IBM System z and Linux
Enhancing the value of mainframe investments

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IBM Canada Ltd.
Agenda

- Virtualization
- Linux on Mainframes
First, a few words about product naming ...

<table>
<thead>
<tr>
<th>Long Form</th>
<th>Short Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM @server® zSeries</td>
<td>z990</td>
</tr>
<tr>
<td>IBM System z9</td>
<td>z9-109</td>
</tr>
</tbody>
</table>

- **System z™ = System z9™ + eServer™ zSeries™**
- **Notes:**
  - Hardware *does not* have a slash
  - Software *does* have a slash
    - z/OS®
    - z/VM®
    - z/VSE™
    - z/TPF™
    - z/Architecture® ("considered" software)
Virtualization
Virtualization users see idealized resources

- From the Merriam-Webster Online Dictionary:
  - Main entry: vir·tu·al
  - Function: adjective
  - Etymology: Middle English, possessed of certain physical virtues, from Medieval Latin virtualis, from Latin virtus strength, virtue
Today’s IT environment

*IT environments are increasingly heterogeneous and complex*

The role of modern middleware is to integrate and simplify
IT complexity drives many hidden costs
*That may place the future success of your enterprise at risk*

- **Managing today’s mixed IT platform environments can be complex and costly**
  - Thousands of servers
  - Underutilized assets
  - Hundreds of applications
  - Thousands of software licenses
  - Thousands of distributed control points
  - Ineffective costing methodologies

- **The Result**
  - Massive complexity
  - Spiraling people costs
  - Increased availability and downtime costs
  - Increased security breach costs
  - Sub-optimal investment choices
The changing expense profile

*Total Cost of Ownership across all platforms*

- People expense has tripled as a %
- Software expense has doubled as a %
- Hardware is less than 1/3 of its original %

Source: IBM Customer studies 1999-2004
Complex infrastructures create challenges

- Management of complex, heterogeneous environments too hard
- IT asset utilization is too low
- Privacy, security and business continuity
- Swamped by the proliferation of technology and platforms to support
- Operational speed is too slow; IT flexibility too limited
- Inability to manage the infrastructure seamlessly
Virtualization is a fundamental imperative

“Virtualization is the process of presenting computing resources in ways that users and applications can easily get value out of them, rather than presenting them in a way dictated by their implementation, geographic location, or physical packaging. In other words, it provides a logical rather than physical view of data, computing power, storage capacity, and other resources.”

– Jonathan Eunice, Illuminata Inc.

Virtualization is far more than just partitioning or single products
IBM’s long term focus on virtualization

- While virtualization sounds complex, it’s really a simple idea – IBM systems can provide virtualization capabilities that are unique in the marketplace
  - IBM mainframe virtualization - 40-yr history of world class hardware and software innovation
  - Open development leveraged across all servers and storage systems
  - All IBM systems can run multiple operating systems concurrently
  - Can manage non-IBM server and storage infrastructures
  - Does not require “rip and replace” hardware and software upgrades
  - Builds on existing infrastructure to help manage heterogeneous environments
Why IT optimization is important

- **Fuel growth by managing costs:**
  - 80% of CEOs view growth as a key focus area
  - Operational costs far exceed the budgets for new hardware, they are growing at approximately 2½ times the compound annual growth rate*

- **Complexity is growing:**
  - Existing computing capacity is highly underutilized
  - Gartner predicts that enterprises that don't leverage virtualization technologies will spend as much as 25% more for their x86 servers

- **Business Flexibility:**
  - Agility has been made a high priority across the organization … [however] only 13% of the CEOs rate their organization’s ability to respond to changing business conditions as very responsive **

*IDC, 2004 **CEO Study of 456 WW CEOs IBM Corporation, 2-04; Graphic: IDC Directions 4-7-04 Customer Adoption of On-Demand Enterprises.
IT optimization

