2007 System z Summit

DESTINATION z

IBM System z Strategic Directions

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IBM Distinguished Engineer
System z Brand

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Agenda

- **Centralization & Virtualization**
  - New ways to measure success
- **Lean and Green**
- **IBM System z™ Growth opportunities**
- **Nextgen systems**
- **Global IT infrastructure roles**
- **Application Deployment**
- **Summary**

New Innovations

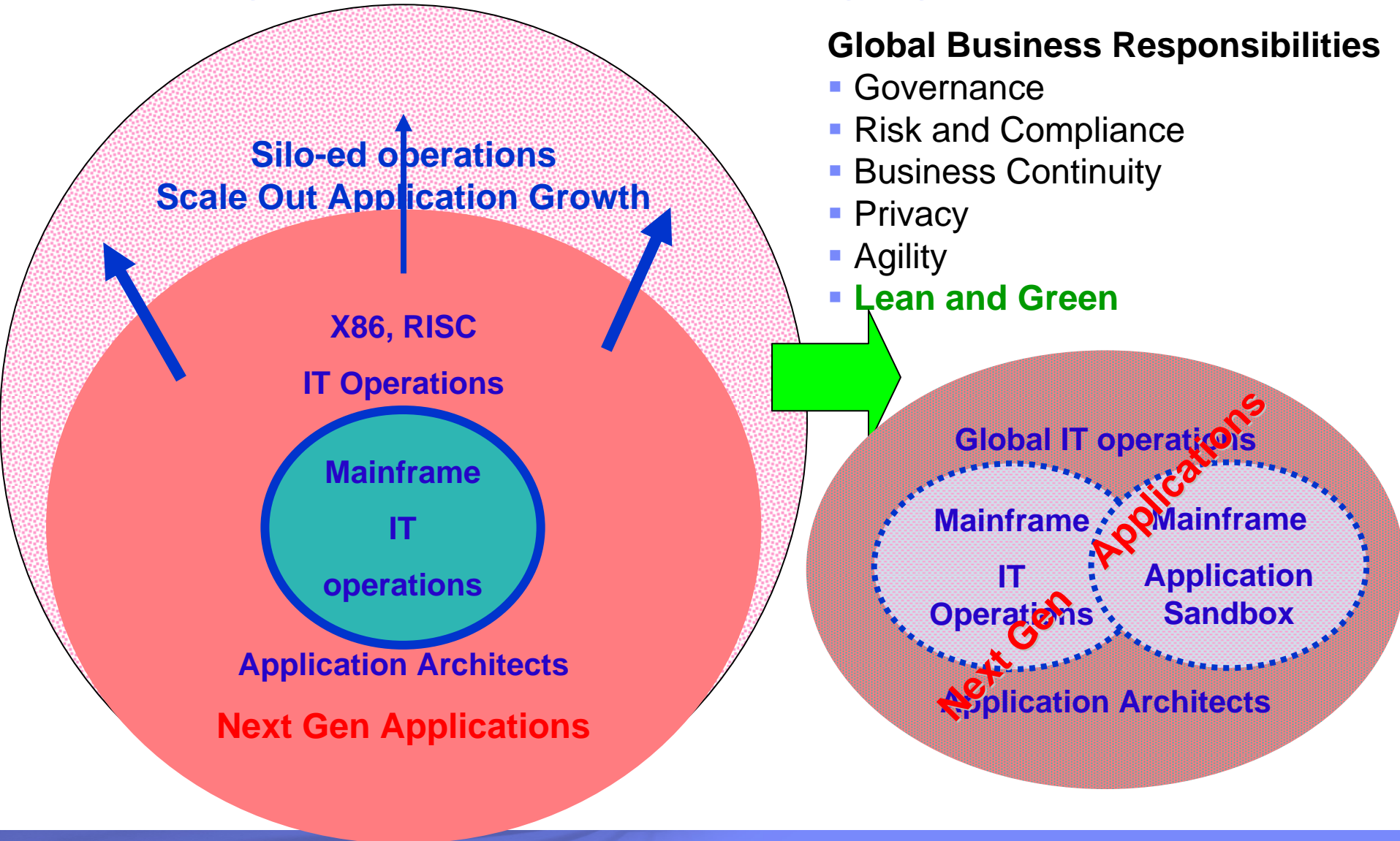## Cool New Solutions – Based on x86, Power, Cell processors

- HDTV
- Home Media Servers
- Digital Media Player
- Automotive

- Imaging
- Communications
- Medical
- Storage

- Surveillance
- Security
- Aerospace and Defense
- Visualization

That are or can be made better when used in conjunction with System z:

- Billing
- Operational Risk
- Inventory Management
- E-911 correlation
- Authentication, Audit, Compliance

The Mainframe is connected – It must COLLABORATE with others

IT Management Trends are changing

Silo-ed operations
Scale Out Application Growth

X86, RISC

IT Operations

Mainframe

IT

operations

Application Architects

Next Gen Applications

Global Business Responsibilities
- Governance
- Risk and Compliance
- Business Continuity
- Privacy
- Agility
- **Lean and Green**

Global IT operations

Mainframe

IT Operations

Mainframe

Application Sandbox

Next Gen Applications

Application Architects

Today's IT Complexity Has Driven Many Hidden Costs

Customers' desire for a solution to complexity-driven pain has never been higher
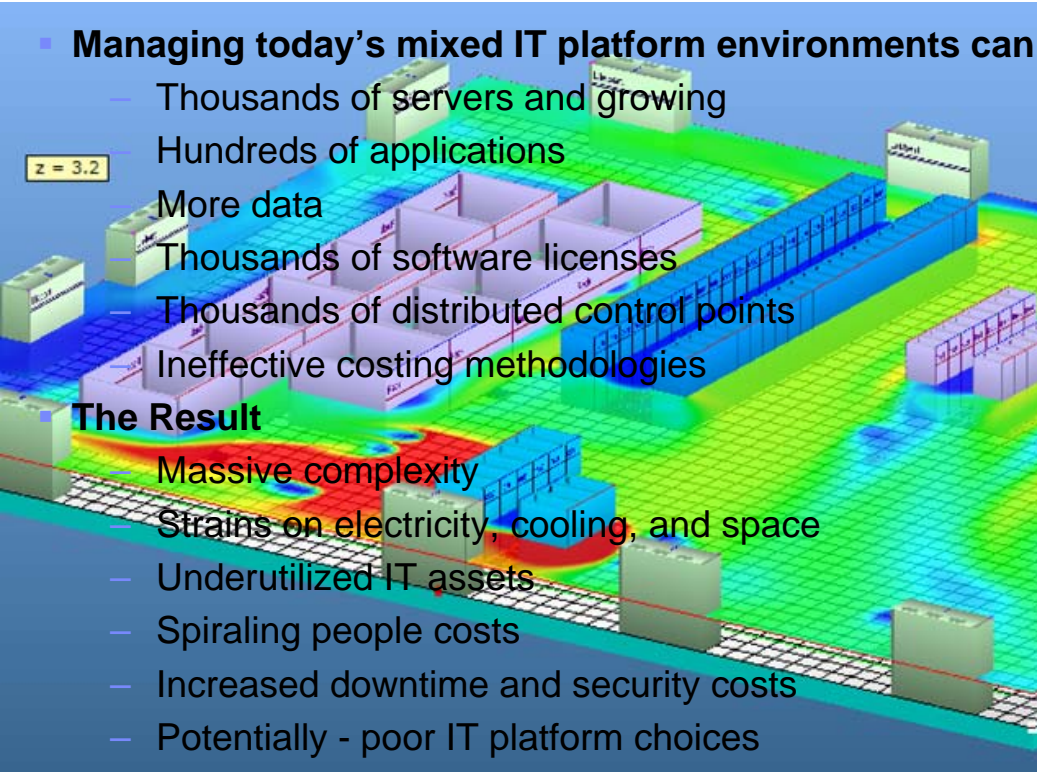
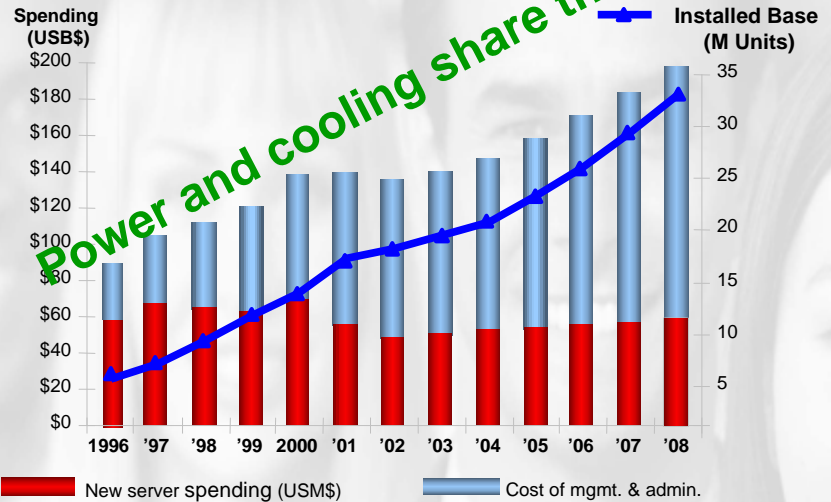- **Managing today's mixed IT platform environments can be complex and costly**
  - Thousands of servers and growing
  - Hundreds of applications
  - More data
  - Thousands of software licenses
  - Thousands of distributed control points
  - Ineffective costing methodologies
- **The Result**
  - Massive complexity
  - Strains on electricity, cooling, and space
  - Underutilized IT assets
  - Spiraling people costs
  - Increased downtime and security costs
 - Potentially - poor IT platform choices

z = 3.2

Cost of People vs. Spending on new systems

Power and cooling share this curve

Spending (USB$) — Installed Base (M Units)

