IBM System z Technology Summit

zEnterprise – The First System Of Systems

The Economics Of Workload Optimization

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27th Jan 2011

zEnterprise Is The Unification Of The Best Of Mainframe And Blade Technologies

A system of systems that unifies IT for predictable service delivery

NEW

IBM zEnterprise 196 (z196)

- Optimized to host large-scale database, transaction, and mission-critical applications
- The most efficient platform for large-scale Linux consolidation
- Capable of massive scale-up
- New easy-to-use z/OS V1.12

zEnterprise Unified Resource Manager

- Unifies management of resources, extending IBM System z qualities of service end-to-end across workloads
- Part of the IBM Systems Director family, provides platform, hardware and workload management

zEnterprise BladeCenter Extension (zBX)

- Selected IBM POWER7 blades and IBM System x Blades* for tens of thousands of AIX and Linux applications
- High-performance optimizers and appliances to accelerate time to insight and reduce cost
- Dedicated high-performance private network

* All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represents goals and objectives only.

The IBM zEnterprise System
Delivers Greater Simplification, Flexibility, And Value

- The IBM zEnterprise 196 is the world's fastest and most scalable enterprise system

- Delivers lower cost acquisition and operation than a 'one-size-fits-all' approach

- Enables a mixed set of workloads to be deployed on best fit technologies

- Extends the reach of System z qualities of service

- Improves service through tighter integration for multi-tier workloads

Smarter Planet Solutions Usually Include Different Workloads

Transaction Processing and Database

- Application Database
- Data Warehousing
- Online Transaction Processing
- Batch

Analytics

- Data Mining Applications
- Numerical
- Enterprise Search

Business Applications

- Enterprise Resource Planning
- Customer Relationship Management
- Application Development

Web, Collaboration and Infrastructure

- Systems Management
- Web Serving/Hosting
- Networking
- File and Print

Different Workloads Have Different Characteristics

Workloads

Workloads

Workloads

- Huge transaction workload
- High I/O bandwidth
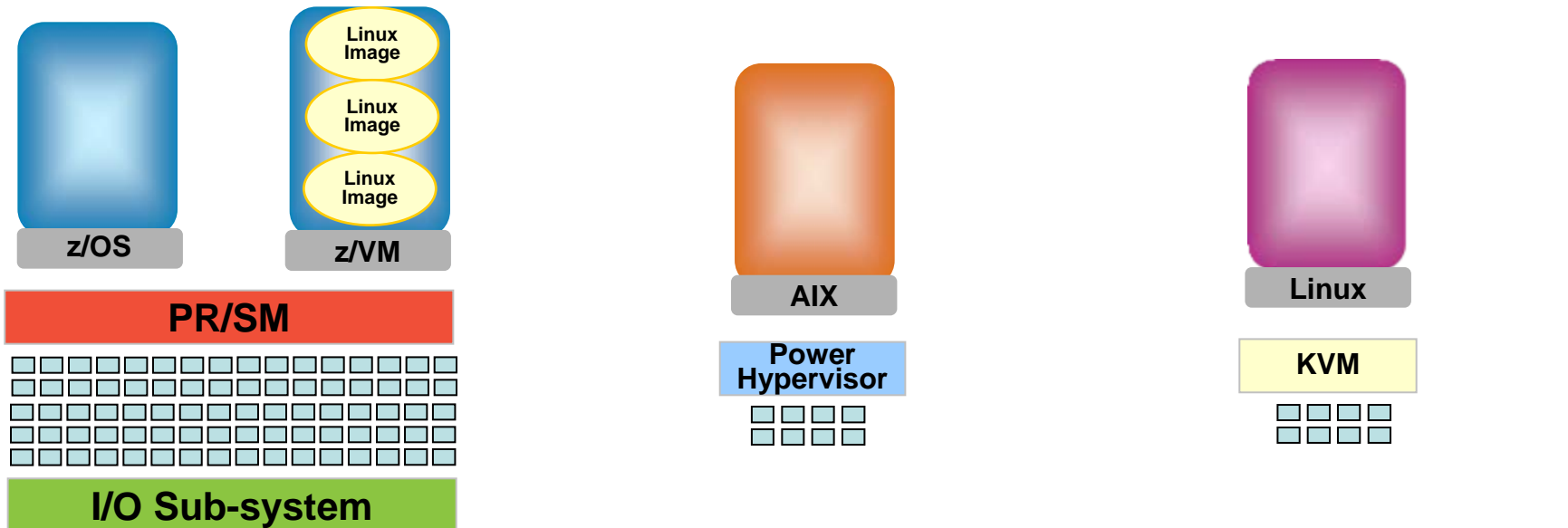- High quality of service requirements