- Customers leveraging scale up and scale out technologies to simplify and integrate their on demand operating environment
- As one solution option:
  - Large SMP and Rack Optimized servers integrated with Linux, Java and Grid technologies can enable this transformation
Ideal blade implementations

- Clustered workloads
- Distributed computing applications
- Infrastructure applications
- Small database
- Processor and memory intensive workloads
- Centralized storage solutions
Ideal mainframe implementations

- High performance transaction processing
- I/O Intensive workloads
- Large database serving
- High resiliency and security
- Unpredictable and highly variable workload spikes
- Low utilization infrastructure applications
- Rapid provisioning and re-provisioning
Design / architect continuum – A general “ROT”

- **x86**
  - Few servers
  - Moderate to high average CPU % busy
  - Low I/O requirements

- **RISC (POWER)**
  - CPU intensive
  - Large memory
  - LPAR benefits
  - Moderate I/O

- **Mainframe**
  - Many servers
  - Low to moderate average CPU % busy
  - Virtual servers on demand
  - High I/O requirements
  - Integration with “legacy” systems
Software for Linux on various platforms

- Most Open Source server software will run on any architecture
- Intel x86
  – Largest volume of commercial software
- Intel Itanium
  – Limited commercial software – primarily databases, compute intensive, and ERP
- AMD 64, Intel EM64T – eServer xSeries, BladeCenter
  – Tolerates x86 software, limited exploitation
- IBM POWER – System p, System i, BladeCenter JS
  – 750+ commercial applications available
- IBM Mainframe – System z
  – 750+ commercial applications available
Linux on Mainframes

ibm.com/zseries/linux
What is Linux on System z?

- A native mainframe operating environment
  - Exploits IBM System z hardware
  - Not a unique version of Linux

- Application sourcing strategy
  - The IBM commitment to z/OS, z/TPF and z/VSE is not affected by this Linux strategy
  - Customers are offered additional opportunities to leverage their investments through Linux
  - New doors are opening for customers to bring Linux-centric workloads to the platform
Why Linux on System z?

1. Increased solutions through Linux application portfolio
2. Large number of highly skilled programmers familiar with Linux
3. Integrated business solutions
   - Data richness from System z
   - Wide range of Linux applications
4. Industrial strength environment
   - Flexibility and openness of Linux
   - Qualities of service of System z
5. Unique ability to easily consolidate large number of servers
Customers perceive a distinct gap between mainframe capabilities and other platforms

**Server Platform Perceptions – Ratings on a Scale of 1-5**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Rating by Platform</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mainframe</td>
<td>UNIX</td>
<td>“Wintel”</td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>4.81</td>
<td>3.59</td>
<td>2.64</td>
<td></td>
</tr>
<tr>
<td>System Integrity / Security Controls</td>
<td>4.65</td>
<td>3.30</td>
<td>2.27</td>
<td></td>
</tr>
<tr>
<td>Backup and Recovery (Including Disaster Recovery)</td>
<td>4.54</td>
<td>3.35</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td>Workload Management</td>
<td>4.49</td>
<td>3.07</td>
<td>2.23</td>
<td></td>
</tr>
<tr>
<td>Average Response Time</td>
<td>4.15</td>
<td>3.60</td>
<td>2.96</td>
<td></td>
</tr>
<tr>
<td>Data and Transaction Processing</td>
<td>4.49</td>
<td>3.61</td>
<td>2.75</td>
<td></td>
</tr>
<tr>
<td>Integration of data, applications across business processes</td>
<td>3.59</td>
<td>3.47</td>
<td>3.09</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>4.39</td>
<td>3.43</td>
<td>2.66</td>
<td></td>
</tr>
</tbody>
</table>

Survey of over 700 existing zSeries customers. Question: For each attribute shown below, please rate each platform based on your experience / perceptions. (Note that you may rate different platforms as having equivalent levels). 0 = Not sure; 1 = Poor, 2, 3 = Average, 4, 5 = Best-in-class

Respondents consistently view the mainframe as differentiated in its capabilities

Compared to market research in 2000, mainframe lead over Wintel has increased, gap over UNIX maintained
Customers viewed the mainframe as best suited to deliver enterprise wide capabilities

The mainframe is seen as substantially better suited to perform all Enterprise Roles, compared to other platforms.

