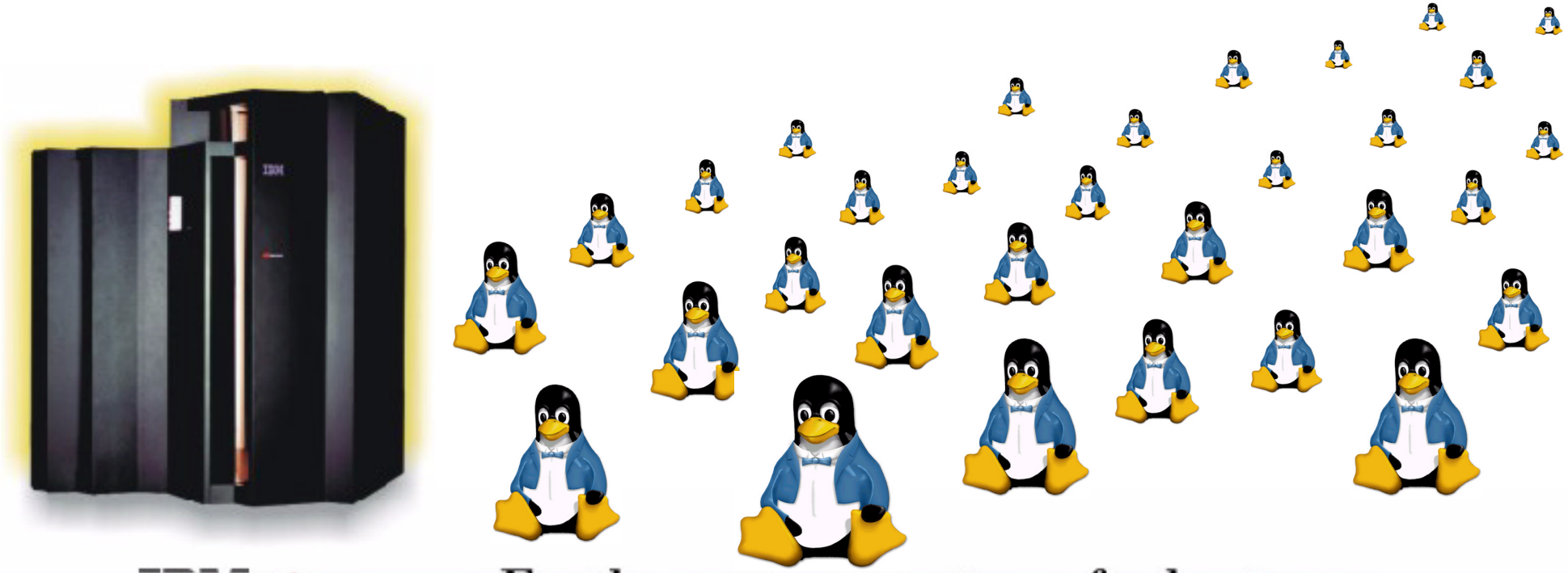
Len Santalucia
Americas Linux Sales

LINUX® Solutions with IBM S/390 & zSeries



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IBM Supports Linux 100%

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Next Generation e-business

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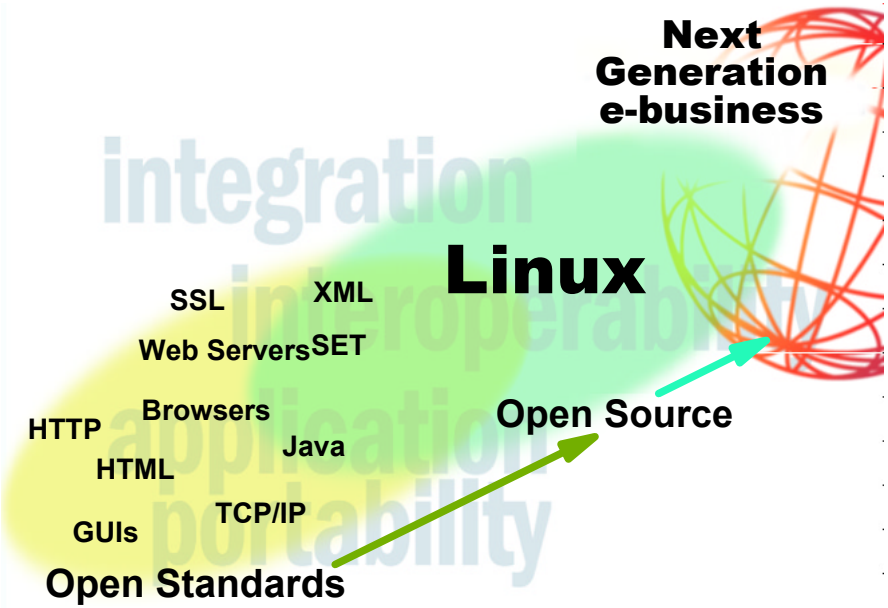
More connectivity, more devices