- High processing intensity
- Integer or floating point

- Light to moderate processing
- Modest quality of service requirements

zEnterprise – Environments Optimized For Different Workloads

z/OS

Linux Image
Linux Image
Linux Image

z/VM

PR/SM

I/O Sub-system

AIX

Power Hypervisor

Linux

KVM

- 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

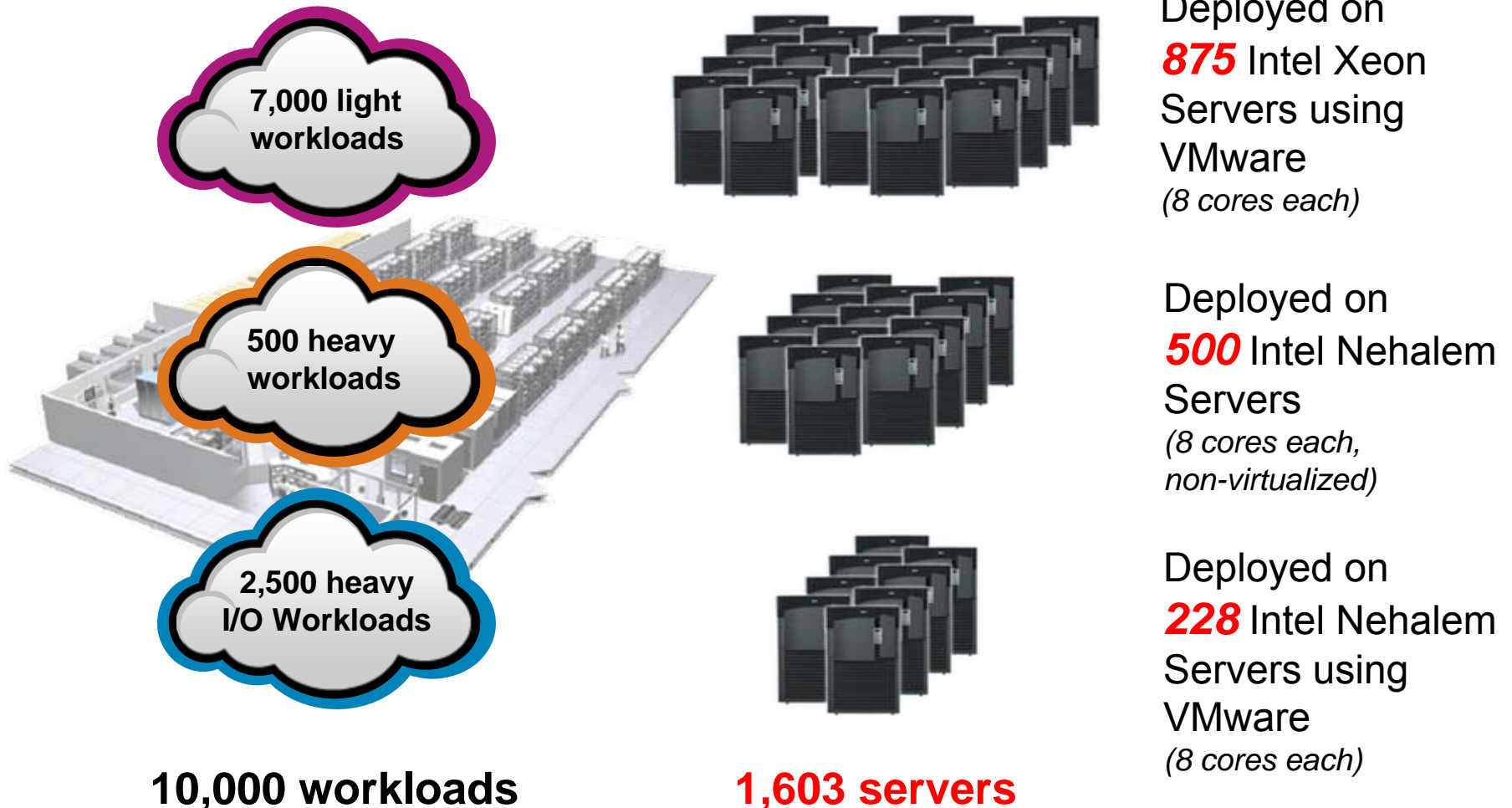- Floating point accelerators

- Scales to 8-12 cores per blade

- Fast processing threads

- Commodity I/O

- Modest qualities of service
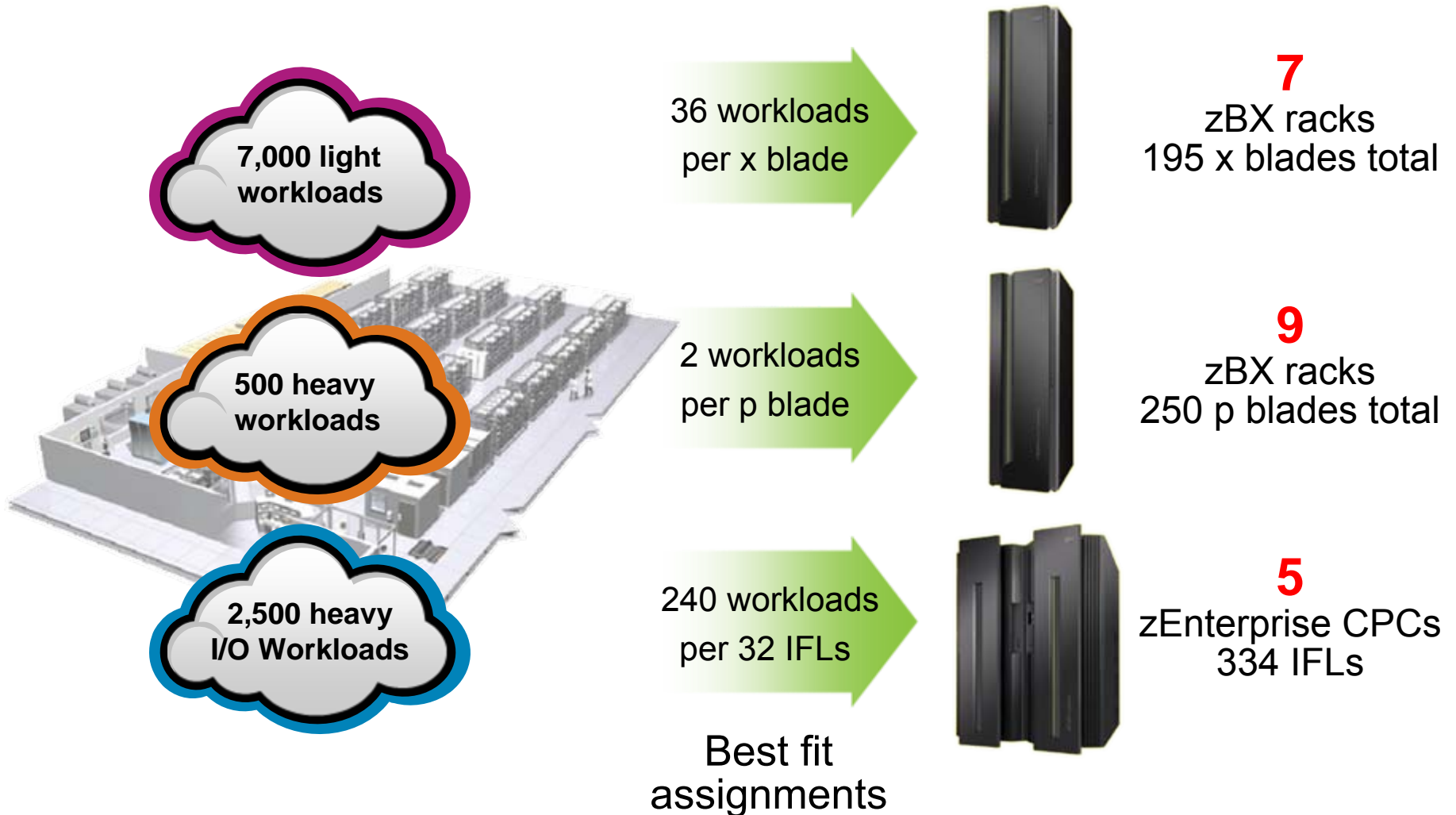
"Best Fit" Proposition
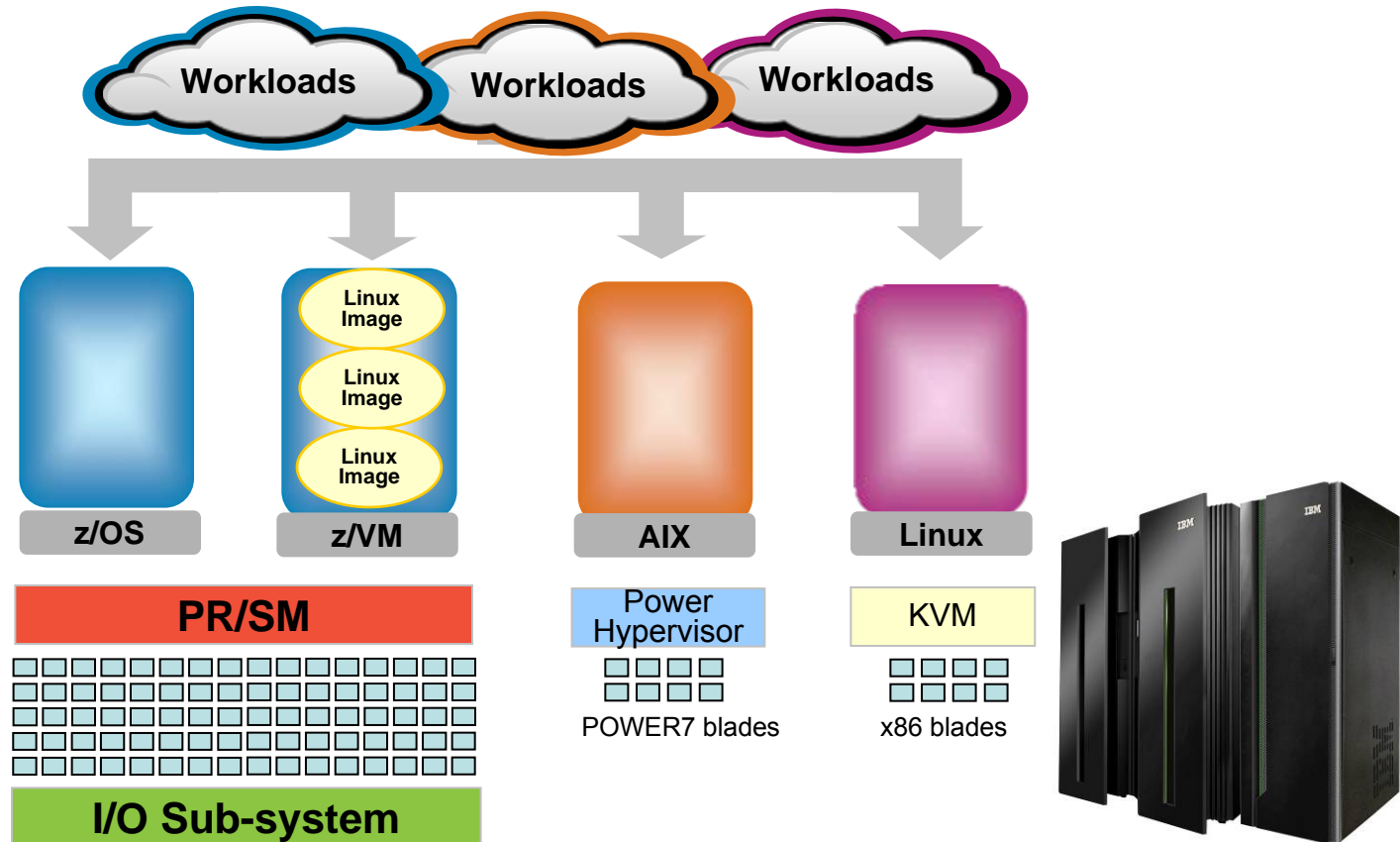
- Deploy or consolidate workloads on the environment best suited for each workload
  - ▶ Yields lowest cost of operation for workload requirements

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

7,000 light workloads

500 heavy workloads

2,500 heavy I/O Workloads

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)
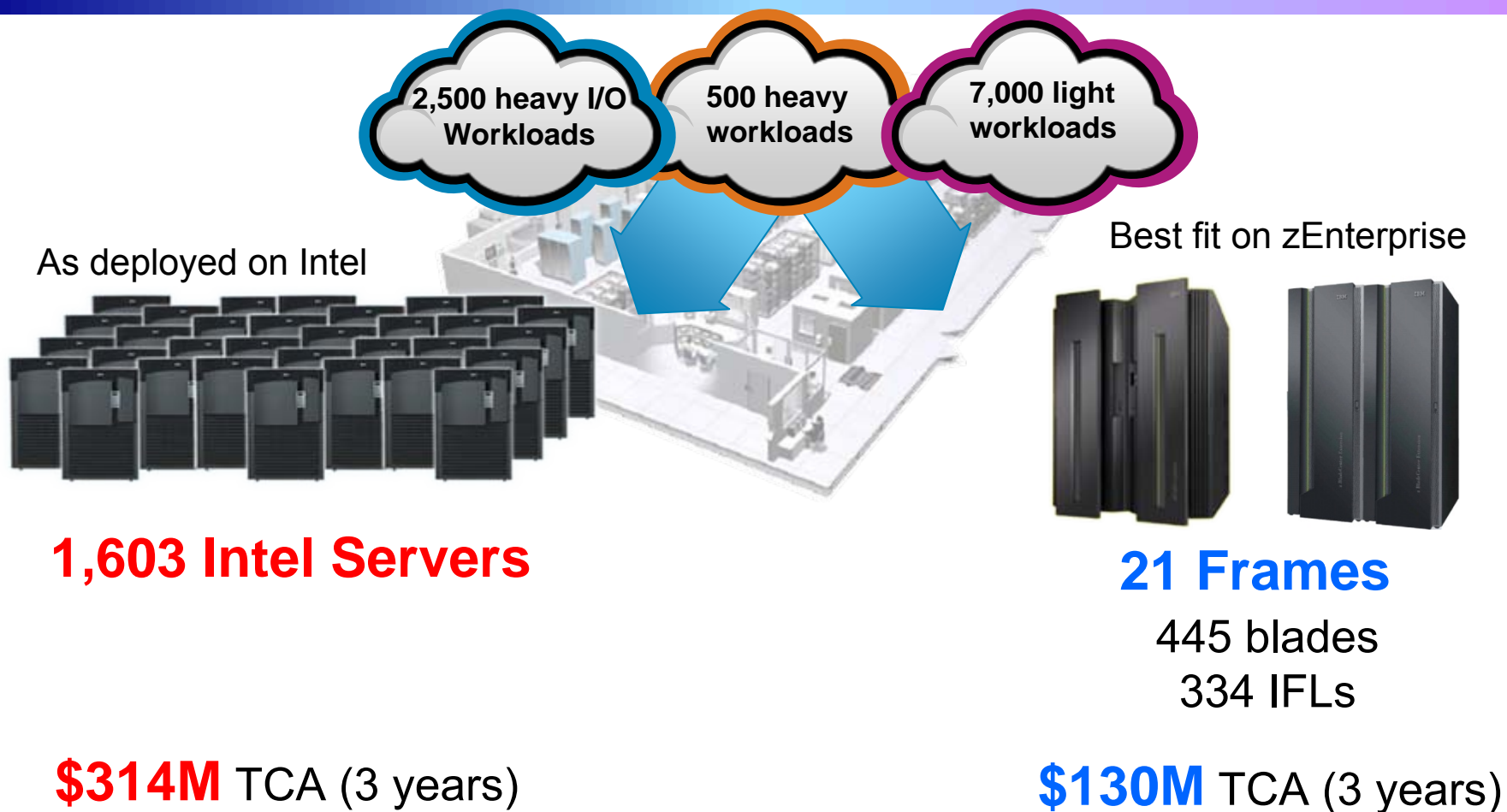
10,000 workloads   **1,603 servers**

