10 YEARS of Enterprise Linux® on System z®

IBM

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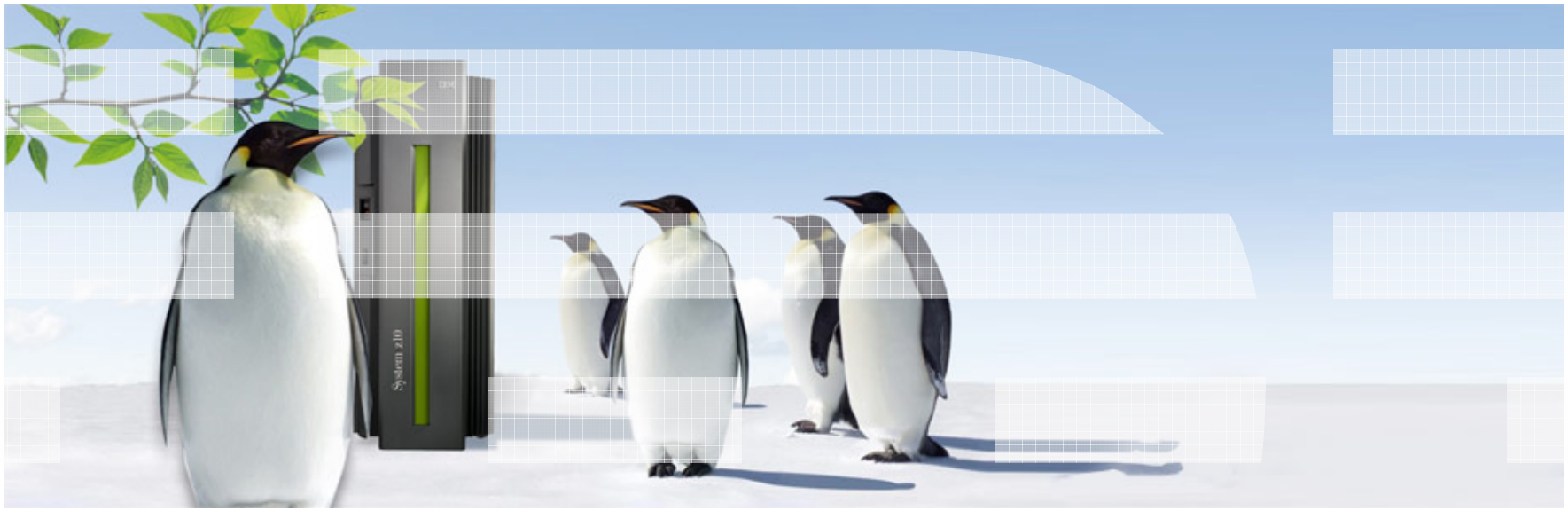
Linux on IBM System z