- Data transaction servers
- Web application servers
- Appliance servers
- Pervasive devices

Next generation e-business

- Technology advances
- Increased integration
- Business innovation
- Standards and open source



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

Irving Wladawsky-Berger

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What Is Linux?

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A fully-networked UNIX-like operating system

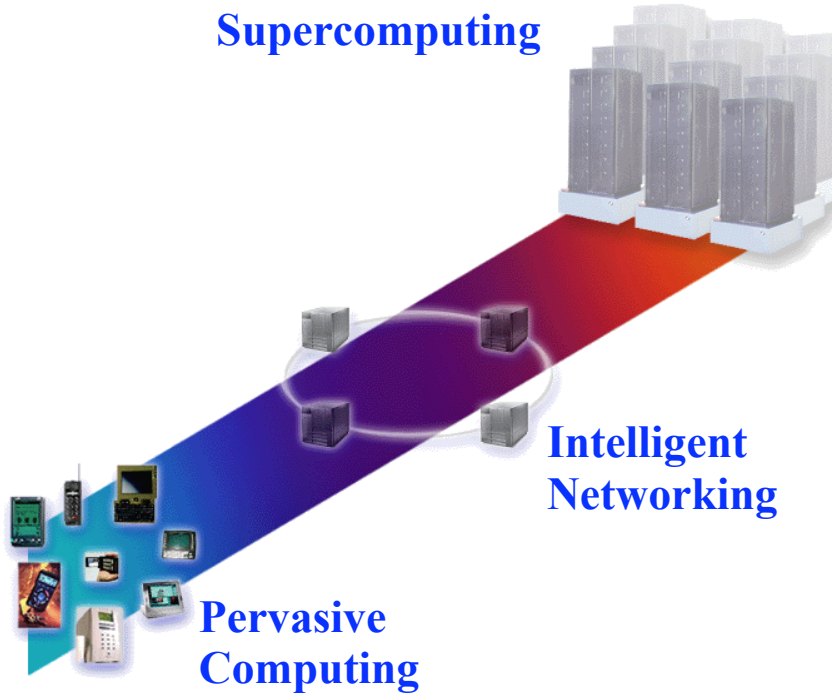
Multi-user, multitasking, multiprocessor

Coexists with other operating systems

Open Source software

- Community Development Network
- **Fosters Fast Technical Innovation & Support**
- **Guarantees No Single Vendor Control**

