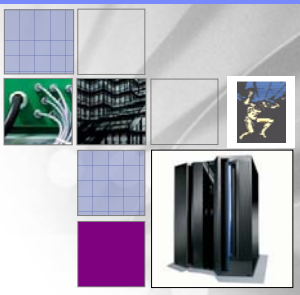
IBM

IBM System z Directions
The future data center
Technology Status and Roadmap focus

a System z for "every" application
breaking down the "server walls"



Svend Erik Bach
Distinguished Engineer, IBM Nordic/Europe
seb@dk.ibm.com

A Strategic Vision for the Future
Role of the IBM System z Mainframe

IBM Systems

IBM

Agenda

- System z positioning today…
- Some consolidation trends
- General investment areas
- zNext and application trends
- zFuture - hybrid application server architecture

Emerging data serving platform with multiple application personalities
"The end" of the general purpose processor era !

System z9 - today

Unlimited Scalability - High Flexibility
Resilience - Security
Integration

continued
large investments
and
effective price reduction HW and SW

Current status - System z9

Investment:

- **3 years**
- **$1.2 billion**
- **5,000 tech professionals**

System z - today

Scalability - High Flexibility
Resilience – Security (EAL5)
Integration

Continued effective price reduction HW and SW

z9 EC *Enterprise Class*

Up to 64 engines (cores)
Multiple Capacity levels
- 4 levels: 199, 386, 468, 580 MIPS
zAAP, zIIP, IFL engines
RoHS compliant
Upgrade from z900, z990, z9-BC

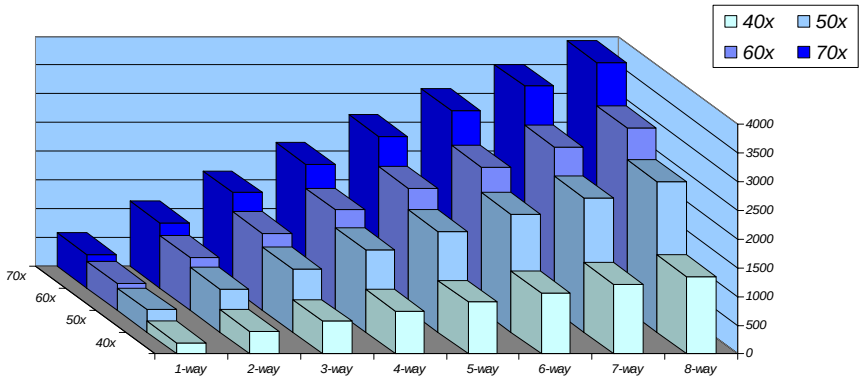
4 Advanced z9 BC MCM's (Book's)
Concurrent Install / Upgrade / Repair
Concurrent upgrade of microcode

z9 BC *(Business Class)*

Up to 8 engines (cores)
R07: 1-3 way + speciality engines
S07: 0-4 way + speciality engines
Multiple Capacity Levels
-10 levels: 26 - 172 MIPS
- 9 levels: 193 - 480 MIPS
zAAP, zIIP, IFL engines
RoHS compliant
Upgrade from z800-4, z890

26 to 17500++ MIPS
Corresponds to up to 3 million++ TPC-C

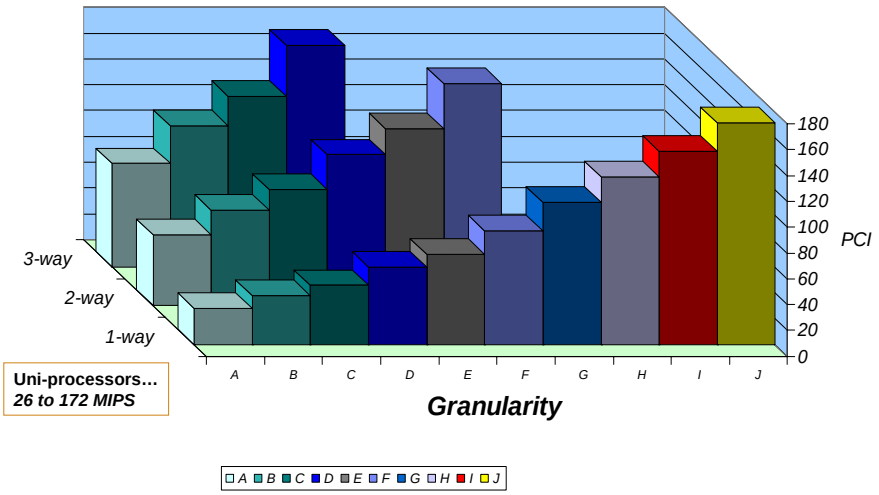
Processor Granularity like we have with z9 will continue



1-way	2-way	3-way	4-way	5-ways	6-ways	7-ways	8-ways	SW Model
199	388	569	740	903	1058	1206	1347	4xx
386	753	1104	1436	1752	2053	2339	2613	5xx
468	913	1338	1741	2124	2489	2836	3168	6xx
580	1131	1659	2158	2633	3086	3515	3927	7xx

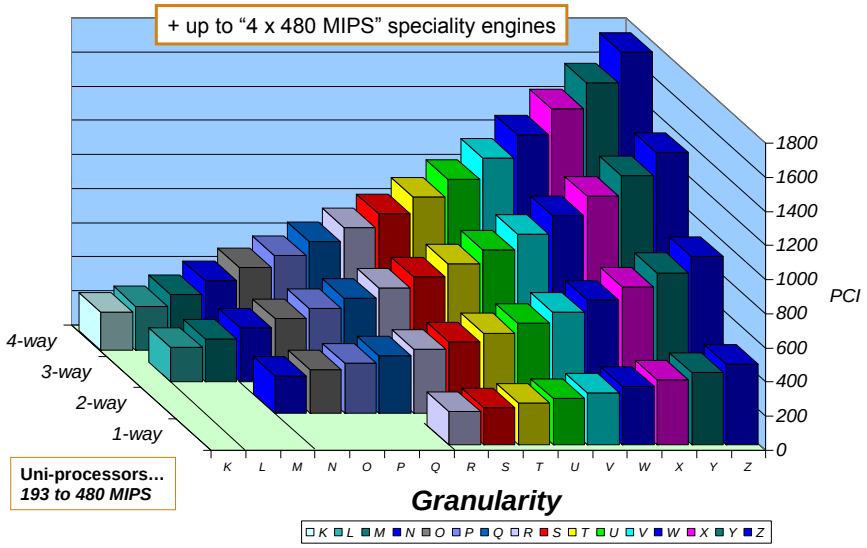
Processor Granularity z9 BC R07 – *26 to 172 MIPS*

+ up to “4 x 480 MIPS” speciality engines



Uni-processors…
26 to 172 MIPS

Processor Granularity z9 BC S07 – *193 to 1782 MIPS*



Uni-processors…
193 to 480 MIPS

Future oriented growth workloads

Specialty Engines - technology investment protection

zAAP/zIIP processors
Provides the economic justification
for
the technical “relevant” and integrated
and
application solution infrastrcuture

No SW charges
$95K - $125K per engine

Building on a strong track record of technology innovation with speciality engines....
DB compression, SORT, Encryption, Vector Facility...

Information Processing
Self-describing Info

IBM System z9
Integrated Information
Processor (IBM zIIP) 2006

Application Technologies
Self-describing Info

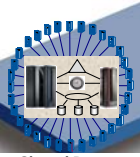
IBM System z
Application Assist
Processor (zAAP) 2004

DB DRDA
DB Parallel
DB Utilities
XML
IPsec
CA, BMC, other tools

Open
Technologies

Integrated Facility
for Linux (IFL) 2001

JAVA
XML



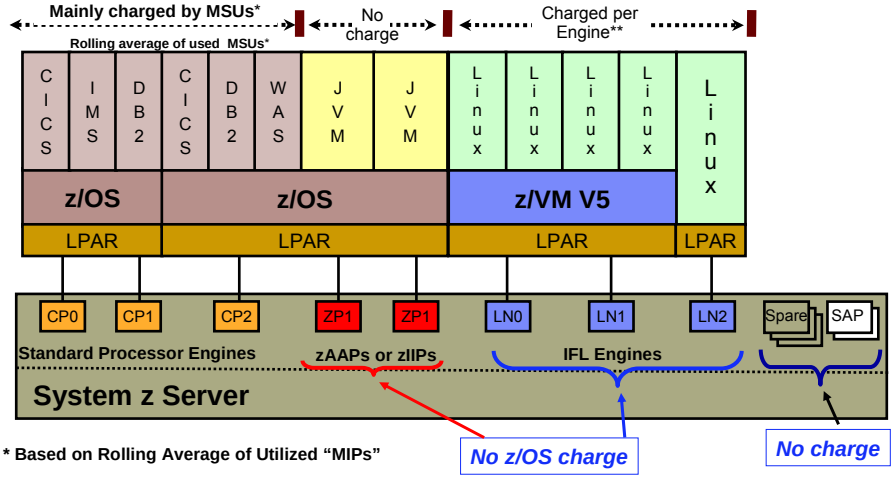
Shared Data
Clustering

Internal Coupling
Facility (ICF) 1997

Usage is completely transparent for Applications
managed “under the cover” by z/OS and the PRSM Virtualization Hypervisor

Value - SW charge methods for specialty engines

*Example: the enterprise pays for **less** than 3 engines (Work Load Charge - rolling avg usage) of z/OS and CICS - even though 8 engines are installed and activated*

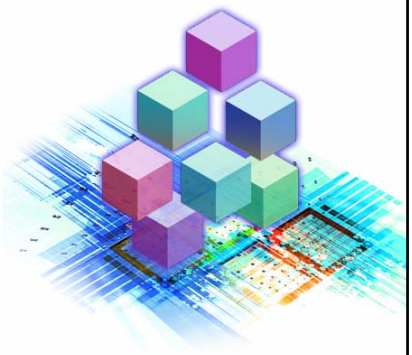


* Based on Rolling Average of Utilized "MIPs"

A Service Oriented Architecture (SOA) is Key

SOA will continue to be a critical enabler of business process innovation

- Packaging business functions from new and existing applications in a simple and standardized way creates services that are available for use
- Services can be reused and combined to deploy composite applications to address new opportunities
- Increasing use of "Web" services based on open standards complements existing services technology
- Classic Silo systems mgt approach is challenged opening an opportunity around centralization & integration with System z



The flexibility to treat elements of business processes and the underlying IT infrastructure as secure, standardized components (services) that can be reused and combined to address changing business priorities

The mainframe is a platform for people, info, process integration

Delivers all the essential SOA qualities

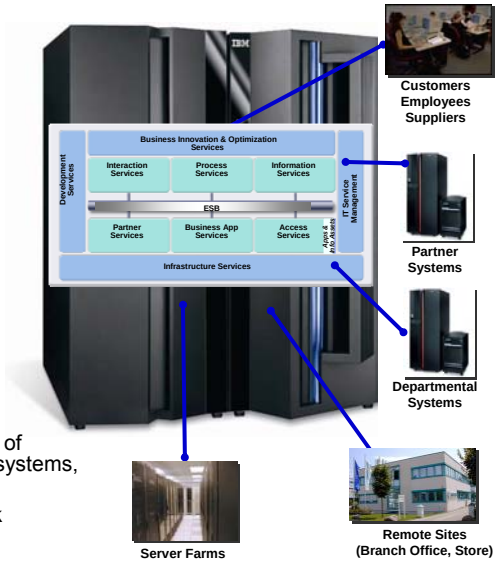
Architecturally compatible:

- **SOA Reference Architecture**
- **Architectural services**
- **Communications and integration**
- **Process control**
- **Reuse of core assets**
- **Helps address industry standards**

Operationally superior:

- **End-to-end security features**
- **24/7 availability**
- **Massive scalability**
- **Automated recoverability**
- **Centralized operations**

- Not just a collection of technologies
- $100B investment into an integrated stack of applications, middleware, data, operating systems, HW and architecture
- HW & SW designed and optimized to work together to achieve business objectives in demanding customer environments



SOA on System z9

A Compelling case for utilizing your most valuable assets!

Extend and Enrich core CICS, IMS and WebSphere applications

CICS, IMS and DB2 are enabled for SOA today!