It is seen as most differentiated in its ability to deliver enterprise workload management.

CIOs/CTOs belief in the mainframe’s ability to deliver Enterprise Roles equivalent to that of other decision makers.

Survey of over 700 existing zSeries customers.
What System z brings to Linux

- **The most reliable hardware platform available**
  - Redundant processors and memory
  - Error detection and correction
  - Remote Support Facility (RSF)

- **Centralized Linux systems are easier to manage**

- **Designed to support mixed workloads**
  - Allows consolidation while maintaining one server per application
  - Complete work load isolation
  - High speed inter-server connectivity

- **Scalability**
  - System z9 109 scales to 54 application processors
  - eServer zSeries 990 scales to 32 application processors
  - eServer zSeries 890 scales to 4 application processors
  - Up to 8 dedicated I/O processors (SAPs)
  - Hundreds of Linux virtual servers
What is different about Linux on System z?

- **Access to System z specific hardware**
  - Crypto support – PCICA, CPA, PCIXCC, Crypto2
  - Traditional and Open I/O subsystems
    - Disk (ECKD or SCSI) and tape
    - SAN File System and SAN Volume Controller
  - OSA-Express and OSA-Express2 for very high speed communication between z/OS and Linux
  - HiperSockets for ultra-high speed communication between z/OS or z/VSE and Linux

- **z/VM aware**
  - Enhanced performance
  - System management tools
Value of Linux on System z

- Reduced Total Cost of Ownership (TCO)
  - Environmental savings – single footprint vs. hundreds of servers
  - Consolidation savings – less storage, less servers, less software licenses, less server management/support

- Improved service level
  - Systems management (single point of control)
  - Reliability, availability, security of System z hardware and z/VM software
  - High performance integration with z/OS

- Speed to market
  - Capacity-on-demand capability on System z
  - Dynamic allocation of on-line users, less than 10 seconds to add a new Linux server image using z/VM and IBM DS8000
Roadblocks to Linux adoption on System z

- Wide acceptance of Linux as an enterprise-class environment, but still skepticism outside Intel platform and certain applications
- Be prepared to answer some tough questions:
  - “Why should we use Linux in the first place?”
  - “Why should I run a ‘free’ operating system on such an expensive platform?”
  - “What if we don’t know anything about VM? Or Linux?”
  - “What if our end users don’t like it?”
  - “Nobody else is doing it, right?”
- Be willing to accept your own answers; sometimes a different approach may be better
System z multidimensional virtualization
Virtualization is built in, not added on

- **Application support dimension (open, stable)**
  - Open, stable operating system
  - Virtual server awareness infrastructure
  - Enterprise applications

- **Hypervisor dimension (powerful, flexible)**
  - Shared-memory based virtualization model
  - Granular resource sharing and simulation
  - Flexible virtual networking
  - Resource control and accounting
  - Server operation continuity (failover)
  - Server maintenance tools and utilities

- **Hardware dimension (robust, reliable foundation)**
  - Legendary reliability, scalability, availability, security
  - Logical partitioning (LPAR)
  - Processor and peripheral sharing
  - Inter-partition communication
  - Virtualization support at the hardware instruction level
System z – A closer look at the ultimate virtualization resource

- **Massive consolidation platform**
  - 60 logical partitions, 100s to 1000s of virtual servers under z/VM
  - Virtualization is built-in, not added-on
  - HiperSockets for memory-speed communication
  - Most sophisticated and complete hypervisor function available

- **Intelligent and autonomic management of diverse workloads and system resources based on business policies and workload performance objectives**