Runs on multiple platforms >



Linux Momentum Building

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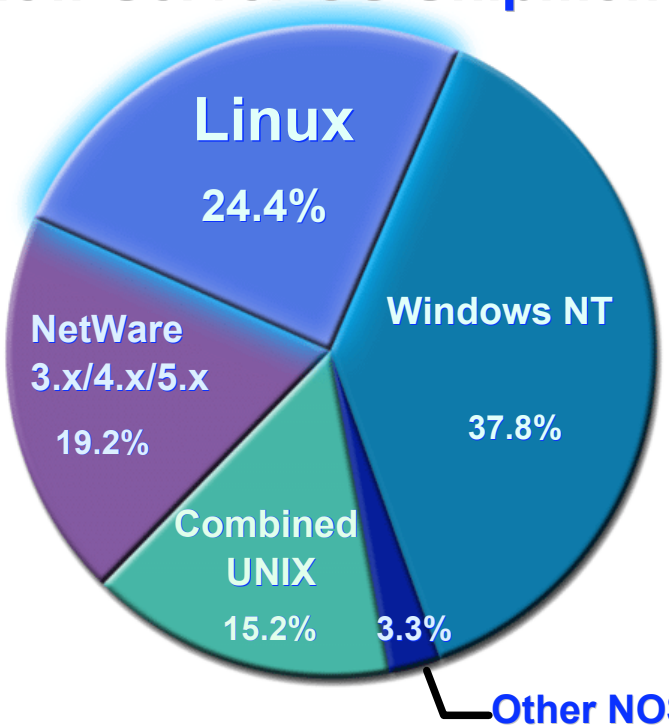
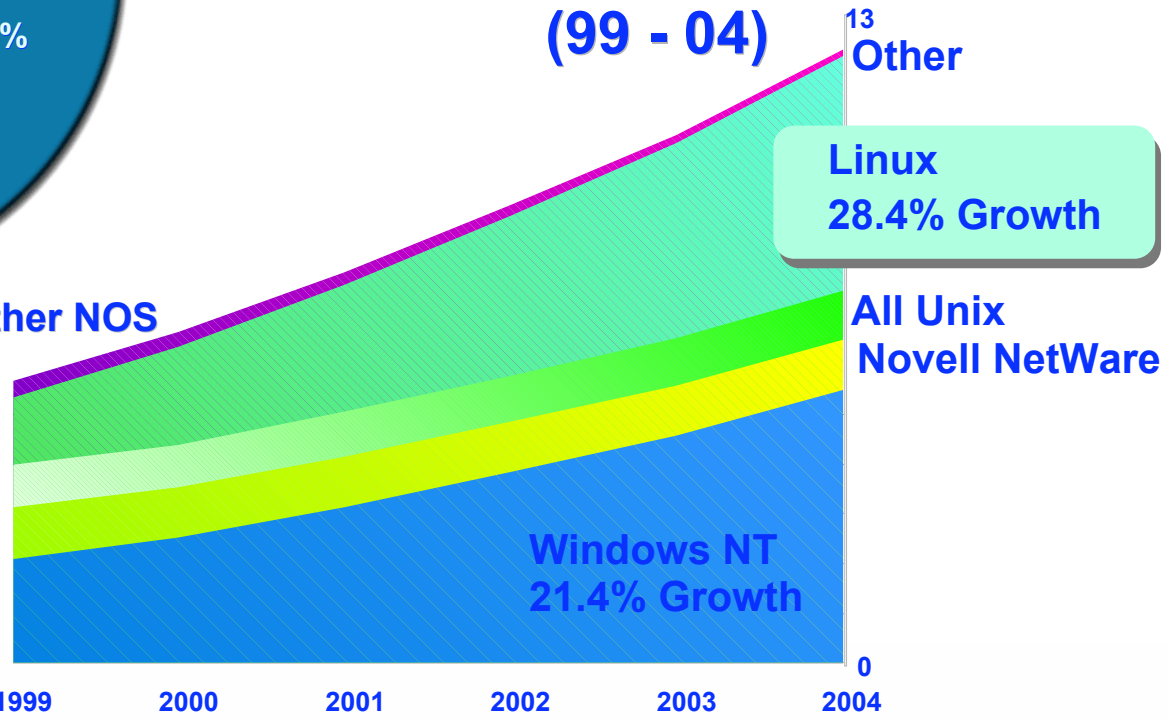
1999 New Server OS Shipments



- 1998 - 1999 Linux shipments grew 93.3% YTY
- 1999: #2 volume OS
- Linux shipments projected to have highest growth (99 - 04)

New Server OS License Forecast (99 - 04)