Ability REUSE of CICS / IMS services as WEB Services

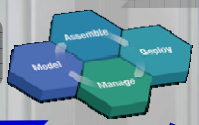
Ability to connect/integrate to/with new composite applications

Creates opportunities for new business processes with …

Running on **any** platform, including z/OS and Linux for System z9

Core System z9 applications

WebSphere SOA platform products



Unlocks the value of…

- **For asset reuse..**
  - **Time to value**
  - **Lower risk**
  - **Lower cost**
- **... and service integrity**
  - **Security**
  - **Availability**
  - **Recoverability**

- **For advanced services…**
  - **User interaction**
  - **Process management**
  - **Information integration**
  - **Enterprise service bus**

SOA Entry Points to get started …..relationship to System z

Both Business Centric and IT Focused

People
- WebSphere Portal
- Websphere Portlet
- Front End Tooling Innovation
- SOA Dashboard Offerings

Websphere/MQ products
Granular pricing up to 10% usage of LPAR
GETTING STARTED pricing
Manual today – productized in future

Information
- WebSphere Information Server
- DB2 V9
- WebSphere RFID Premises Server / Device Infrastructure
- Master Data Management

Process
- WebSphere Process Server for z/OS
- WebSphere Business Modeler
- WebSphere Business Monitor
- WebSphere Integration Developer

Websphere Transformation Extender

Service Deployment Reuse
- WebSphere Application Server V6.1
- CICS Transaction Server V3.1
- IMS V9
- z/Transaction Processing Facility
- WebSphere Service Registry/Repository
- WebSphere Developer for z/OS

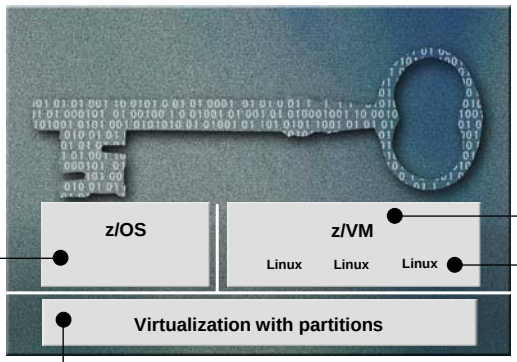
Connectivity
- WebSphere MQ
- WebSphere Enterprise Service Bus for z/OS
- Web Sphere Message Broker
- WebSphere Adapters for z/OS

The IBM SW Development Platform
Rational – Websphere - Tivoli
A new face for System z
Integrated & role specific

Certifications on System z

Certification of mainframe products and components

The Common Criteria program developed by NIST and NSA establishes an organizational and technical framework to evaluate the trustworthiness of IT Products and protection profiles



z/OS
- **Common Criteria** EAL4+ with CAPP and LSPP
  - z/OS 1.7 + RACF
- **IdenTrust™** certification for z/OS PKI Services

z/VM
- **Common Criteria** EAL3+ with CAPP and LSPP
  - **z/VM 5.1 + RACF**

Linux on System z
- **Common Criteria** EAL4+ with CAPP and LSPP
  - **SUSE LES9 certified**
- **Common Criteria** EAL3+ with CAPP and LSPP
  - **Red Hat EL3 certified at EAL3+**
  - **Red Hat EL4 EAL4+ in progress**

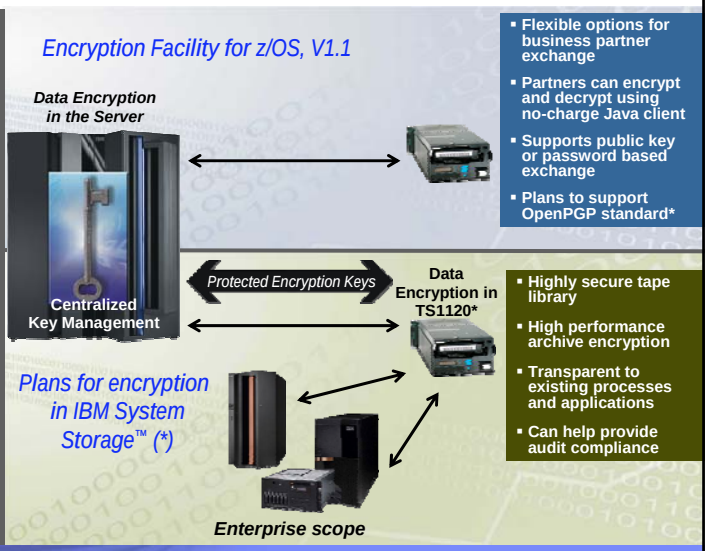
System z EC and other System z servers
- **Common Criteria** EAL5 with specific Target of Evaluation
  - **Logical partitions**
- FIPS 140-2 level 4
  - Crypto Express 2

See: www.**ibm.com**/security/standards/st_evaluations.shtml

Tape Encryption with Key Management on System z

Why z/OS centralized key management?

- Can help to protect and manage keys
  - Highly secure and available key data store
  - Long term key management
  - Audit-ability
  - Disaster recovery capabilities
- Single point of control
- Over a decade of production use



- Flexible options for business partner exchange
- Partners can encrypt and decrypt using no-charge Java client
- Supports public key or password based exchange
- Plans to support OpenPGP standard*

- Highly secure tape library
- High performance archive encryption
- Transparent to existing processes and applications
- Can help provide audit compliance

(*) All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

System z - I/O Subsystem

unique capability
"all" I/O is handled outside the application engines
ALL I/O interfaces may be SHARED

I/O bandwidth up to 170 GB/sec via 1024 channels (I/O interfaces)
ALL I/O devices may be accessed via up to 8 I/O interfaces
I/O may be initiated on one interface & execute over other interfaces
Huge I/O Configurations – Concurrency in Access to same storage device

ESCON

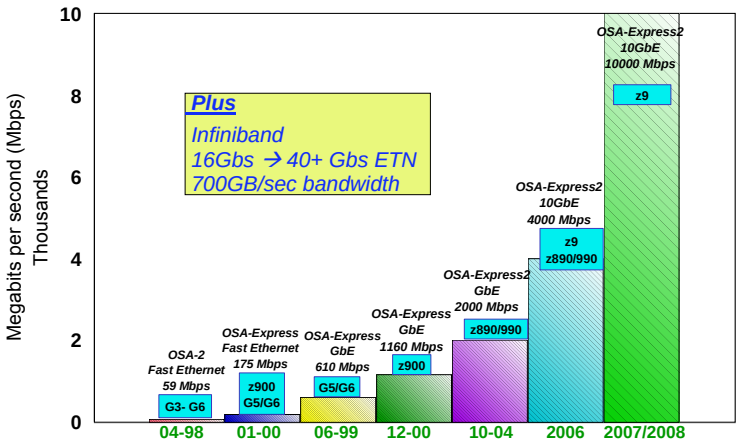
FICON
may run/interleave a high number of concurrent I/O operations - MIDAW - 4Gbs

FCP

1, 2, 10 Gigabit networks
Crypto adapters – SSL/Secure Crypto
Coupling Links (up to2GB/sec)

Future
.....

System z Network I/O Performance objectives



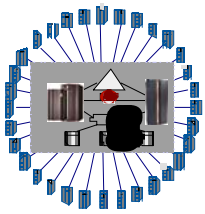
All statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only

z/OS Continuous Availability

Single System

- Built In Redundancy
- Capacity Upgrade on Demand
- Capacity Backup
- Hot Pluggable I/O
- Concurrent Maintenance

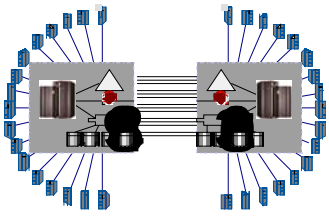
Parallel Sysplex



1 to 32 Systems

- Addresses Planned/Unplanned HW/SW Outages
- Flexible, Nondisruptive Growth
- Capacity beyond largest CEC
- Scales better than SMPs
- Dynamic Workload/Resource Management

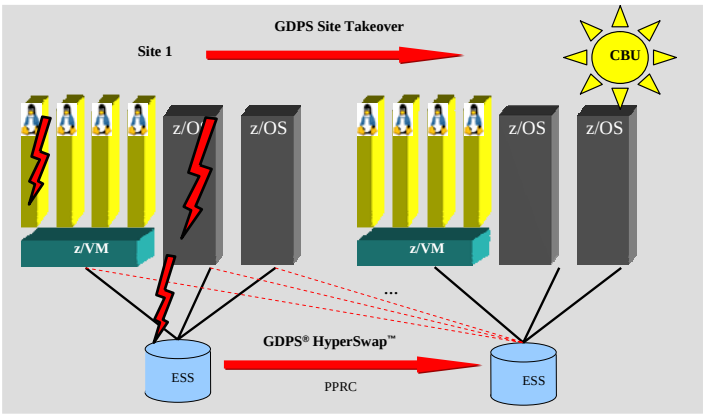
GDPS



Site 1 Site 2

- Addresses Site Failure/Maintenance
- Sync Data Mirroring (100KM)
- Async Data Mirroring (Any distance)
- Eliminates Tape/Disk SPOF
- No/Some Data Loss
- Application Independent
- Coordinated z/OS & zLinux support

GDPS/PPRC Multi-Platform Resiliency



- ✓ **Coordinated near-continuous availability and DR solution for z/OS and Linux guests running under z/VM**
  - ***Valuable for customers with distributed applications***
    - *SAP application server running on Linux for System z*
    - *SAP DB server running on z/OS*
- ✓ **Planned and Unplanned Reconfigurations**

Some Questions

has the mainframe a future role
is it being developed
is it being invested into

Future Directions

"I think there is a world market for maybe five computers."

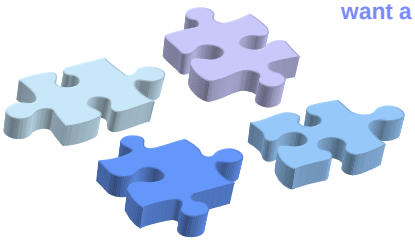
Thomas Watson, chairman of IBM, 1943

"Computers in the future may weigh no more than 1.5 tons. "

Popular Mechanics, 1949

"There is no reason anyone would want a computer in their home. "

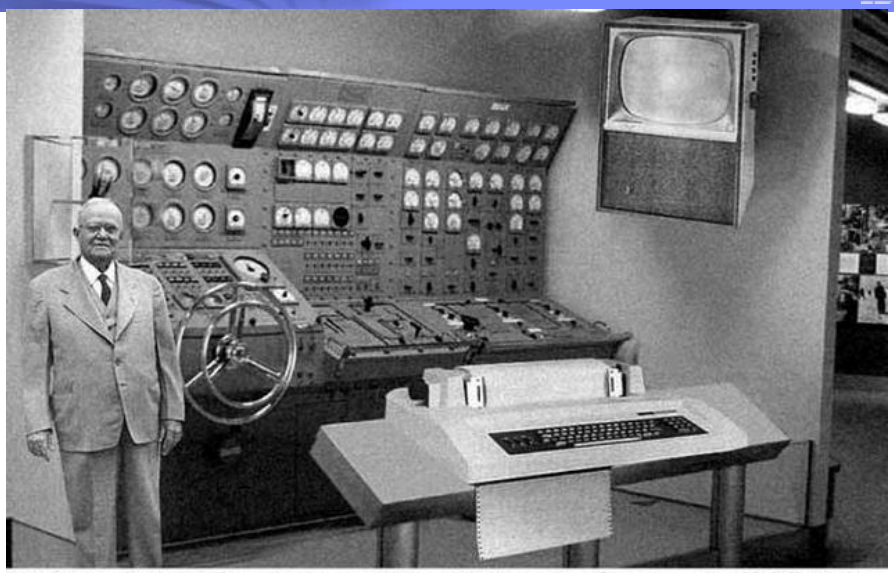
Ken Olsen, founder of DEC, 1977



"640K ought to be enough for anybody. " **Bill Gates, 1981**

"Prediction is difficult, especially about the future"

Yogi Berra



Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 50 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use.

Notable quotable…

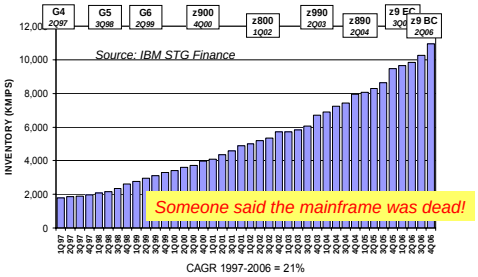
"I predict that the last mainframe will be unplugged on March 15, 1996"

Stewart Alsop, former InfoWorld columnist (now at Fortune Magazine), March, 1991

10 years later…..

