IBM Linux and Technology Center

Introduction to Linux on System z

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Agenda

- What is Linux
- Linux & IBM
- Linux on System z
- Virtualization with z/VM
- Integrated Facility for Linux (IFL)
- Workload / Software for Linux on System z
- Back-end integration scenario
- Consolidation scenarios and examples

What is Linux ?

In the simplest terms, Linux is an operating system

It was created in October 1991 by a University of Helsinki student named Linus Torvalds (Linux stands for Linus's UNIX)

Linux itself is actually just the kernel; it implements multitasking and multiuser functionality, manages hardware, allocates memory, and enables applications to run

Developed under the GNU public license (GPL)

Boots up quite everywhere on servers, clients, game consoles, mobile and embedded devices

Linux is shipped in so called distributions

IBM collaborates with the Linux community

Active participant since 1999

One of the leading commercial contributors to Linux

More than 600 full-time developers working with Linux and open source

Linux Kernel & Subsystem Development

Kernel Base Architecture Support
GNU
Security
Systems Management
RAS
Virtualization
Special Projects
Filesystems, and more...

Expanding the Open Source Ecosystem

Apache & Apache Projects
Eclipse
Mozilla Firefox
OpenOffice.org
PHP
Samba, and more...

Promoting Open Standards & Community Collaboration

The Linux Foundation
Linux Standards Base
Common Criteria certification
Open Software Initiative, and more...

Foster and Protect the Ecosystem

Software Freedom Law Center
Free Software Foundation (FSF)
Open Invention Network, and more...

Linux on IBM Systems: Leveraging common strengths and differentiated capabilities

Differentiated

System x®

Virtualization and consolidation through Xen and VMware
Real Time Linux: Latency matters
Extremely broad range of ISVs
Innovations such as Power Executive and the rear door heat exchanger

Power®

Advanced RAS features
Live partition migration
Performance parity with AIX
x86 consolidation platform
Extensive ISV support via the Chiphopper™ program

System z®

Run natively or in an IFL
Consolidate hundreds or thousands of workloads
Extensive ISV support via the Chiphopper™ program

Intrinsic

Security

CAPP/EAL 4+ Common Criteria
SELinux, AppArmor
Very rapid time to fix if vulnerabilities are discovered

Efficiency

Dynamic, tickless kernel
Fastest revisions (and newest features) of any mainline OS kernel

Scalability

Wristwatches to mainframes
Considerable effort in community to support scaling up and out

Linux on System z : The fastest growing server platform

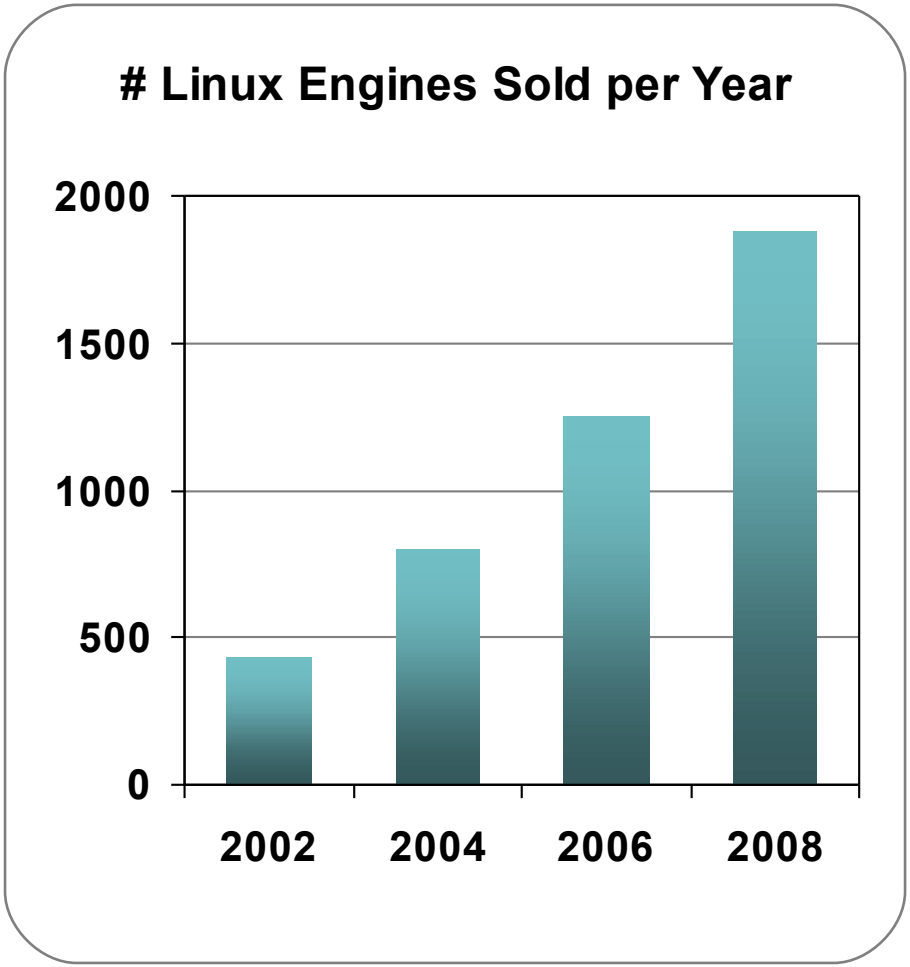
2008 New Linux Capacity on System z equivalent to approximately 40-60,000 x86/x86-64 cores

77% increase in System z Linux MIPS

Approximately 1,300 System z customers are now using Linux on System z in production

Linux counts for approx. 15% of the customer System z installed base (MIPS)

More than 2450 Linux applications are supported on System z, 15% growth in 2008



Linux on System z

Synonym for Linux running on any IBM mainframe

Completely open source under the GNU General Public License.

Close to 100% open source status is unusual among Linux distributions

Only the tape driver is still an OCO driver (needed for TSM Back-up)

Many Linux software packages did not require any code change to run on Linux on System z

Not emulated on a mainframe: It runs as a complete native operating system, like other mainframe operating systems, at full speed using mainframe processor instructions.