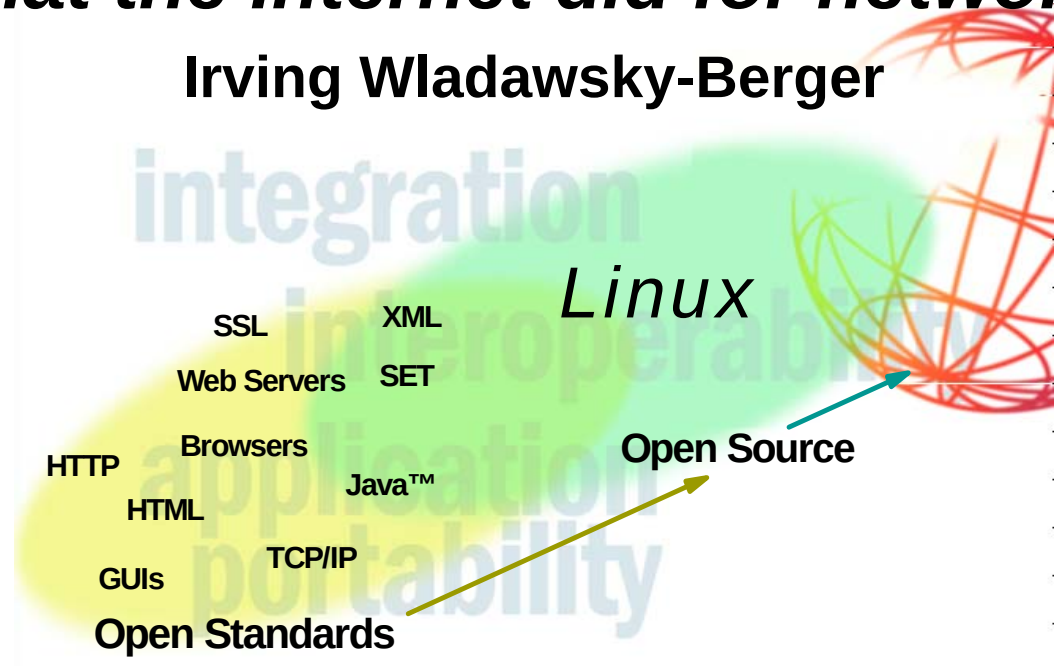
A Simple Idea that Changed the World



Innovation, vision and strategic direction

"Linux will do for applications, what the Internet did for networks"

Irving Wladawsky-Berger



The Linux operating system

- **Growing Marketplace Acceptance**
  - The continual compound growth of Linux deployments and large skill pool attests to the market acceptance
- **Industry Wide Initiative**
  - Linux is the first operating system that the entire industry has rallied around. Not just select vendors
- **Multi-platform**
  - Linux runs on every platform, there is no other operating system with this characteristic
- **Basis of Innovation**
  - Because of its open nature, Linux is the basis for new and innovative uses of technology

- **Open Source**
- **No single vendor**
- **Coexistence**
- **Born on the web**
- **Small and modular**
- **Community developed and owned**
- **Unix heritage**

The IBM Linux strategy

- **Leverage Linux to create a pervasive application development and deployment environment that will drive applications growth**
  - Responsible participation with the Open Source community
  - Support a native Linux on all server platforms
- **Ease the deployment of Linux applications on IBM servers**
  - Develop IBM Linux based offerings
  - Platforms, services and packaged solutions
- **Expand IBM Linux Technical Center of Competence**
  - Partner and contribute IBM technology and skills to the open source community
  - Enhance IBM Linux and Open Source technical skills

In the beginning … Bigfoot

- The original i370 project was started in August 1998 by Linas Vepstas, at the instigation of Daniel Lepore
- Later, Neale Ferguson, Peter Schulte-Stracke, and Rob van der Heij joined in to provide code and shoot bugs
- Rick Troth helped with boot-loader issues
- The result of this effort was a compiler, an assembler, a port of glibc, and a kernel that would usually boot but was missing important features, such as disk drivers and network drivers, never mind a variety of infrastructure

Timeline – 1999

- **January**
  - A splinter group begins work on a Linux on S/390 project in Böblingen, Germany, just for the "coolness factor." Their work is neither sanctioned nor budgeted and most likely cannot be found on any official charts.
- **October**
  - Embracing Linux at IBM became Sam Palmisano's bet while he was a senior vice president. "*The Internet has taught us all the importance of moving early, the advantage of being a first-mover*," Palmisano said in an interview. "*We want to be riding that Linux momentum at the front, not trailing it*."
  - First public discussion of IBM's Linux for S/390 port at WAVV by Dr. Strassemeyer in his keynote address with a "secret" preview running on an IBM MP3000
- **December**
  - IBM publishes a collection of patches and additions to the Linux 2.2.13 kernel for System/390 to start a market evaluation, and creates excitement in the developer community.

The IBM project team

- **The sponsors**
  - Karl-Heinz Strassemeyer
  - Boas Betzler
- **The early development team**
  - Ingo Adlung*
  - Eberhard Pasch*
  - Hartmut Penner*
  - Martin Schwidefsky*
  - Holger Smolinski
  - Ulrich Weigand*

* IBM Corporate Award for Linux on S/390

The IBM project team

- **Some of the "sales team"**
  - Jim Elliott
  - Erich Amrehn
  - Jim Savoie
  - Bill Reeder
  - Len Diegel
  - Tom Murphy