IBM Annual Report 2001

- Things have changed in the mainframe area since 1991…
- 21%+ compound growth rate in MIPS since 1997…*(year 1 after the death)*

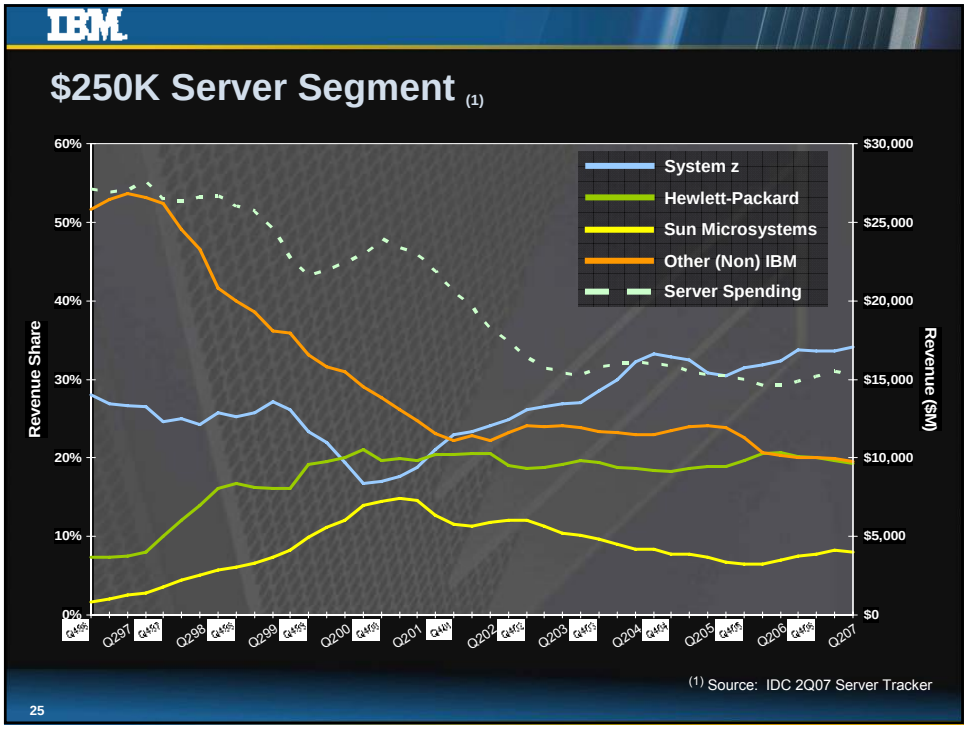


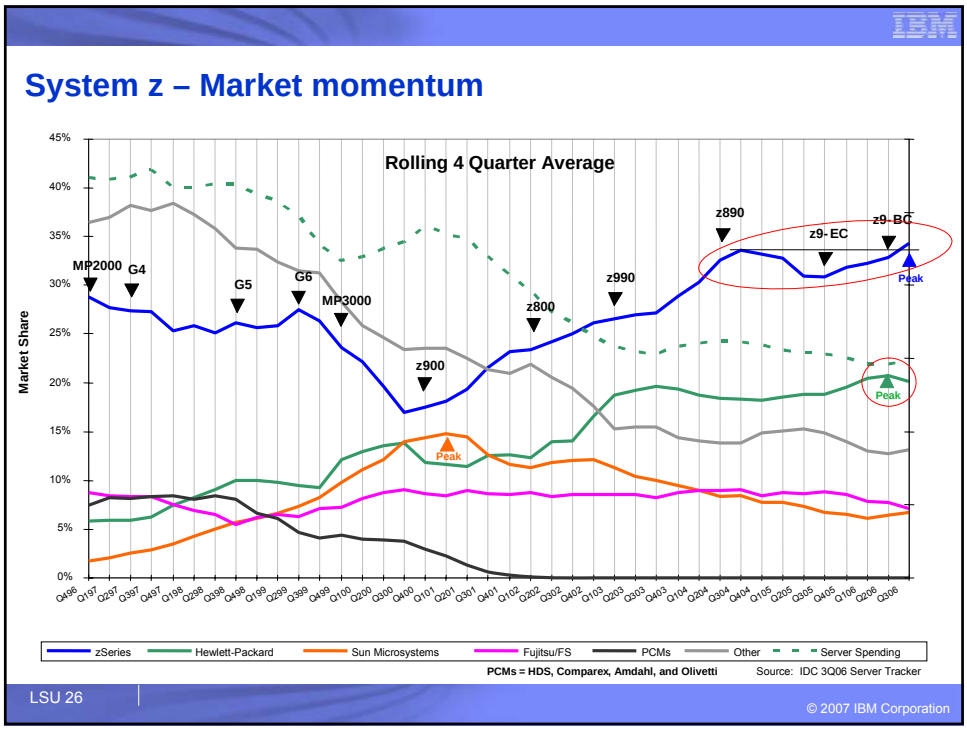
"It's clear that corporate customers still like to have centrally controlled, very predictable, reliable computing systems – exactly the kind of systems that IBM specializes in."

Letter from Steve Alsop to Lou Gerstner in 2001

Mainframes Still Dominate Top Enterprises
Some Key Facts -

- **95 % of the Fortune 1000 enterprises use *IMS***
  Originally written in 1968 to support NASA's Apollo moon landing program
- **25 of the world's top 25 Banks, 23 of the top 25 US Retailers, and nine out of 10 of the world's largest insurance companies run *DB2 on System z***
- **490 of IBM's top 500 customers run *CICS***
- **IBM's *CICS* handles more than 30 billion transactions a day**
- **IBM has 50,000 *CICS* customer licenses, and 16,000 customers**
- **There are more than 950,000 *CICS* application programmers**
- **More than 275 ISVs sell over 800 *Linux* applications on System z**


IBM
$250K Server Segment (1)
System z
Hewlett-Packard
Sun Microsystems
Other (Non) IBM
Server Spending
Revenue Share
Revenue ($M)
60%
50%
40%
30%
20%
10%
0%
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Q297
Q298
Q299
Q200
Q201
Q202
Q203
Q204
Q205
Q206
Q207
(1) Source: IDC 2Q07 Server Tracker
25


IBM
System z – Market momentum
Rolling 4 Quarter Average
Market Share
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
MP2000
G4
G5
G6
MP3000
z900
z800
z990
z890
z9- EC
z9- BC
Peak
Peak
Peak
zSeries
Hewlett-Packard
Sun Microsystems
Fujitsu/FS
PCMs
Other
Server Spending
PCMs = HDS, Comparex, Amdahl, and Olivetti
Source: IDC 3Q06 Server Tracker
LSU 26
© 2007 IBM Corporation

System z Growth

- Five consecutive quarters of revenue growth through 2Q07
- Eight consecutive quarters of MIPS growth - >11M MIPS installed
- 130% YTY specialty engines MIPS growth
- $952 Million in revenue influenced by Global Systems Integrators
- New Customers

Source: IBM Finance, & CSI Finance '07

New Customers, New Markets, New Wins

Nationwide On Your Side

FARMERS Gets you back where you belong

worldspan

CAIXA

First National Bank Omaha

BELARUSBANK JOINT-STOCK SAVINGS BANK

Bank of Tokyo-Mitsubishi UFJ

eci ECI TELECOM

BALDOR MOTORS • DRIVES • GENERATORS

HOPLON Infotainment

神州数码 Digital China

NEXXAR GROUP

What's driving the growth

- Integration of Java-based workloads through zAAPs
- Linux
- Database / application integration
- SOA
- Business resilience
- Power and cooling reduction
- Security

Reduction of complexity

The clean sheet of paper

What do clients require in the enterprise infrastructure of today?

- **High levels of scalability - Physical / Virtual**
- **Integration across heterogeneous servers with advanced middleware**
- **Economies of scale**
  - *Low cost of ownership for current workloads and future growth*
  - *Ability to run multiple mixed workloads on fewer servers in a highly automated environment*
- **High levels of automation**
- **Business continuity**
  - *Comprehensive security*
  - *Continuous availability*

The IBM Mainframe platform – *value and cost*

solving today's challenges with tomorrow's innovation and investment protection

Enable Rapid Innovation and Growth

- *Transform and modernize existing "stable and mature" IT assets to reduce time to market/value*
- *Exploit an open and flexible computing environment to develop & deploy new J2EE capabilities*
- *Free IT resources to develop new customer and business capabilities – versus maintenance and fix activity*

Deliver High Quality Service to the Business

- *Platinum service for "core" & Gold service for "distributed"*
- *"Always open for business" – near continuous availability*
- *Synchronize DR across platforms*
- *Keep data safe, avoid outages and their hidden costs*
- *Virtualize all component levels to maximize resource*

Provide Tight Security, Compliance and Audit

- *Centralized control*
- *Simplify & Integrate (reduce complexity)*
- *Safe from Attack – protecting data and privacy*

Optimise IT Costs and Improve IT ROI

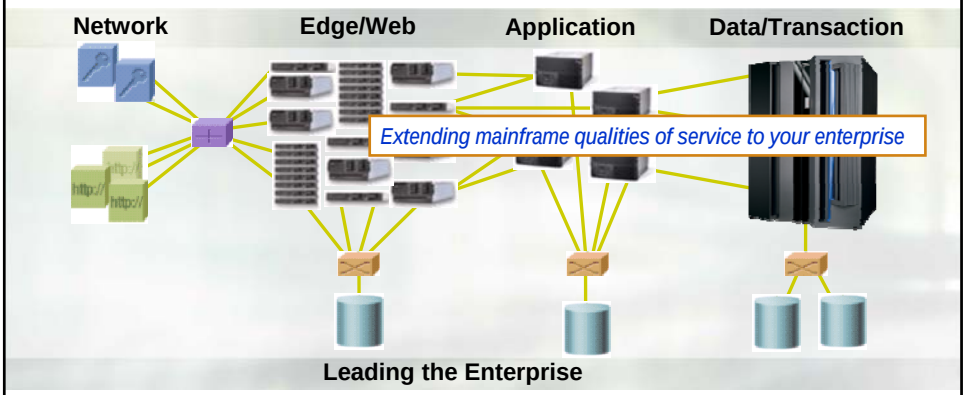
- *Re-use existing IT application and data assets*
- *Consolidate and integrate distributed servers and applications - reduce assets and people support costs*
- *Automate workload mgmt to reduce IT staff cost*
- *Use "z" specialty engines to reduce incremental cost*
- *Use virtualization to share resources, increase utilization, increase flexibility and reduce risk*
- *Use "z" capacity-on-demand and capacity back-up to minimize IT cost, increase IT flexibility and reduce risk*
- *Exploit sub-capacity "z" SW pricing to align cost with use*
- *Reduce floor space and power/cooling needed*

Predictable, low incremental cost to grow

- Organic growth of core applications
- New J2EE (zAAP) and Linux applications (IFL)
- Data, XML, security, etc. (zIIP)

Continuing reduction in cost per core "z" trx

System z - four enterprise-wide roles of the mainframe

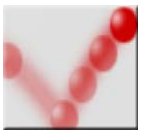


Integration with workload mgmt

Virtualization

Security

Business Continuity

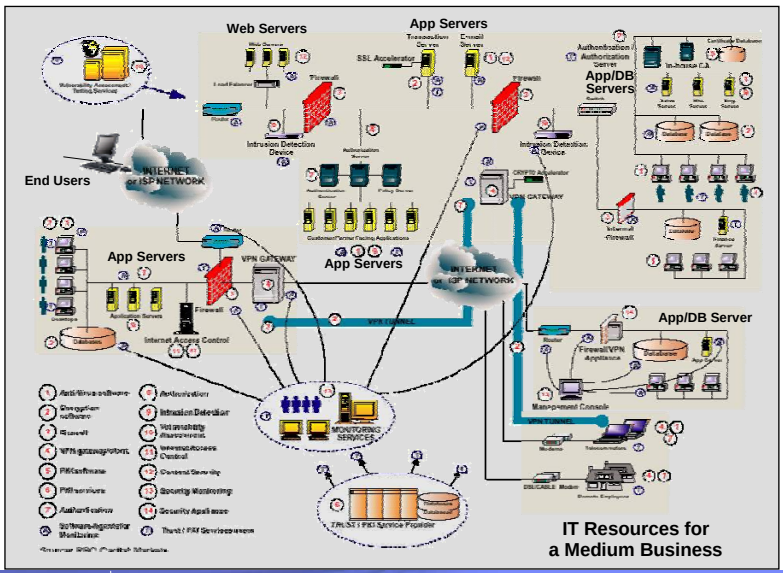


System z

Some consolidation trends

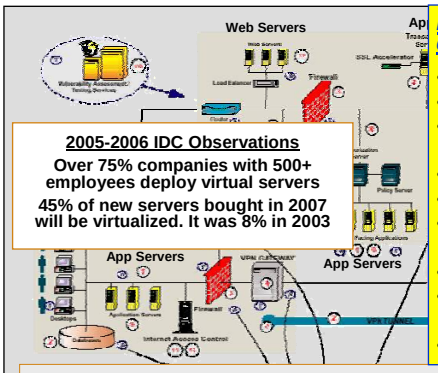
Today….Server proliferation leading to complexity

Low efficiency, Rising IT mgnt costs, Business Responsiveness issues



Today….Server proliferation leading to complexity

Low efficiency, Rising IT mgnt costs, Business Responsiveness issues



2005-2006 IDC Observations

Over 75% companies with 500+ employees deploy virtual servers

45% of new servers bought in 2007 will be virtualized. It was 8% in 2003

IT Complexities drives hidden costs and delays TTM / business growth

- **Low utilization**
- **Rigid configurations – Silo's**
- **Fixed resources per server**

- **Management complexities**
- **Servers managed individually**
- **"Lack of availability" configurations**

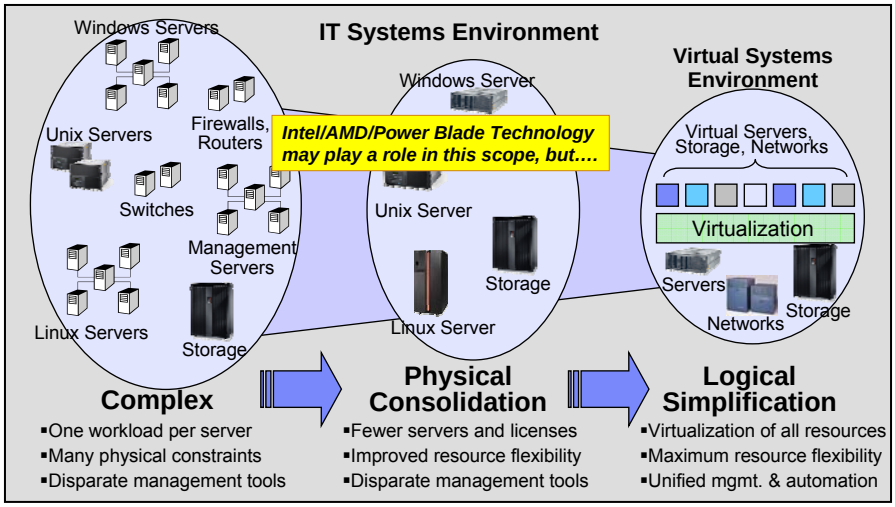
- **Power/Cooling issues**
- **Space issues**

- **Complexity of application integration**

Natural questions to ask…

- **How can we get more out of the systems & people we have ?**
- **How can we ensure that our systems perform as required so they don't cause problems or slow us down in our business development ?**
- **How to keep operational costs down to meet budget & ensure that costs to manage IT don't spiral out of control ?**

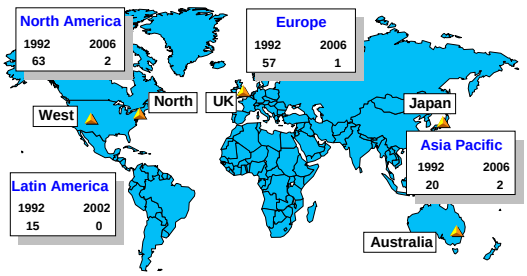
Consolidation using efficient virtualization



Virtualized IT infrastructures can reduce server hardware costs.
Footprints shrink, resource utilizations rise, operational costs drop.