Exploits all the current mainframe hardware

IBM currently supports two Linux distributions, Red Hat and Novell SUSE.

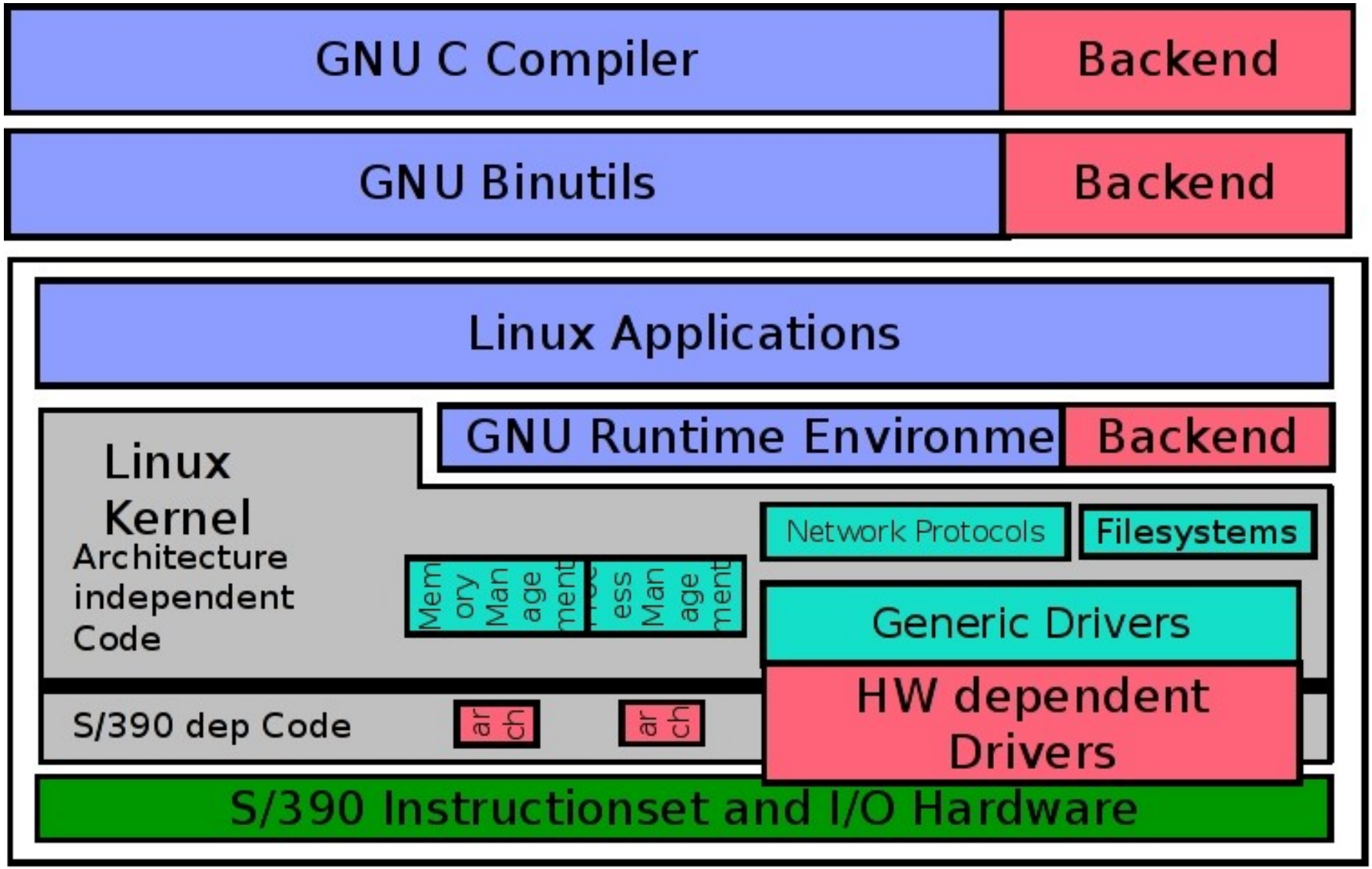
Other notable but unsupported distributions include Debian, Gentoo, Slackware, and CentOS.

The IBM commitment to z/OS, z/VSE and z/TPF is not affected by the IBM Linux strategy

Linux versus mainframe terminology

Linux world	mainframe world
system administrator	system programmer
network management	systems management
boot	IPL
4-processor machine	4-way
main memory	main storage
disk	DASD
scheduler	dispatcher
NIC	OSA

Linux on System z architecture



Virtual machines on System z

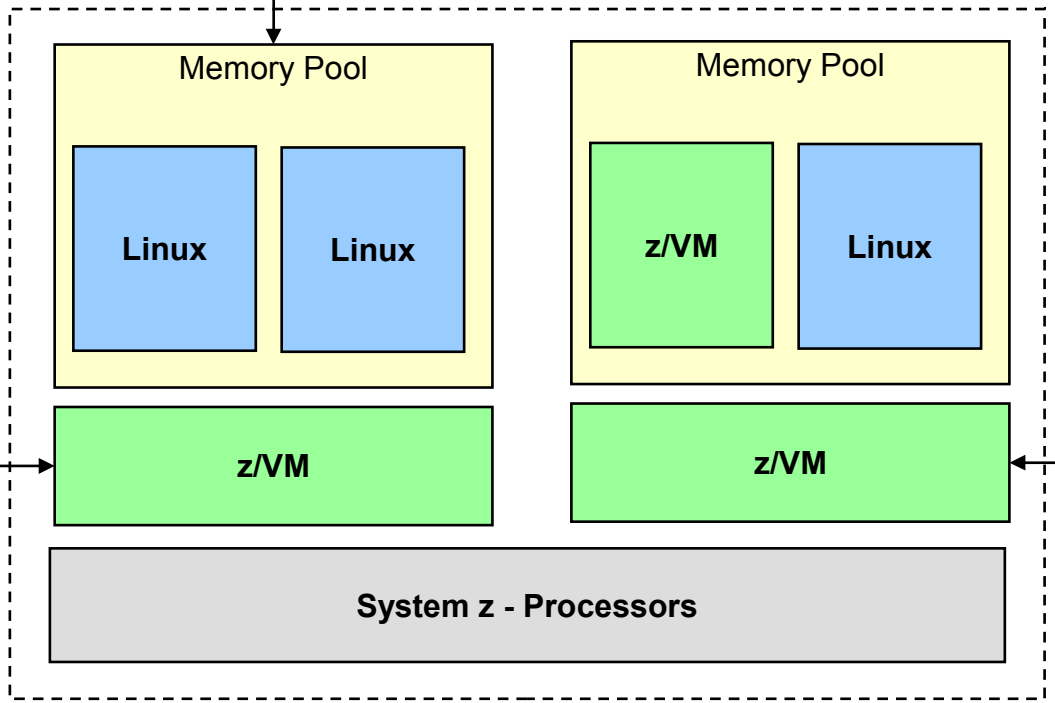
Memory is shared using extremely efficient hardware assists significantly reducing overall memory needs.

