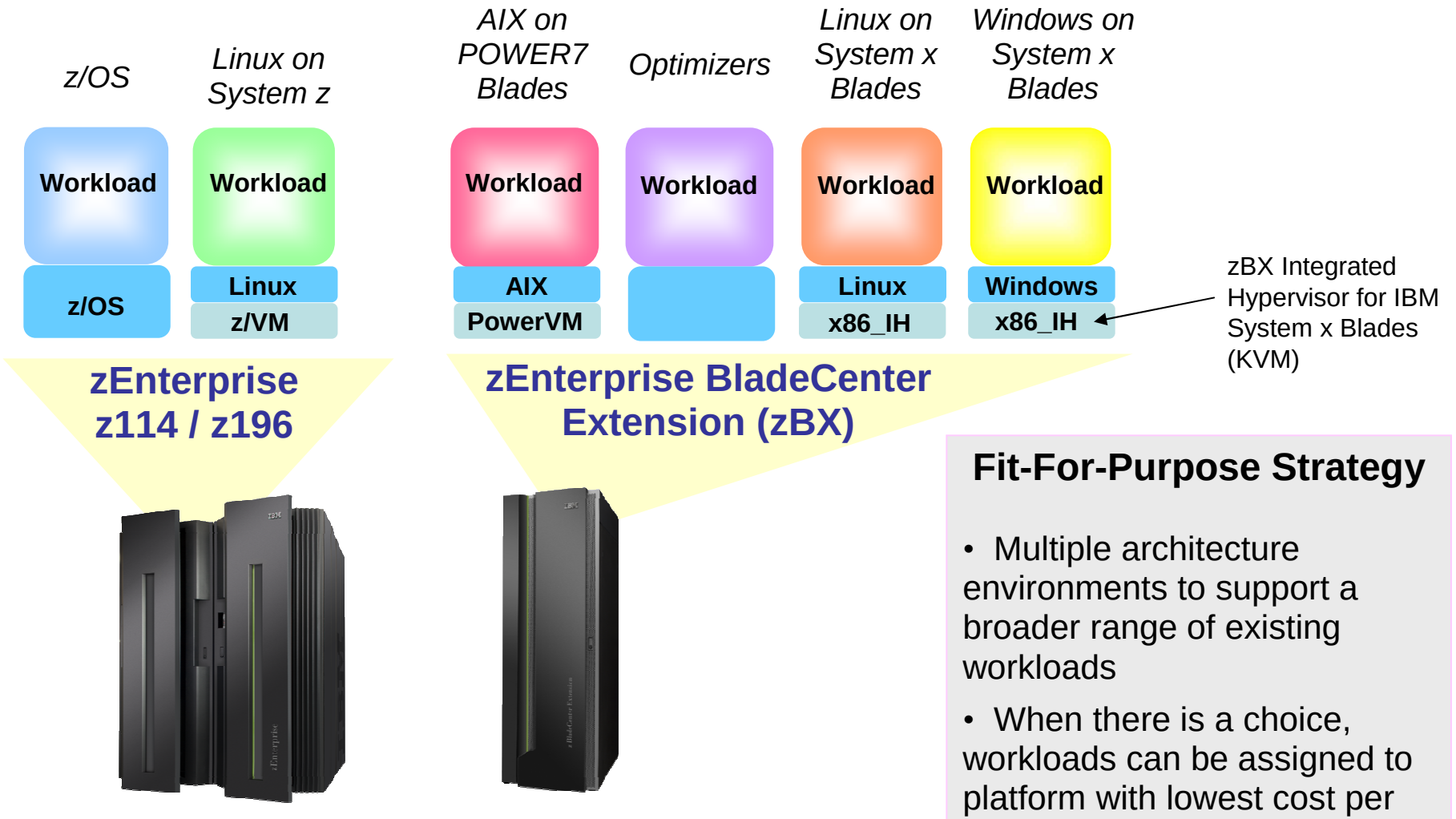
zEnterprise BladeCenter Extension (zBX)

zEnterprise 196

zEnterprise BladeCenter Extension (zBX)