from IDC "Server Operating Environments Market Forecast & Analysis" June 2000

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Linux Momentum Building

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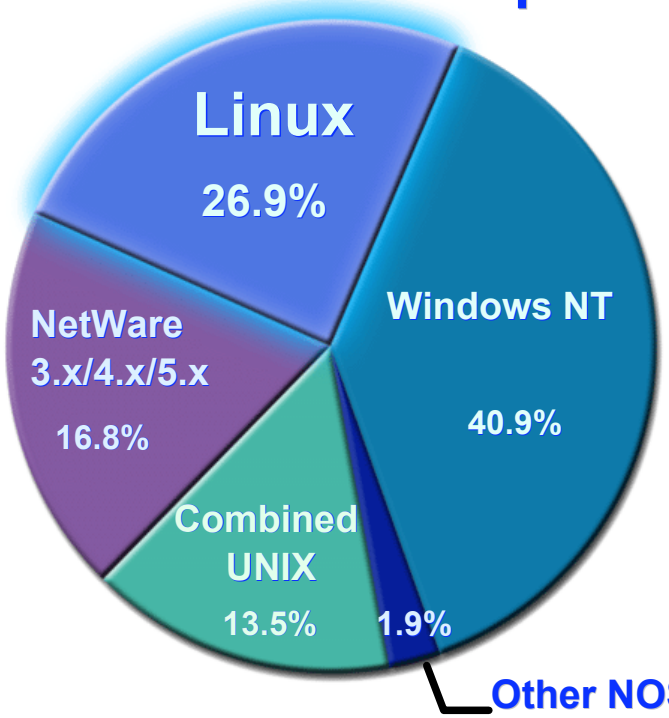
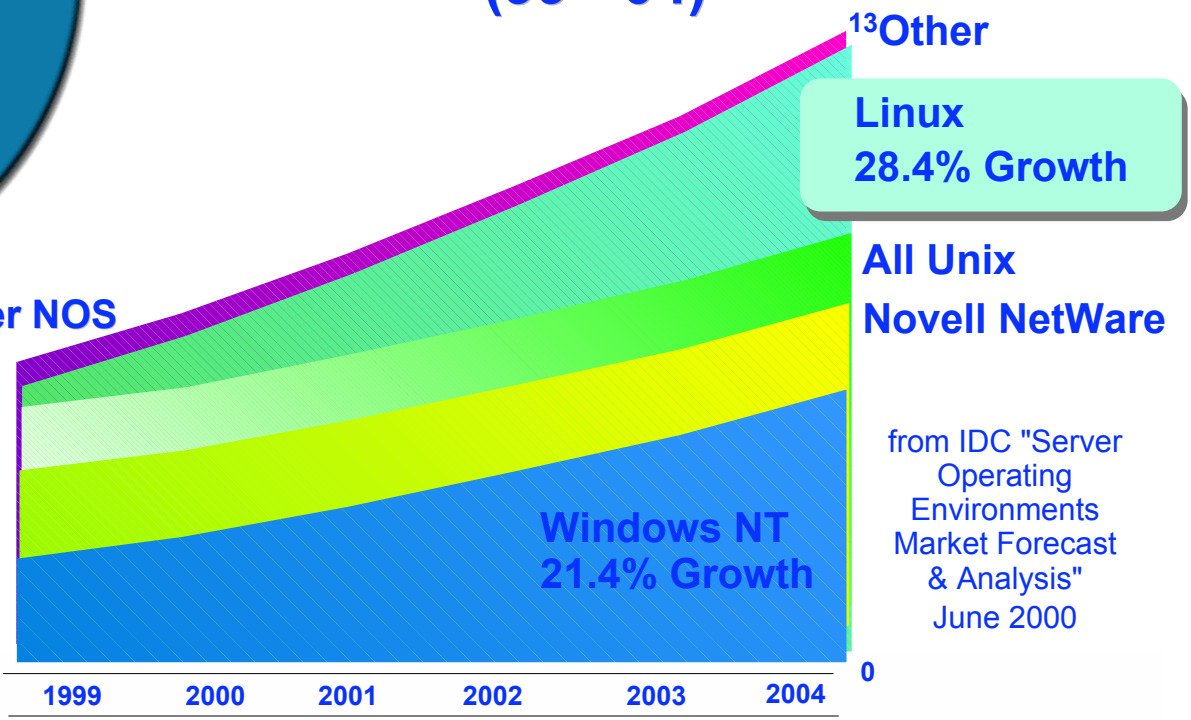
2000 New Server OS Shipments



from IDC "Server Operating Environments: 2000 Year in Review" January 2001

- Linux - fastest growing OS - 24.4% YTY
- 2000: #2 volume OS
- Linux shipments projected to have highest growth (99 - 04)

New Server OS License Forecast (99 - 04)



from IDC "Server Operating Environments Market Forecast & Analysis" June 2000

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Linux Momentum Building ...