Can create multiple z/VM instances.

z/VM instances can be at different release or patch levels.

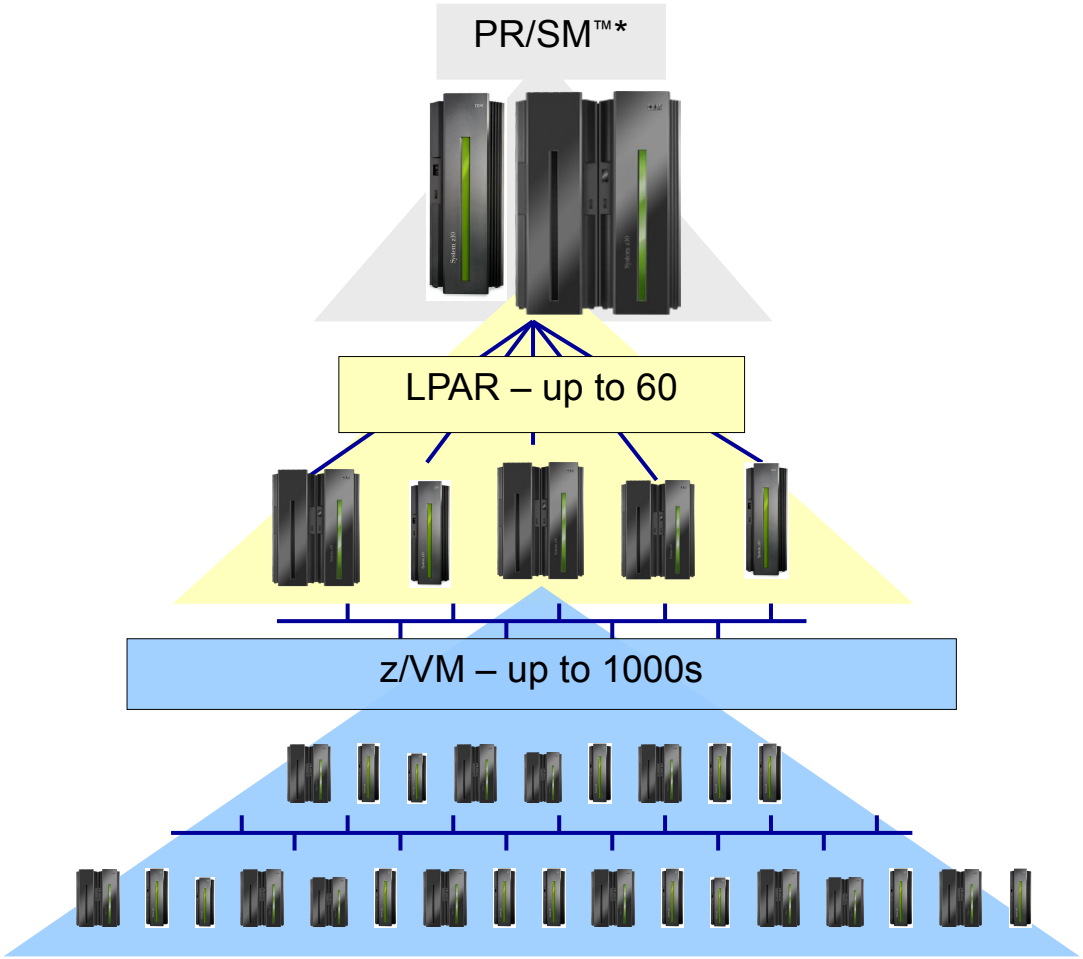
CPU resources not used by one z/VM instance are available to another using LPAR settings.

The roots of z/VM have been in use since 1967.



Run 10s to 1000s of guests varying in size up to 64 virtual CPUs.
Guest to guest virtual networking is supported.

System z extreme virtualization technologies



* Processor Resource/Systems Manager (PR/SM) transforms physical resources into virtual resources so that several logical partitions (LPAR) can share the same physical resources.