IBM zEnterprise System

zEnterprise Has Different Environments For Different Workload Requirements

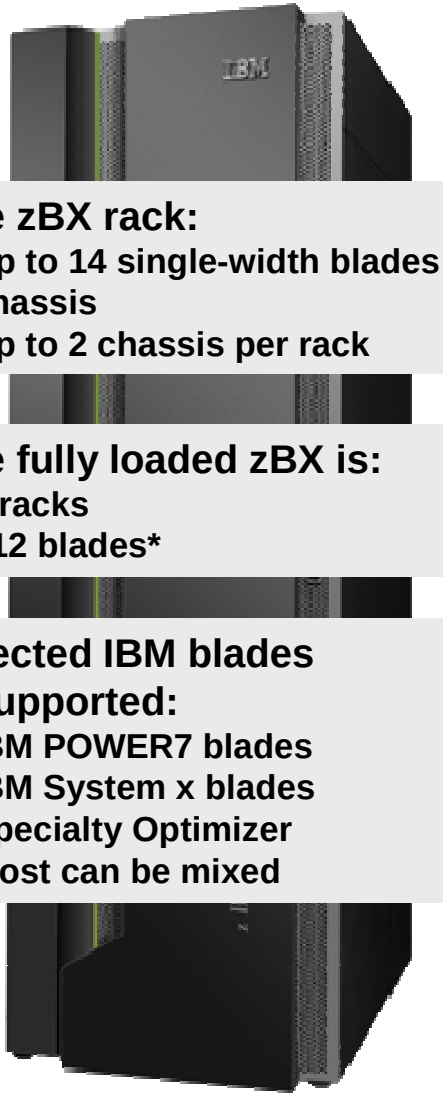


Fit-For-Purpose Strategy

- Multiple architecture environments to support a broader range of existing workloads
- When there is a choice, workloads can be assigned to platform with lowest cost per workload

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**

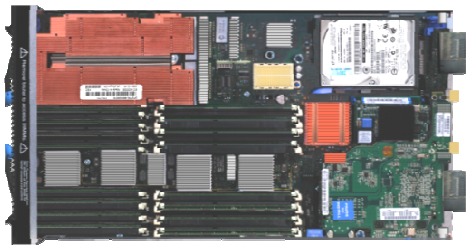
One fully loaded zBX is:
- **4 racks**
- **112 blades***

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

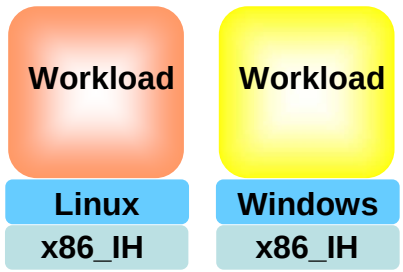
AIX on POWER7 Blades



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

Linux on System x Blades

Windows on System x Blades



- 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

- No MIPS or MSU rating for zBX software

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
…

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**

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!