$200 / $180 / $160 / $140 / $120 / $100 / $80 / $60 / $40 / $20 / $0

35 / 30 / 25 / 20 / 15 / 10 / 5

1996 '97 '98 '99 2000 '01 '02 '03 '04 '05 '06 '07 '08

■ New server spending (USM$)   ■ Cost of mgmt. & admin.

Source: *IDC, On-Demand Enterprises and Utility Computing: A Current Market Assessment and Outlook, IDC #31513, July 2004.*

Benchmarks don't always demonstrate the right value

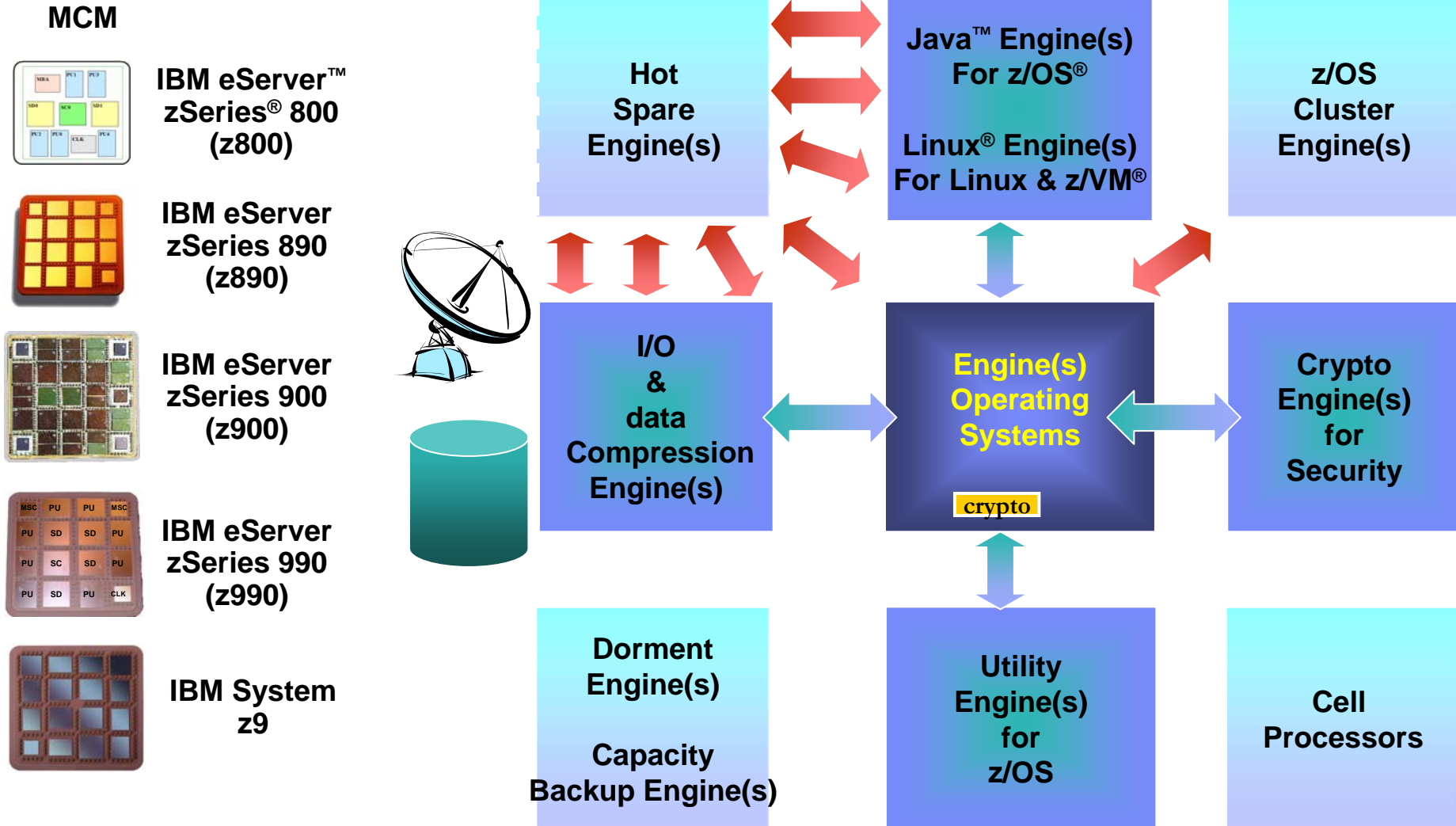**BladeCenter®   +   System z   =   Enterprise Solution**

Several compartments
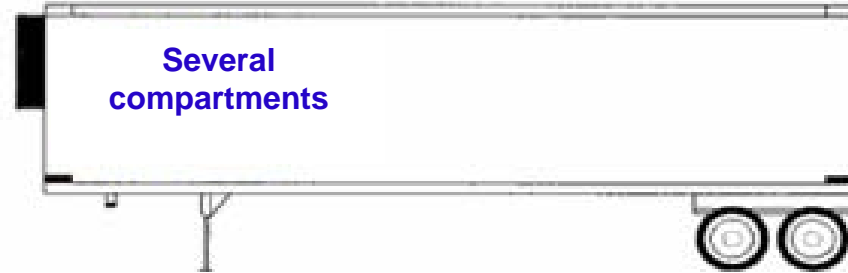
- 40 Miles/gallon - Gas
- 7 cubic feet of storage
- 4 passenger
- $15,000

- 10 Miles/gallon - Diesel
- 7 cubic feet of storage
- 2 passenger
- $55,000

- **Problem 1: Which is cheaper to commute to work with?**
- **Problem 2: You want to move contents of your home:**
  - How many vehicles and trips will be required to move?
  - Are extensions, such as the trailer, valuable?
  - How do you get the Grand Piano moved? What if it rains?
- **They aren't mutually exclusive either:**
  - The family rides in the car, the furniture rides in the truck

Mainframe – Co-Processors and Specialty Engines

MCM

IBM eServer™ zSeries® 800 (z800)

IBM eServer zSeries 890 (z890)

IBM eServer zSeries 900 (z900)

IBM eServer zSeries 990 (z990)

IBM System z9

Hot Spare Engine(s)

Java™ Engine(s) For z/OS®

Linux® Engine(s) For Linux & z/VM®

z/OS Cluster Engine(s)

I/O & data Compression Engine(s)

Engine(s) Operating Systems

crypto

Crypto Engine(s) for Security

Dorment Engine(s)

Capacity Backup Engine(s)

Utility Engine(s) for z/OS

Cell Processors

# IBM System z: The Ultimate Virtualization Platform

- ***Virtualize* everything with up to 100% utilization rates**
  - CPU, memory, network, I/O, cryptographic features, coupling facility, ...
- ***Massively scale* your workload on a single System z mainframe**
  - The Linux-on-z/VM record is 97,943 virtual machines
  - Each virtual machine on z/VM can access up to 24,576 devices
- ***Security* for everything**
  - Highest security classification for general purpose servers in the world
  - System z LPAR technology is EAL 5 certified
- ***Non-disruptively add* anything**
  - 54x CPU scalability per mainframe, 32x CPU scalability per z/VM LPAR
  - z/VM is designed to support up to 8 TB of active virtual memory
- ***Optimize and integrate* it all with the IBM software portfolio**

System z Virtualization: a Multidimensional Solution
Virtualization Support is Built In, Not Added On (and has been for 40 years!)