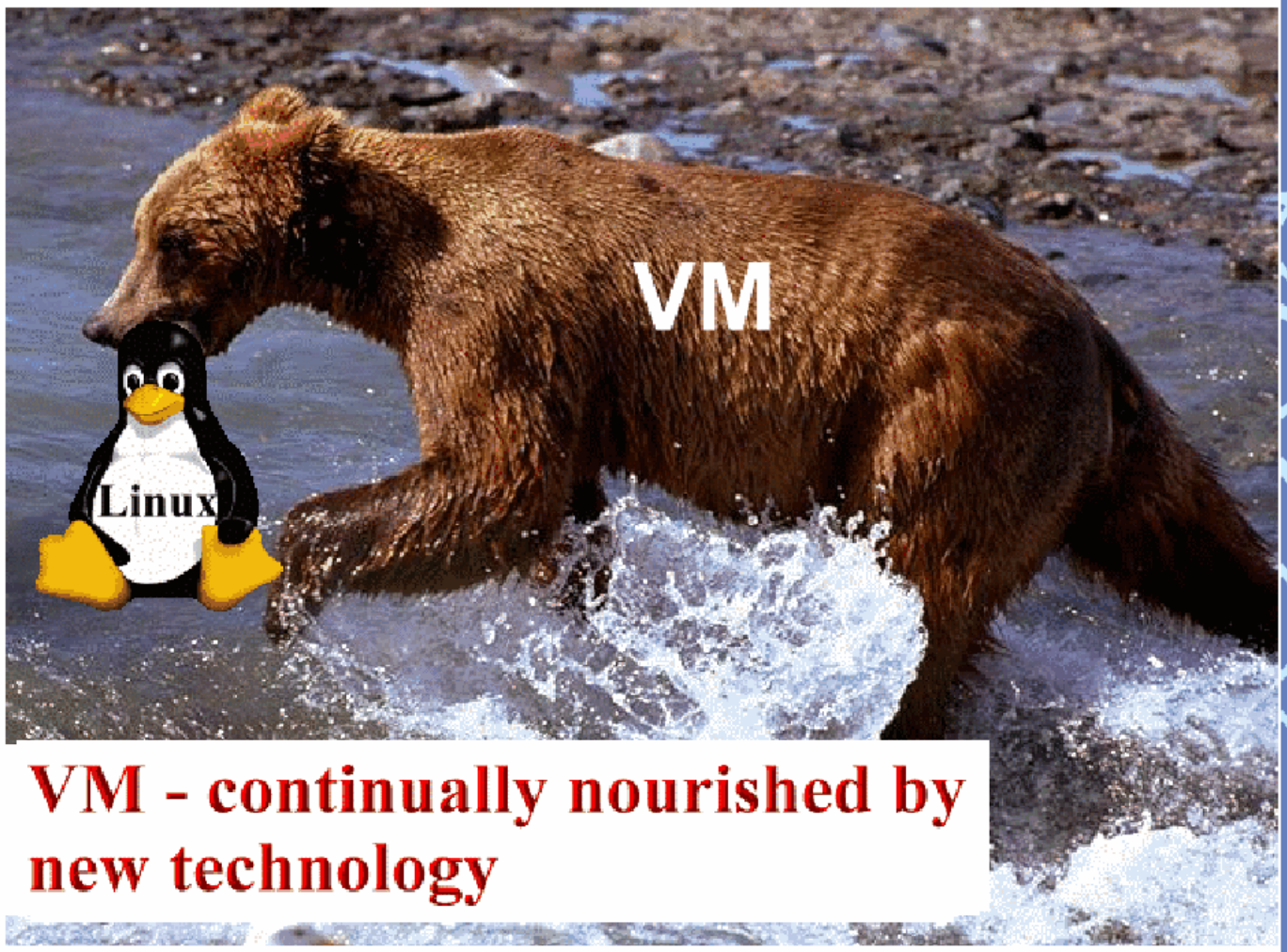
The business case for Linux on S/390

1. **Increased solutions through Linux application portfolio**
2. **Large number of highly skilled programmers familiar with Linux**
3. **Integrated business solutions**
   - Data richness from zSeries
   - Web capability of Linux applications
4. **Industrial strength environment**
   - Flexibility and openness of Linux
   - Qualities of service of zSeries
5. **Unique ability to easily consolidate large number of servers**

Timeline – 2000

- **January**
  - Linux for S/390 becomes available for technology demonstration from the Marist College Server, which allows clients to test it. Clients respond with over 4,000 downloads.
- **February 2000**
  - Mentioned at LinuxWorld Expo in NYC in keynote address by Linus Torvalds
  - Public showing at the Expo on an IBM MP3000 by Boas Betzler and Ed Gauthier
  - "*S/390: The Linux Dream Machine*" article by Scott Courtney http://www.linuxplanet.com/linuxplanet/reports/1532/1/
- **March 2000**
  - Romney White presents Linux on S/390 at SHARE 94 in Anaheim (Session 9309) to a standing room only crowd