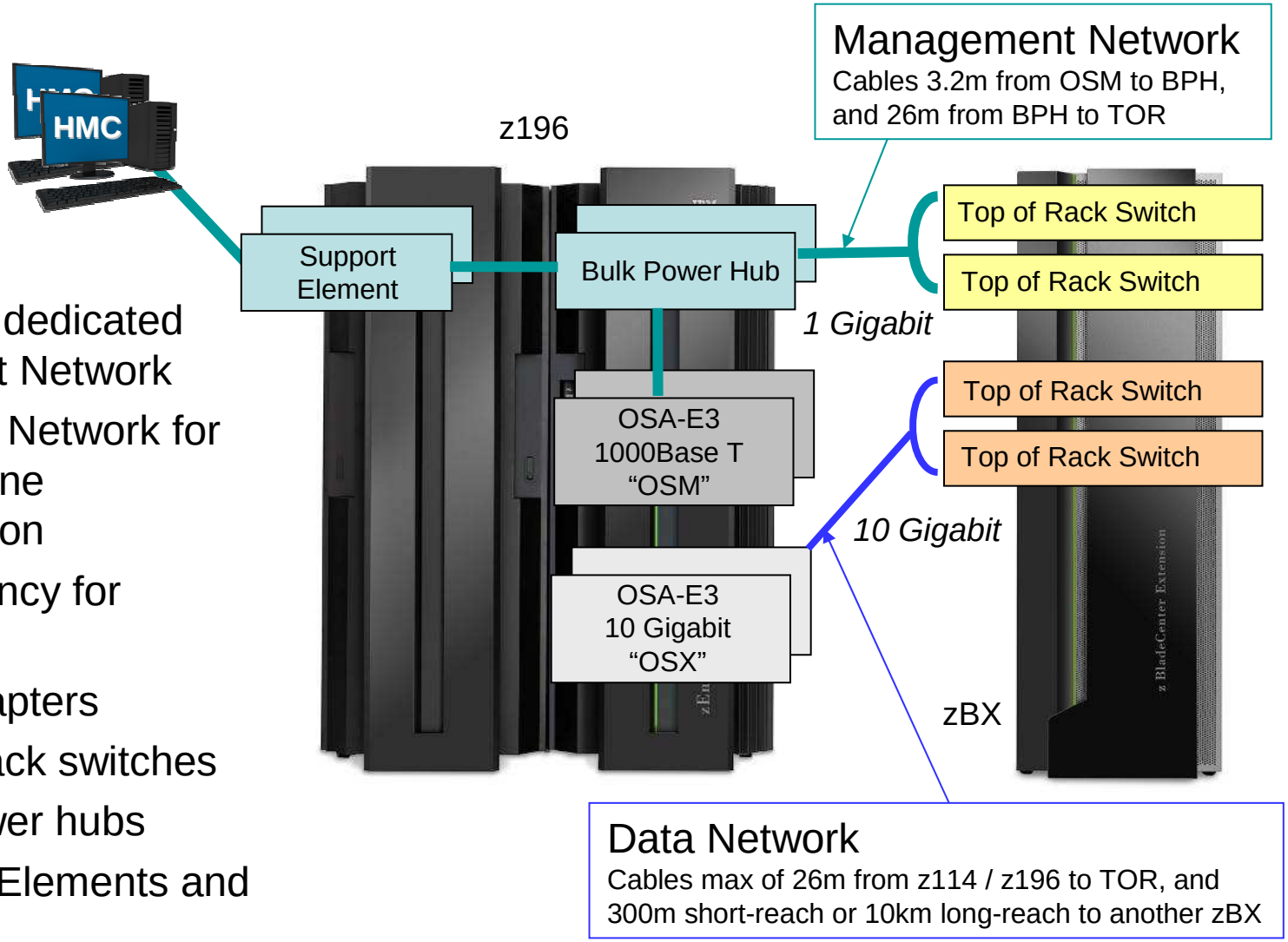
IBM

zManager Provides Platform And Resource Management Across zEnterprise Environments

Process	Typical Distributed Management Practices	zManager
Asset Management	■ Discover assets with ad hoc methods ■ Manual entitlement management	■ Automated discovery and management of entitlement assets
Deployment Management	■ Manually configure hypervisor and build networks	■ Automated deployment of hypervisor and attachment to integrated networks
Security Management	■ Different ways to manage administrator access	■ Centralized, fine-grained administrator access management
Change Management	■ No visibility into impact of changes	■ Track dependencies for change impact
Capacity and Performance Management	■ No end-to-end transaction monitoring ■ Manually adjust CPU resources to meet changing workload demands	■ End-to-end transaction monitoring to isolate issues ■ Automatic CPU resource adjustments to meet changing workload demands