With coordinated investments in the virtualization technology stack

- **Application support layer**
  - Open, reliable operating system
  - Virtual server awareness infrastructure
  - Enterprise applications
- **Hypervisor layer (z/VM)**
  - Shared-memory based virtualization model
  - Highly granular resource sharing and simulation
  - Flexible virtual networking
  - Resource control and accounting
  - Server operation continuity (failover)
  - Server maintenance tools and utilities
- **Hardware layer**
  - Legendary reliability, scalability, availability, security
  - Logical partitioning (LPAR)
  - Processor and peripheral sharing
  - Interpartition communication
  - Virtualization support at the hardware instruction level

Application Support

Hypervisor
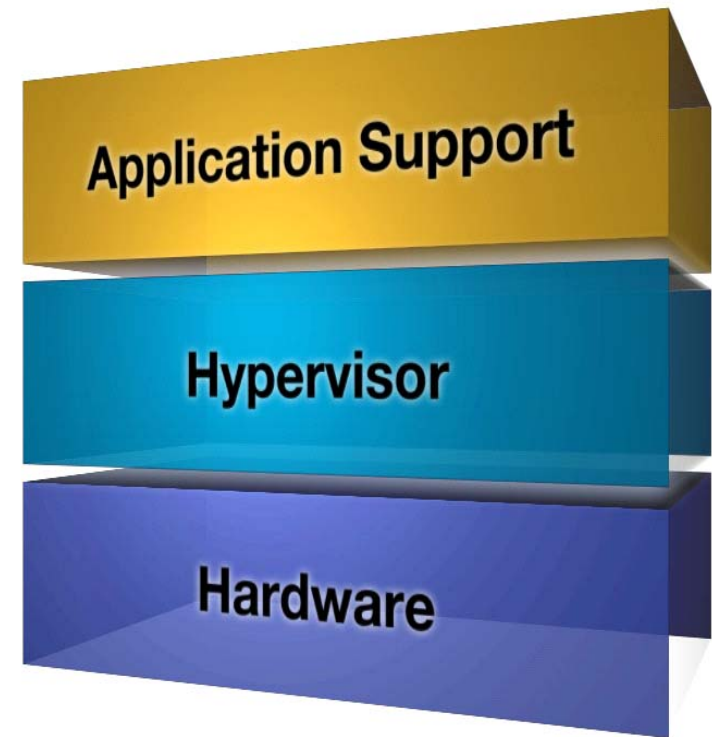
Hardware

System z virtualization starts on the chip; an integration of hardware, firmware, and software functionality

z/VM Virtualization Leadership
The Value of Scaling on a Single Hypervisor

- **Grow virtual server workloads without linearly growing energy costs**

- **Enhance staff productivity with a single point of control at the hypervisor level**

- **Dynamically add and remove physical resources in a single machine to optimize business results**

- **Exploit hypervisor automation tools with higher degrees of integration and optimization**

Extreme Virtualization with System z
## *Understanding the Value Proposition*

- **Business pain points addressed by server virtualization:**
  - Underutilized IT assets
  - Environmental costs
  - Linear software costs per server image
  - Staff inefficiencies managing multiple real servers
  - Spiraling people costs

- **x86 virtualization pain points addressed by System z**
  - Virtual server workload management
  - Reliable high-bandwidth I/O virtualization
  - Virtual server and total system performance reporting and planning
  - Virtual server reconfiguration outages
  - Virtual machine security and integrity
  - Server sprawl with added complexity

Clients need to develop an enterprise-wide virtualization strategy that leverages the strengths of mainframe virtualization

Secure Virtualization Changes Operational Model
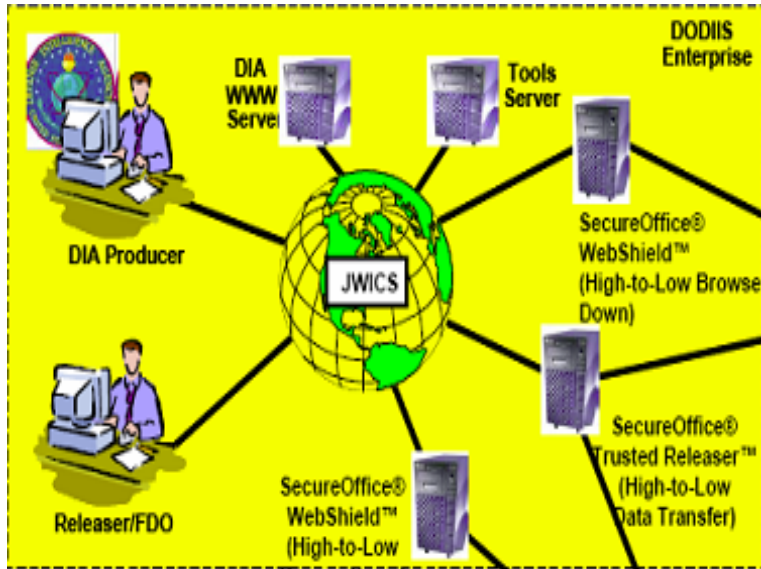
- **Cross Domain Database:**
  - Provide real time access to data avoid batch delays
  - collaboration across communities
- **Cross Domain Presentation Client**
  - Reduces desktop clutter
  - Reduce power consumption
  - Reduces leak potential with central mgt
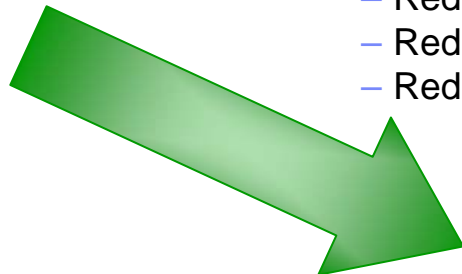
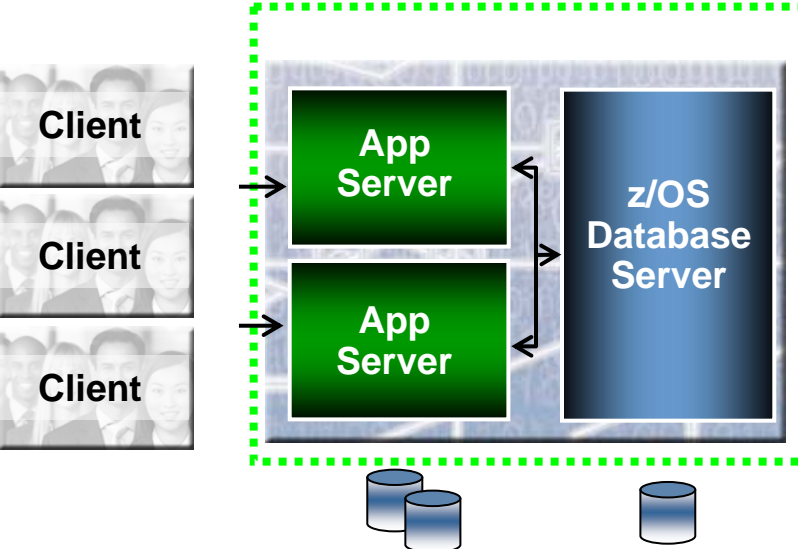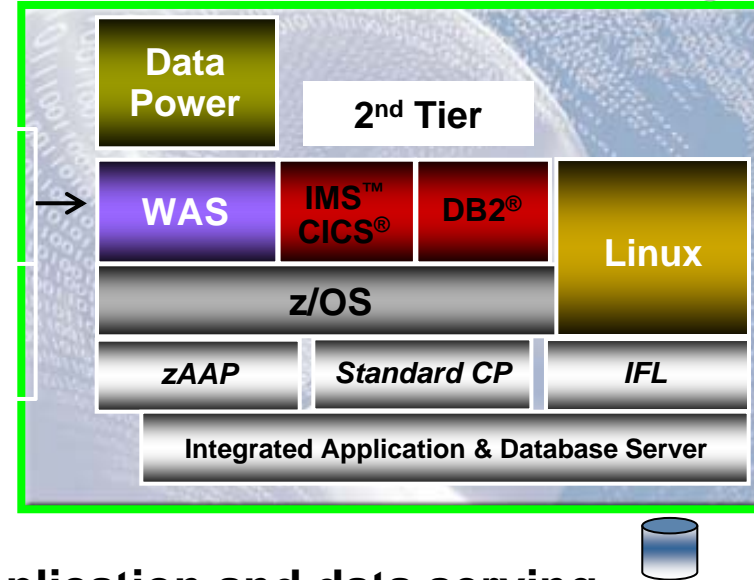|	
Near-linear scalability	up to 900,000+ concurrent users; TBs of data
"Mean Time Between Failure"	measured in decades versus months
¼ network equipment costs	virtual and physical connectivity
1/25th floor space	400 sq. ft. versus 10,000 sq. ft
1/20 energy requirement	$32/day versus $600/day
1/5 the administration	< 5 people versus > 25 people
Highest average resource utiliz.	Up to 100% versus < 15%
Capacity Management & upgrades	On demand; in hours, not weeks/months
Security intrusion points	Reduced by z architecture and # of access pts.
Higher concurrent workload	hundreds of applications versus few
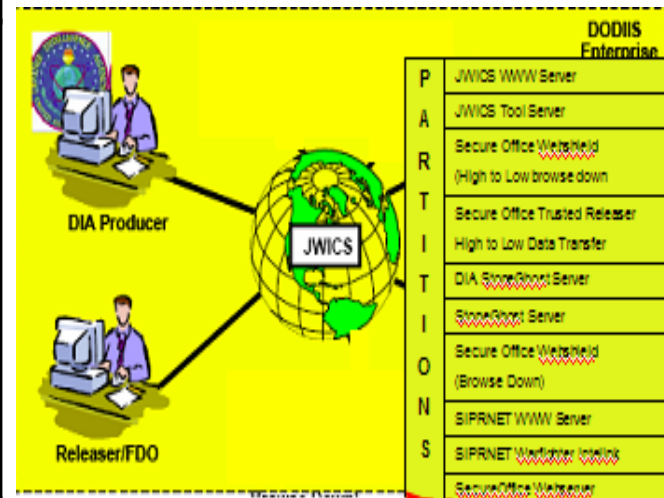
Enterprise hub for data & SOA