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 CPCs
334 IFLs

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 x86 blades is a statement of direction only. Results may vary based on customer workload profiles/characteristics.

Compare Server Cost Of Acquisition

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

1,603 Intel Servers

21 Frames

445 blades
334 IFLs

$314M TCA (3 years)

$130M 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.

59%
less

Compare Network Cost Of Acquisition

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

Additional network parts

313 switches	7,038 cables	6,412 adapters

13,763 total network parts

$3.8M TCA

Additional network parts

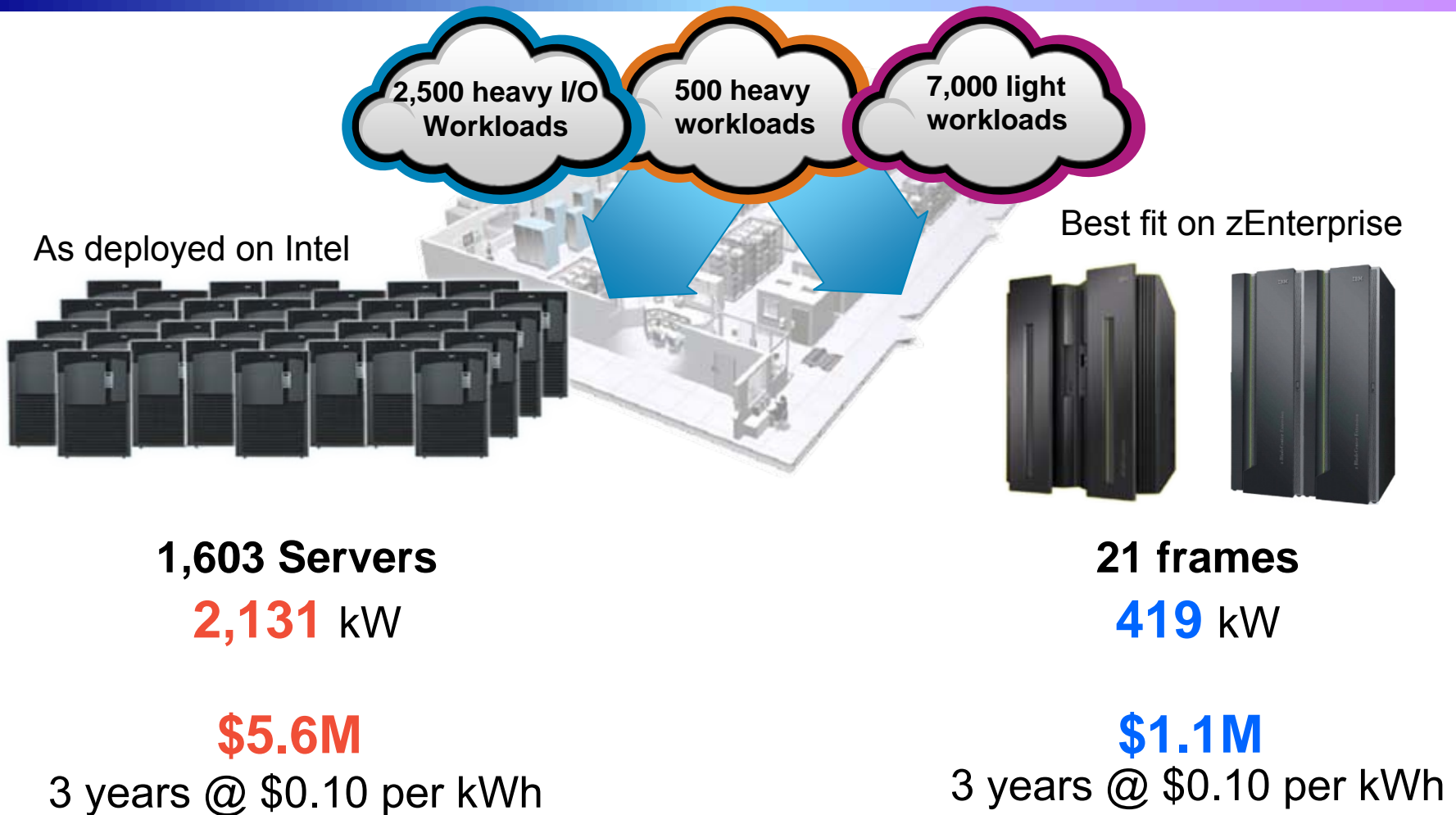| 7 switches	142 cables	74 adapters

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.

Compare Power Consumption

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

1,603 Servers

2,131 kW

$5.6M
3 years @ $0.10 per kWh

21 frames

419 kW

$1.1M
3 years @ $0.10 per kWh

80%
less

Server configuration based on IBM internal studies. Calculations for Intel servers based on published power ratings and industry standard rates. Prices are in US currency, prices will vary by country.

Compare Server Infrastructure Labor Costs

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

411,296 labor hours/yr
198 administrators

$94.8M
3 years @ $159,600/yr

151,204 labor hours/yr
73 administrators

$35.0M
3 years @ $159,600/yr

63%
less

Configuration based on IBM internal studies. Labor model based on customer provided data from IBM studies
Labor rates will vary by country

Compare Storage Cost

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

3 DS8700

6 XIV via SAN

1 SONAS

7.7 PB embedded storage
31% utilization
1,603 points of admin

$211M TCO (3 years)

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

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

4.5 PB provisioned storage
53% utilization
10 points of admin

$108M TCO (3 years)

49%
less

Simplification – Fewer Parts To Assemble And Manage

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

As deployed on Intel

Best fit on zEnterprise

As deployed on Intel		Best fit on zEnterprise
1,603	Servers	21 frames
13,763	Network (parts)	223
2,131	Power (kW)	419
198	Administrators	73
1,603	Storage admin points	10

The Savings Are Cumulative

2,500 heavy I/O Workloads

500 heavy workloads

7,000 light workloads

Three Year Cost of …	Deploy on Intel	Best fit on zEnterprise
Servers	$ 314M	$ 130M
Network	$ 3.8M	$ 0.2M
Power	$ 5.6M	$ 1.1M
Labor	$ 94.8M	$ 35.0M
Storage	$ 211M	$ 108M
Total	**$ 629M**	**$ 274M**
Total cost per workload	**$ 63K**	**$ 27K**

56% **less**

Results may vary based on customer workload profiles/characteristics. Prices
based on publicly available US list prices. Prices may vary by country

Manage All Four Environment As A Single Unified Platform

IBM Tivoli Service Management Center for System z	**End-to-End Service Management**
Unified Resource Manager	**Integrated Platform Management**
System z Hypervisor — Power Hypervisor — System x Hypervisor Data Network Management Network	**Integrated Fit-for-Purpose Platform**
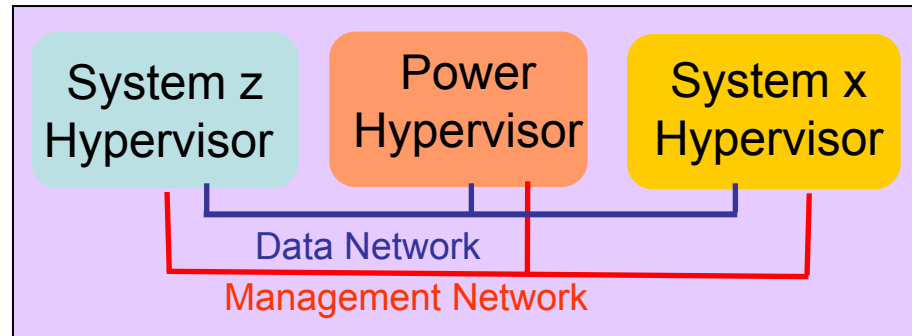
zEnterprise

Extends System z quality of service to all environments

zBX Specialty Appliances Use Breakthrough Technologies To Streamline Workloads

IBM Smart Analytics Optimizer

- Works transparently with DB2 for z/OS

- Accelerates select queries from DB2 for z/OS, with unprecedented response times

WebSphere DataPower

- Helps simplify govern and enhance the security of XML and IT services

- Provides connectivity, gateway functions, data transformation, protocol bridging and intelligent load distribution

Blade appliances are pre-packaged, self-contained units (including hardware, software, memory, etc.) and designed for specific workload optimizations.