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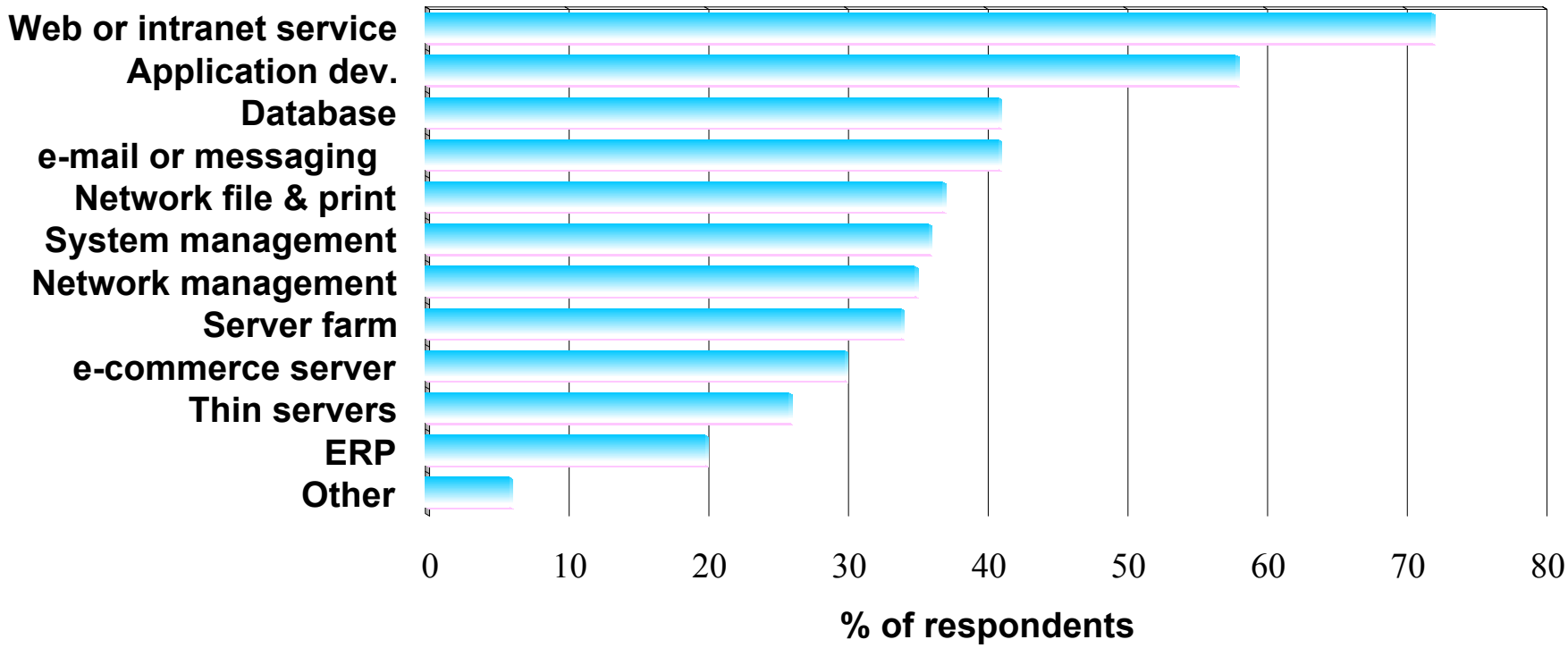
Server-based Use Of Linux In The Next 12 Months



7/98 Survey: 3% IT managers had plans in 2 years
3/99 Survey: 14% claim use of Linux
12/99 Survey: 26% claim use of Linux, another 11% plan use in 1 year

Source: InformationWeek Research Survey of 300 IT Managers 24 Jan 2000

Why has its acceptance grown so fast?

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It is **Public** - Governed by GPL

It is unowned and unownable

It is **Portable** - by design. The Linux operating system has been ported to many different hardware platforms,: servers, clients and appliances

It conforms with **Posix** standards - Accepts 1,000s of programs written to standards

Result: *After an application has been ported to Linux once, it generally requires only a re-compile to deploy it on any other Linux hardware platform*

IBM's Linux Focus

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Focus area	Actions
Hardware	Netfinity servers, ThinkPad and Intellistation clients (Intel-based), RS/6000, S/390 and zSeries, pSeries, iSeries, xSeries @server systems
Software	Key products ported to Linux (DB2, WebSphere, Lotus Domino, VA Java, MQSeries, etc.)
Services	WW Support, Training, Professional and Consulting Services offerings, Competency Center, zSeriesPenguins
Alliances	WW Partners with Caldera, Red Hat, SuSE, & TurboLinux on solution delivery and support
Open source	Significant code contributions and technical resources working with the open source community