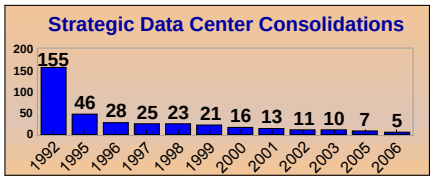
***The next wave of virtualization innovation will simplify IT management*.**

Massive Consolidation of IGS Data Centers Targeted Cost and Efficiency Objectives –



Tactical and operational efficiencies

- Consolidation of infrastructure
- Application consolidation/reduction
- Global resource deployment
- Enterprise end-to-end architecture optimization



IBM Metrics	1992	Today
CIOs	128	1
Host data centers	155	7
Web hosting centers	80	5
Network	31	1
Applications	15,000	4,700

IBM Consolidation

…Announcement Highlights

- ***IBM will consolidate thousands of servers onto approximately 30 System z mainframes***
- ***Substantial savings in multiple dimensions: Energy, SW, System Support costs***
  - ***Saving = around 40%***
- ***Major proof point of IBM's 'Project Big Green' initiative***
- ***The consolidated environment will use 80% less energy***
- ***This transformation is enabled by the System z's sophisticated virtualization capability***

IBM'S PROJECT BIG GREEN SPURS GLOBAL SHIFT TO LINUX ON MAINFRAME

Plan to shrink 3,900 computer servers to about 30 mainframes targets 80 percent energy reduction over five years

Optimized environment to increase business flexibility

ARMONK, NY, August 1, 2007 – In one of the most significant transformations of its worldwide data centers in a generation, IBM (NYSE: IBM) today announced that it will consolidate about 3,900 computer servers onto about 30 System z mainframes running the Linux operating system. The company anticipates that the new server environment will consume approximately 80 percent less energy than the current set up and expects significant savings over five years in energy, software and system support costs.

At the same time, the transformation will make IBM's IT infrastructure more flexible to evolving business needs. The initiative is part of Project Big Green, a broad commitment that IBM announced in May to sharply reduce data center energy consumption for IBM and its clients.

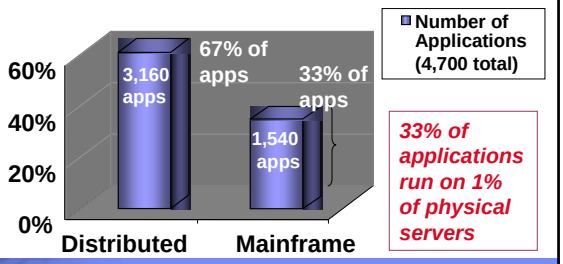
Server growth and physical space challenges

Infrastructure Challenges

- **Floor space** challenges in key facilities
- **Underutilized assets** maintaining outdated Web infrastructure
- Additional physical space needed for future **SO growth**
- Continued infrastructure **cost pressure**

Distributed server consolidation is the next step in cost savings after the massive consolidation of IGS/ITD Data Centers

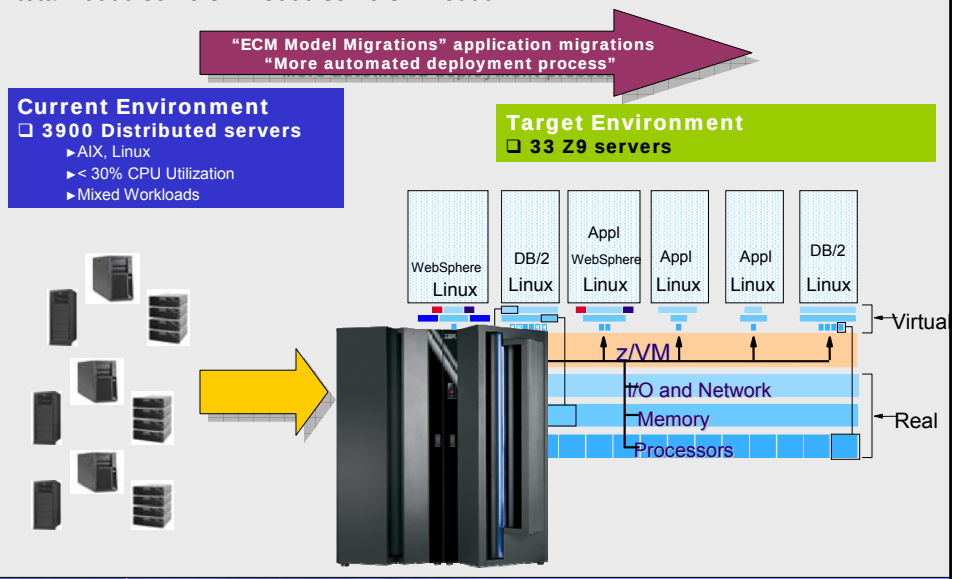
Application Distribution: MF and Distributed



33% of applications run on 1% of physical servers

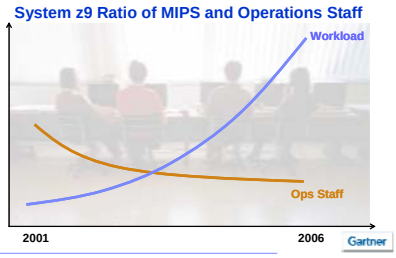
IGA Enterprise Computing Model

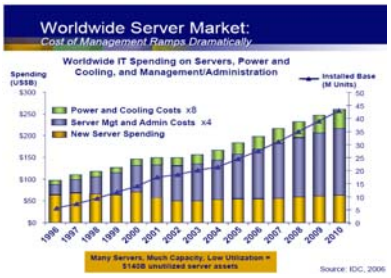
total 16000 servers => 8000 servers => 3900

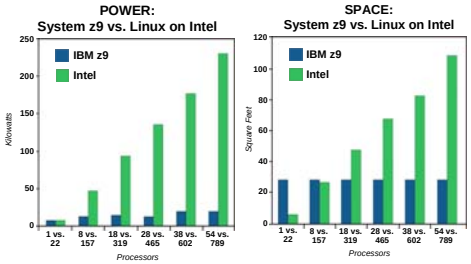


Why z Now?

Source: Tony Picardi, IDC
Economist.com: Make it simple. October 28th, 2004
From The Economist print edition







Server proliferation – complexity and energy crisis

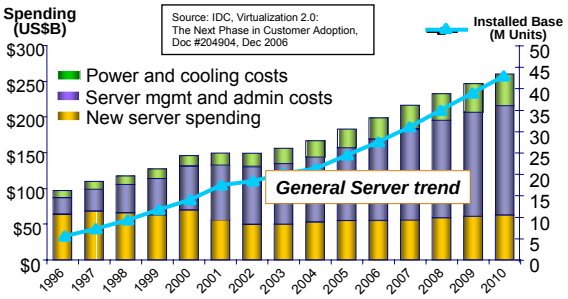
- **IT Complexity is driving business pain and cost for many installations**
  - **People Cost has doubled as a % of Total IT Cost from 33% in 1996 to 66% in 2006** [1]
  - **Software costs continue to grow linearly with distributed server growth** [1]
- **Energy costs are rising and have become a high priority concern**
  - **Global climate and environmental concerns**
- **Increased technology density brings with it additional energy requirements**
  - **Projections on Power Use for 50k Sq. Ft. Data Centers:** [2]

Year	Avg. Watts Per Sq. Ft.	Total kWh	Annual Utility Cost (8.68 cents kWh)
2003	40	17,520,000	$1,520,736
2005	80	35,040,000	$3,041,472
2007	240	105,120,000	$9,124,416
2010	500	219,000,000	$19,009,200

- **Continued server proliferation is unsustainable due to energy requirements and cost, the cost of infrastructure complexity and the resulting inflexibility of the infrastructure**

1 Source: IDC, On-Demand Enterprises and Utility Computing: A Current Market Assessment and Outlook, IDC #31513, July 2004.
2 Source: AFCOM, "Trends in Data Center Design and Construction," California Data Center Design Group

Economic trends driving Virtualization



IT budget trends…

1995	
HW	= 65%
SW	= 14%
People	= 14%
Other	= 7%

2004	
HW	= 18%
SW	= 28%
People	= 45%
Other	= 9%

Virtualization is getting HOT, but so are the Data Centers

Power and cooling spend may eventually exceed new server spending

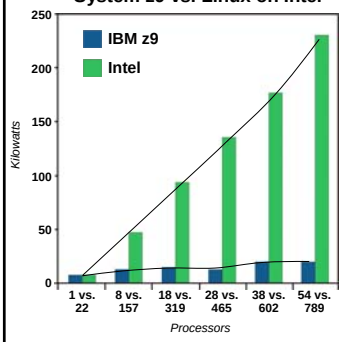
VIRTUALIZATION

- **Has primarily been a server consolidation story …but storage and networks are catching on**
- **Promises to radically simplify Systems Management**
- **Basis for new IT delivery and provisioning paradigm including pre-built images or appliances**

System z9 high utilization capabilities may help reducing power/facility costs
when consolidating low utilization Linux on Intel® servers

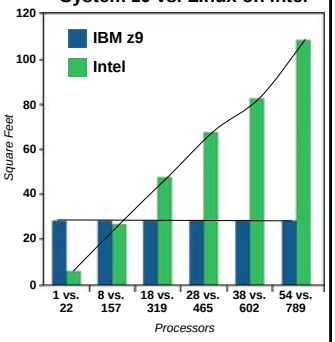
Power and Space Consumption

POWER:
System z9 vs. Linux on Intel



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 the same work for 1/12th power consumption!

SPACE:
System z9 vs. Linux on Intel



The Linux on Intel 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 energy efficient solution for multiple workloads

The IBM Global Account team identified 3,900 OS images for potential consolidation on System z

Approach

1. Included scope of 8,600 images eligible for migration to find 3900 'fit for purpose' and with TCO savings
2. Used commercial TCO model to estimate savings
3. Holistic approach taken, including System p™ virtualization for appropriate work, application portfolio reduction, asset optimization
4. Selected workload that runs on multi-platforms for ease of migration – focus on transactional based workload

Initial Priority for consolidation to Linux on System z

DB2

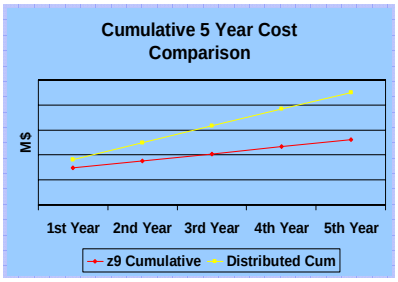
Lotus

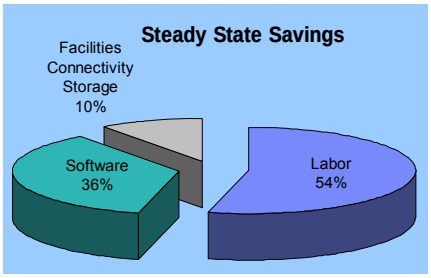
WebSphere

SAP

IBM Distributed Consolidation to System z

- **Performed TCO and consolidation assessment on IBM portfolio**
  - Cross-IBM effort: System z, SW Migration Services, TCO Academy, Migration Factory
  - Analysis considers today's environment vs. "to be" environment; savings is net after hardware and migration investments





Identified substantial savings opportunity

- Annual Energy Usage reduced by 80%
- Total floor space reduced by 85%

Savings are primarily driven by labor, with additional significant savings in floor space, power, connectivity and software

5 Year Cost Savings	
Cost Element	**% of Savings**
Facilities	4.5%
Connectivity	4.0%
Storage	0.6%
Software	36.1%
Annual System Administration	54.9%
Cumulative Cost	**100%**

In addition to cost savings, risk and opportunity cost need to be analyzed

- What are the risks of doing the project?
- What is the risk of NOT doing anything?
- What opportunities are missed?