- **Utilization often exceeds 80%**
  - Handles peak workload utilization of 100% without service level degradation
z/VM – unlimited virtualization

- Mature technology – z/VM introduced in 1967
- Software Hypervisor integrated in hardware
  - Sharing of CPU, memory and I/O resources
  - Virtual network – virtual switches/routers
  - Virtual I/O (mini-disks, virtual cache, …)
  - Virtual appliances (SNA/NCP, etc.)
- Easy management
  - Rapid install of new servers – cloning or IBM Director task z/VM Center
  - Self-optimizing workload management
  - Excellent automation and system management facilities
  - Flexible solution for test and development systems

z/VM 5.2 – 64-bit support – real and virtual
IBM Director 5.1 with the z/VM Center simplifies deployment of guest images
The value of z/VM for Linux

- **Enhanced performance, growth and scalability**
  - Server consolidation enables horizontal growth
  - N-tier architecture on two tiers of hardware
  - Extensive support for sharing resources
  - Virtual networking
  - Effective isolation of Linux images, if required

- **Increased productivity**
  - Development and testing
  - Production support

- **Improved operations**
  - Backup and recovery
  - Command and control
Integrated Facility for Linux

- **Additional engines dedicated to Linux workloads**
  - Supports z/VM and Linux on zSeries
  - IFLs on “sub-uni” systems run at “full speed”
    - e.g. z800, z890

- **Traditional mainframe software charges unaffected**
  - IBM mainframe software
  - Independent Software Vendor products

- **Linux and z/VM charged only against the IFLs**
## Current workload share on utilized IFLs

### Year-end 2005

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%</td>
<td>Application serving for z/OS</td>
<td>e.g. WebSphere, SAP, CICS TG, DB2 Connect</td>
</tr>
<tr>
<td>20%</td>
<td>Data serving</td>
<td>e.g. Oracle DB, DB2 UDB</td>
</tr>
<tr>
<td>4%</td>
<td>Workplace serving</td>
<td>e.g. Domino, other e-mail</td>
</tr>
<tr>
<td>4%</td>
<td>Infrastructure serving</td>
<td>e.g. Apache, Samba</td>
</tr>
<tr>
<td>2%</td>
<td>Linux application development/deployment</td>
<td></td>
</tr>
</tbody>
</table>

Notes: extrapolation based on analyzing 1/3 of inventory, excludes all IBM
Application serving with Linux on System z

The best LAN is one with no wires
GDPS multiplatform resiliency for System z

- Designed for use with distributed applications
- SAP application server running on Linux for zSeries, SAP DB server running on z/OS
- Coordinated near-continuous availability and DR solution for z/OS, z/VM and Linux guests
- Uses z/VM HyperSwap function to switch to secondary disks
- Sysplex support allows for site recovery
# Where to deploy on System z – z/OS or Linux?

<table>
<thead>
<tr>
<th>Technical Considerations</th>
<th>Other Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux ➔ z/OS</td>
<td>▪ Application availability</td>
</tr>
<tr>
<td>Quality of Service</td>
<td>▪ Workload Management function and granularity</td>
</tr>
<tr>
<td>Linux ← z/OS</td>
<td>▪ File sharing across a Sysplex</td>
</tr>
<tr>
<td>Speed of deployment</td>
<td>▪ Manageability and scaling characteristics</td>
</tr>
<tr>
<td>Degree of portability</td>
<td>▪ Availability of skill</td>
</tr>
</tbody>
</table>
# Platform selection for Linux applications

## Technical Considerations

<table>
<thead>
<tr>
<th>System z</th>
<th>Other architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality of Service</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Speed of deployment</strong></td>
<td>Instances 2 - n</td>
</tr>
<tr>
<td><strong>Data Intensity</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Compute Intensity</strong></td>
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</tbody>
</table>

## Other Considerations

- **Application availability**
  - Certification of solution on hardware/software platform
- **Workload Management**
- **Manageability and scaling characteristics**
  - Especially DB2 on z/OS
  - Proximity of data to application
  - The best network is an internal network!
Linux on System z ISV status

ibm.com/zseries/os/linux/apps/all.html
Linux on System z Web site

ibm.com/zseries/linux

An ideal foundation for on demand operating environments

What do you get when you combine the scalability and reliability of IBM mainframe servers with the flexibility and open standards of Linux?