Integrated z/OS Application & Database Servicing

Networked Web Serving

Client

Client

Client

| App Server | z/OS Database Server |

| App Server |

1st Tier

Client

Client

Client

Data Power

2nd Tier

| WAS | IMS™ CICS® | DB2® | Linux |

z/OS

| zAAP | Standard CP | IFL |

Integrated Application & Database Server

Potential advantages of consolidating your application and data serving

- Security — Fewer points of intrusion
- Resilience — Fewer Points of Failure
- Performance — Avoid Network Latency
- Operations — Fewer parts to manage
- Environmentals — Less Hardware
- Capacity Management — On Demand additions/deletions

- Utilization — Efficient use of resources
- Scalability — Batch and Transaction Processing
- Auditability — Consistent identity
- Simplification — Problem Determination/diagnosis
- Transaction Integrity — Automatic recovery/rollback

With Integrated Facility for Linux (IFL)

With IBM zSeries Application Assist Processor (zAAP)

System z has been **Cool** since before it was cool to be **Green**

July 31, 2001

Mary Ann Christie
IBM, Corporate Program Manager,
Environmentally Conscious Products (ECP)

Dear Ms. Christie,

I am pleased to inform you that the US Environmental Protection Agency will announce that ENERGY STAR® is recognizing IBM's eServer z900, the reinvented mainframe, for its contributions to energy savings with a "Certificate of Recognition." Although servers are not covered within the scope of ENERGY STAR, IBM's energy saving efforts through technology and architectural design can contribute significantly to energy savings, thereby reducing pollution caused by energy generation.

IBM's z900 is the first e-business enterprise server designed for the high-performance data and transaction needs demanded by next generation e-business. The technologies used in the z900 enable far greater performance while requiring considerably less energy than its predecessor products, extending its energy saving benefits to its customers worldwide. IBM not only applied its semiconductor technologies such as copper wiring and "silicon on insulator" (SOI), but reinvented the mainframe to handle the unpredictable demands of e-business, allowing thousands of virtual servers to operate within one box. Companies that in the past required hundreds of individual Unix-based servers now can potentially save significant energy and dollars by using one z900 to accomplish the same task. These savings can be even more dramatic when floor space requirements of a server farm are considered. Compared to the average server farm that requires some 10,000 square feet of floor space, a single IBM z900 only requires around 400 square feet. At an average of 100 Watts per square foot, energy savings are significant.

Energy efficiency continues to be a key product design attribute for IBM products. Over the last three generations of IBM's large CMOS servers, the energy improvement per input/output (ESCON) channel has been measured to be an annualized 30% improvement. The latest generation, the eServer z900, addresses energy savings as well as one of the greatest e-business challenges–to efficiently and robustly manage unpredictable resource requirements, allowing resources to shift automatically to the applications that need them. The eServer z900 offers customers the performance they demand and energy savings that benefit the environment.

Congratulations.
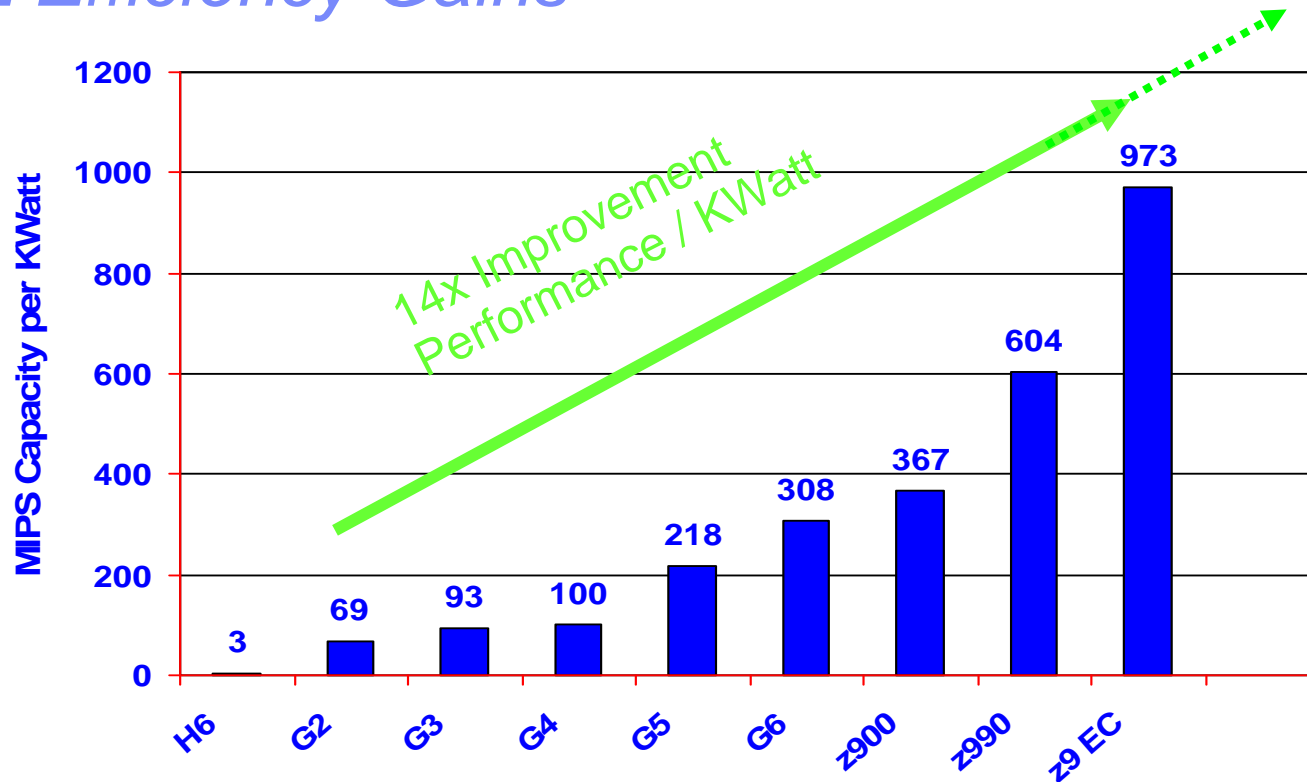
Sincerely,

Craig Hershberg
ENERGY STAR for Office Equipment
& Consumer Electronics
hershberg.craig@epa.gov
Phone: (202) 564-1251

Certificate of Recognition

ENERGY STAR®
Recognizes

IBM Corporation

*for its Server z900, the reinvented mainframe,
for its contributions to energy savings.*

Ann Bailey
Chief, Labeling Branch
ENERGY STAR
US Environmental Protection Agency

Be **Lean** and **Green** through System z Technology
System z Efficiency Gains

Bar chart: MIPS Capacity per KWatt

System	MIPS Capacity per KWatt
H6	3
G2	69
G3	93
G4	100
G5	218
G6	308
z900	367
z990	604
z9 EC	973

14x Improvement Performance / KWatt

13 years (CMOS Evolution) G2 – z9 EC

Power increase	20%/year
Performance increase	50%/year
Power Density increase	17%/year