The resulting facilities savings are substantial and contribute to IBM's green initiative

- **80% Savings in Annual Energy Usage**

Comparison of Annual Energy Usage for Workloads				
	Distributed solution		z Solution	
	Kilowatts	Cost* ($K)	Kilowatts	Cost* ($K)
Power	2,661	$2,331	512	$449
Cooling	605	$530	117	$102
Total Energy	3,266	$2,861	629	$551

(*) Electrical cost calculated at rate of .10 per kW

- **85% Savings in total floor space**
  - 11,045 square feet for distributed solution, 1,643 square feet for z solution

System z

Trends and Investments

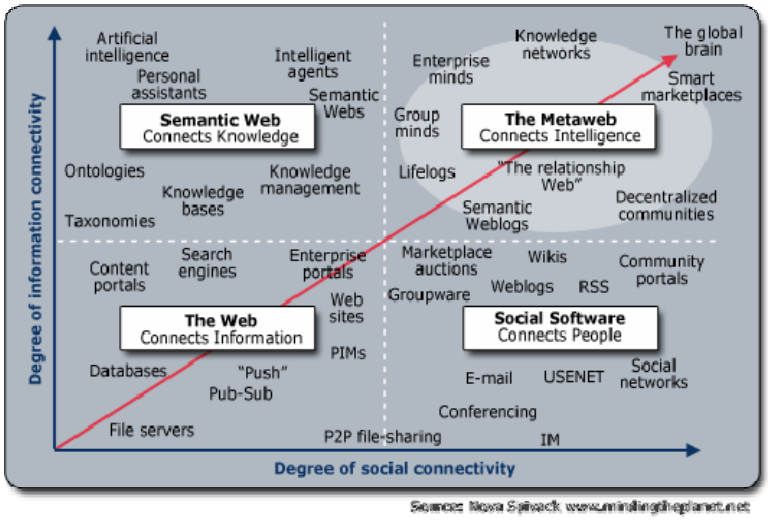
Technology forces and Market trends - *guiding System z directions*

- **IT Simplification and Flexibility**
  - *Consolidation, Virtualization, Integration, ITSM - of heterogeneous infrastructures*
- **Service Oriented Architecture -** *for Application & Infrastructure*
  - *Driven by Business Process Optimization (BPO)*
  - *Modernization of Core applications*
- **Emerging "hybrid integrated applications"**
  - *Digital convergence - data, image, voice, animation*
  - *Integration of massive amount of structured and unstructured data*
  - *Data analytics as integrated part of a business process*
  - *Special purpose acceleration*
- **Community driven computing**
  - *WEB 2.0 with Real time collaboration and Games*
- **Power / Cooling efficiency**
  - *Virtualization*
- **Market trends**
  - *Emerging geographies and Industry specific initiatives*
  - *Regulations, **compliance and security** related technology forces*
  - ***Business resilience***
  - *Ability to adjust and react (TTM)*
  - *Drive for cost reductions*

Web 2.0 Technologies – Web 2.0 vs 1.0

Web 1.0 was…	Web 2.0 is…
Alpha	Beta
a tool	a lifestyle
banner ads	Adsense
about HTML	about XML
a commodity	a service
publishing	participation
proprietary	open source
about reading	about writing
about home pages	about blogs
direct marketing	viral marketing
about lectures	about conversation
about companies	about communities
about client-server	about peer-to-peer
about advertising	about word of mouth
about conference events	about unconferences
about services sold over the Web	about Web services

The Future of the Web



Strategic Investments…

System z9
- **$1.2 billion and 5,000 tech professionals**
- **Increased investments for next generation's…**

Increased ISV investments… ***Linux and z/OS***

SAP **$40M**

ORACLE
- **Joint Initiative**
- **Expanded Technology**
- **Ongoing collaboration for zLinux offerings**

Simplification[1] **$100M**

Academic initiative

Field Technical skills expansion - ***Project Zeus***
- **250+ "support" people added to platform in 2007[1]**
- **750+ more "support" people during 2008[1]**

The Mainframe Charter – investing in the future

Innovation
- ***Focus on Enterprise wide manager (Hub) roles***
  - Business Resilience (BR) - Enterprise BR Hub
  - Workload Manager (WLM) - Enterprise WLM Hub
  - Security - Enterprise Security Hub
  - *Business Integration - Data and SOA Hub*
- ***On Demand solutions***
- ***Simplification***
- ***Continue to "Raise the Bar" on technology leadership***

Value
- ***Make System z attractive for new workloads***
- ***Continued focus on specialty engines & accelerators***
- ***Drive granularity to support broad market***
- ***Generation to generation price/perform improvements***
- ***Simplification***

Community
- ***ISV applications & Partner relationships***
- ***Build new skills in marketplace***
- ***Focus on next generation***
- ***Focus on emerging geographies***
- ***Simplification***

z/OS System Management Strategy

Making z/OS easier to deploy, administer, and service, *October 8, 2006*

IBM announced a cross-company effort to make the IBM System z mainframe … easier to use for a greater number of computer professionals by 2011. The goal of this **five-year effort**, which will include an investment of approximately **$100 million**, is to enable technology administrators and computer programmers to more easily program, manage and administer a mainframe system -- as well as to increasingly automate the development and deployment of applications for the mainframe environment. The initiative, involving a team of hardware and software experts, leverages IBM's expertise in automation and systems management.
ibm.com/press/us/en/pressrelease/20384.wss

Over the next five years, IBM intends to simplify*:

- System health monitoring with event analysis & problem mgnt
- System installation and configuration
- Workload management
- Security management
- Network management
- Data and storage management

z/OS Management Simplification Strategy

Today

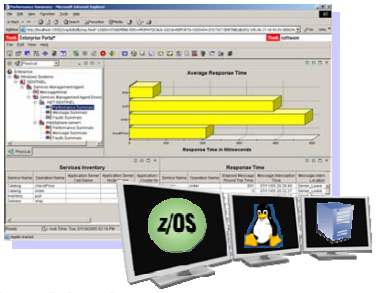
Expert-friendly, long learning curve for people new to platform

- Multiple, inconsistent UIs – no central system management portal
- Many interfaces foreign to those new to platform
- Manual tasks requiring extensive documentation
- Years of experience

Tomorrow - starting Today*

- ✓ ***Central*** z/OS management portal
- ✓ ***Simplified***, ***automated*** task-oriented mgmt interface, with integrated user assistance
- ✓ ***Modern*** look & feel; more familiar to those new to platform
- ✓ Focus on ***customer goals***
- ✓ ***Optional*** for those who prefer traditional interfaces

Simplification strategy



Easier…

- *–Installation*
- *–Configuration*
- *–Administration*
- *–Maintenance*

For…

- *–New-to-z clients*
- *–Existing clients*

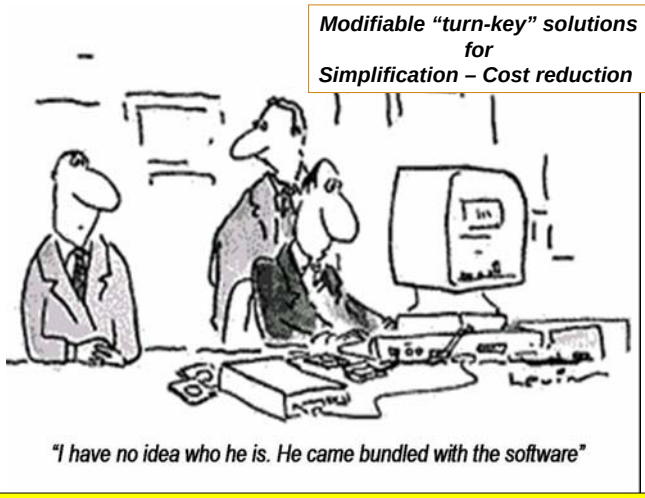
Building blocks…

	**Automation of management tasks; reduce "manual labor"**
	**Modern console that is common across IBM**
	**Reliable, scalable, secure & open management infrastructure**

Appliances for Data serving, Web serving, File/Mail serving, Security serving, etc..

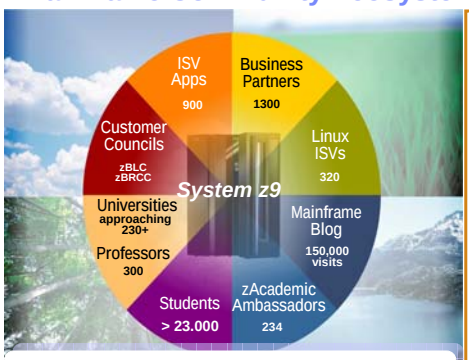
Data Serving / Web Serving / Mail Serving / etc. Appliances (Bundle)

Modifiable "turn-key" solutions for Simplification – Cost reduction



Appliances or Integrated Solution bundling will be a major part of the simplification

Mainframe Community Ecosystem



Go to **ibm.com**/software/info/education/assistant/
Click on 'Systems and Servers'

Customer councils

IBM Academic Initiative

- **GOAL - 20,000 new skills by 2010**
  - ✓ *more than 23.000 so far !!!!!*
- **290+ colleges and universities**
  - ✓ *grew 1000% in 2 years with 50% outside US*
- **300 professors registered**
- **200+ IBM ambassadors**
- **14 courses + 3 new on the way…**
- **New e-learning courses developed**
- **new initiatives planned**
  - *matching students with schools*
  - *more majors and certifications*
  - *faculty awards, contests…*

Partners – heavy investments

- **1350+ mainframe ISVs**
- **1,500 mainframe partners**
- **training, loaner program, discounts**
- **24/7 HW/SW/support**

Mainframe blog & community

- **http://mainframe.typepad.com**
- **zNextGen community kicked off with Share**

Mainframe blog: http://mainframe.typepad.com

System z

Focus areas

for

The future Processor Roadmap

System z roadmap focus areas - expanding to a wider set of workloads

Leading edge technology

zNext – granular range of offerings from Entry to High End

- Multi-core microprocessor design for commercial and compute intensive work
- **Chip design optimized for mixed workloads & virtualization**
- High bandwidth, low latency interconnect using open standards
- Extensions to memory support
- Operating System and PR/SM co-operation to reduce N-way cost
- Advanced power management

High Frequency & multi-core
Compute intensive capabilities
HW (CPU/IO) & SW efficiency

zFuture - granular range of offerings from Entry to High End

- Integrated platform – processors and accelerators – building on the past
- Industry leading I/O performance
- Potential for Appliance, Application accelerator and Cell exploitation
- Continued exploitation of Specialty Engines
- Throughput computing – multi core chip

Throughput Computing
Integration Platform
Multiple Application Personalities

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,
Online Data Analytics, Web & Collaboration Content DB

SOA, Consolidation and Enterprise Wide Role

- Enterprise SOA
- Virtualization
- E2E Enterprise Security
- E2E Enterprise Business Continuance

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

Server Availability Design Focus

Less Impact

	Past	Present	Future
Unscheduled Outages	✖	✖	✖
Scheduled Outages	✖	✖	✖
Planned Outages		✖	✖
Preplanning Requirements			✖

System z

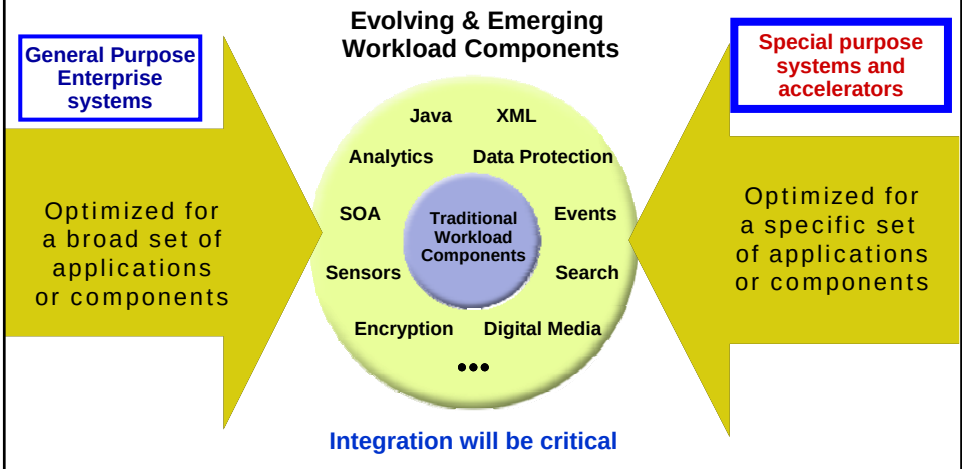
Focus areas for

the future Processor Roadmap

Support of emerging applications

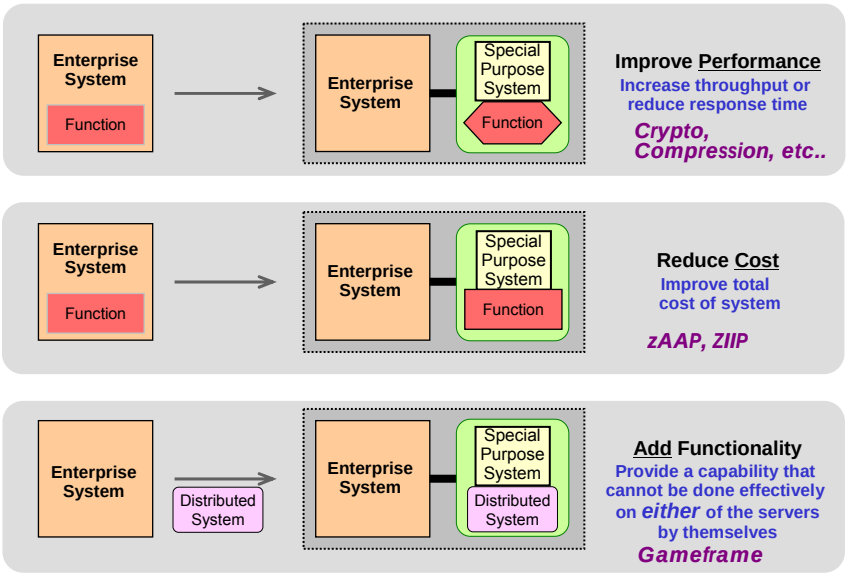
Emerging applications…with federated transactions