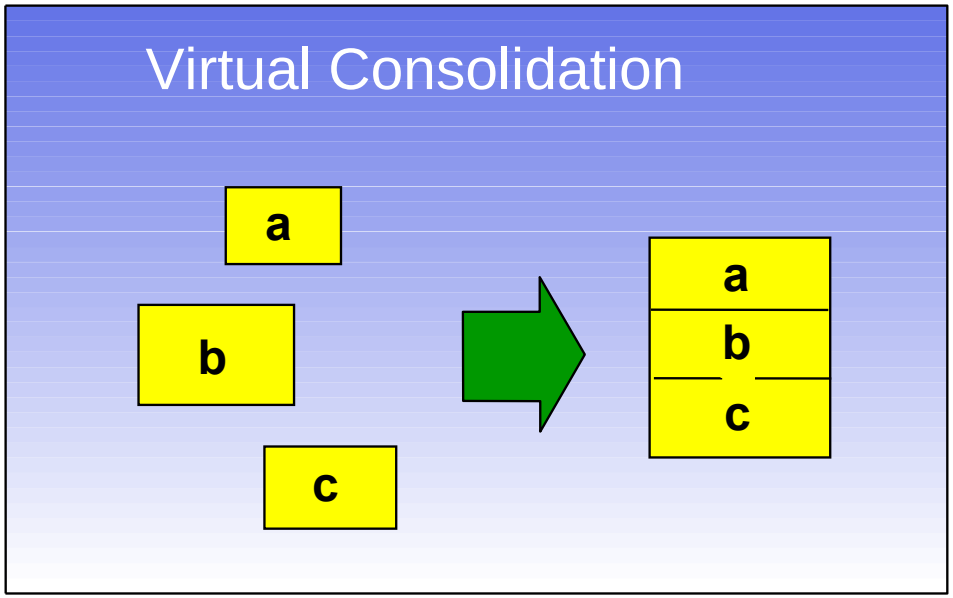
- **Sharing everything** architecture
- **Highly granular** resource sharing
- **Any virtual processor** can access any virtual I/O path within the attached logical channel subsystem
- z/VM can **simulate devices** not physically present
- **Application integration** with HiperSockets and VLANs
- Intelligent and autonomic **workload management**
- **Virtualization is transparent** for OS execution
- Hardware-enforced **isolation**

Rationalized consolidation using System z virtualization technologies

Consolidation into the same number of OS images on one physical server using a Virtualization technology.

System z PR/SM provides a first level of virtualization, allowing to run multiple independent LPARs (up to 60 on System z10 EC)

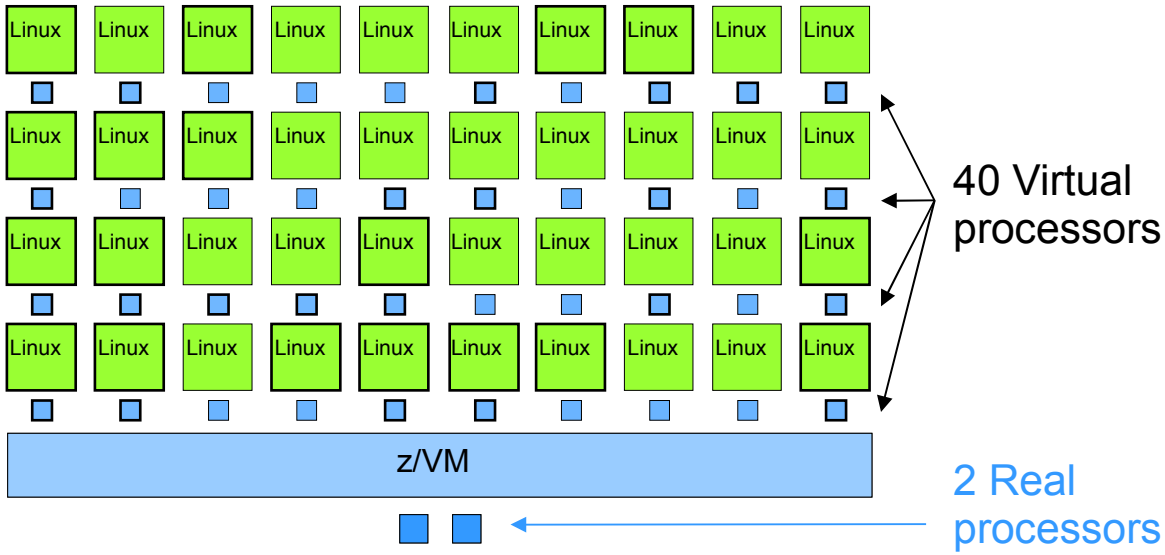
z/VM virtualization technology allows a large number of independent guests to share resources for better hardware utilization, in a secure, transparent, and dynamic manner.



Matching the attributes of a Dynamic Infrastructure:
Resource overcommitment

VIRTUALIZATION

A good **overcommitment capability** is important and **improves the system utilization rate** and **simplifies the management** of the guests.



Software licensed for **2 real processors** can run on **40 virtual processors** in this example.

z/VM handles resource overcommitment extremely well: You can host a virtual Linux environment that consumes considerably more processors and memory, in aggregate, than what is configured in the z/VM LPAR.

Integrated Facility for Linux (IFL)