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

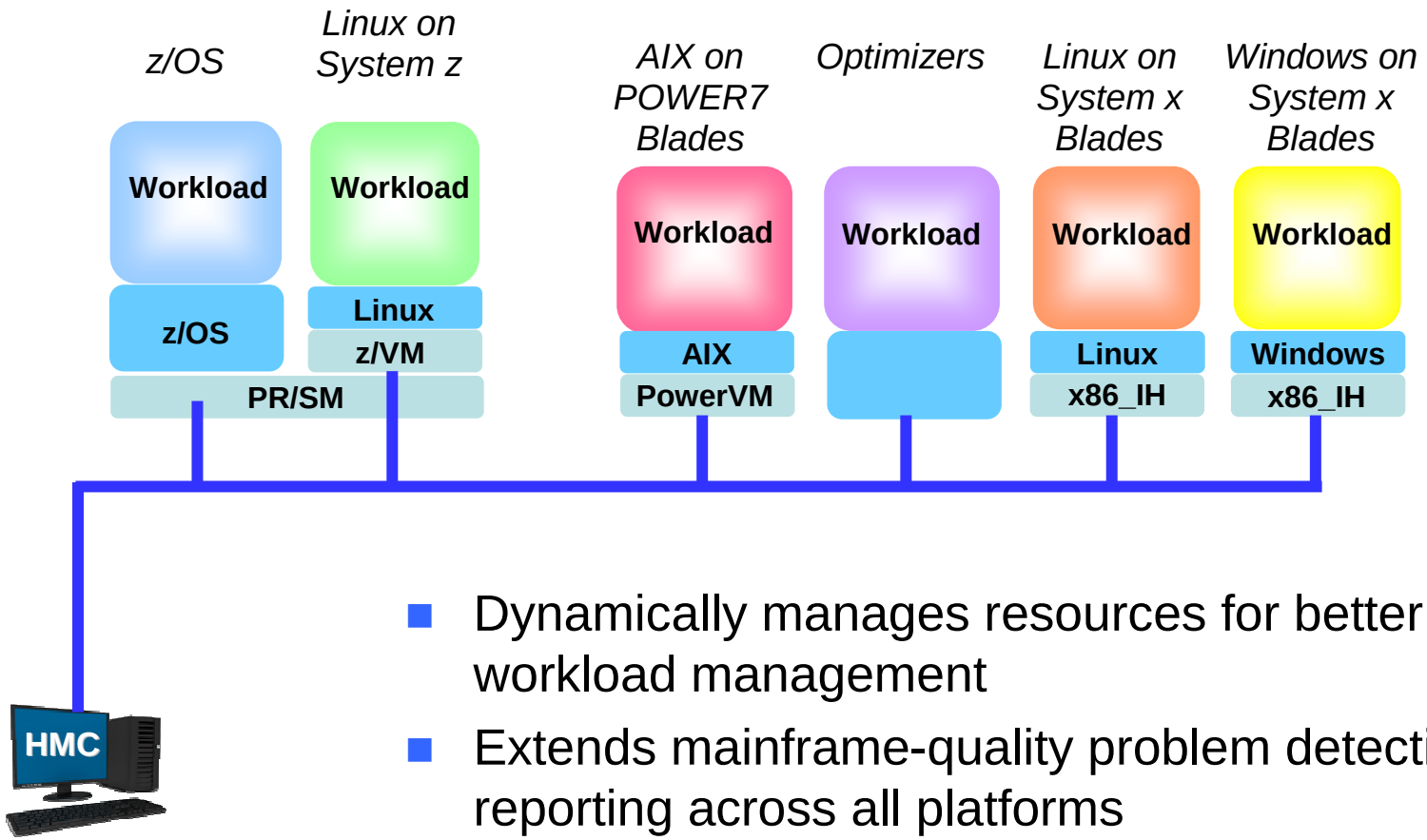


zEnterprise Network Simplification And Security

- "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"

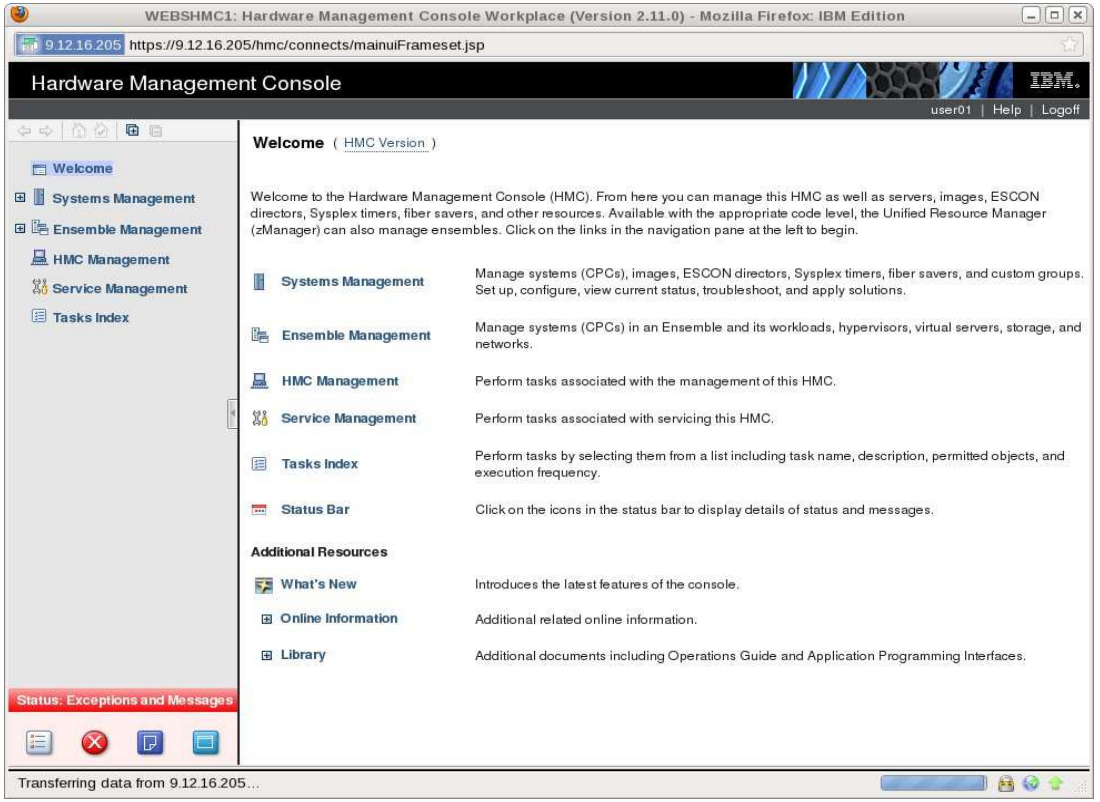
- Security
  - Management Network:
    - Tightly restricted to zManager use only
  - Data Network:
    - Accessible only by authorized virtual machines
  - Logical security via virtualization
  - zManager includes strict "role-based" access control
  - No need for additional encryption or firewall