Linux Under VM
One Perspective



VM - continually nourished by new technology

IBM S/390

Timeline – 2000

- **May 17, 2000**
  - Formal announcement of Linux for S/390 by IBM at Vista (IBM's mainframe customer executive event) by Bill Zeitler (GM S/390) with a demo by Jim Elliott
  - IBM takes out a full page advertisement for Linux for S/390 in the Wall Street Journal

- **May 2000**
  - David Boyes described "Test Plan Charlie" where it was demonstrated that >41,400 separate instances of Linux could run simultaneously on one LPAR of a single S/390 server under VM. The S/390 was pushed until it had no more resources to allocate, but the system never crashed.

Timeline – 2000

- **August 2000**
  - IBM S/390 Virtual Image Facility for Linux announced
  - Integrated Facility for Linux announced for 9672 G5/G6
  - At the Atlanta Linux Fest, Linux for S/390 won “Best of Show” award

- **October 2000**
  - zSeries announced – 1st 64-bit mainframe family
  - z/OS, z/VM V3 and z/VSE

zSeries application sourcing strategy

- **The IBM commitment to z/OS and z/VSE was not affected by this Linux strategy**
- **zSeries customers are offered additional opportunities to leverage their investments through Linux**
- **New doors are opening for zSeries customers to bring Linux-centric workloads to the platform**
- **Application sources**
  - z/OS and z/VSE – Traditional
  - z/OS – Unix System Services
  - Linux on zSeries
  - WebSphere – Java, Enterprise Java Beans, CORBA

What zSeries brought to Linux

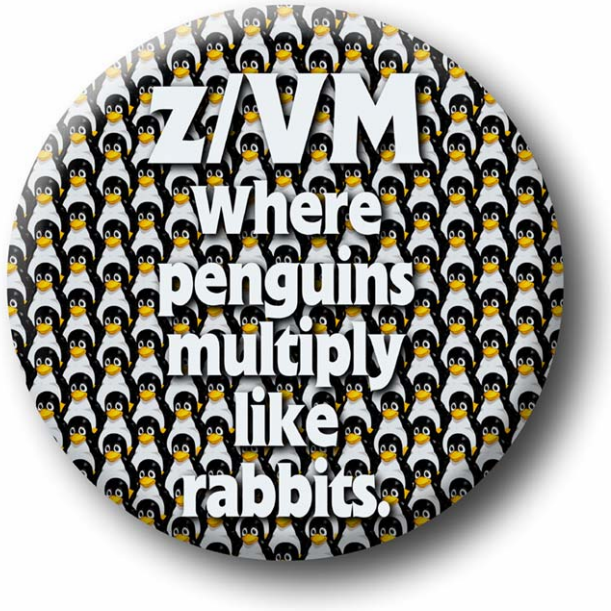
- **The most reliable hardware platform available**
  - Redundant processors and memory
  - Error detection and correction
  - Remote Support Facility (RSF)
- **Centralized Linux systems are easier to manage**
- **Scalability**
  - Physical – scale to 16 application processors and up to 3 dedicated I/O processors
  - Logical – scale to hundreds of Linux images
  - Non-disruptive capacity upgrade on demand
- **Designed to support mixed work loads**
- **Allows consolidation while maintaining one server per application**
- **Complete work load isolation**
- **High speed inter-server connectivity**

Value of Linux on zSeries

- **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 zSeries hardware
- **Speed to market**
  - Capacity-on-demand capability on zSeries
  - Dynamic allocation of on-line users, less than 60 Seconds to add a new Linux server image using z/VM