IBM Linux Partnerships

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Red Hat

- Strength - Marketshare
- Relationship- Comprehensive
  - IBM Online Store
  - DB2/WebSphere integrated
- IBM Platforms:
  - Complete

TurboLinux

- Strength - US/China
- Relationship- Comprehensive
  - DB2
- IBM Platforms:
  - Complete

SuSE

- Strength - EMEA
- Relationship - Comprehensive
- IBM Platforms:
  - Complete

Caldera

- Strength - Imbedded to Enterprise
- Relationship- Limited
  - WebSphere
  - VisualAge
- IBM Platforms:
  - xSeries

IBM as a member of the Linux Community

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- **IBM Linux Technology Center (LTC)**
  - Responsible for IBM open source contributions to Linux
    - working with Linux Community to accelerate maturation of standard, platform-independent Linux as an Enterprise platform (aka "helping make Linux better!")
    - http://oss.software.ibm.com/developerworks/opensource/linux
  - Kernel and other component development, test, service/support, documentation, standards, performance, etc.
  - ~200 dedicated open source Linux developers, located worldwide, actively contributing to Linux

- **Industry Leadership in support of Linux and OSS**
  - Establishing technical relationships with community by participating in existing and initiating new OSS projects
  - Facilitating OSS development community access to enterprise HW/SW (e.g. OSDL)
  - Providing support to Linux Open Source organizations and initiatives (FSG, LSB & LI18NU, Gnome Foundation, KDE League, FSF)
  - Industry Leader for Linux support across hardware and software product lines (eSeries, IBM Middleware and development tools, IGS support, services, education, Linux Competency centers in EMEA and AP)
  - Partnering with several Alliance Distribution Partners to maximize customer flexibility in choosing a Linux solution

Our Linux Portfolio for Developers

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WW Porting Centers

- Substantial investment in the open source operating system during the next 4 years worldwide
- Centers will provide workshops and technical support services, helping Linux developers design and code their applications;
- Linux testing capabilities - xSeries, pSeries, iSeries, zSeries and NUMA platforms + Middleware
- Linux performance tools to evaluate reliability and performance.
- Proof of concept, Migration, Porting, Remote Testing

Boeblingen
Hursley
Warsaw
Stuttgart
Paris
Montpellier
Greenock
Budapest
San Mateo
Waltham

20,000+ Developer tool Kits shipped

No charge for development use
Full function, market- available products:

- WebSphere Application Server 3.02 Advanced Edition
  - DB2 Universal Database for Linux
  - Lotus Domino Application Server for Linux 5.0.3
  - Visual Age for Java for Linux development tools
  - Development Kit, Java Technology Edition (IBM JVM and JRE)
  - DB2 7.1 and WebSphere Redbook
  - WebSphere HomePage Builder 4.0

Available Today from:

- www.ibm.com/linux
- www.calderasystems.com

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Why Linux for S/390?