zManager Owns The Private Management Network For Hypervisor Communications



- Dynamically manages resources for better workload management
- Extends mainframe-quality problem detection and reporting across all platforms
- Monitors system-wide energy efficiency

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*
Asset Management	■ Automated discovery and management of entitlement	**9%**
Deployment Management	■ Automated deployment of hypervisors and virtual networks	**33%**
Capacity and Performance Management	■ Automatic resource adjustments to meet changing workload demands	**52%**
Security Management	■ Centralized, fine-grained administrator access	**20%**
Change Management	■ Dependency tracking across platform for change impact	**41%**

*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

zEnterprise 114

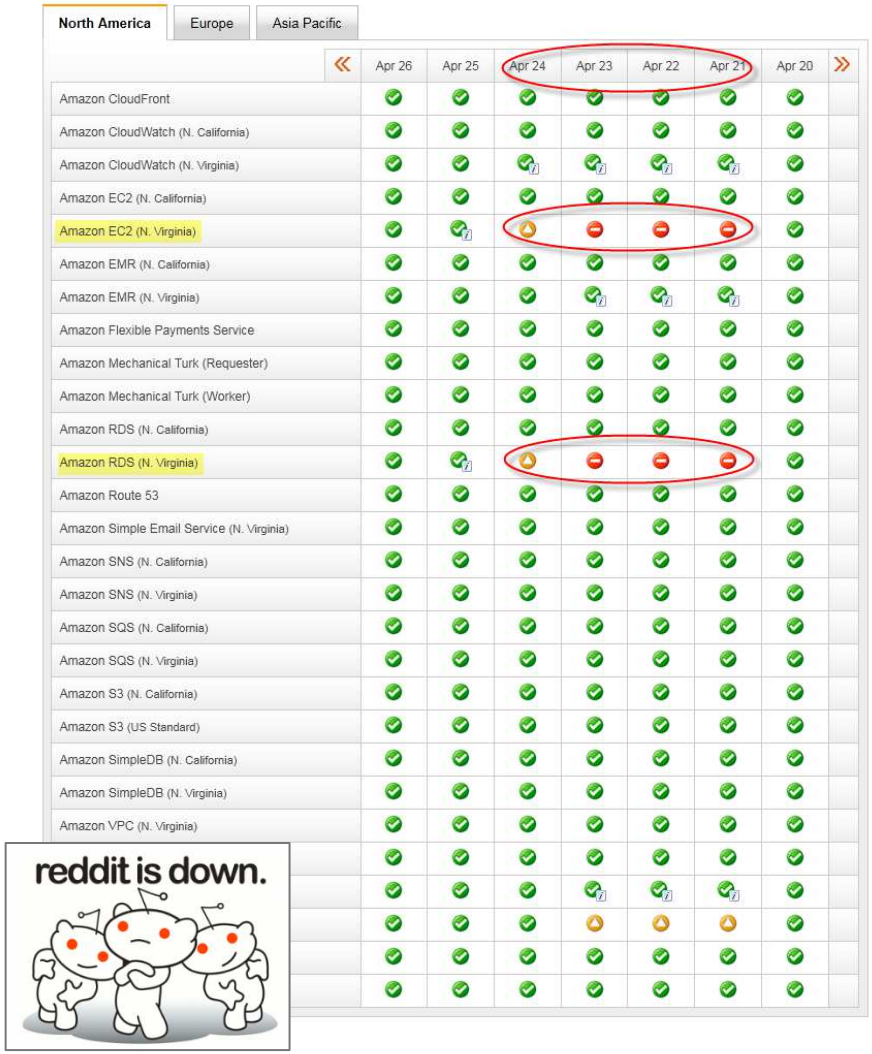
zEnterprise BladeCenter Extension (zBX)