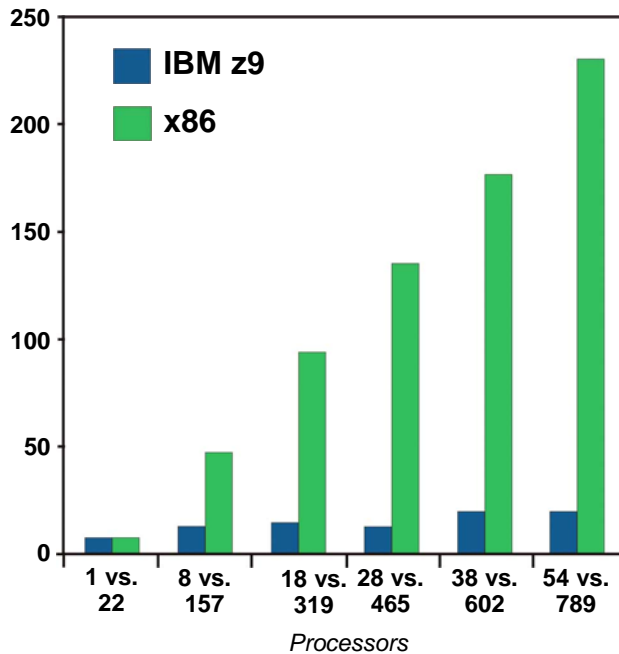**Net Effect: CMOS G2 to z9 EC**

Performance Increased by	192x
Performance/KWatt Increased by	14x
Performance/Sq Ft Increased by	4,000x

Power and Space Consumption

When consolidating low utilization Linux on Intel servers, the System z9 Mainframe's ability to provide high utilization may help to reduce both power and facility costs
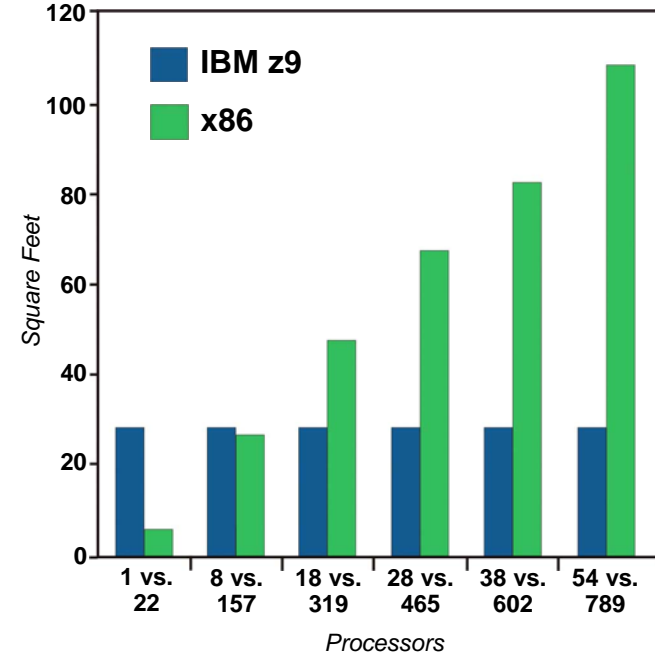
POWER:
System z9 vs. Linux on x86

In a consolidation, the IBM System z9 Enterprise Class (EC) may provide up to 4 times the same work in the same space and may provide up to 12 times the work for the same power consumption

SPACE:
System z9 vs. Linux on x86

The Linux on x86 servers selected in this example are functionally eligible servers considered for consolidation to a System z running at low utilization such that the composite utilization is approximately 5%. The utilization rate assumed for System z EC is 90%. This is for illustration only actual power and space reductions, if any, will vary according to the actual servers selected for consolidation.

Today's Mainframe:
More powerful, less power – simply an efficient solution for multiple workloads

System z Deployment Considerations

- **Supports Open Programming models**

  - Web services, Java, C/C++ - in both Linux for z and z/OS systems

- **Benefits of Scale Out environment in a Scale Up container**

  - Modularized to add server instances and functionality where and when needed – Software As a Service – On Demand

- **System z provides an open programming model with operational superiority to other platforms**

  - Applications can leverage best of x86/RISC worlds with mainframe to produce best Global IT Infrastructure TCO to customers.

- **System z becomes more of a Service Bureau for the enterprise, deploying Software as a Service**

  - Rethink your end to end Spreadsheets

System z expanding to a wider set of workloads

Leading edge technology

zNext Entry and High End offerings

- High frequency multi-core microprocessor design
- High bandwidth, low latency interconnect using open standards
- Large memory support and Coherent Shared Memory construct
- Operating System and PR/SM™ affinities for improved performance
- Advanced power management – environment optimization
- Integrated Cell processor

**Compute intensive capabilities
HW (CPU/IO) & SW efficiency**

zNext+1- granular range of offerings from Entry to High End

- Highly integrated hybrid platform
- Industry leading I/O performance
- Appliance, Application accelerator and Cell exploitation
- Continued exploitation of Specialty Engines

**Throughput Computing
Hybrid platform for Integration
Multiple Application Personalities
Data Server and Messaging Appliances**

System z expanding to a wider set of workloads

System z as the Enterprise Data Server

- OLTP/ERP
- Data Warehouse
- Enterprise Archiving
- Master Data Management
- Threat and Fraud
- Information

**Transactional DB, Warehouse,
Data Analysis, Content Mgnt., Infrastructure DB,
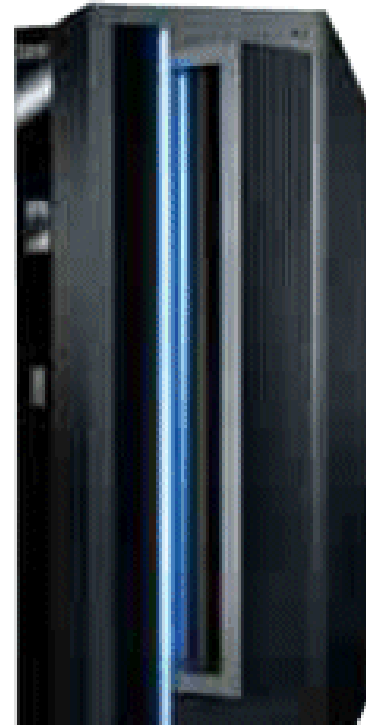Mining, Web & Collaboration Content DB**

SOA, Consolidation and Enterprise Wide Role

- Enterprise SOA
- Virtualization
- End to End Security
- End to End Business Continuance

**Business Process Apps, Application
Accelerators, System Management, Web
Serving/Proxy Caching, Gaming & Interactive
Virtualization, Network IMS/VOIP**

The z Software Strategy

- **Reinvigorate the System z Ecosystem:**
  - Attract New System z Customers and Application Workloads
  - Retain and Grow Existing System z customers
  - Make the Mainframe Relevant to a new IT Generation
- **Platform Modernization and Simplification are key:**
  - Evolve to an SOA Server
    - Systematic Reengineering of the Software Stack
    - More Open Standards Compliant and Common Middleware
    - Integration with the z Platform for Added Functions
  - Deliver Extensive Data Management Services
    - Leading Edge Relational Function
    - Reinvigorated Data Warehousing Competitiveness
    - Autonomic Tooling to Augment Human Expertise
  - Make System z Easy to Install and Manage for Better TCO
    - New Faces of z
    - Simplified Labor Intensive Tasks
    - More End to End Management Capability from a z Central Point of Control

New Business Problems leverage new technologies

Evolving & Emerging Applications

On Demand enterprise

On Demand IT infrastructure

Event-based business processes

Real-time collaboration

Security and privacy

Business resilience

Massive amounts of data

Next generation user interfaces

Industry-specific applications
Business processing
Decision support
Collaboration
IT & Web infrastructure
HPC applications