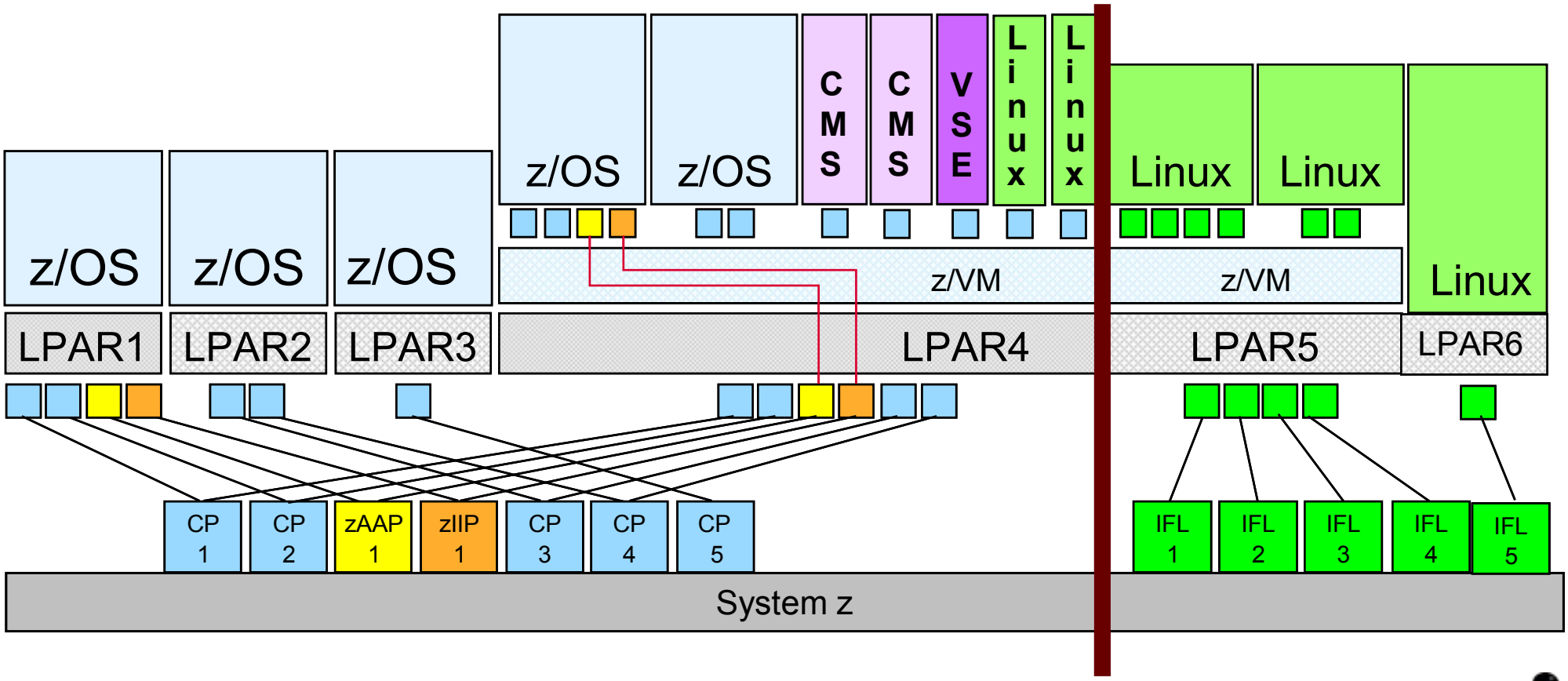
Additional engines dedicated to Linux workloads

Supports z/VM and Linux on System z

IFLs run on z800, z890, **z9 EC**, **z9 BC, z10 EC, z10 BC**

Traditional mainframe software charges unaffected

Linux and z/VM charged only against the IFLs



What makes a best fit workload for Linux on System z?

Leverage classic strengths of the System z:

High availability

High I/O bandwidth capabilities

Flexibility to run disparate workloads concurrently

Requirement for excellent disaster recovery capabilities

Security

Shortening end to end path length for applications

Co-location of applications

Reduction in network traffic

Simplification of support model

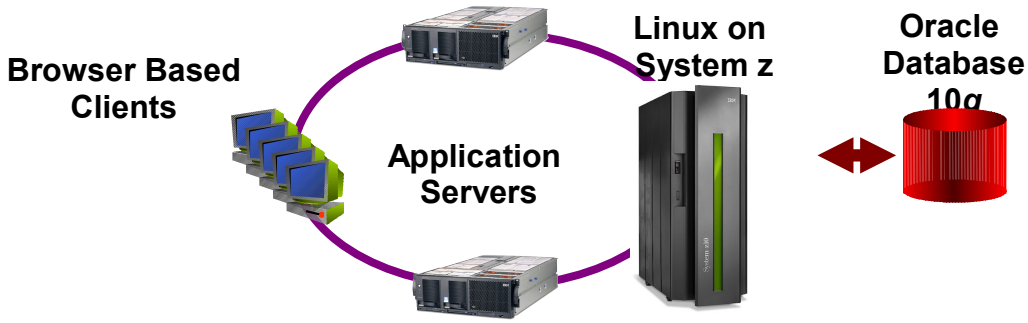
Consolidation of applications from distributed servers

IBM Software on Linux

Software and System Development (Rational. software)	Integration and Application Infrastructure (WebSphere. software)	Integrating Data and Content (Information Management software)	Collaboration and Access (Lotus. software)	IT Service Management (Tivoli software)	Business Intelligence (COGNOS)
Architecture Management	Application and transaction infrastructure	Database Servers	Application Design and Development	Security Management	Business Intelligence
Quality Management	Application Integration	Data Management Tools	Dashboard and Business Solutions	Server, Network and Device Management	Performance management
Process and Portfolio Management	Business Process Management	Enterprise Content Management	E-Mail, Calendaring and Collaborative Applications	Business Application Management	Budgeting, Forecasting, and Scorecarding
Change and Release Management	Commerce	Enterprise Content Management	Instant Messaging, Web Conferencing	IT Service Management	Reporting and analysis
Host Tools/Integration, Languages and Compilers	Mobile and speech middleware	Dynamic Warehousing and Business Intelligence	Social Software	Service Provider Solutions	
	Portals	Information Platform and Solutions	Team Collaboration, Content Management and e-forms	Storage Management	
			Mobile and Wireless Products		

Over 500 Linux offerings – see the matrix at: http://www.ibm.com/linux/matrix
IBM Software for Linux: http://www.ibm.com/software/os/linux/software/

Why Oracle for Linux on System z



Value Statement

- The best TCO characteristics can be obtained from consolidating many servers with low CPU utilization and taking advantage of the virtualization capabilities of z/VM.
  - Lower hardware and software costs
  - Ease of operations
  - Simplified infrastructure
  - On Demand servers
- However, Linux scales well in an LPAR or with z/VM and may resolve other issues or problems such as availability.
  - The new System z10 EC class machines compete with other technologies (We're fast)
  - Great scalability for consolidation or single large databases
- Linux provides for a common skill base on all architectures it runs on

The Technology Stack

- Oracle9i Release 2 Enterprise Edition
- Oracle Database 10g Release 1 and 2 EE
- Oracle Application Server AS 10g (Base, J2EE, SOA, Identity Manager)
- Oracle Clustered File System V2 (OCFS2)
- Oracle Applications
  - PeopleSoft Enterprise 8.9
  - Siebel CRM 7.3
  - Oracle E-Business Suite 11i