zEnterprise 196

zEnterprise BladeCenter Extension (zBX)

IBM zEnterprise System

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



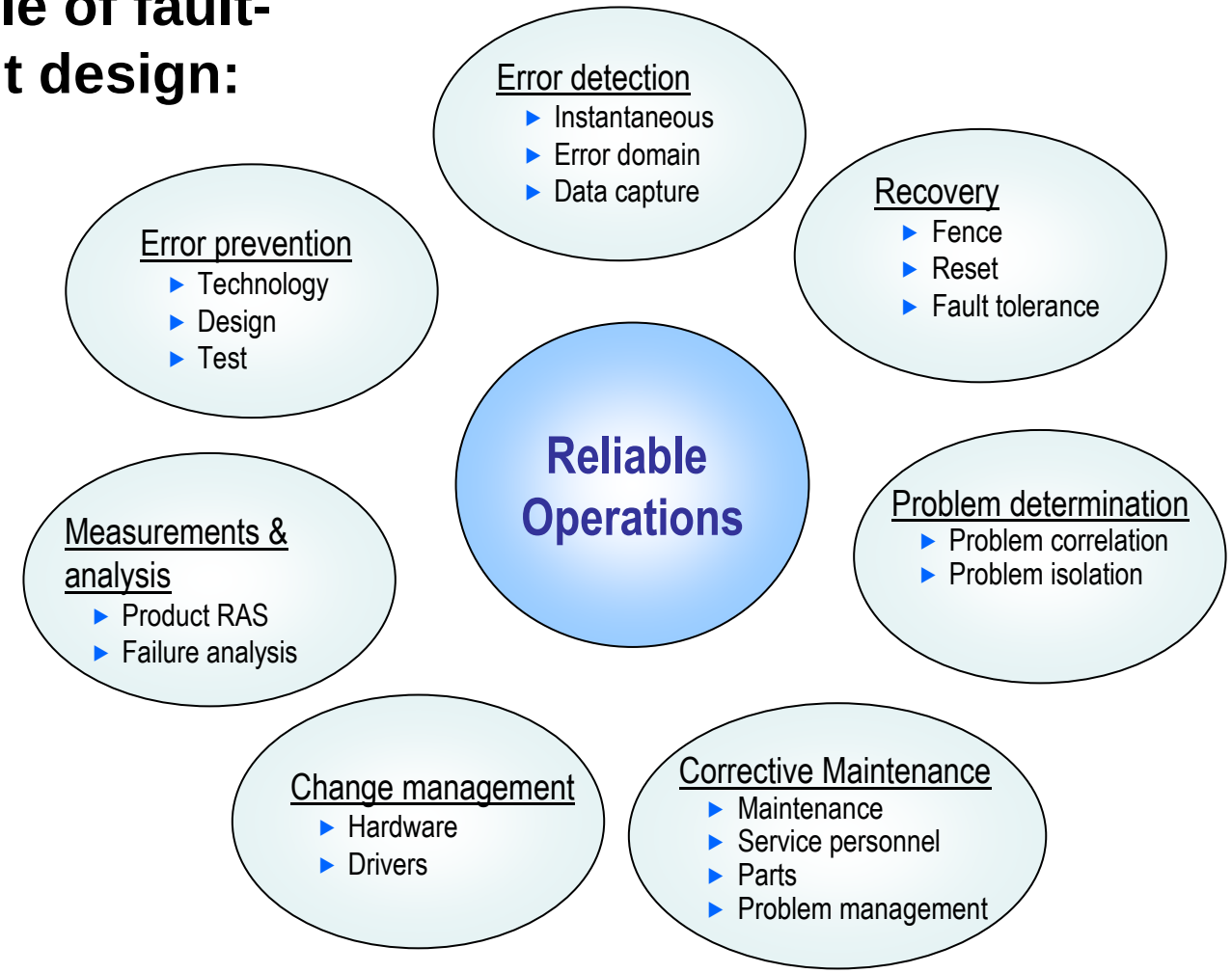
Amazon public cloud platform suffered a 3+ day outage in April, 2011