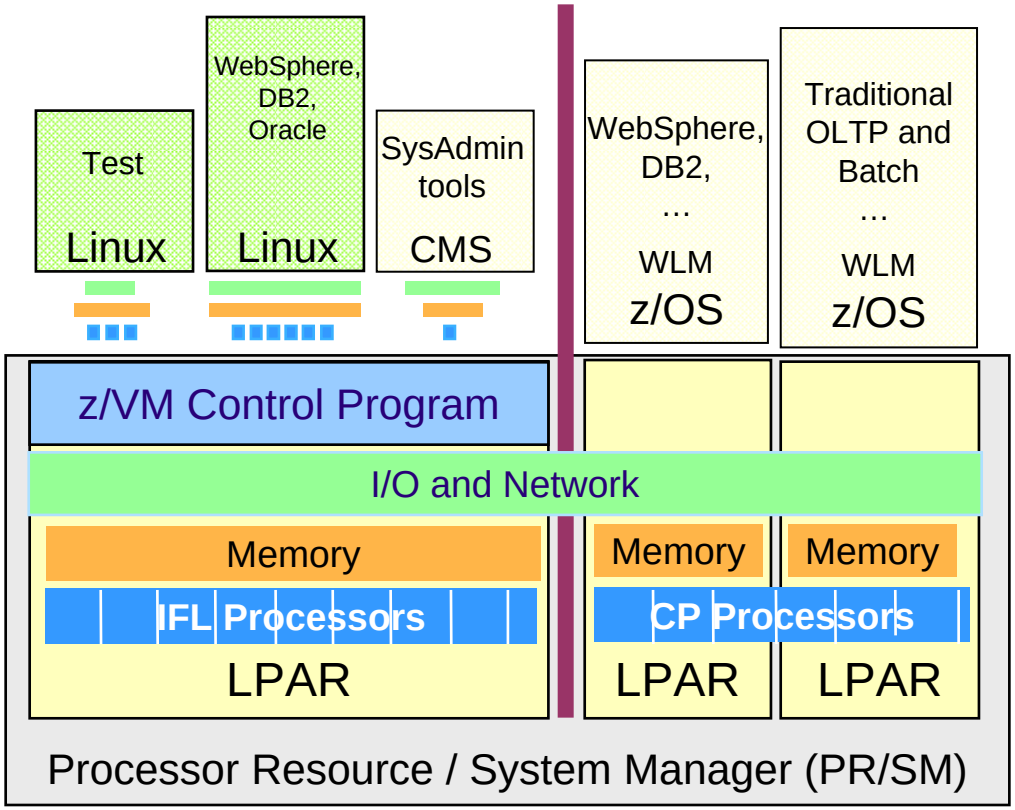
z/VM – Unlimited virtualization

- **z/VM provides a highly flexible test and production environment for enterprises deploying the latest e-business solutions**
- **z/VM helps enterprises meet their growing demands for multi-system server solutions with a broad range of support for operating system environments**
- **Mature technology – VM/370 introduced in 1972**
- **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
  - Self-optimizing workload management



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”
- **Traditional mainframe software charges unaffected**
  - IBM mainframe software
  - ISV products
- **Linux and z/VM charged only against the IFLs**



Timeline – 2001

- **February 2001**
  - IBM announces plans to spend $1B on Linux development at LinuxWorld Expo in NYC
  - IBM wins “Best Hardware” at the Expo with an eServer zSeries 900 running Linux
  - Linux Community Development System launched

- **May 2001**
  - z/VM V4.1 announced
- **August 2001**
  - My 1st SHARE presentation on Linux on zSeries (9200)
- **October 2001**
  - z/VM V4.2 announced
- **2001**
  - HiperSockets becomes available
  - SUSE Enterprise Linux Server 7 becomes available

Timeline – 2002 and 2003

- **2002**
  - 1st Linux only mainframe – the z800 “IBM eServer zSeries Offering for Linux”
  - Major ISV announcements include: mySAP.com, Oracle9i Database Server, System Management Solutions from BMC, CA and Tivoli
  - Open FCP (Fibre Channel Protocol) support and Storage Area Network (SAN) enablement are developed
  - SUSE Linux Enterprise Server 8 becomes available
- **2003**
  - Over 250 apps are now available, including Lotus Notes and Tivoli System Automation for Linux
  - Virtualization improvements such as the Discontiguous Saved Segments (DCSS) technology and Parallel Access Volume (PAV) support for improved I/O performance are developed
  - Red Hat Enterprise Linux 3 becomes available

Timeline – 2004 and 2005

- **2004**
  - Increasing numbers of businesses think that Linux on zSeries delivers true business value – great security and resiliency, simple infrastructure, great utilization of resources, and application flexibility to respond to changing market demand.
  - SUSE Linux Enterprise Server 9 becomes available.
  - z/VM V5.1 announced
- **2005**
  - The biggest Linux on zSeries client now runs more than 290 IFLs.
  - New reliability and virtualization enhancements through developed HyperSwap and N-Port-ID Virtualization (NPIV) support are unveiled, allowing for continuous operations and high utilization.
  - Red Hat Enterprise Linux 4 becomes available.