Evolving & Emerging Workload Components

Java   XML

Analytics   Data Protection

SOA

Traditional Workload Components
z/OS, z/VM, z/VSE™

Events

Sensors

Search

Encryption   Digital Media

Linux
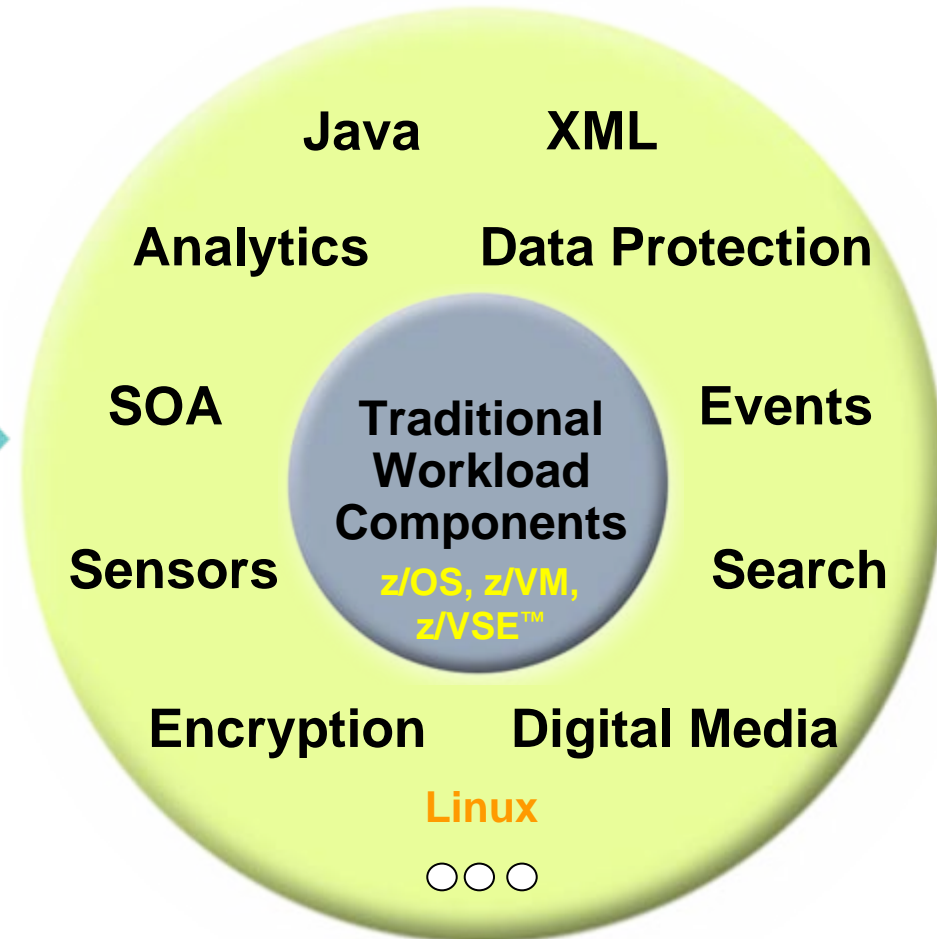
A Variety of Ways to Solve New Problems

Network

Apps

Services

Database Workload

Appliances
DataPower®

Accelerators
Cell Blade

Special Purpose Servers
Blue Gene®

Value Proposition: More efficient function delivery & implementation than general purpose code and algorithms
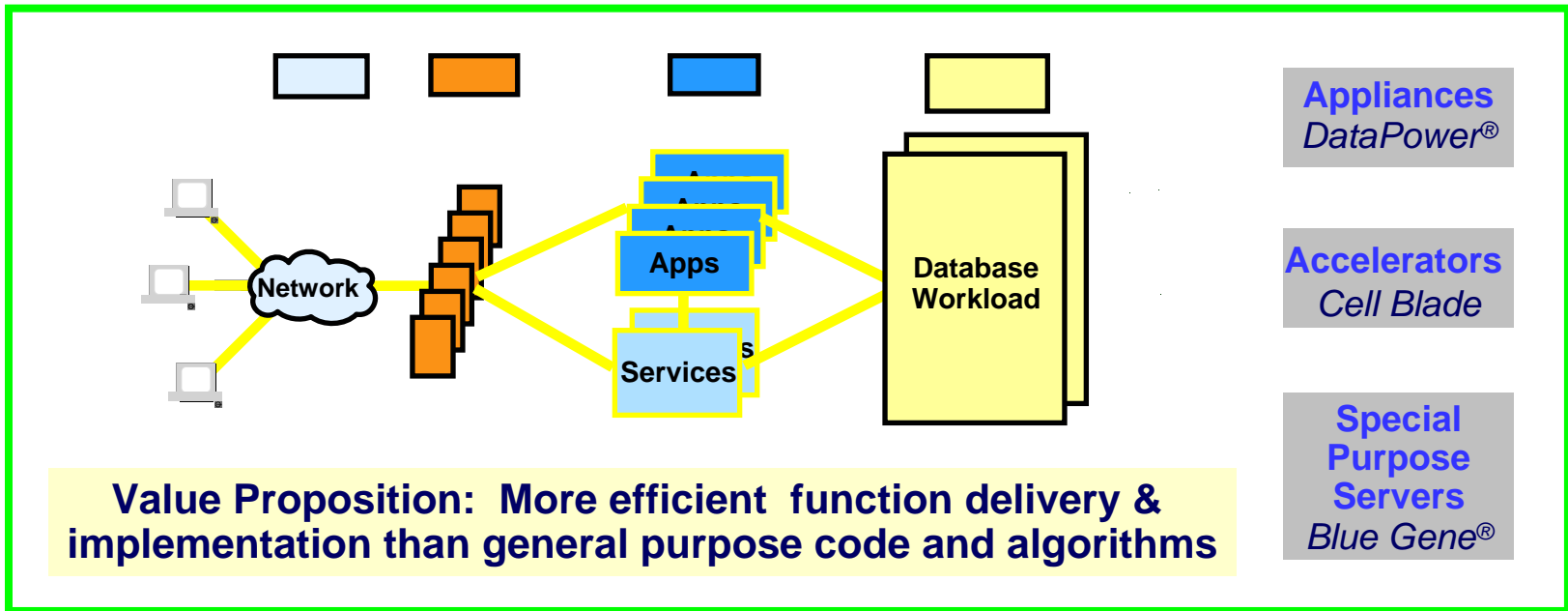
Key Enablers

Programming Model
Distributed system models, multi-tier, SOA, events, …

Open Standards
Electrical, protocol, data (e.g. XML, SOAP), …

Fast standard communication
Ethernet, InfiniBand, uDAPL, ICSC, OpenIB, …

Development tools & services
Foundries, Eclipse, open source ecosystems, …

Accelerator building blocks
FPGAs, SoC ASICs, Network Processors, Linux, …

Evolving & emerging applications will drive systems optimization

Both general purpose and special purpose capabilities will be needed –
integration will be critical

Enterprise systems

Evolving & Emerging Workload Components

Special purpose systems and accelerators

Optimized for a broad set of applications or components

Java   XML

Analytics   Data Protection

Linux

SOA   Events

z/VSE

Traditional Workload Components

Sensors   Search

z/OS

Encryption   Digital Media

z/VM

•••

Optimized for a specific set of applications or components

Hybrid systems
will optimize to workloads

Scalable Hybrid Server Platform

Single Server as Resource Pool

Virtual Servers

Virtual Networks

Hypervisor

HMC — Control

SMP Server

HW Console for manual control

Example: single high-end SMP server

Multiple Logical Servers as Resource Pool

Console

Mgmt Center

Control

Virtual Servers   **Virtual Servers**

Virtual Networks

Hypervisor • • • **Hypervisor**

Physical Networks

Z Server   Other server

• Movable virtual servers
• End-to-end virtual networks
• Hybrid Server Management

Management Center
(HMC, VSM, CAM, EWLM …)

Example: z Hybrid Server

A new game-changing "mainframe" system

- z/OS and its sysplex capability is positioned to provide leadership in enterprise data serving, high volume traditional transaction processing, and messaging infrastructure
- An opportunity exists to integrate the virtues of the System z with pools of other servers, as well as other hardware accelerators, in a hybrid design
- State of the art resource virtualization and platform management technology are applied to create a highly integrated platform
- Key goal: Manage a pool of heterogeneous servers within the hybrid much like a single homogeneous SMP server
- The integrated hybrid platform will provide value beyond what could be provided with distributed systems configurations
- Integration of these towers occurs at two levels
  - Low latency, high performance, instrumented interconnect between the elements of the hybrid
  - Integrated platform management functions leveraging virtualization providing ease of use, flexible resource management, policy driven QoS aligned to specification of business applications, and single system image across the hybrid

Data serving enhancements

Data storage and usage patterns are changing !!

- **Structured & unstructured data**

- **Highly secure and robust high performance file system**

- **Warehousing & analytics**

- **Very low latency interconnects**

Tomorrow's Mainframe:
   The simplicity of a single data server for all your data !