Objectives include complete application integration in an optimal fashion



Both General and Special Purpose capabilities needed because of increasing transaction variability

Inboard Special Purpose Systems and Accelerators – *Value Propositions*



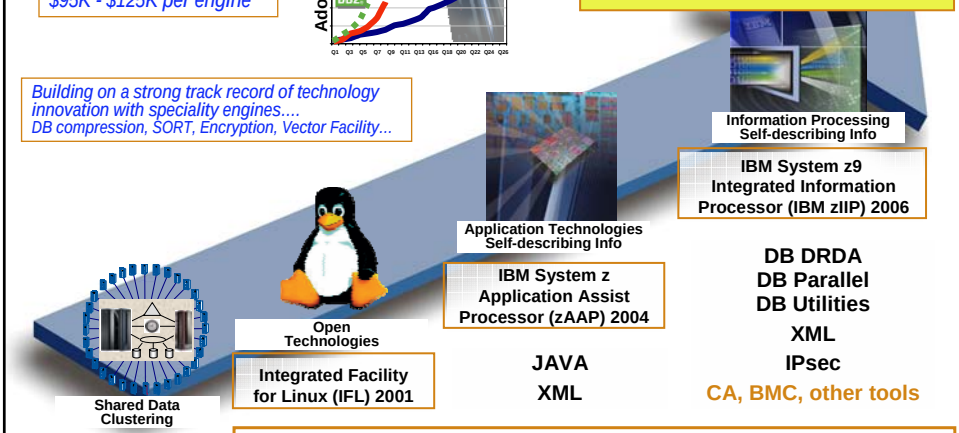
Future oriented growth workloads

Specialty Engines - technology investment protection

zAAP/zIIP processors
Provides the economic justification for the technical "relevant" and integrated and application solution infrastrcuture

No SW charges
$95K - $125K per engine

Building on a strong track record of technology innovation with speciality engines....
DB compression, SORT, Encryption, Vector Facility...



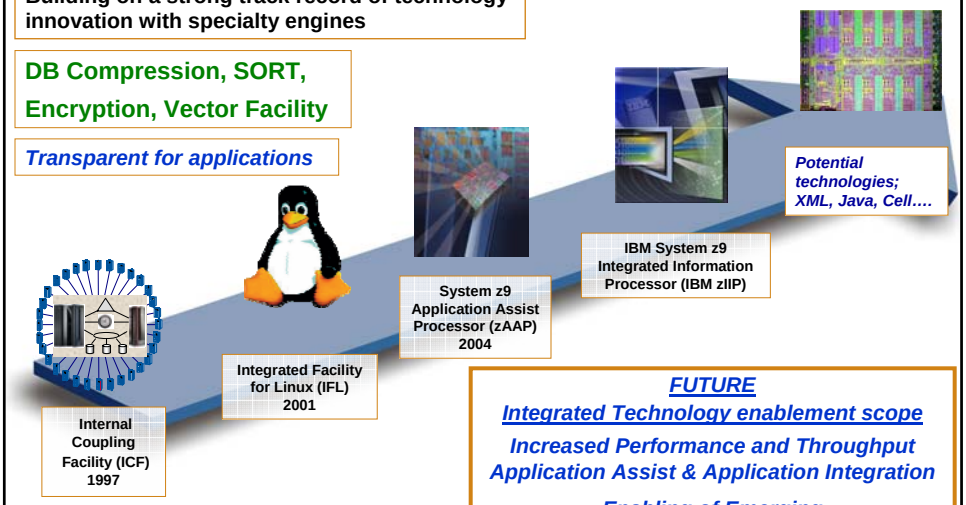
Usage is completely transparent for Applications managed "under the cover" by z/OS and the PRSM Virtualization Hypervisor

Evolution of specialty engines

Building on a strong track record of technology innovation with specialty engines

DB Compression, SORT, Encryption, Vector Facility

Transparent for applications



Internal Coupling Facility (ICF) 1997

Integrated Facility for Linux (IFL) 2001

System z9 Application Assist Processor (zAAP) 2004

IBM System z9 Integrated Information Processor (IBM zIIP)

Potential technologies; XML, Java, Cell….

FUTURE

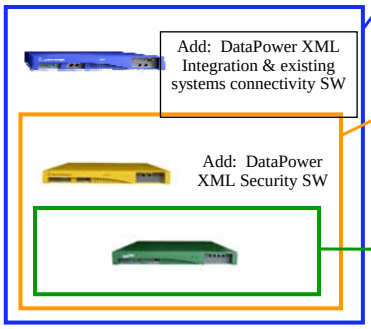
Integrated Technology enablement scope

Increased Performance and Throughput

Application Assist & Application Integration

Enabling of Emerging (hybrid) Transactions models

DataPower Products



- **XI50 Integration Appliance**
  - Expands support to non-XML solutions
  - Advanced architecture
  - Integrated message-level security
- **XS40 XML Security Gateway**
  - Security, agility and performance
  - Device can off-load application security software
  - Performs XML Web services security functions (parse, filter, validate schema, encrypt/decrypt, signatures, access control, and more)
- **XA35 XML Accelerator**
  - Offloads overtaxed servers by processing XML, XSD, XPath and XSLT at wire speed
  - SW provides significant performance improvements over WebSphere solutions
  - HW + SW provides enterprise-class performance

XML / Security HW/ucode support

DataPower Box owned by IBM's SWG today……
External attachment……may reduce XML cost by 5-20 times (16 at UBS)
Opportunity for further integration…..

From mainframe to gameframe…and beyond…..

a 1st glimpse of the future high end servers

Marrying technology from opposite poles of the computer industry, IBM and a multiplayer online game company (Hoplon Infotainment) are working to integrate the Cell game console processor with Big Blue's mainframe computers

What kind of applications will this be good for?

The project intends to create an environment that can seamlessly run ***demanding simulations,*** such as….

- ***massive on-line virtual reality environments,***
- ***3D applications for mapping,***
- ***enterprise resource planning (ERP) and***
- ***customer relationship management (CRM),***
- ***3D virtual stores and meeting rooms,***
- ***collaboration environments and***
- ***new types of data repositories.***

It plans to achieve this goal by parceling the workload between the mainframe and the Cell processor…

Extract from PRESS RELEASE April 27, 20007…..

Cell Broadband Engine Project Aims to Supercharge IBM Mainframe for Virtual Worlds…..

IBM Collaboration With Brazilian Game Developer, Hoplon Infotainment, Looks to Hybrid Platform for Advanced 3D Simulations; Unique Mainframe Architecture Speeds Integration With Cell/B.E.

ARMONK, NY & FLORIANOPOLIS, BRAZIL - 26 Apr 2007: IBM (NYSE: IBM) today disclosed a cross-company project to integrate the Cell Broadband Engine™ (Cell/B.E.) with the IBM mainframe for the purpose of creating a hybrid that is blazingly fast and powerful, with security features designed to handle a new generation of "virtual world" applications, such as the 3D Internet.

The project capitalizes on the mainframe's ability to accelerate work via "specialty processors," as well as its unique networking architecture, which enables the kind of ultra-fast communication needed to create virtual worlds with large numbers of simultaneous users sharing a single environment.

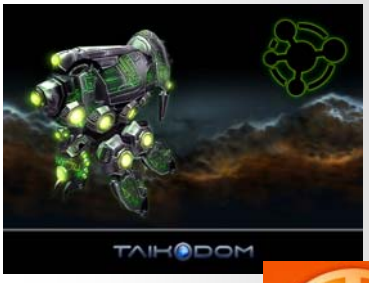
Drawing on IBM's research, software and hardware expertise, the project is being undertaken in cooperation with with Hoplon Infotainment, a Brazilian online game company whose software is a key component of testing the capabilities of the new environment.

……

IBM and Hoplon: 'Gameframe' Project

WW Massive multiplayer (8mill !!) online game managed from a single operating environment - beta test….

IBM and Brazilian gaming company Hoplon are embarking upon a cross-company project to integrate the Cell Broadband Engine with the IBM mainframe for the purpose of creating a hybrid that is blazingly fast and powerful, with security features designed to handle a new generation of "virtual world" applications, such as the 3D Internet.



HOPLON Infotainment

This announcement generated incredible amounts of trade and analyst press – it seemed everyone recognized the latent potential in the marriage of these 2 outstanding technologies.

Brazilian Game Site Chooses Hybrid Mainframe-Cell Platform

Published: May 2, 2007 by Timothy Prickett Morgan (http://www.itjungle.com/big/big050207-story01.html

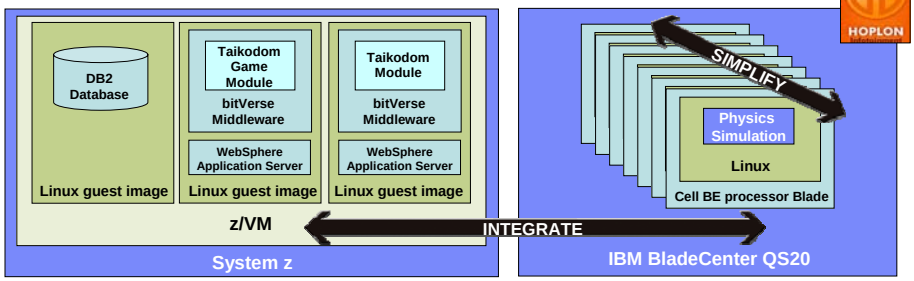
Hoplon is now beta testing Taikodom, a massively multiuser online game that simulates epic space battles, and has hired IBM to get it off of the X64 iron the company had been using to host Taikodom and to help it create a more powerful and resilient system that will be able to do a better job hosting the game when it eventually goes live.

That hybrid system will include IBM's System z9 mainframes acting as the transaction processing and host environment for the game, to which will be clustered blade servers using the "Cell" PowerPC gaming processor that Big Blue created in conjunction with Sony and Toshiba.

While there are a number of systems on the market that have as much memory and I/O bandwidth as a System z9 mainframe, these RISC/Unix systems do not have the same level of security or the sophisticated partitioning and workload management software that that the mainframe has. And because the mainframe can run online transaction processing systems in DB2 and on z/OS partitions side-by-side with Linux partitions that run the Taikodom simulation, Hoplon does not have to manage two different kinds of systems or cluster them in any way to get the two sides to share data.

Everything is consolidated on the same System z9 platform, and the machine can be run at nearly full processor capacity without falling over dead--unlike X64 servers, which rarely run at peak capacity.

Hoplon: Hybrid Schema Mainframe and Cell Processor



Why Taikodom on System z

- **Large Shared Resource Pool**
  - Single point of resource management
  - Single point of operational control
  - Efficient use of underlying compute resources
  - Manage unpredictable loads between Virtual World instances
  - Easy/fast provisioning
- **Integration w/Commercial Business Processing**
  - Security
  - Reliability
  - Availability
  - Auditing
  - Monetary Transactions

Why Taikodom on Cell

- **HPC for Motion and Collision Detection**
  - Physics Simulation
- **Realist Animation**
- **Artificial Intelligence**

Why Taikodon on Cell integrated w/ z

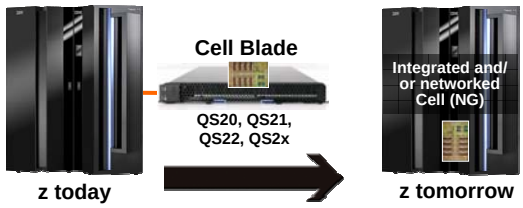
- **HPC enhanced commercial computing**
- **Single System z operational domain**
  - **Avoid standalone distributed cluster**
- **Extend strengths of System z**

Financial Services Clients: Business Value with Cell BE and System z

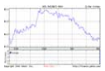
Improve trading profit by reducing the time to identify and take advantage of market opportunities while managing market risk.