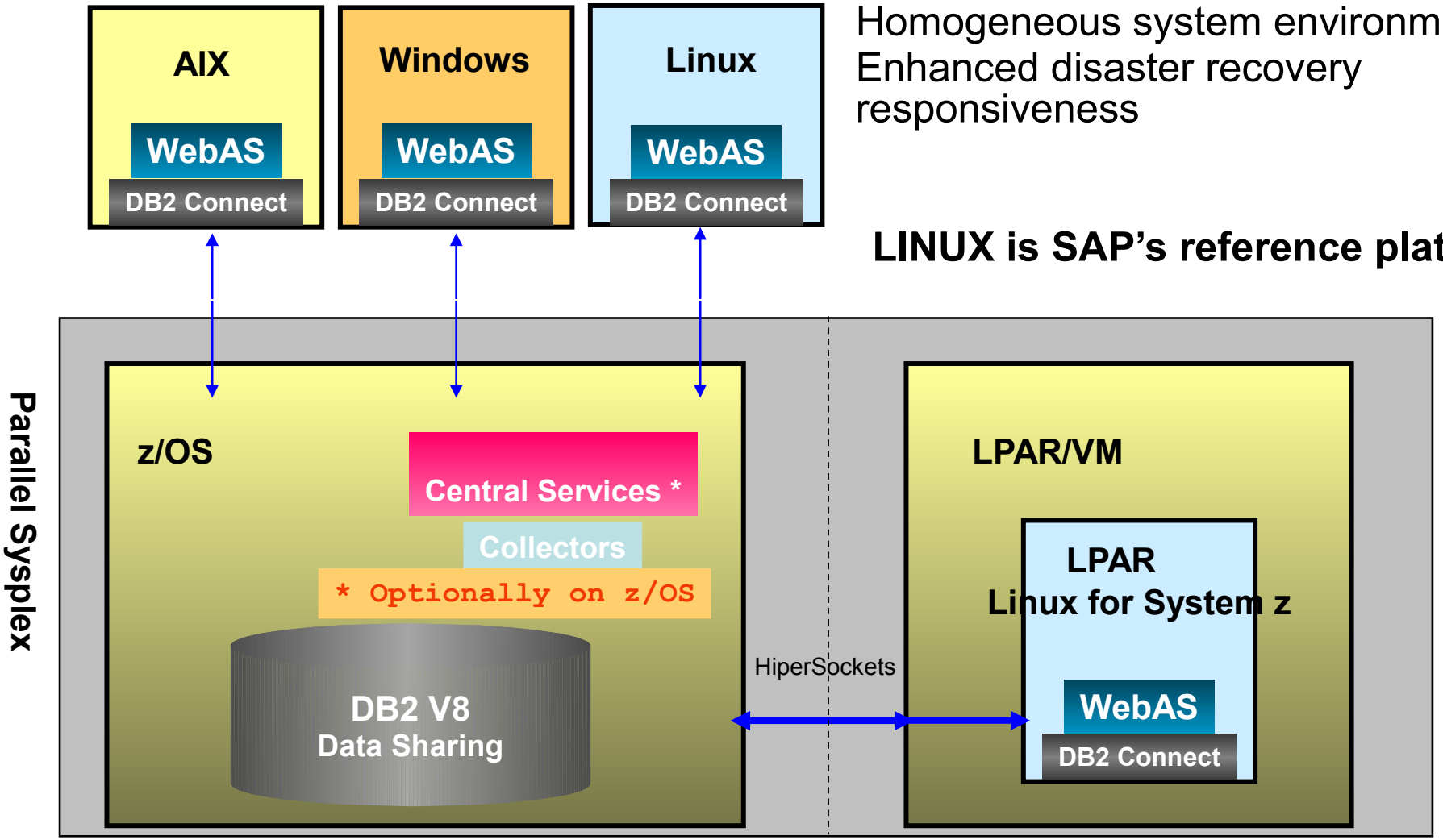
All the applications are split configuration architectures

- Only Oracle Database 10gR2 certified for Linux on System z
- The middle tier must be implemented on a platform other than System z

Why SAP for Linux on System z?

Linux on System z with SAP
Server consolidation
Superior virtualization with z/VM
Full System z exploitation
Homogeneous system environment
Enhanced disaster recovery responsiveness

LINUX is SAP's reference platform!