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# Rational Delivers A Unified Development Tool Set For All zEnterprise Environments
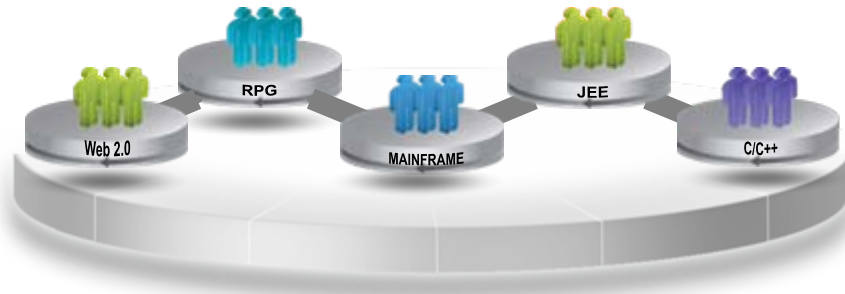
- Unified edit, compile, debug

- Unified development processes

- Unified test

- **Improve development productivity by up to 30%[1]**

[1]Based on IBM customer study

IBM Eagle Studies Demonstrate Most Mainframe Workloads Are Already Best Fit

- A Total Cost of Ownership analysis study for customers

  - Cost and risk analysis of mainframe vs. alternative

  - Tailored to individual customer needs

    - Cost factors unique to each enterprise

    - Costs evaluated over five year period

- *48 of 50* IBM Eagle studies concluded that System z offered better TCO than a distributed alternative

  - Average cost of growing on System z was *41% less* than the distributed alternative
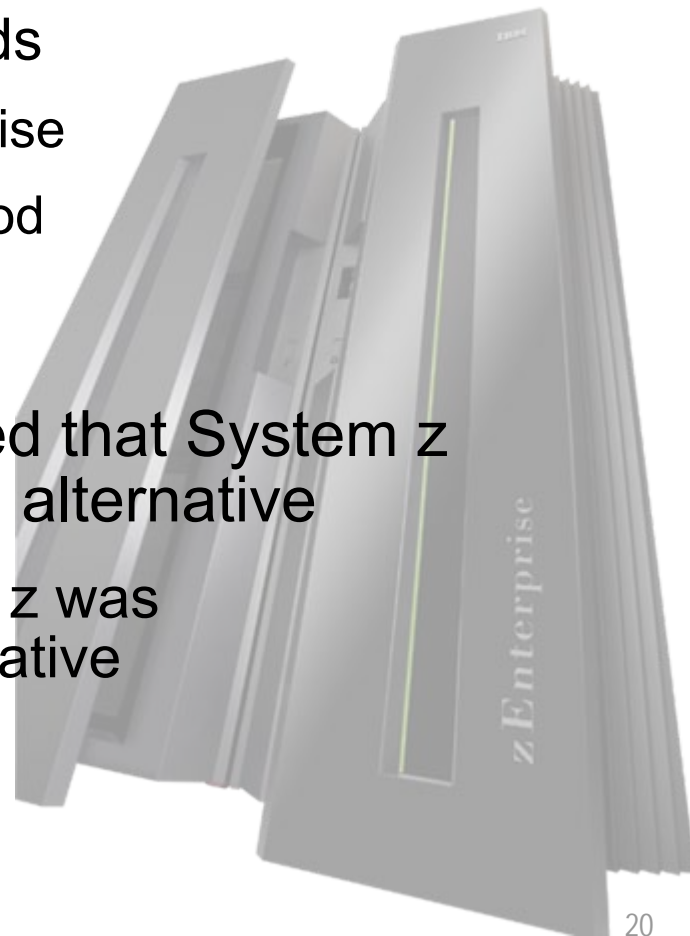
Thriving System z Ecosystem

Linux on System z: Fastest growing server platform

- Installed Linux MIPS growth of 43% CAGR (2004-2009)
- Shipped IFL MIPS increased 65% (YE07 to YE09)
- 70% of the top 100 System z clients are running Linux on z
- Linux is 16% of the System z customer install base (MIPS)

Thousands of ISVs investing in System z platform

As of 1H2010:

- 1,650 unique ISVs have enabled more than 6,300 applications on the System z platform
- 3,000+ Linux applications are supported on System z:
  - ▶ 550 new Linux applications added in 2009; another 80 applications already enabled in 2010
- 4,000+ applications are enabled on z/OS:
  - ▶ 2,000+ applications are enabled on z/OS 1.9 and later

Worldwide adoption of mainframe curriculum

Students educated:

- Over 50,000 worldwide, 5,000 more students in China by 2010

University adoption:

- Over 600 schools enrolled globally
- 90% growth in 2 years; 2,000% since 2003; continued flow of schools adding curricula
- 50%+ outside of US

Worldwide skills:

- 40,000 mainframe skills in growth economies

Based on IBM market analysis

zEnterprise Is A Roadmap To The Data Center Of The Future

Heavy I/O Workloads

Heavy Workloads

Light Workloads
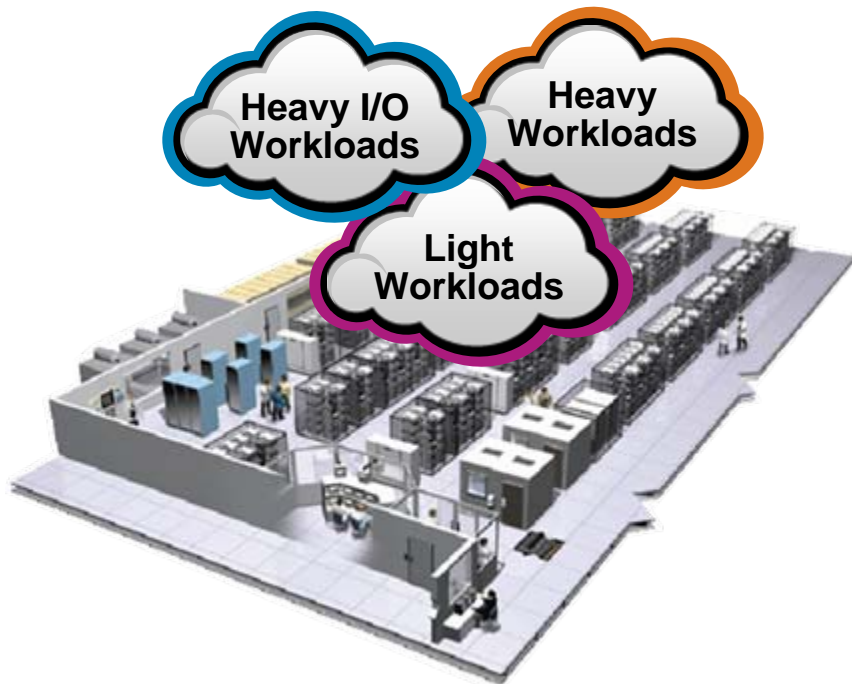
- Lowest cost per unit of work for large scale workloads

- 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

But What's So Different About zEnterprise?

**Let's Have A Closer Look!**

Development Manager

IBM

z196 Has A Familiar 4-Book Design, But Packs More Inside

- Each book has 6 quad-core central processors (CPs) …
  - ▶ Increased from 5 in System z10
  - ▶ Fully connected topology
- ...Plus 2 storage control (SC) chips
  - ▶ Each holds up to 96 MB eDRAM L4 cache shared per node
    - − 192 MB total per book
- Up to 3TB RAIM memory for system
  - ▶ Up to 768 GB per book
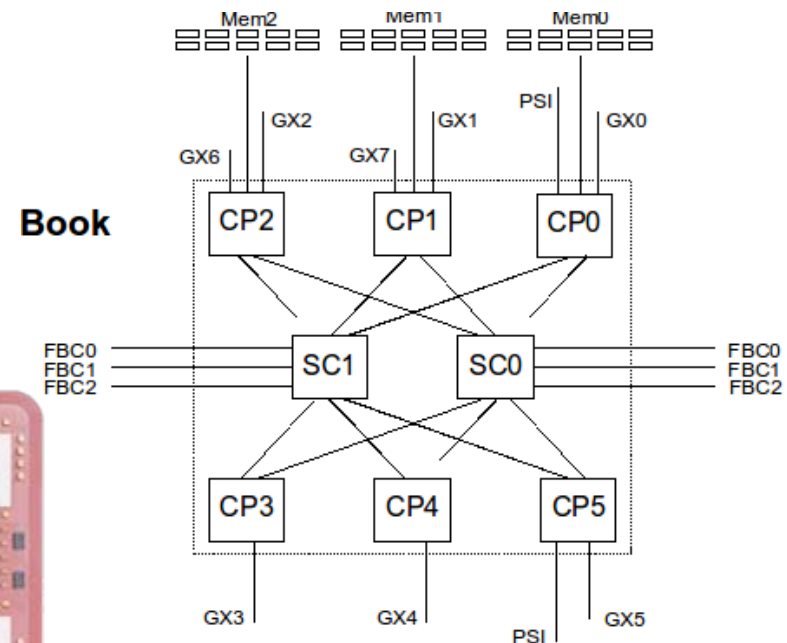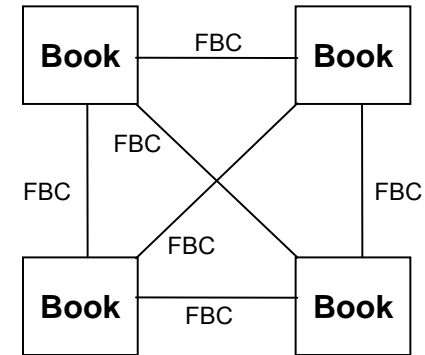
z196 Core Designed To Be The Fastest Available Today