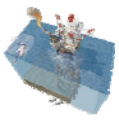
- **Earlier** recognition of the **opportunity**
- **Maximize profit / revenue** with **earlier** detection of **risk**
- Enable trading **decisions** to be made **before competitors**
- **Improve decision making** by **unlocking** historical **information** from corporate applications
- **Increase client satisfaction** and **revenue** through continuous monitoring of portfolio risk (faster alerts and quicker response)

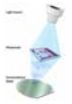
System z and Cell BE Vision is a 'Marriage' of Two Technologies that Perfectly Complement Each Other




Aerospace and Defense


Financial Services Sector


Chemicals & Petroleum


Electronic Design Automation


Digital Video Surveillance


Digital Media


Information Based Medicine

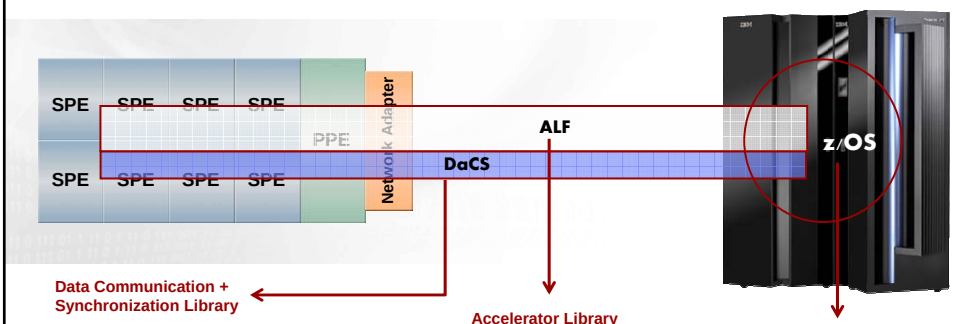
Solution Characteristics

- Mission critical functionality
- Significant amounts of data storage
- Significant transactional content
- Computational intense operations
- Critical need for governance, i.e. security, auditing, compliance, availability
  - Single Management Interface
  - High RAS requirement
  - High Intellectual Property value of data
- High potential for integration with other applications
- Reduced power and space

Examples

- Financial analytics
  - Portfolio Analysis
  - Complex Structured Instruments
  - Monte Carlo
- Medical Imaging
- Computer Vision
- Bioinformatics
- Real Time Ray Tracing
- Physics calculations
- Virtual Worlds

Enable Transparent Management of Cell Accelerator from z/OS



Data Communication + Synchronization Library

Low level API that provides simple data movement operations, synchronization primitives, simple topology, process management, error handling

Accelerator Library Framework

Provides a simple user-level programming framework for Cell library developers that can be extended to other hybrid systems.
The APIs are designed to be portable to other architectures

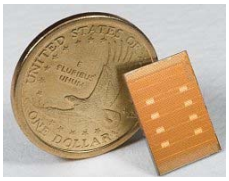
ALF/DaCS Integration w/ System z

- Performance
- Accounting
- Security, RACF
- Recovery
- Serviceability
- Virtualization
- Support zLinux and z/VM

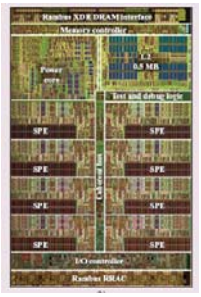
Extend the Cell BE Programming Ecosystem with System z QoS

The Cell Broadband Engine™ (Cell/B.E.)

- Cell BE is a heterogeneous multi-core microprocessor & architecture jointly developed by a Sony, Toshiba, and IBM alliance known as "STI."
  - The architectural design and first implementation were carried out at the STI Design Center in Austin, TX over a four-year period beginning March 2001 on a budget reported by IBM as approaching US$400 million.



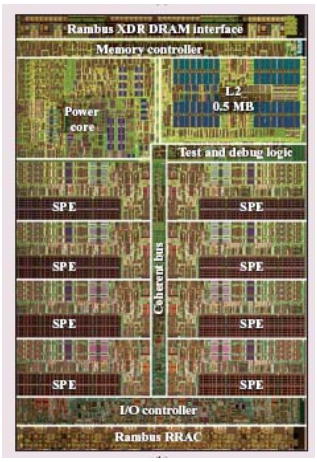
- The Cell chip contains:
  - an IBM 64-bit Power Architecture™ Power Processing Element (PPE) with 2-way hardware multithreading and on chip L1/L2 cache
  - eight new single-instruction multiple-data (SIMD) special purpose RISC Synergistic Processing Elements (SPEs) with 256K local memory
  - Memory and I/O controllers
  - The PPE and the eight SPEs are connected with a high bandwidth coherent Element Interface Bus



- Linux Operating System

Some Cell Broadband Engine™ Numbers

- **Chip numbers:**
  - *Observed clock speed: > 4 GHz*
  - *Peak performance (single precision): > 256 GFlops*
  - *Peak performance (double precision): >26 GFlops*
  - *Area: 221 mm²*
  - *Technology 90nm SOI*
  - *Total number of transistors: 234M*
- **Each SPE contains:**
  - *128 x 128 bit registers*
  - *4 single precision floating point units capable of 32 GigaFLOPS at 4GHz*
  - *4 Integer units capable of 32 GOPS (Billions of integer Operations per Second)*
  - *256 Kilobyte local store*
- **An SPE is just 15 sq.millimetres and consumes less than 5 Watts at 4GHz**
- **Max.theorethical speed:**
  - *4(GHz) x 4(units) x 2(ops) x 8 (SPEs)= 256 GFLOPS*
  - *(counting Multiply-Adds as 2 instructions)*



IBM Blade Center QS20

Premier blade for compute-intensive workloads and broadband media applications

Highlights

First Cell Broadband Engine™ (Cell BE) processor-based systems

Dense computing power and unique capabilities of Cell BE

Accelerate some algorithms to many times the speed of a traditional microprocessor

Especially suitable for compute intensive workloads across a number of industries

The IBM BladeCenter QS20 blade provides two-socket, multicore (one Power Processing Element plus eight Synergistic Processing Elements for a total of nine cores per processor), 3.2 GHz Cell BE processors directly mounted to the planar board.

System z

Focus areas for

the future Processor Roadmap

New “architecture” elements

Continued development of the on demand capabilities

z/OS and PR/SM co-operation to further reduce N-way cost

System z

Focus areas for

the future Roadmap

Technology

Systems Performance

Future improvements in systems performance will require an integrated design approach

Application	Languages, Software Tuning, Efficient Programming
	MIDDLEWARE
System Level	Dynamic optimization, Assist Threads, Morphing Support, Fast Computation Migration, Power Optimization, Compiler Support
Chip Level	Compiler Support, Morphing, Multiple Cores, SMT, Accelerators, Power Shifting, Interconnect Circuits
Technology	Packaging, Efficient Cooling, Dense SRAM - eDRAM Optics - Memory

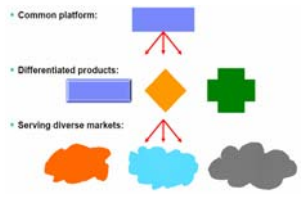
- **Microprocessor frequency will no longer be the dominant driver of system level performance**
- **Integration over the entire stack, from semiconductor technology to end-user applications, will replace scaling as the major driver of increased system performance**
- **Workload variability will be a characteristic of the future transaction profile**
- **Systems will increasingly rely on modular pluggable components continued performance leadership**
- **Systems will be designed with the ability to dynamically manage and optimize power**

IBM "Server" convergence - *reduced cost & increased functionality*

to ensure

- building of high quality platform solutions to a very competitive hardware cost
- transfer of mainframe inspired technologies to enhance QoS and Flexibility
- system management convergence - "identical" functional interfaces to "attack" people cost issues
- and increase the ability to integrate end-to-end

Convergence



while maintaining

- **platform values in...**
- **support of different needs**
- **protecting investments**

Shared Software

SAP, DB2, Tivoli, Domino, MQ, CICS, Java, Websphere

LINUX ENABLED PLATFORMS

Shared Hardware

Power/Mechanical

I/O technologies

System Architecture (LPAR and NUMA)

Logic & Memory Chip and Packaging technologies

"Intel" | Power | S/390

"Intel" System x | *Blade Center* | *UNIX System p* | *Storage "Servers"* | *AS/400 System i* | *Mainframe System z*

IBM "Server" convergence - *reduced cost & increased functionality*

to ensure

- building of high quality platform solutions to a very competitive hardware cost
- transfer of mainframe inspired technologies to enhance QoS and Flexibility
- system management convergence - "identical" functional interfaces to "attack" people cost issues
- and increase the ability to integrate end-to-end

Convergence

while maintaining

- **platform values in...**
- **support of different needs**
- **protecting investments**

Shared Software

SAP, DB2, Tivoli, Domino, MQ, CICS, Java, Websphere

Value for zSeries

- **Sourced from a VOLUME based technology**
- **makes is affordable to maintain and further develop THE platform with the MOST unique scalability, reliability, and availability characteristics**

Logic & Memory Chip and Packaging technologies

"Intel"	Power	S/390

"Intel" System x	*Blade Center*	*UNIX System p*	*Storage "Servers"*	*AS/400 System i*	*Mainframe System z*

z/Architecture vs POWER architecture……

- NO TRUTH TO RUMORS THAT System z WILL BECOME POWER BASED
- POWER is not a technology but a an architecture
- We do not plan to converge the microprocessors for Power and System z to the point that we will have a common chip
- This is due to inherent differences in the architecture of the microprocessors.

  For example, the System z software stack includes customer-written and ISV applications built with the assumption that memory accesses from multiple microprocessors are sequenced by the microprocessor hardware.

  In the Power architecture, the software handles this explicitly.

  As a result, convergence at the microprocessor architecture level will result in reduced performance for Power or rewriting all the software that has been written for S/390.
- As a result of this, most of the current firmware for System z will remain unique.

  This includes PR/SM or LPAR that provides virtualization, the microprocessor microcode, the I/O microcode, and the service subsystem code that provides the error recovery and fault-tolerant capabilities.

zNext (z6) chip technology information

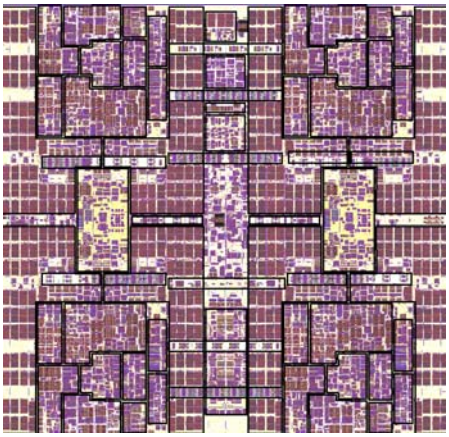
Look at the website below for a detailed public domain presentation of the zNext (z6) chip technology

the following 2 charts shows an extract….

IBM z6 – The Next-Generation **Mainframe**. Microprocessor.
Charles **Webb**. **IBM** Systems &Technology Group, Development. **IBM** Fellow **...**
www2.hursley.**ibm**.com/decimal/**IBM**-**z6**-**mainframe**-microprocessor-**Webb**.pdf -

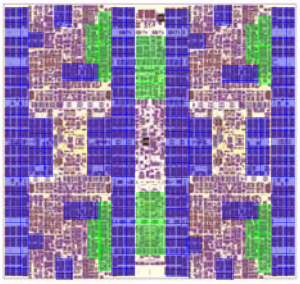
z6 - technology highlights

- **New high-frequency z/Architecture microprocessor core**
  - >4 GHz operation in system
- **4 cores per die**
  - Each with 3MB private 2nd-level cache
- **Accelerator engines**
  - Data compression
  - Cryptographic functions
  - Decimal floating point
- **Integrated SMP communications**
  - Switch connects cores to SMP Hub chip
  - Shared cache and SMP fabric
  - Memory bus controller
  - I/O bus controller
  - EI3 technology up to 3 GHz bus speeds
- **System interfaces**
  - 2 x 48 GB/s SMP Hub
  - 4 x 13 GB/s Memory
  - 2 x 17 GB/s I/O

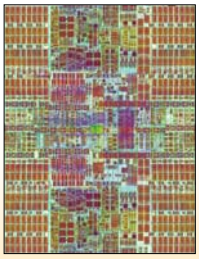


- **991M Transistors**
- **138 Mb SRAM**
- **6 km wire**
- **21.7 X 20.0 mm die**
- **1188 signal / 8765 total chip I/Os**

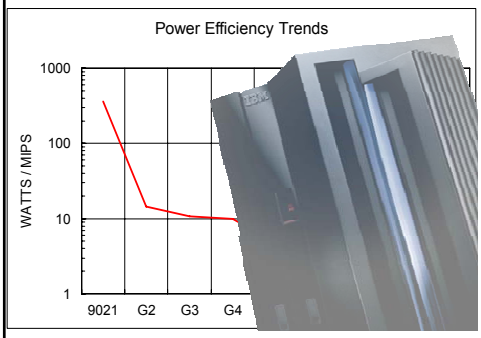
Relationship to Power6

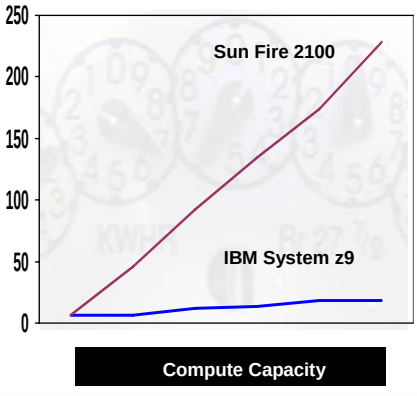


- **Siblings, not identical twins**
- **Share lots of DNA**
  - –IBM 65nm SOI technology
  - –Common design building blocks:
    - •latches, SRAMs, regfiles, dataflow elements
  - –Large portions of FXU, BFU, DFU, MC, GX
  - –EI3 interface technology
  - –Core pipeline design style – (High-frequency, low-latency, mostly-in-order)
- **Different personalities**
  - – Very different Instruction Set Architectures => very different cores
  - – Cache hierarchy and Coherency model
  - – SMP topology and protocol
  - – Chip organization
  - – IBM z6 optimized for Enterprise Data Serving Hub