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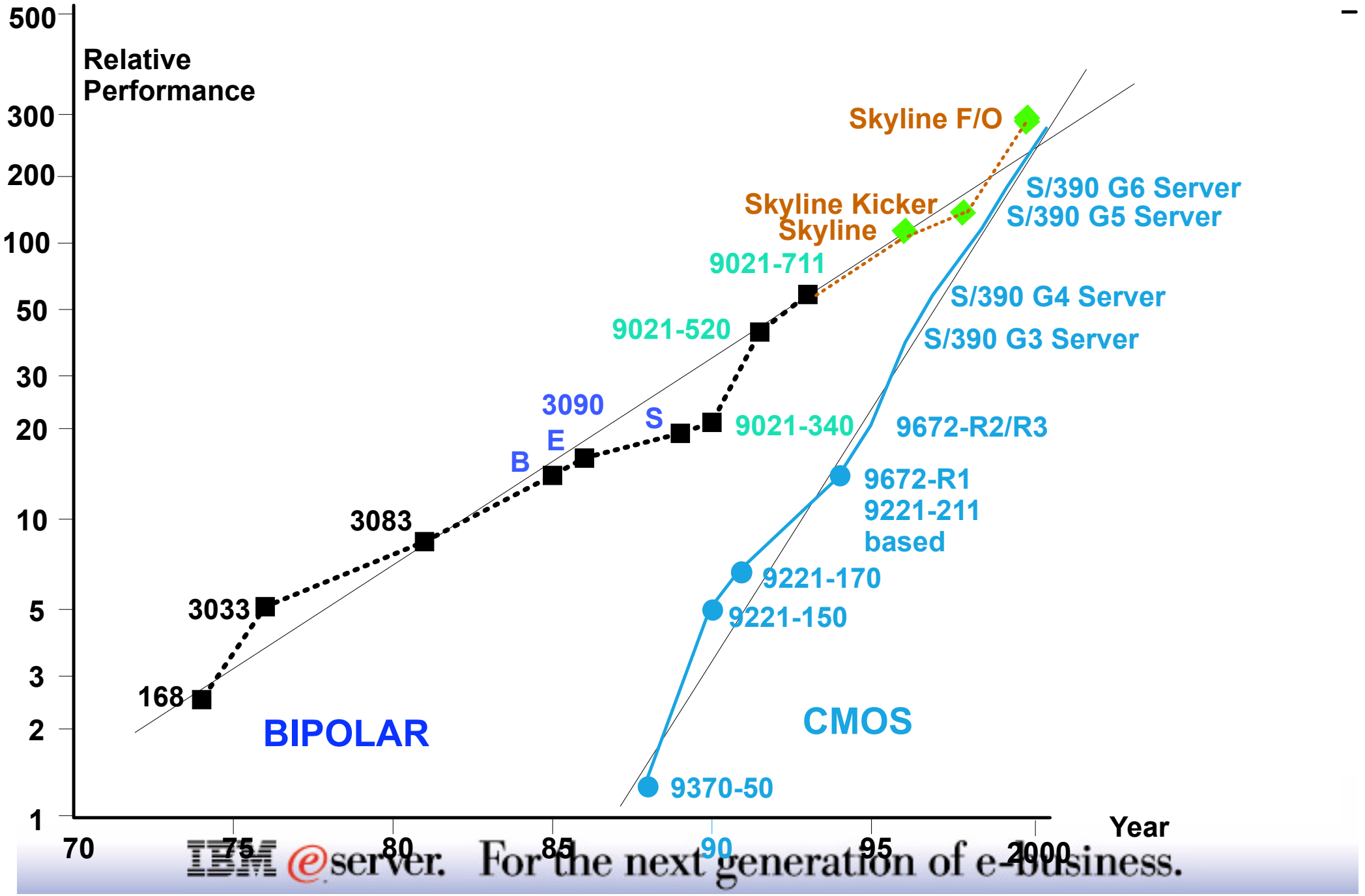
1. Large number of highly skilled programmers
2. Increased application portfolio
3. Industrial strength Linux environment
4. Large scale server consolidation
5. Highly integrated e-business solution

CMOS Uni Processor Performance



A Brief History Of Linux for S/390

IBM @server zSeries

December 1999

- IBM contributes code which enables Linux to run on S/390

January 2000

- Joint Customer Project begins
- Marist College provides first distribution of Linux for S/390

February 2000

- Linux for S/390 makes its debut at Linux World in New York and Paris, Linus Torvalds mentions one hardware platform in his keynote speech at Linux World - the IBM S/390

A Brief History Of Linux for S/390 ...

IBM @server zSeries

May 2000

- IBM announcement at Vista 2000
- TurboLinux and SuSE distribution partners
- IBM and ISV software

August 2000

- IBM S/390 Integrated Facility for Linux
- IBM S/390 Virtual Image Facility for Linux
- Additional IBM and ISV software

October 2000

- Linux for zSeries
- Red Hat as a distribution partner
- Additional hardware support
  - OSA GbE & HiperSockets

Press Reaction To Linux for S/390

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"It is a bit of a radical concept, and one that certainly wasn't a mainstream idea until this morning."