Workload share on utilized IFLs

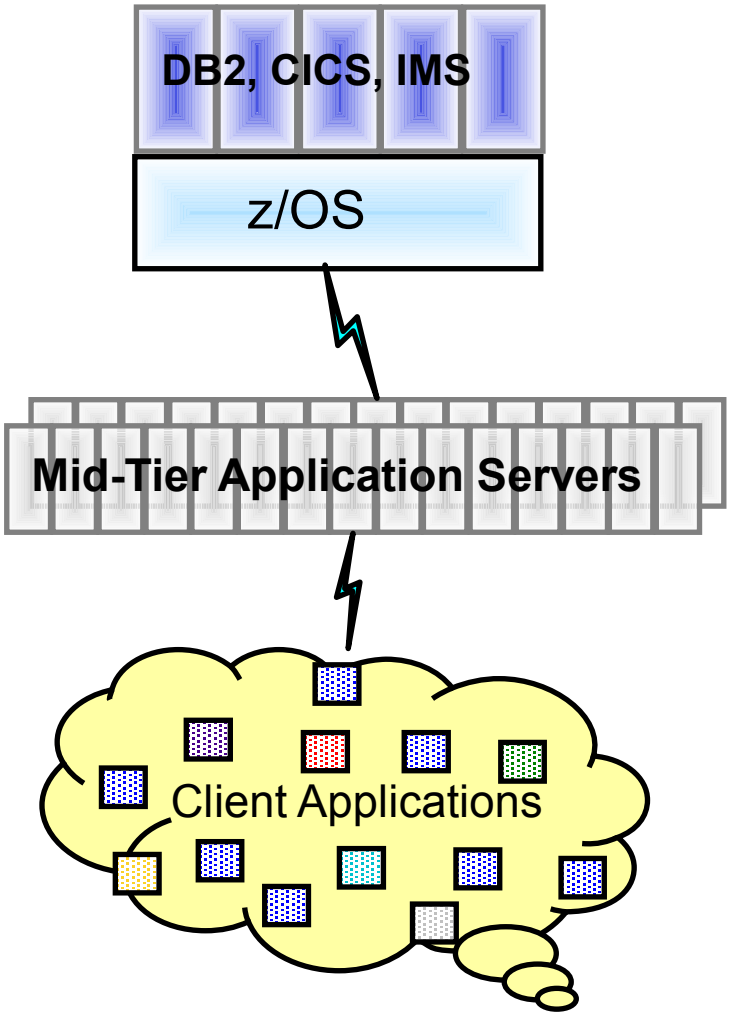
Primary applications

60%	Application serving for z/OS e.g. WebSphere, SAP, CICS TG, DB2 Connect
30%	Data serving e.g. Oracle DB, DB2 UDB
5%	Workplace serving e.g. Domino, Scalix, other e-mail
5%	Infrastructure serving e.g. Apache, Samba, NFS, etc.
<1%	Linux application development/deployment

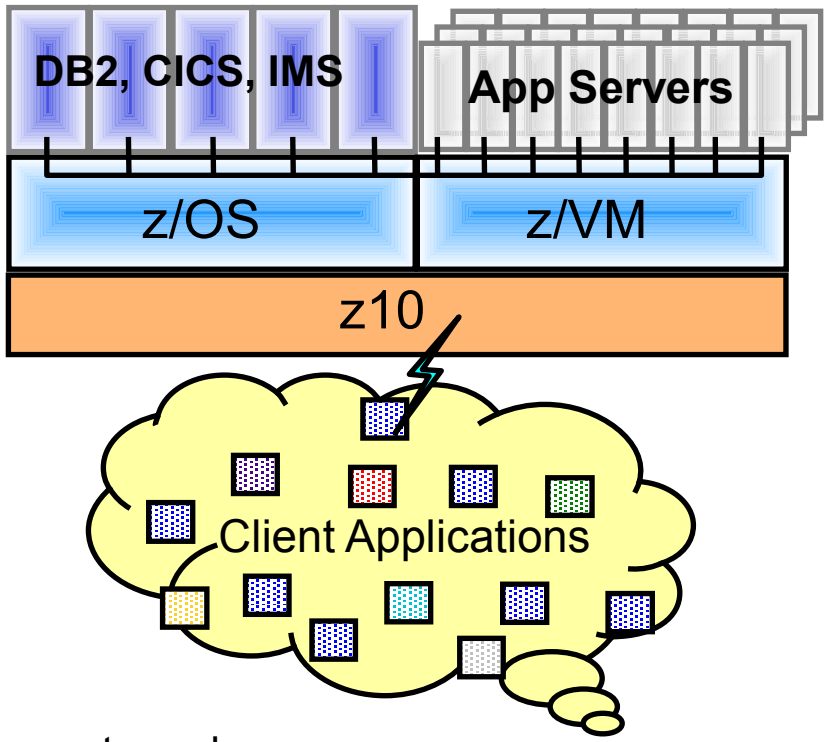
Notes: extrapolation based on analyzing 1/3 of inventory, excludes all IBM

Scenario 1: back-end integration

n-Tier Architecture



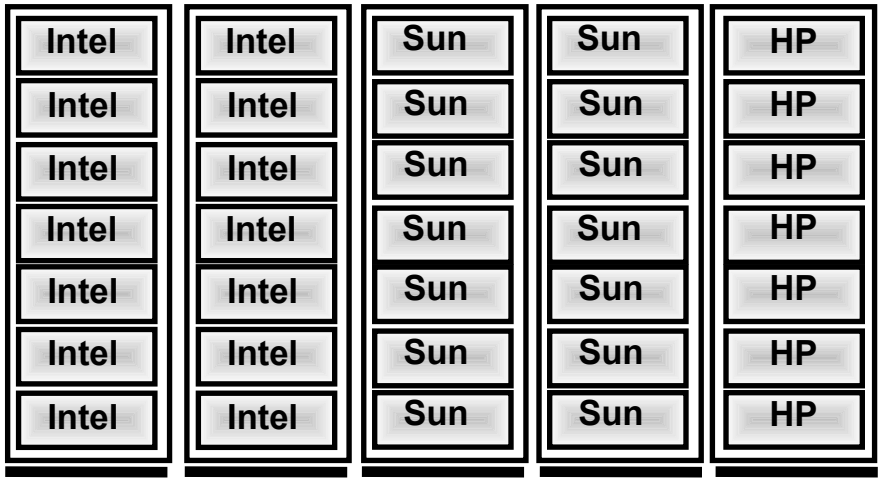
n-Tier Architecture
on 2-Tiers of Hardware



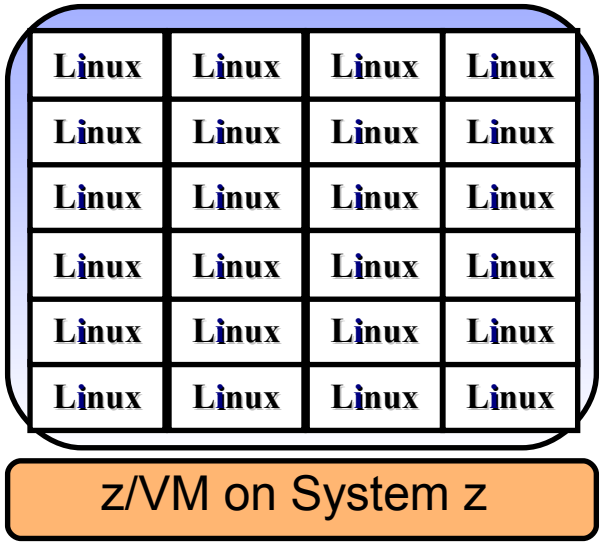
- No change to end-users
- Reduce expense (Hardware, software, floor space, energy, people)
- Exploit co-residency of application and data servers (improved performance, less complexity)
- Bring mainframe discipline to application servers