- Quad-core CP chips designed to reach speeds of 5.2 GHz
  - ▶ Exceeds z10 speed of 4.4 GHz
- Four levels of cache:
  - ▶ Over twice as much on-chip cache as System z10
  - ▶ L1: 64KB I / 128K D private, per core
  - ▶ L2: 1.5MB private, per core (adjacent)
  - ▶ L3: 24MB per chip, shared by all 4 core
  - ▶ Interface to L4 cache (SC Chips) at 40+ GB/sec
- Cryptographic and data compression co-processors
- Memory controller
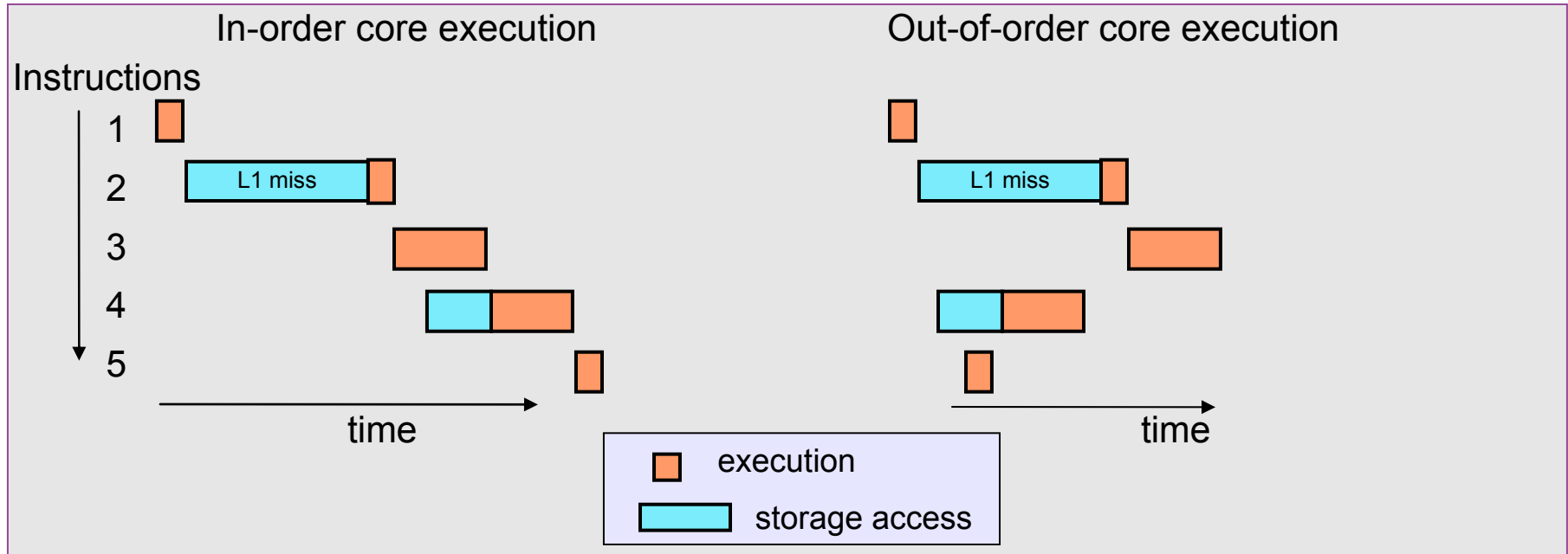- I/O Bus Controller (GX)
- Over 100 new instructions
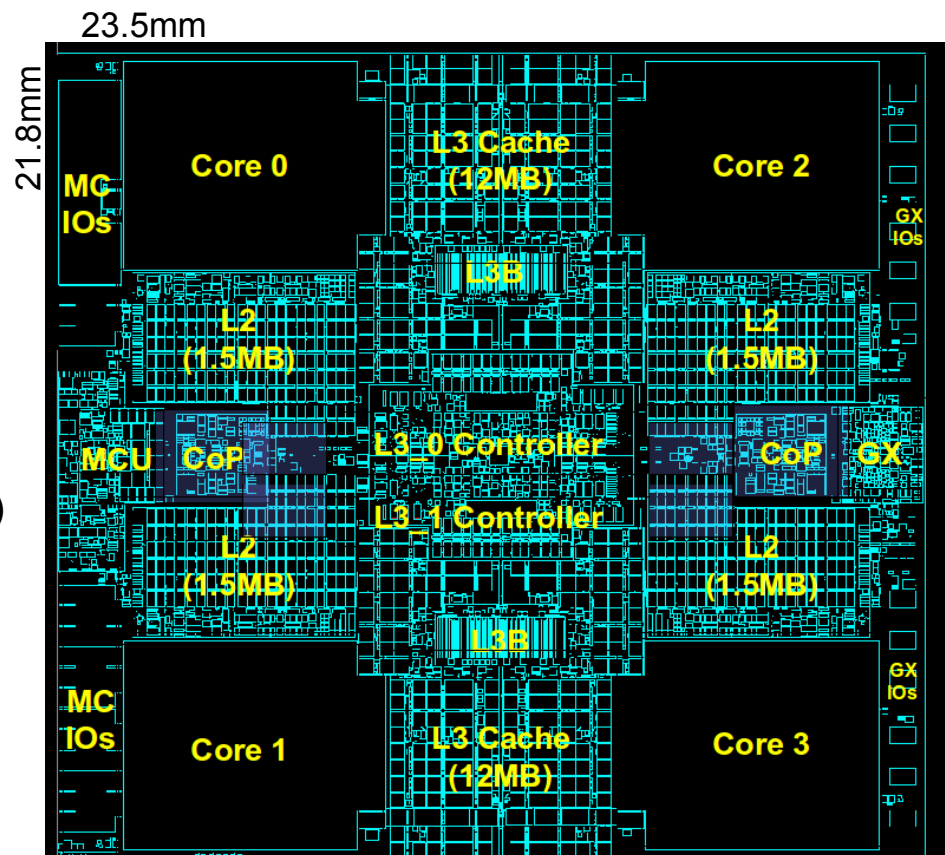
CP Floor Plan – 512.3 mm², 1.4B transistors

40% improvement for n-way processors
60% more total capacity than System z10

zEnterprise Includes System z's First Out-Of-Order (OOO) Core

- Instructions can be reordered
  - Later (younger) instructions can execute ahead of older stalled instruction
  - Re-order storage accesses and parallel storage accesses
  - Yields significant performance benefit for compute-intensive applications

In-order core execution   Out-of-order core execution

Instructions

1

2   L1 miss

3

4

5

time   time

execution

storage access

z196 – A New Generation Of Mainframe Available In Five Models

- Machine type 2817
  - ▶ Five models – M15, M32, M49, M66, M80
- Scalable to 96 CPs
  - ▶ 20 CPs per node (24 for M80)
  - ▶ 80 configurable as GP, IFL, ICF, zAAP, zIIP
  - ▶ 2 spares per system, up to 14 SAPs
- Hot-pluggable I/O
- Capacity On Demand capabilities included
- Up to 60 logical partitions
  - ▶ Up to 1TB per LPAR
- Support for:
  - ▶ z/OS, z/VM, z/VSE, z/TPF, Linux on System z

Sub-capacity pricing available:
*7xx = 100%*
6xx = 64%
5xx = 49%
4xx = 20% (xx = 01 - 15)

z196 Introduces New I/O Drawer Technology Designed For Concurrent Use

- z196 infrastructure supports both cages (z10 EC style) and drawers (z10 BC style) for I/O

  ▶ Both support full range of FICON, ESCON, OSA, ISC, Crypto Express and Infiniband cards