Today's mainframe

Four Global IT Infrastructure roles of the Mainframe

- **End to End business resilience manager**
- **End to End security manager**
- **End to End workload manager**
- **Enterprise hub for data & SOA**

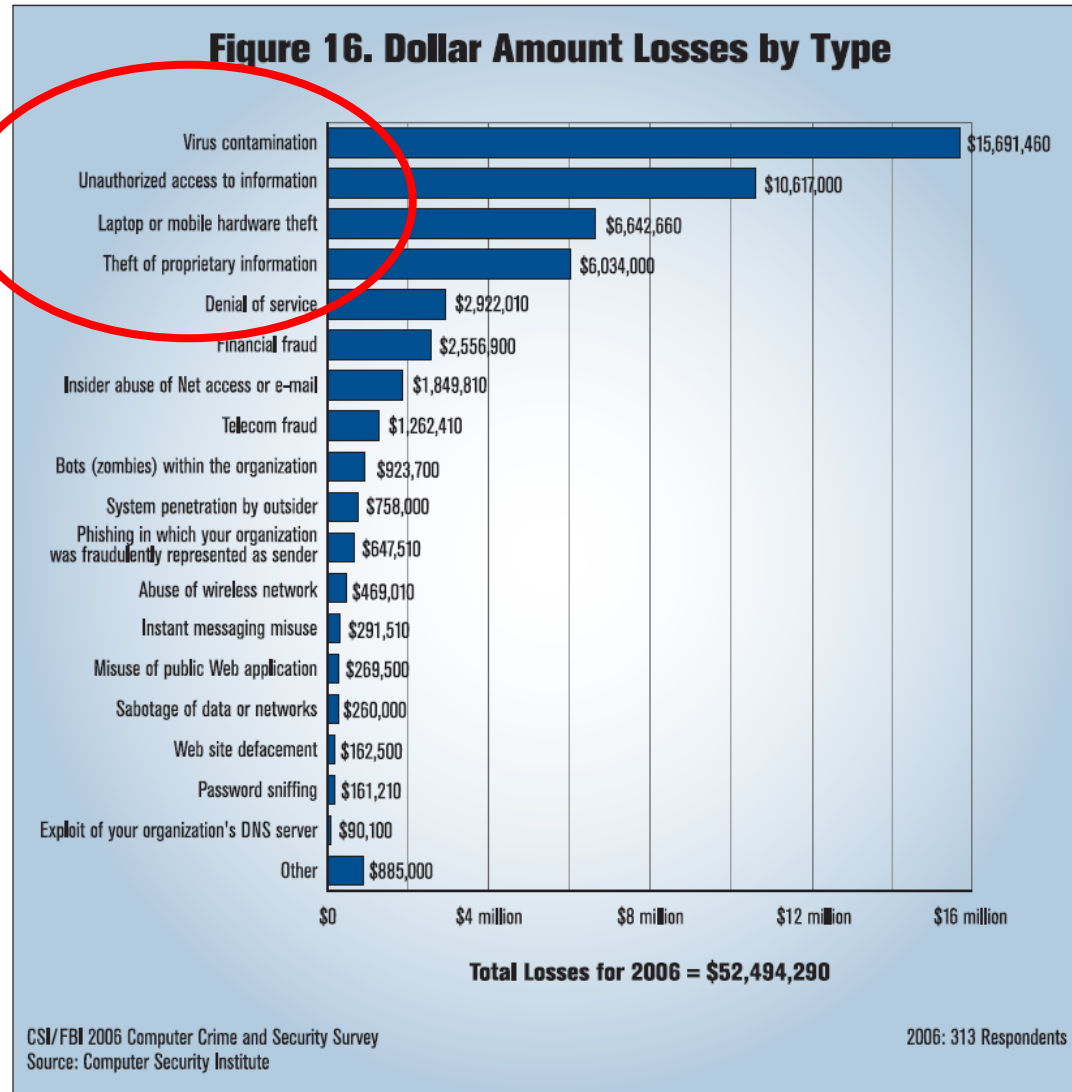*If data is the life blood of the business . . .*

then your data server is the heart of your SOA

Cost of Security Incidents

- **Computer Crime Survey indicates virus attacks still as the source of the greatest financial losses implying a need for a trusted platform**

- **Unauthorized access to information is second ranked, implying a need for better data protection.**

- **Loss from unauthorized access to information:**
  - Was 303,234 in 2005
  - Is $10,617,000 in 2006

- **Loss from theft of proprietary information**
  - Was $355,552 in 2005
  - Is 6,034,000 in 2006.

 *System z can address 4 out of the top 5 incidents (not laptop theft)*

Figure 16. Dollar Amount Losses by Type

Type	Amount
Virus contamination	$15,691,460
Unauthorized access to information	$10,617,000
Laptop or mobile hardware theft	$6,642,660
Theft of proprietary information	$6,034,000
Denial of service	$2,922,010
Financial fraud	$2,556,900
Insider abuse of Net access or e-mail	$1,849,810
Telecom fraud	$1,262,410
Bots (zombies) within the organization	$923,700
System penetration by outsider	$758,000
Phishing in which your organization was fraudulently represented as sender	$647,510
Abuse of wireless network	$469,010
Instant messaging misuse	$291,510
Misuse of public Web application	$269,500
Sabotage of data or networks	$260,000
Web site defacement	$162,500
Password sniffing	$161,210
Exploit of your organization's DNS server	$90,100
Other	$885,000

Total Losses for 2006 = $52,494,290

CSI/FBI 2006 Computer Crime and Security Survey
Source: Computer Security Institute

2006: 313 Respondents

CSI/FBI Computer Crime Survey 2006

IT security challenges

Need to maintain business innovation and growth in the face of risks

- **Increasing *complexity* of security issues in today's environment**

- ***Compliance* with regulations and audit requirements is difficult**

- ***Limiting* and *tracking access* to sensitive or private information and assets**

- **Establishing a *trusted relationship* with customers and partners**

- **Protecting against *security incursions* and *risks to confidential information***

- **Security issues are hurting the *bottom line!***
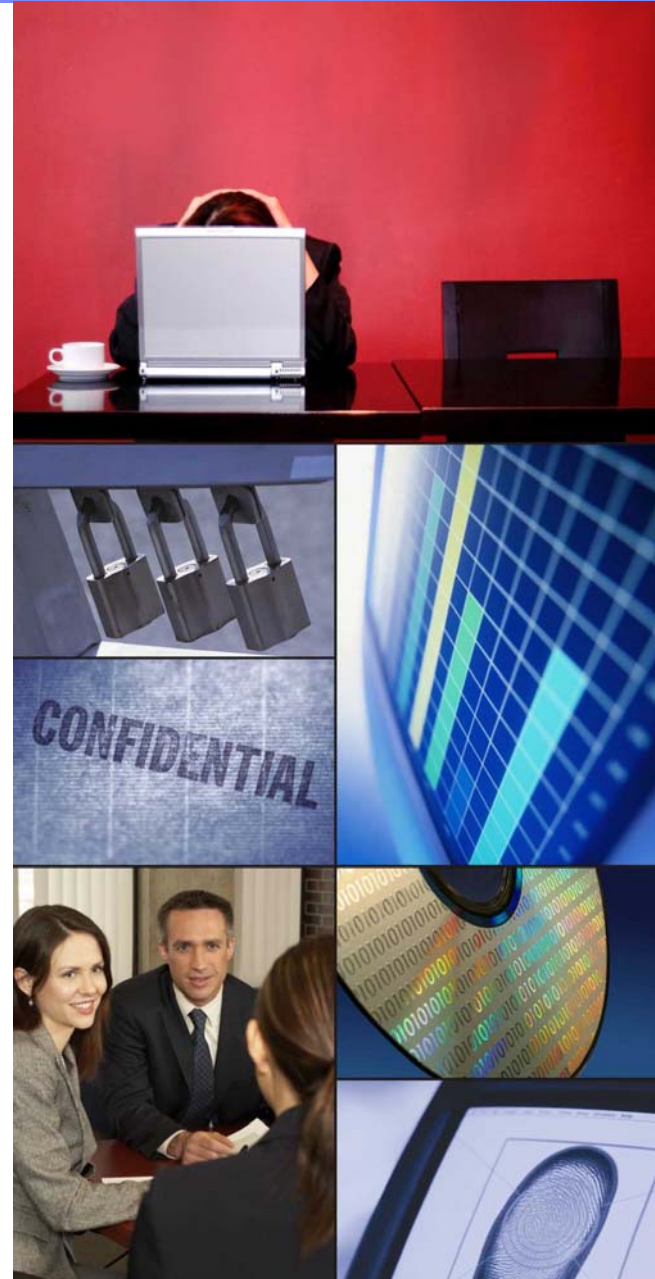
System z - Security Leadership

- **Security-rich holistic design to help protect system from malware, viruses and insider threats**
  - Data, application and virtualization integrity features to confidently place mixed workloads on System z
  - Centralized role-based access controls to resources access the System z enterprise
- **Encryption solutions to help secure data from theft or compromise – on network or storage media**
  - Built on time-tested System z encryption infrastructure with System z availability, disaster recovery, and access controls
  - Tamper-resistant encryption module to protect encryption keys from detection with highest certification at FIPS 140-2 Level 4
- **End to End security solutions leveraging the proven security process of your mainframe**
  - Policy-based identity management for the enterprise with Tivoli® Identity Manager on z/OS
  - Centralized, highly-secure and resilient key manager for IBM tape encryption solutions across the enterprise
- **Allowing you to address compliance needs with more confidence**
  - Provides extensive audit information to enable regulatory compliance while Extending the inherent compliance features of z/OS with Tivoli Insight for integrated audit, monitoring and compliance
  - Independent Common Criteria certifications attest that System z solutions have been methodically designed, tested, and reviewed for secure operations
    - System z is the only server with EAL 5 certification for logical partitioning
    - Operating systems certifications include z/OS at EAL4+, z/VM at EAL 3+ and Linux on z at EAL 4+