→ Get started with Linux on IBM System z

Featured topics

→ Migrating Linux production servers from 2.4 to 2.6 kernel

The recently published edition of the zSeries Test Report has added a new chapter on migrating Linux production environments with lots of middleware from Linux distributions based on the 2.4 kernel (SLES8 and RHEL3) to those based on the 2.6 kernel (SLES9 and RHEL4). The complete test report with all Linux and z/OS chapters is available from the zSeries Platform Test Web page.

→ New product announcement: IBM Virtualization Engine and Infrastructure Services for Linux on System z9 and zSeries

IBM Virtualization Services for Linux on System z9 and zSeries makes infrastructure simplification real by transforming integrated technologies, and extending the leading edge mainframe virtualization and management functions. With the product components, virtualization "best practices" can be extended into distributed environments, allowing to unify your heterogeneous IT infrastructure management consistently and open standards-based.
z/VM Web site

ibm.com/vm

z/VM®
the newest VM operating system based on 64-bit z/Architecture.

Currently marketed releases of z/VM

Now available:  
z/VM V5.2
Also available:  
z/VM V5.1
z/VM V4.4

z/VM provides a highly flexible test and production environment for enterprises deploying on demand business solutions. Built upon the solid VM/ESA base, z/VM exploits the z/Architecture and helps enterprises meet their growing demands for multi-user server solutions with a broad range of support for operating system environments such as z/OS, OS/390, TPF, z/VSE, CMS, or Linux on System z9 and zSeries. Read more about z/VM.

Summary of News and Updates

View 02 Feb. 2006 updates.
Read the z/VM and VM Site News and Changes for a summary of VM-related news, announcements, pointers, new classes, and places to hear about z/VM virtualization technology.

Worldwide announcement letters (US letters / product links below)

→ Dec. 16, 2005  
z/VM V5.2 Generally Available
→ Nov. 08, 2005  
IBM Virtualization Engine, V2.1
→ Nov. 01, 2005  
Revised transferability T’s and C’s for IBM z/VM V5.2
Internet list server discussions

- **VMESA-L discusses z/VM**
  - To subscribe, send a note to listserv@listserv.uark.edu. In the body of the note, write only the following line:
    - `SUBSCRIBE VMESA-L firstname lastname`
  - View and search the current list and archives:
    - [http://listserv.uark.edu/archives/vmesa-l.html](http://listserv.uark.edu/archives/vmesa-l.html)

- **LINUX-390 discusses Linux on System z**
  - To subscribe, send a note to listserv@vm.marist.edu. In the body of the note, write only the following line:
    - `SUBSCRIBE LINUX-390 firstname lastname`
  - View and search the current list and archives:
Summary
Three pillars of a successful Linux solution

- **On Demand Business**
  - Responsive
  - Variable
  - Focused
  - Resilient

- **IBM**
  - End-to-end
  - Hardware, software and services
  - Value-net of partners

- **Linux**
  - Freedom of choice
  - Cost effective
  - Secure
  - Innovative
What next?

- Familiarize yourself with the facts
- Establish an Open Policy
  - It should be inclusive, not exclusive!
- Align to Open Standards
  - Insist on them!
- View Open Source and Linux as valid alternatives for IT systems
- Make decisions based on business value; not hype and hope!
  - Be pragmatic
- Be prepared for change!
Thank you

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ibm.com/systems/systemz9
ibm.com/vm/devpages/jelliott
linux.ca/drupal/blog/58
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