Energy Management

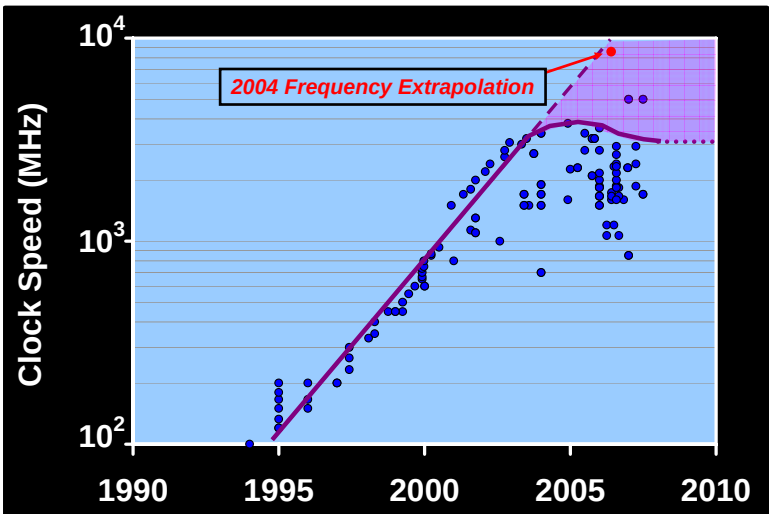




- ✓**Configuration Based Power Planning Tools**
- ✓**Power Monitoring Tools**
- ✓**Power Management Policies**

Microprocessor Clock Speed Trends

Managing power dissipation is limiting clock speed increases



What's Causing The Problem?

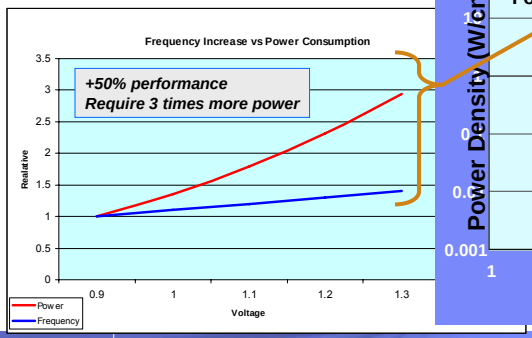
Power Wall Power components:

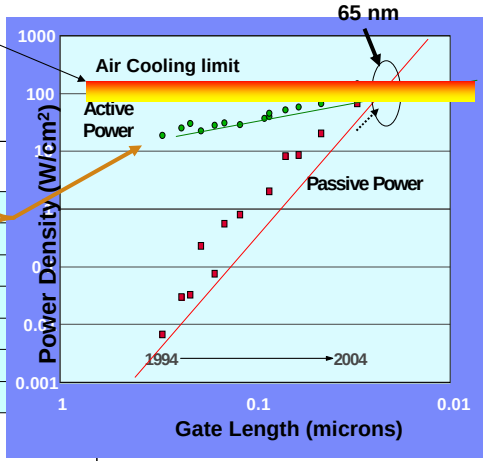
- Active power
  - P=(1/2)CV2f
- Passive power
  - Gate leakage
  - Sub-threshold leakage (source-drain leakage)

Air-speed 100KM/hour.. Safety limit… Noise limit…

Net:

•Further improvements require structure/materials changes

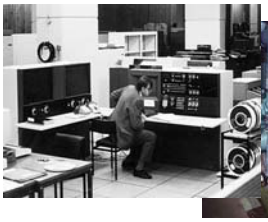




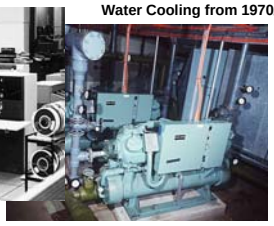
Water cooling WILL be re-introduced in the data center

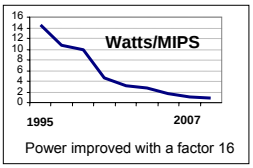
Distributed server farms may generate as much as 3800 watts per sq foot (was 250 in 1992)
The z9 mainframe generate from 100 to 300 watts per sq foot
The mainframe is generally superior by respect to environmental compared to other platforms

S/370 model 168 – mid 1970s – 3 MIPS



Water Cooling from 1970/80s





Power improved with a factor 16

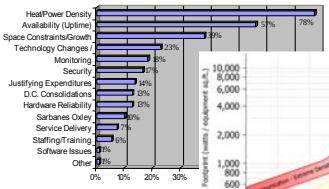
Water cooling will be re-introduced in the Data Center (technology need)

- chip modules (boards)…heat generation density is rising sharply with increased density
- frame doors (rear-door exchanger, may reduce cooling need, power need)
- Intelligent power management of server/storage infrastructure….

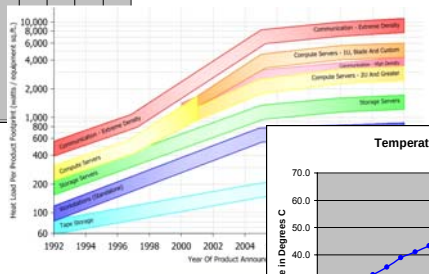
NEW: Rear Door Heat Exchanger (RDHx) for Power Architecture systems

INSTALLATION HEAT AND POWER LEVELS ARE MAJOR ISSUES…

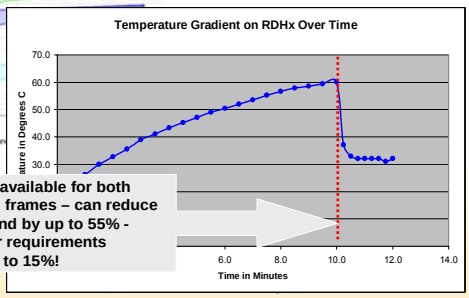
Top Facility / Network Concerns



DEMANDS ARE GROWING…



RDHx OFFERS RELIEF!…



RDHx is now available for both 19" racks and 24" frames – can reduce cooling demand by up to 55% - and power requirements by up to 15%!

System z

Focus area for future Roadmap

zFuture

Pain Points - all platforms

- Infrastructure complexity - Management costs - Application integration costs
- Growing SW cost challenges for the “good enough computing” trend
- Skills shortage and Application shortage inhibit timely support of new business requirements
- Performance issues for new emerging industry workloads on all platforms - like “growing path-lengths” and “latency challenges caused by lack of data proximity”
- Service availability pressures, - caused by competitive treats and globalization trends, which extends the geographical delivery scope
- Ever increasing compliance, audit and security requirements
- Environmental challenges (power, facility,…)

System z

Focus areas for the future Roadmap

Application focus areas

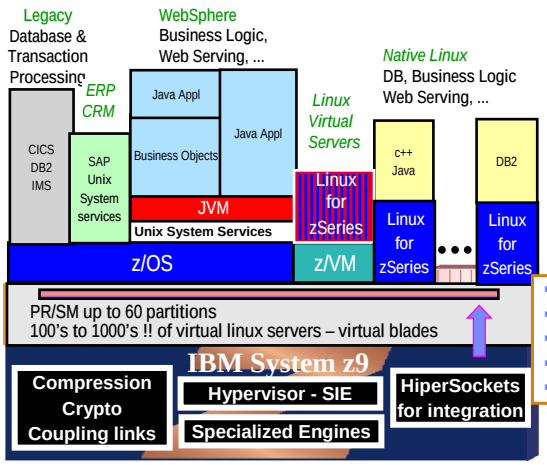
System z as the enterprise data server

Transactional DB Data Warehouse	Data Analysis Content Management Infrastructure DB	Online Data Analytics Web/collaboration content DB
• **OLTP/ERP** • Scalability Enhancements (v9) • DB2 Fast Load		• **OLTP/ERP** • Scalability Enhancements (v10)
• **Warehousing** • Data Warehouse Tools for z • DataQuant on z/OS • AlphaBlox for Linux	• **Warehousing** • AlphaBlox for z/OS • Warehouse Acceleration Kit	• **Warehousing** • Data Warehouse Tools for z
• **Enterprise Archiving** • Content Management WebServices • Records Mgt for CM for z/OS • Enterprise Tape Management • Record Mgr for Linux	• **Enterprise Archiving** • ImagePlus Performance • Full Text Search for Linux for z	• **Enterprise Archiving** • Policy Based Archiving with OAM • Full Text Search on Linux for z
	• **Threat & Fraud** • Global Name Recognition	• **Threat & Fraud** • Entity Analytics for z/OS
	• **Information** • Extract-Transform-Load for II • Quality Stage for z/OS • Legacy to RDBMS replication • Information Services Director for Linux	• **Information** • Information Integration connectors (ICEE) • Information Analyzer • Information Services Director
• **Master Data Management** • WebSphere Customer Center on z	• **Master Data Management** • WebSphere Product Center z	
▸ **Extended zIIP and zAAP exploitation** ▸ **SAP BI Accelerator** ▸ **Data Serving Bundle** ▸ **Large Memory z/OS and DB2**	▸ **Content Manager Full Text Search** ▸ **NFS v4 Client enhanced performance & Security** ▸ **Warehousing pre-configured Stacks (BCU)** ▸ **Network Latency reduction via new IO interfaces** ▸ **Control Unit Software Disk Encryption**	▸ **Cell Processor accelerator** ▸ **Premier System z Data Serving processor** ▸ **Storage Data Accelerator** ▸ **DB2 for z/OS Oracle Compatibility** ▸ **System z Low-End Disk** ▸ **20% data serving performance improvements** ▸ **NFS v4 Security and Performance** ▸ **Archiving Virtual Tape System (VTS) Enhancements**

SOA, Consolidation and Enterprise Wide Role

Business Process Apps Application Accelerators	System Mgt Web Serving / Proxy Caching	Gaming & Interactive Virtualization Networking IMS/VOIP
• **Enterprise SOA** • Java Accelerator • Web 2.0 on Linux onRamp • XML on zAAP and zIIP	• **Enterprise SOA** • WebSphere Process Server Batch • High Performance WebServing • Ported Linux tools for z/OS • DataPower Security Integration • Shared MQ Revitalization • WebSphere Presence Server DB2 z/OS	• **Enterprise SOA** • DataPower Physical Integration • Modern and Integrated Web Server • Shared MQ Revitalization • WebSphere Presence Server on z
• **Virtualization** • Large Memory Linux • Dynamic Memory Upgrade • Director Virtualization Mgt • Linux Data Mirroring	• **Virtualization** • GPFS on Linux • Live Guest Migration • Pre-Configured Linux Solutions	• **Virtualization** • EWLM Integration • ITCAM/EWLM Integration • Linux 'Non-Stop' (Coupling exploitation) • PD Workbench for Linux • Active Storage Management
• **Enterprise Security** • E2E Reporting and Compliance • Key Management Simplification (TKE) • IPSEC on zIIP	• **Enterprise Security** • Autonomic Compliance and Defense • Application Intrusion Detection Svcs • New Crypto Cipher Keys (ECC) • System z Key Mgt	• **Enterprise Security** • Open Standard Access Control (XACML) • H/W & S/W Cryptography • FIPS Certified Crypto • E2E Privacy and Governance
• **Enterprise Business Continuity** • Enterprise Topology (RDS Next) • XRC/zGM use of zIIP	• **Enterprise Business Continuity** • Multi-Platform TSA/GDPS • CCMDB use of DB2 for z/OS • Active-Active e2e Solution (Confirm)	• **Enterprise Business Continuity** • CMDB on z/OS • Coupling Enhancements • Network Hosting on z/OS
• **Specialty Engines** • zIIP, zAAP	• **Appliance** • DataPower…..other	• **Accelerators** • Cell, x86, Java….other • **Appliance** • DB2, File, Messaging • **Architectures integration**

System z – *the IT infrastructure in a box….*



- Open platform for integration of multiple variable workloads
- Most advanced HW/SW virtualization
- Shared Resources - Dynamically scheduled and rescheduled according to a business policy
- Internal networks for integration (HiperSockets™)
- Dynamic Workload Mgnt of Complex mixed workloads
- 100% utilized
- Continuously Available
- "Effective" TCO

- **Expanding to a wider set of work loads**
- **Leading Edge Technology**
- **Cost Optimization via Virtualization**
- **Efficient Power management**
- **Security and Business Resilience**

The future system z-architecture will be a natural development using the UNIQUE z-technologies like Virtualization & Hypervisors – Clustering – Fast Low Latency Interconnects Attached or Integrated Accelerators and Co-processors in new innovative way

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