**Mitigating the risk of security breaches
and helping to protect your organization's brand image - and bottom line**

Nextgen Deployment – Building the Sandbox
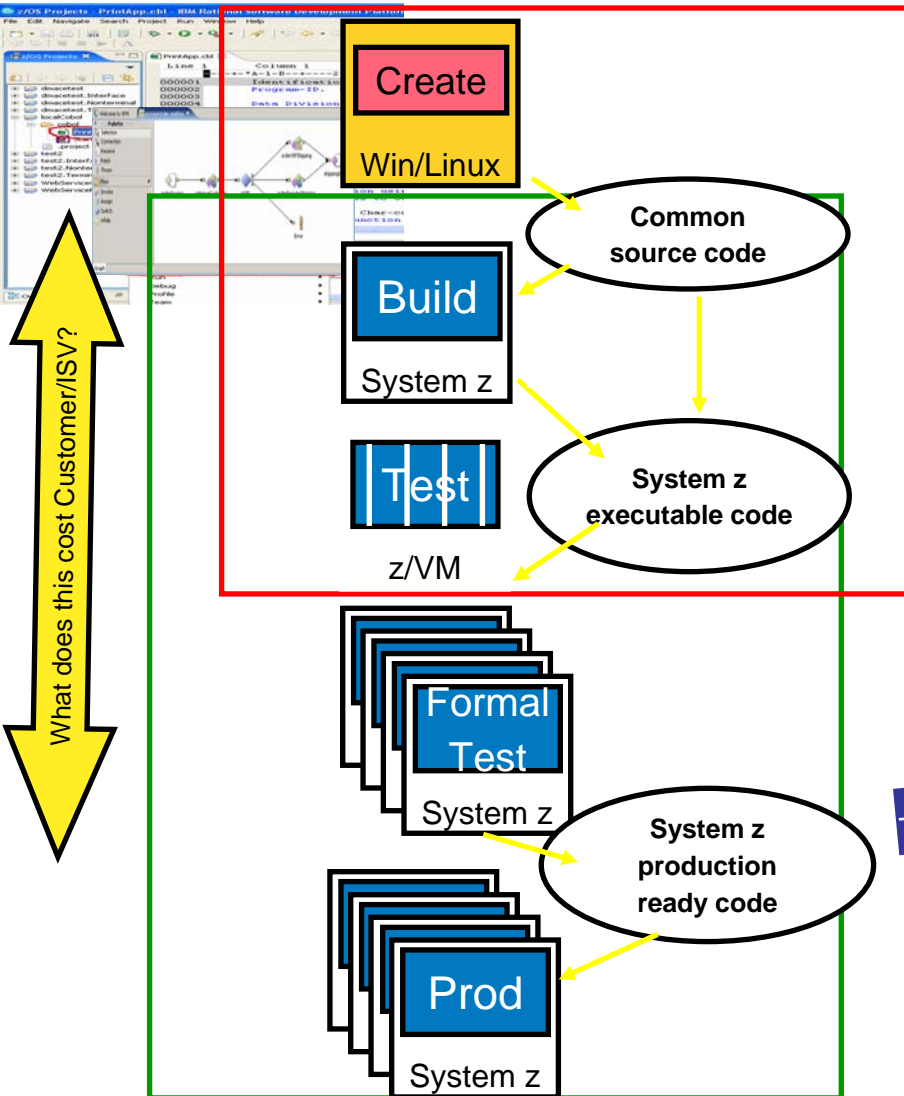
- **Use of Rational® Developer for System z on the desktop and mainframe for seamless deployment**

- **Use of IT skills to build z environment for the "nextgen" efforts, enabling application architects accessability to the platform**

- **Use of z/VM to get a z image accessible to every user that wants it**

- **T's and C's, such as the z Platinum or Application Initiatives to get affordability of the sandbox**

- **Paving the On Ramp to the Mainframe Super Highway**

Global IT Opportunities with z/OS and System z

- **Business resilience** – leverage System z to help fail over (Disaster Recover) other servers' data
- **The vault** – Data can be referenced from System z (like DB2) for other servers, but with Integrity, Security and Resilience – simplifying Compliance – HIPAA, Sarbanes-Oxley
- **Compliance Manager** for the enterprise
- **Trust Authority for the enterprise -** identification and authentication, audit/compliance, Root Certificate Authority (saving real $) – Consolidating Audit records
- **Penetration Testing** – ensuring security of operational deployment
- **Business Process Integration** – build Web services on the mainframe
- **Utilizing the zAAP, IBM System z Integrated Information Processor (zIIP)** – changing the economics for deploying on the mainframe
- **Infrastructure Simplification – *SNA consolidation, sharing applications***
- **SMB** - the scale and managability of the mainframe, but delivered in containers suitable for the SMB (on demand!) – a Service Bureau model for deployment
- **Virtual BladeCenter** – TCO experience with provisioning Linux on z
- **A z on every developers desktop** – make the platform accessible to every developer via z/VM
- **Unlimited growth** – the answer is 64 bit.....move those old boxes up to z9's and take advantage of 64 bit and additional engines
- ***The mainframe is a weapon, use it wisely***
  - Cultivating growth opportunities

In Summary: The future System z

- **We are delivering a New Generation of systems on z**
  - SOA and z together extend and leverage decades of massive business Investments
  - Highly Integrated design using the best technologies including specialty engines and accelerators

- **Mainframe superior operations and qualities of service continue to improve, including:**

  Extending today's leadership into the future …

  - Large scale performance for data intensive commercial environments
  - Unsurpassed virtualization capabilities with management integration
  - Built-in availability and resiliency for planned and unplanned outages
  - End to end security in the enterprise
  - State of the art automation
  - Excellence in centralized operation for simplified Global IT infrastructure

Over 40 years ago, IBM changed the worlds of computing and business – and transformed itself – with the revolutionary System/360. The spirit of that time thrives today in a new era of big bets, innovation, and on demand business.

Functional Comparison of z/VM and VMware ESX

Attribute	z/VM V5.3	VMware ESX 3	System z Value
Supported operating systems	Linux, z/OS, z/VSE, z/TPF, z/VM itself	Linux, Microsoft™ Windows™, Netware, Solaris 10	z/VM-on-z/VM = added flexibility
Scalability and Performance			
Hypervisor scalability	Up to 32 CPUs, 256 GB of memory, 8 TB of "active virtual memory"	Up to 32 CPUs, 64 GB of memory	Cost-saving, extreme scalability of virtual server environment
Virtual Machine (VM) scalability	Up to 64 CPUs, 1 TB of memory, extensive I/O bandwidth	Up to 4 CPUs, 16 GB of memory, modest I/O bandwidth	Virtualizes servers on z/VM that cannot run on VMware
CPU sharing	No limit	Up to 8 VMs per CPU	Add servers without adding HW
Architected (practical) VM limit	Thousands (hundreds) per copy of z/VM	128 (singles) per copy of VMware	Avoid real server sprawl
CPU capacity on demand	Yes, non-disruptively	No	Fast, easy capacity growth
In-memory support	Minidisk cache; Virtual Disks in Storage; DCSS (shared program executables)	Shared virtual memory pages (detected via background operation)	Enhanced resource utilization
Logical Partition (LPAR) support	Yes	No	Secure Linux access to z/OS
Flexible Operations			
Resource over-commitment support (memory, CPU, network, I/O)	Extensive	Modest	Absorb workload spikes; add more servers to a "full" system
Reconfiguration of Virtual Machines	Non-disruptive re-config for CPU, I/O, networking; VM re-boot for memory	VM reboot required for re-config of CPU, memory, ethernet, disk	Higher server and application availability; staff productivity
Command and control, monitoring, automation infrastructure	Extensive, robust, time-tested	Modest	Cost-optimized systems management support
Virtual Machine mobility support	No; single-image scalability of z/VM does not require mobility for mgmt	Yes; essential for workload mgmt across multiple copies of VMware	Can dynamically add or remove resources to meet demand
Integrity and Security			
Fault isolation / hypervisor security	Hardware-assisted isolation*; CAPP/EAL 3+	No I/O virtualization separation; CAPP/EAL 2	Helps to avoid security breaches; data security and integrity
Run multiple copies of hypervisor on single server	Yes; share CPU, I/O, and networking resources among z/VM systems	No	Workload isolation; lower-cost failover (using same hardware)

* z/VM runs in System z LPARs, which have achieved EAL 5 certification; System z HiperSockets provide high-speed, secure connectivity among LPARs.