- Unlike cages, drawers can be added or removed without affecting system power

  ▶ Must have at least 2 drawers installed to work non-disruptively

- Drawers are favored on z196

  ▶ Up to 32 I/O cards – use 1-4 drawers

  ▶ With 32-72 I/O cards – use 1 or 2 cages , plus up to 2 drawers

Reduce downtime and increase flexibility with non-disruptive, pluggable I/O

z196 Front View

Z Frame   *A Frame*

I/O Drawers
8 slots each

I/O Cage
28 slots each
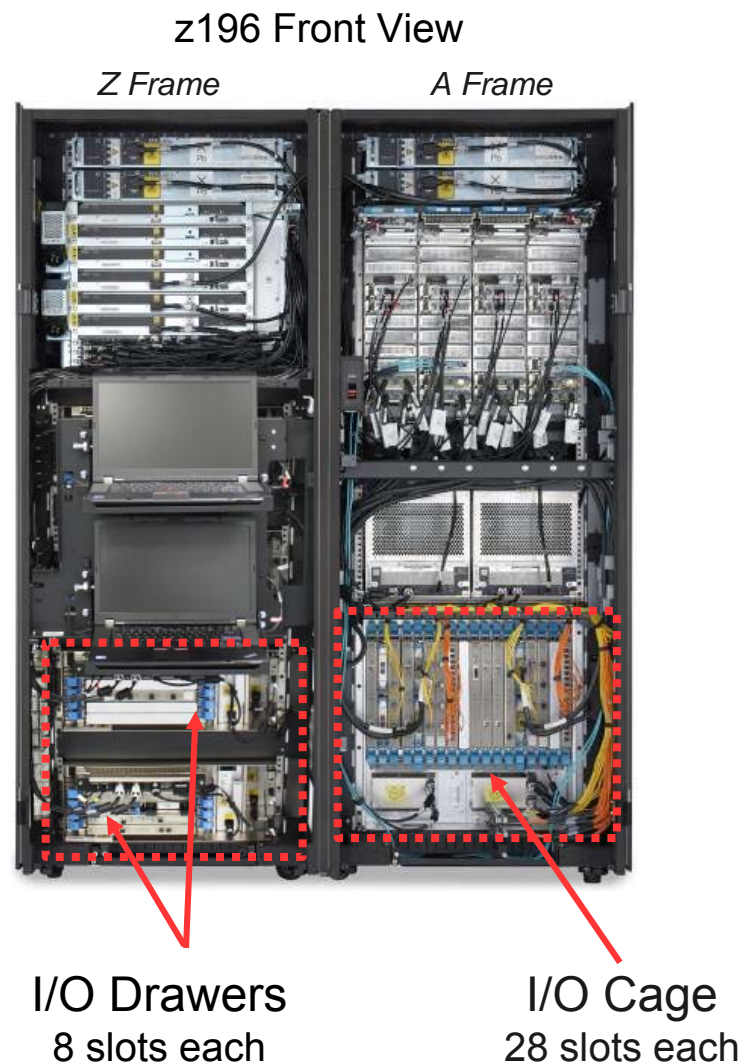
z196 Yields Dramatic Improvements Over IBM System z10

For Linux

Up to **60%**

Improvement in performance

at **33%**

Less cost

zEnterprise

For z/OS

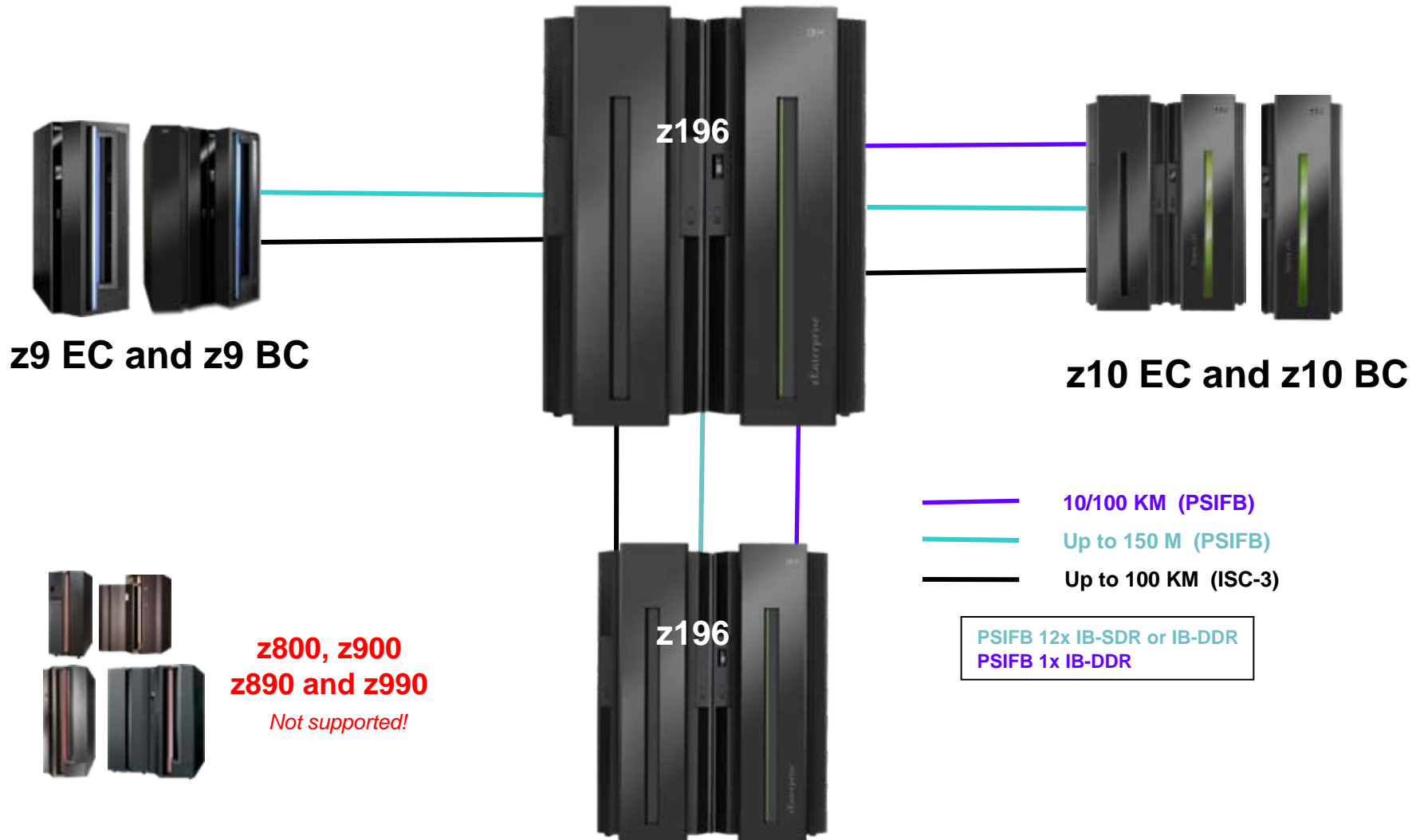Up to **40%**

Improvement in performance

with **60%**

More capacity

With no increase in energy consumption

* Based on 60% increase in total capacity and 40% improvement in engine speed of z196 compared to z10. Also, includes new pricing for IFL, memory and maintenance.

z196 Can Coexist In A Parallel Sysplex With z10 And z9

z196

z9 EC and z9 BC

z10 EC and z10 BC

z800, z900
z890 and z990

Not supported!

z196

10/100 KM (PSIFB)

Up to 150 M (PSIFB)

Up to 100 KM (ISC-3)

PSIFB 12x IB-SDR or IB-DDR
PSIFB 1x IB-DDR

zBX Is An Extension Of System z

Machine Type: 2458 – Model 002

- **Integrated IBM Certified Components**
  - ▶ Standard parts – Top-of-rack (TOR) switches, BladeCenter Chassis, Power Distribution Units, Optional Acoustic Panels

- **System z support**
  - ▶ Problem reporting, hardware and firmware updates

- **Expanded operating system support for zEnterprise**
  - ▶ AIX, Linux on System x[1]

- **Simplified management**
  - ▶ Improved time to install and implement new applications
  - ▶ Central point of management for heterogeneous workloads
  - ▶ No change to applications

Optimizers
- **IBM Smart Analytics Optimizer**
- **WebSphere DataPower appliance[1]**

Select IBM blades
- **BladeCenter PS701 Express**
- **System x[1]**

| |
|---|
| **One to four 42u racks – up to 112 blades, < 26m from z196** |
| **No System z software running in zBX – Passport Advantage software licensed to blades** |
| **No MIPS/MSU rating** |
| **Configured for high availability** |
| **Optional rear door heat exchanger** |

[1] All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represents goals and objectives only.

zBX Supports New Power PS701 Blades

- POWER7 8-core processor 3.0GHz

- Single wide blade server

- 3 configurations supported in zEnterprise System

  ▶ 32 GB, 64 GB, 128 GB

- AIX OS 5.3 or greater

- PowerVM

- Hot Swap POWER blades in BladeCenter Chassis

- Auto sensing by z196 initiates configuration and firmware updates done at HMC
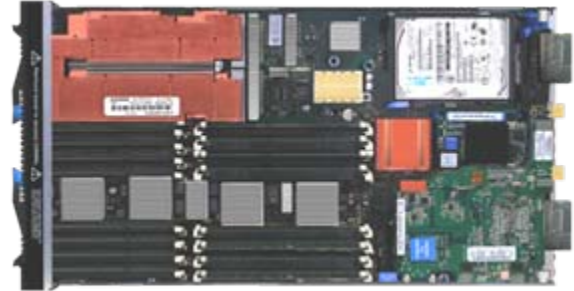
Machine Type: 8406
Model 71Y

System z support extended to zBX blades:
- Problem reporting and 'phone home' capability
- Blade warranty provided as part of zBX warranty and terms
- Support by IBM System z Service Support Rep (SSR)