Timeline – 2006 and 2007

- **2006**
  - The number of available applications approaches 1,000, with over 300 ISVs developing.
  - SUSE Linux Enterprise Server 10 becomes available.
- **2007**
  - IBM announces project “Big Green,” which shrinks 3,900 servers to about 30 System z servers running Linux, in order to reduce power consumption by 80% in five years. Project Big Green spurs a global shift to Linux on System z.
  - z/VM 5.3 supercharges System z virtualization – over 1,000 virtual images can run on a single copy of z/VM, which helps reduce energy consumption and data-center costs.
  - Red Hat Enterprise Linux 5 becomes available.

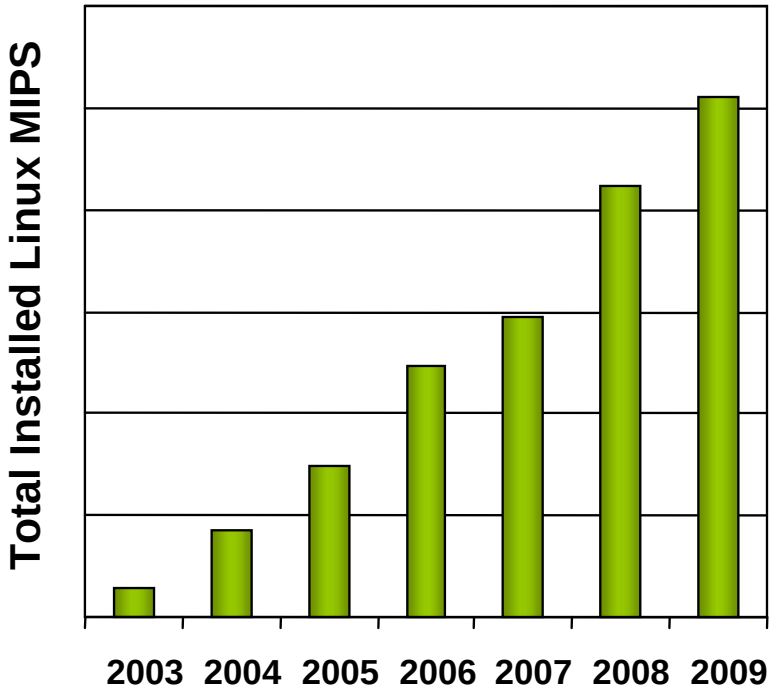
Timeline – 2008, 2009 and 2010

- **2008**
  - IFLs include authorization to run OpenSolaris Operating System.
- **2009**
  - IBM introduces Enterprise Linux Server and Solution Edition for Enterprise Linux for large-scale consolidation and savings; both are quickly embraced by clients worldwide.
  - z/VM V6.1 – A foundation for future virtualization growth becomes available
  - SUSE Linux Enterprise Server 11 becomes available.
- **2010**
  - Now over 3,150 Linux applications are available.
  - Cloud Computing, Business Intelligence and Collaboration are only a few workloads that are best fit to Enterprise Linux on System z.
  - Large-scale server consolidations on System z starting at $1,000 per virtual server instance.

Linux on System z: The momentum continues

- **The momentum continues:**
  - Shipped IFL engine volumes increased 35% from YE07 to YE09
  - Shipped IFL MIPS increased 65% from YE07 to YE09
- **Linux is 16% of the System z customer install base (MIPS)**
- **70% of the top 100 System z clients are running Linux on the mainframe**
- **More than 3,100 applications are available for Linux on System z**

Installed Linux MIPS



* Based on YE 2004 to YE 2009

A Simple Idea that evolved to an Uniquely Powerful Solution

- **Single-server simplicity**
  - Saving opportunities in software and management costs, power and floor space
  - A cluster with one machine backing up another and an additional failover machine
- **Advanced resource utilization and dynamic allocation**
  - Industry leading virtualization and sharing of system resources such as processors, memory, communication, storage, I/O, networking
- **Massive scalability**
  - Running up to thousands of virtual Linux servers concurrently
  - Supporting a broad range of solutions such as cloud computing, business intelligence, collaboration and Web application serving
- **Rock-solid system security and reliability**
  - Most secure commercial server[1] ensuring isolation of each virtual server environment
  - Cost-attractive business resilience and failover solutions

1. IBM System z servers are the world's only servers with the highest level of hardware security certification, Common Criteria Evaluation Assurance Level 5 (EAL5).

10 YEARS of Enterprise Linux® on System z®

IBM

Thank you

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