- 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

Source: http://status.aws.amazon.com

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

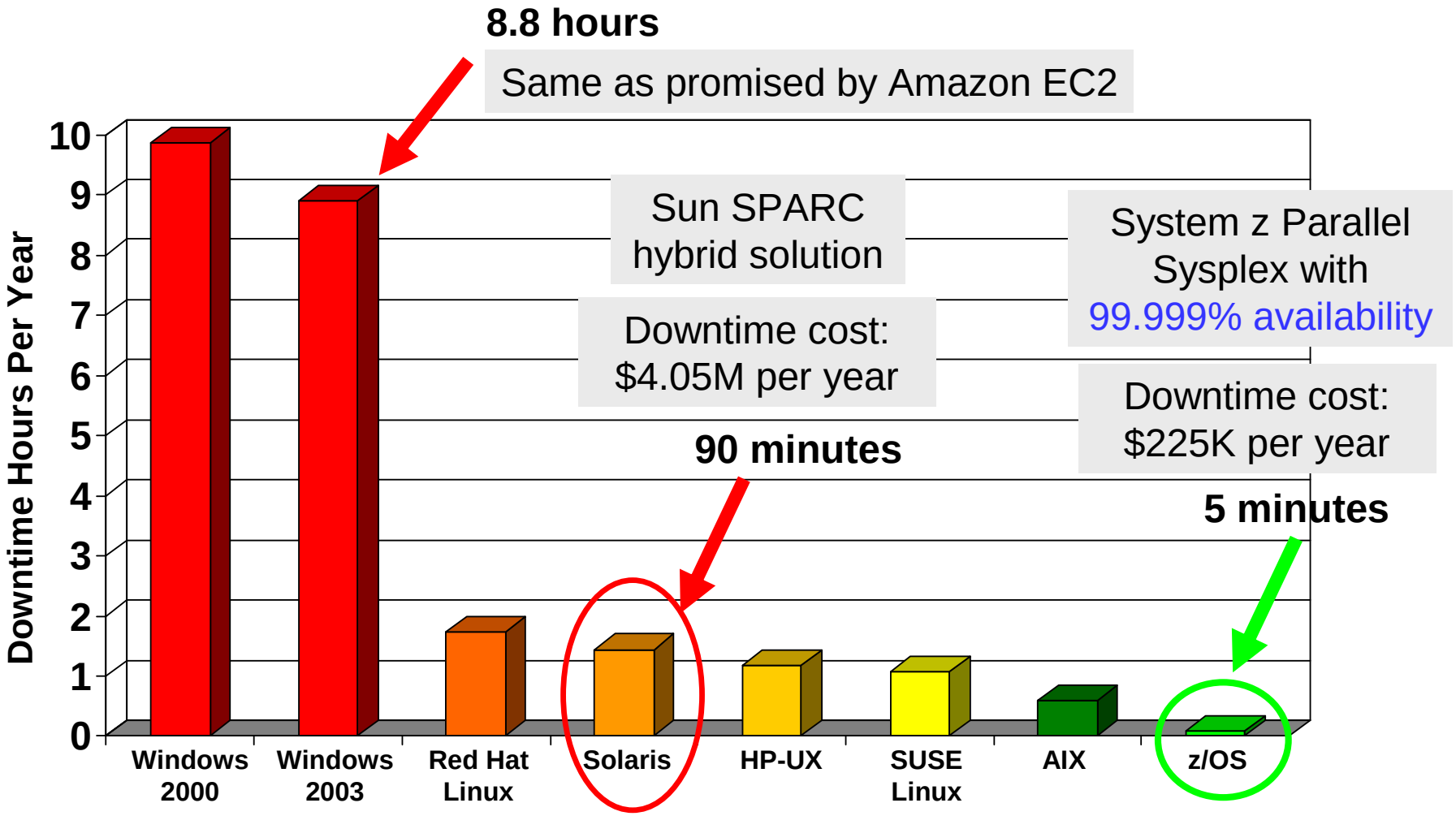
Example of fault-tolerant design:



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

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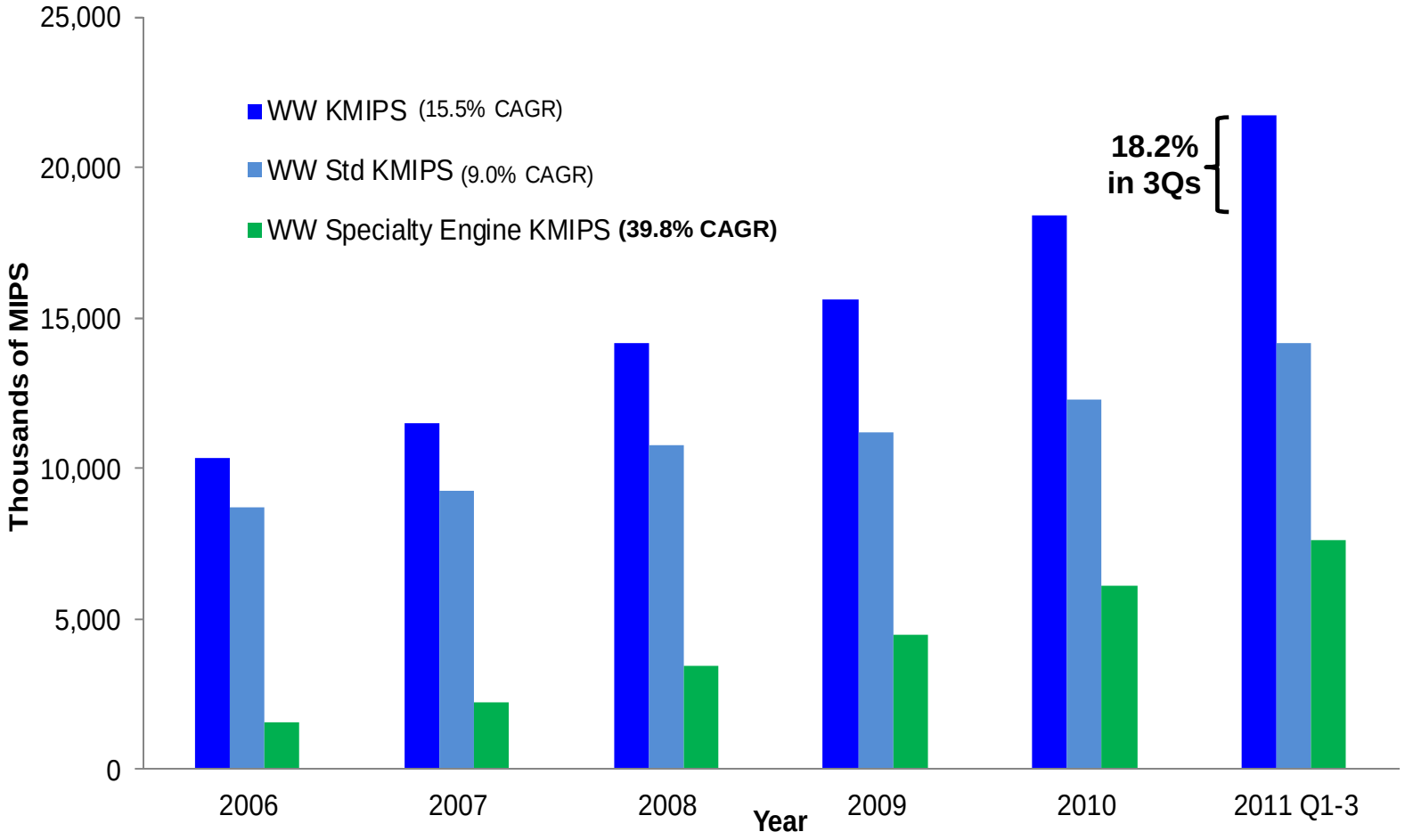
IBM zEnterprise System

System z Continues Robust Growth …

WW System z MIPS Growth



Especially In Growth Markets

Growth Market System z MIPS Growth