IBM Smart Analytics Optimizer - Capitalizing On The Best Of Relational And Columnar Databases
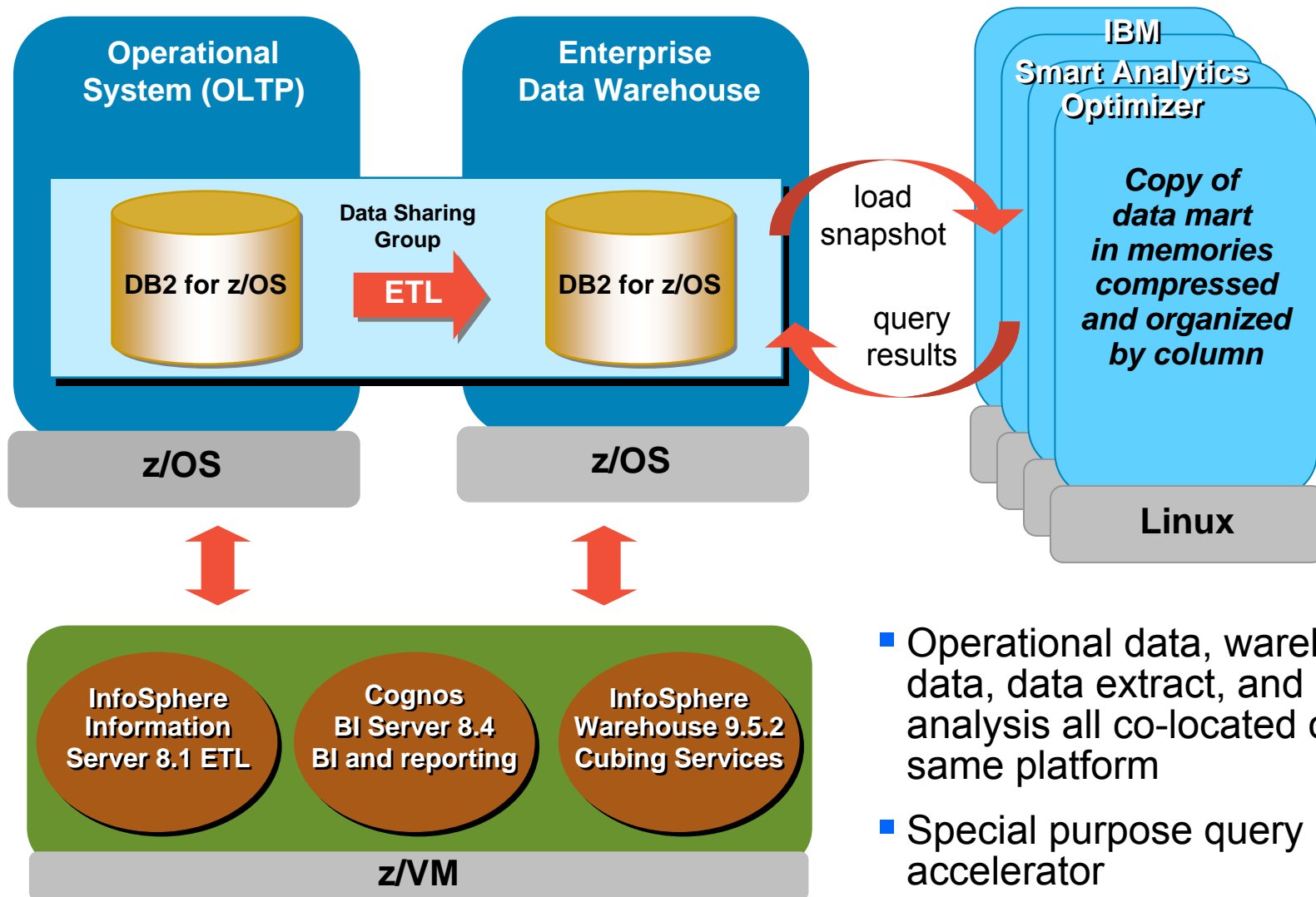
Workload optimized, appliance-like, add-on that enables the integration of business insights into operational processes to drive winning strategies.

- **Performance[1]:** unprecedented faster performance for some queries enables 'train of thought' analyses frequently blocked by poor query performance

- **Integration:** connects to DB2 for z/OS through deep integration providing transparency to all applications

- **Self-managed workloads:** queries are executed in the most efficient way

- **Transparency:** applications connected to DB2, are entirely unaware of the optimizer

- **Simplified administration:** appliance-like hands-free operations, eliminating many database tuning tasks

[1]Based on Internal IBM test results that reflect actual client queries

Consolidate Complete Business Intelligence Solution On zEnterprise

Operational System (OLTP)

DB2 for z/OS

Data Sharing Group

ETL

z/OS

Enterprise Data Warehouse

DB2 for z/OS

z/OS

load snapshot

query results

IBM Smart Analytics Optimizer

Copy of data mart in memories compressed and organized by column

Linux

InfoSphere Information Server 8.1 ETL

Cognos BI Server 8.4 BI and reporting

InfoSphere Warehouse 9.5.2 Cubing Services

z/VM

- Operational data, warehouse data, data extract, and analysis all co-located on the same platform

- Special purpose query accelerator

IBM Smart Analytics Optimizer Enables Near Real-time Analytics On zEnterprise

Enterprise Data Warehouse

DB2 for z/OS

z/OS

load snapshot

query results

IBM Smart Analytics Optimizer

Copy of data mart in memories compressed and organized by column

Linux
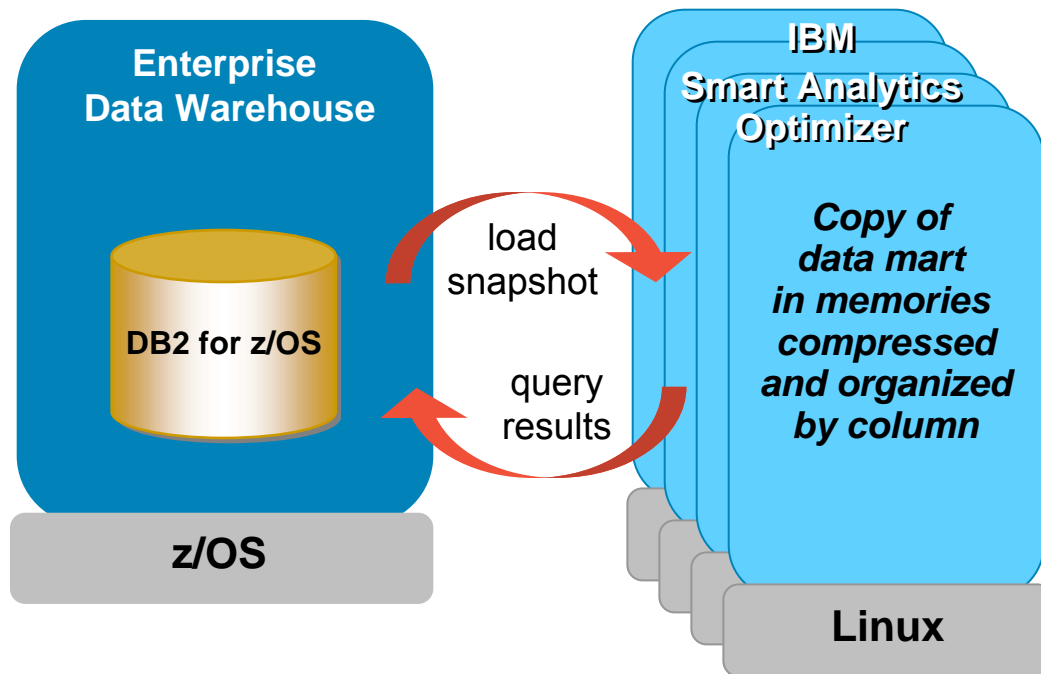
- ■ IBM Smart Analytics Optimizer

- ■ Leverages blade memory and processors for warehouse queries

- ■ Load snapshot then execute queries

■ Early customer results[1]

- ▶ Analysis jobs execute *3 - 171* times faster

- ▶ Cost per job reduced by *1.4 - 1838* times in continuous use

- ▶ Real time analytic performance *7 - 387* samples per day

[1]Based on results from 3 customer studies

WebSphere DataPower Appliance Simplifies Deployment And Hardens Security

What is it?

- Helps simplify govern and enhance the security of XML and IT services

- Provides connectivity, gateway functions, data transformation, protocol bridging and intelligent load distribution

How is it different?