Scenario 2: server consolidation

Traditional Server Farm



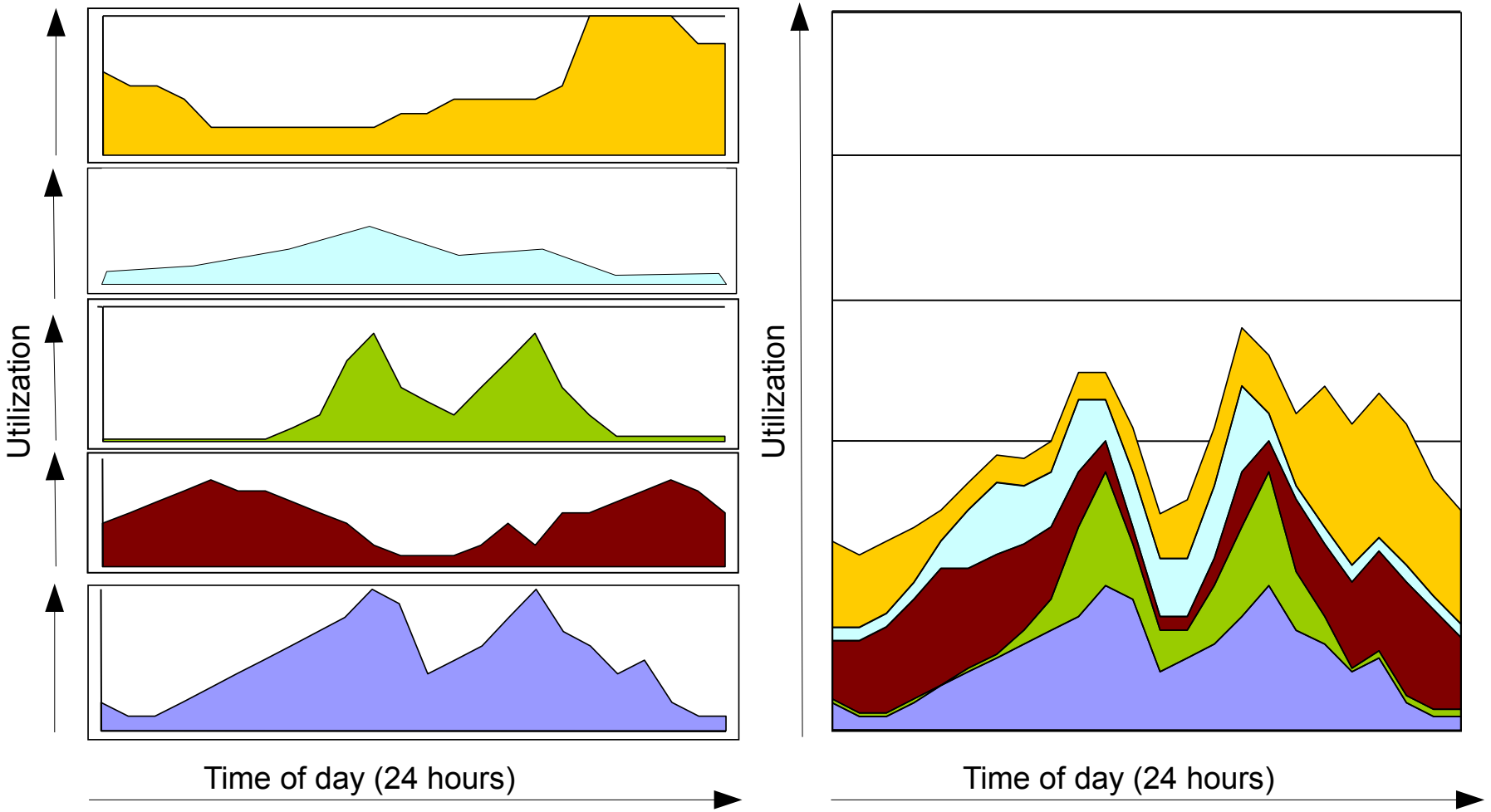
Server farm in a box



- Discrete servers consume incremental expense
- Hardware price and maintenance
- Floor space, power, cooling
- Additional support staff
- Per server image software fees
- Connectivity requires kilometres of cables and expensive switches
- High availability ensured by spares / re-boots
- Disaster recovery rarely successfully tested

- Reduce costs without sacrificing server autonomy (one server per application)
- Virtual, high-speed, inter-server connectivity
- Exploit an architecture designed for High Availability
- Mainframe qualities of service
- Proven disaster recovery services
- Connect to discrete servers as required

Resource optimization using virtualization and sharing



Consolidating several separate physical servers with workloads with non overlapping utilization peaks allows better hardware resources utilization and better peak handling capabilities

IBM consolidation announcement highlights

Project "Big Green"

Reduced Cost

- IBM Consolidation Effort
  - 3900 servers to 15 - z10 mainframes
  - 80% savings in annual energy usage
  - 85% savings in total floor space
  - Labor: 54% reduction
  - Software: 36% reduction
  - Improved availability and DR

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.

Extreme Virtualization with System z
Opportunities for Cost Savings

- **Energy and floor space savings**
  - Up to 80% in some cases, including IBM itself
- **Reduced software license fees via CPU over-commitment**
  - One System z client saved 90% on software license fees with Linux-on-z/VM
- **Enhanced staff productivity with large-scale virtual server deployment and management using z/VM**
  - 50% or more productivity boost experienced by many
- **Reduced application outages**
  - Running z/VM on the highly reliable System z platform is the best of both worlds
- **Flexible configuration options for business continuity**
  - Multiple LPARs on a single system gives you fail-over without duplication of hardware
  - Capacity Backup on Demand CPUs gives you cost-attractive multi-system fail-over
- **Low cost economic model for technology refreshes**
  - System z9 specialty engines carry forward when upgrading to System z10
  - Refresh hundreds of virtual servers by upgrading a single box

More information

ibm.com/systems/z/linux

www.vm.ibm.com

Questions?