- Security

- Improved support

- System z packaging

- Operational controls

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zEnterprise zBX Integration

- Hypervisors are shipped, serviced, and deployed as System z Licensed Internal Code
  - ▶ Booted automatically at power on reset

- Pre-configured private and physically isolated internal management network
  - ▶ 1 Gbps that connects all resources for management purposes

- Private and secure data network
  - ▶ 10 Gbps that connects all resources
  - ▶ Access-controlled using integrated virtual LAN (VLAN) provisioning that requires no external switches or routers
  - ▶ Less latency – fewer 'hops' to get to the data and no need for encryption / firewall
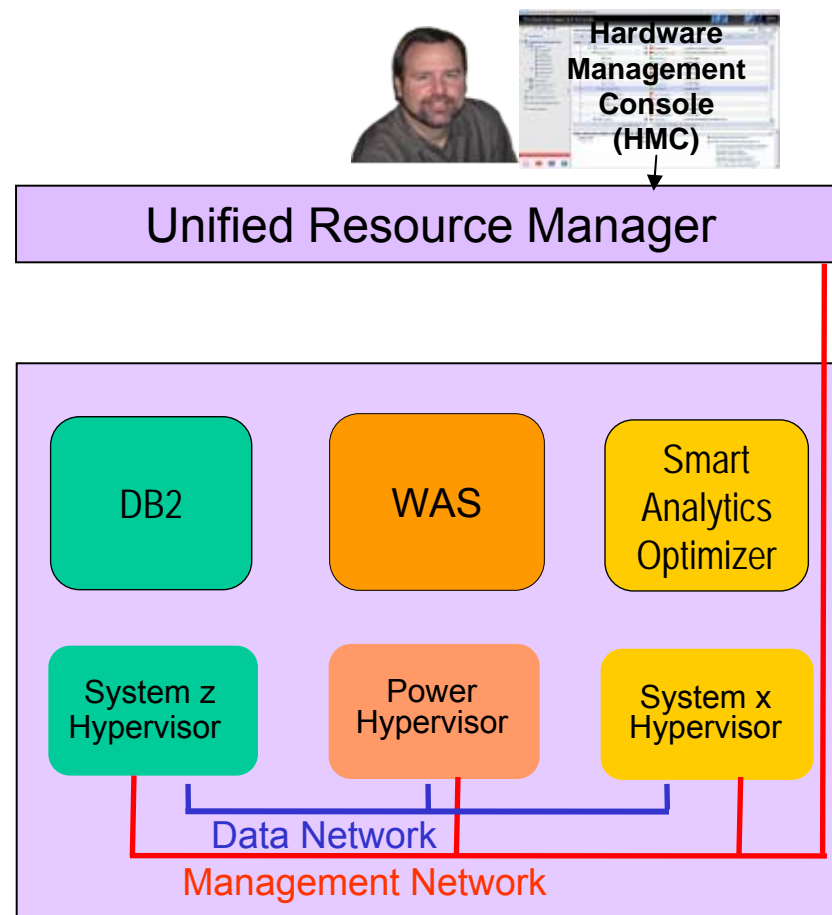 - ▶ Full redundancy for high availability

Centralized and Secure Virtualization Platform

System z Hypervisor	Power Hypervisor	System x Hypervisor

Data Network

Management Network
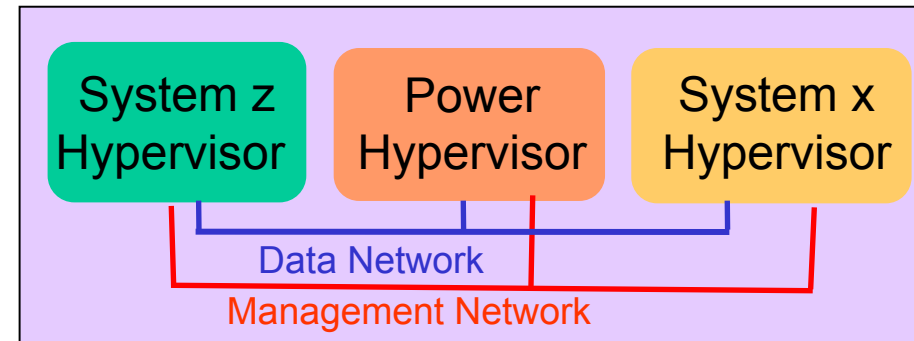
zEnterprise

Unified Resource Manager Integrates Management Of z196 And zBX Environments

- **Automatic inventory of all elements**

- **Automatic installation of hypervisors**

- **Create virtual networks**

- **Create virtual machines on any hypervisor from one console**

- **Manage performance of virtual machines as a group for a business workload**

Hardware Management Console (HMC)

Unified Resource Manager

| DB2 | WAS | Smart Analytics Optimizer |
| System z Hypervisor | Power Hypervisor | System x Hypervisor |

Data Network

Management Network

Unified Resource Manager Works With HMC And SE To Manage Resources Between z196 And zBX

System z Hardware Management Console (HMC)
with Unified Resource Manager

System z Host

z/OS

z/TPF z/VSE

Linux on System z

Linux on System z

z/VM

System z PR/SM

z HW Resources

Support Element

Select IBM Blades

Linux on System x

AIX on POWER7

Blade Virtualization

Blade Virtualization

Optimizers

DataPower [1]

IBM Smart Analytics Optimizer

Future Offering

Future Offering

Blade HW Resources

zBX

Private data network (IEDN)

Unified Resource Manager

Private Management Network INMN

Private High Speed Data Network IEDN

Customer Network

Customer Network

A Smart New Release Of z/OS Yields Improved Performance And Ease Of Use

z/OS Version 1 Release 12....

Control-Area Reclaim improves performance up to 40% for applications using VSAM

Additional new data set types enable easier data management

Management and administration simplified with the z/OS Management Facility (z/OSMF); WLM Policy Editor integrated into z/OSMF

… a Smarter Operating System

Innovative self-learning, self-managing and self-optimizing capabilities

Learns heuristically from its environment; reports system abnormalities

Predictive Failure Analysis predicts problems before they occur

Real-Time Diagnostics quickly analyses key indicators on a running system

Discovery and Auto Configuration brings "plug and play" capabilities to z/OS platform

zEnterprise Is A New Generation Of Computing Power

A "system of systems" to revolutionize the data center

z196 – a new, fast, high-performance breed of mainframe

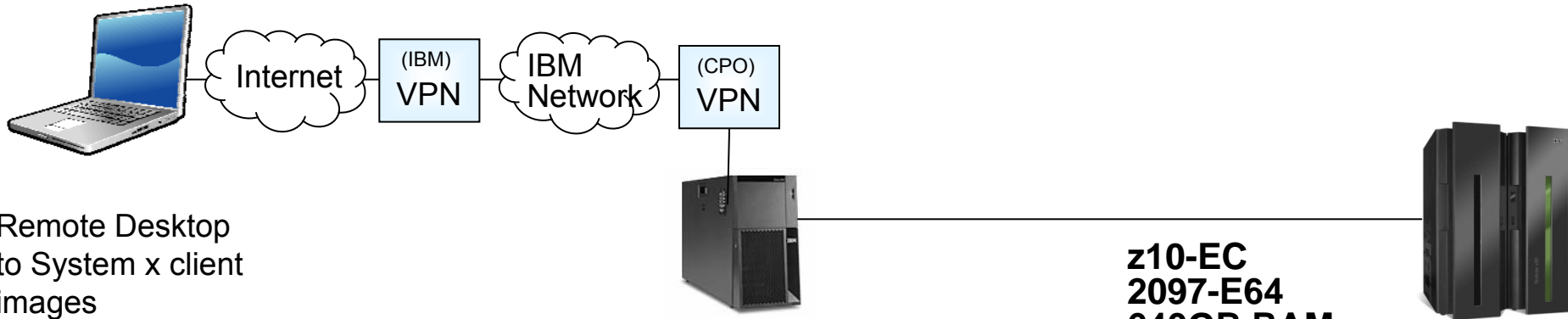*zBX – integrated AIX and Linux-based application blade servers and blade appliances*

Unified Resource Manager – resource and workload management firmware extending across the systems

Our Agenda Today

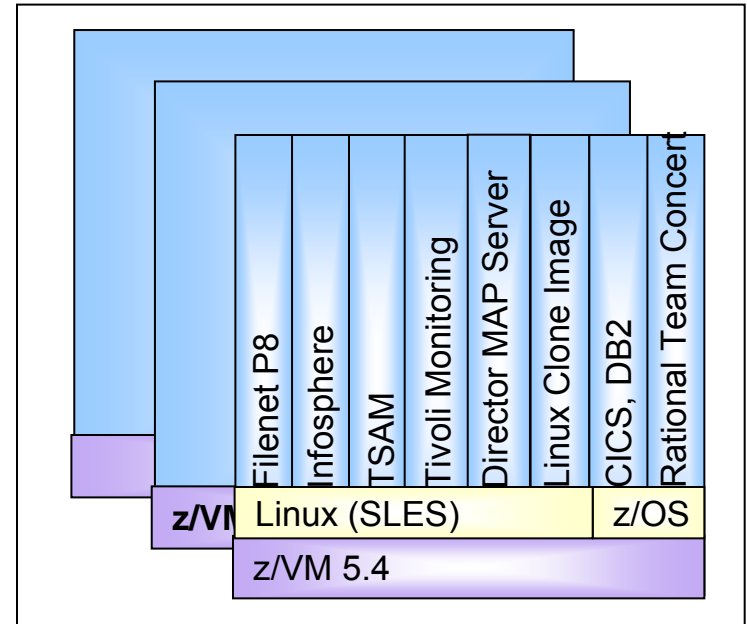|	
10 Minutes	*Welcome by Regional Sales Exec*
8:40 am	Enterprise computing and the economics of workload optimization
9:50 am	Virtualization and consolidation on zEnterprise
11:00 am	Reducing IT labor costs
12:00 pm	***Lunch***
1:00 pm	Deploying Web Applications
2:10 pm	Data serving and business analytics on a single platform
3:20 pm	Unify Mainframe and Distributed Development

DEMO: Architecture

Remote Desktop to System x client images

System x VMware images running as desktop or server clients to System z

Internet

(IBM) VPN

IBM Network

(CPO) VPN

**z10-EC
2097-E64
640GB RAM**

**System x 3950
8 x 3.5GHz Xeon MP
65GB RAM**

Eclipse	Cognos BI	Tivoli Directory Server	FastTrack, DataStage	Oracle + SQL Server	Tivoli Enterprise Portal

VMware ESX Server

Filenet P8	Infosphere	TSAM	Tivoli Monitoring	Director MAP Server	Linux Clone Image	CICS, DB2	Rational Team Concert

z/VM Linux (SLES) z/OS

z/VM 5.4