- Computerworld, IBM targets Linux at mainframe users, 5/17/00

"The fact that IBM, a company most high-tech watchers wrote off as a dying brontosaurus at the beginning of the decade, has managed to outrun the competition in embracing Linux and open source technologies"

- Upside Today, IBM: World's fastest Linux company, 5/31/00

"With Websphere on Linux along with connectors to data on OS/390, you've got a very interesting foundation for e-business and b-to-b transactions"

- Internet Week, Linux Gets Ready for Mainframes - SuSe and TurboLinux plan distributions for IBM System 390, 5/29/00

Customer And Partner Work In Progress

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Customers

- Marist College - Linux for S/390 powers the Linux for S/390 web site
- University of Nebraska - support for academic programs
- Grede Foundries - firewalls, domain name servers, etc.
- GAD - one day port Linux for S/390 service German financial industry
- Dimension Enterprises - server consolidation for a telco client add virtual Linux servers in just seconds & "Test Plan Charlie" scalabilty test 97,973 (99,999 actual)
- Beijing University Firebird bulletin board open source application
- TeliaTelecom ISP - consolidating UNIX servers onto single G6 ZZ7 w/ Linux and VM and scalability plans to 30,000+
- ACTS Corp. - Delivering online tests and surveys
- Many Wall Street firms

Partners

- Equant - network and service provider
- Infocrossing - application services provider
- UTS Global - international porting center for Linux for S/390
- Sendmail - leading provider of Internet mail solutions

Misc

- zSeriesPenguins.ihost.com Worldwide Linux Community Development S/390 System
- CEO LVG Investing $1 Billion across all IBM eServers and Software Offerings

Telia Consolidates ISP Activities on Single IBM Mainframe with Linux and Shark

Copenhagen, December 5, 2000 - IBM and Telia, Scandanavia's largest telecommunications and internet service provider, today announced that Telia will be the first European company to deploy a major commercial IT system based on Linux. Telia will install a combination of IBM mainframe and Shark storage technology, both running on Linux, to host and run their business and consumer Internet services operations across Scandanavia. Telia also offer to customers in the Nordic countries IP-VPN (Internet Protocol/Virtual Private Network) services.

Telia will replace its 70 existing web hosting unix servers with a single IBM S/390 ZZ7 enterprise server, which will host more than 1500 virtual internet Linux servers simultaneously. Each virtual server acts as a web server for individual Telia-hosted business customers. Telia will also move data from its current storage servers to a 11.4 Terabyte IBM Enteprise Storage Server ("Shark").

"This new S/390 ZZ7 running Linux allows us to rethink our total pricing structure for internet services and to offer customers a more affordable web application service than ever before", says Henrik Wulff Riedl, CFO, TeliaNet." With this Installation, Telia wants to give higher availability and reliability to its customers while saving costs at the same time. In addition, Telia is intending to convert an existing customer billing system for internet service providers based on Oracle databases.

"The combination of the IBM mainframe with Linux makes it easy to install new servers for internet service customers on the fly," continued Mr. Riedl. "Before, it took us 5 hours to setup a new server, now it is a matter of less than five minutes. Together with IBM's Enterprise Storage Server "Shark" and its 11,4 Terabytes of storage capacity we now are able to give virtually unlimited web capacity to our customers without going through the trouble of installing and reconfiguring the systems all the time."

All of the virtual internet servers will be managed by Telia's business customers independently as if they were using their own separate physical machines. **At Telia, one single person will be able to manage all the independent virtual web servers via a single graphical management system.**

"This represents a breakthrough for commercial systems in Europe, proving that Linux can scale to meet rapidly growing business needs, and also demonstrating the power of Linux on IBM's server line-up," said Erich Clementi, Vice President, IBM Enterprise Systems Group, EMEA.

The IBM S/390 is able to host up to 30.000 virtual Linux servers at the same time using IBM's VM (Virtual Machine) operating system to host servers virtually independently. Telia was briefed by IBM at its Linux Integration Center in Boeblingen and the decision was taken just 10 days after the visit. The ZZ7 machine will be shipped medio December.

Why ACTS chose Linux, S/390, and VM

- ACTS Corp. (www.actscorp.com) is a software maker that has taken web-based delivery of exams and surveys to a new level , providing smooth recovery from any disruption, advanced security, and ease-of-use. Products are TestManager and SurveyManager, being marketed to industry, government, academia, and individuals such as graduate students.

- ACTS ported its software from Linux on Intel, to S/390 Linux and VM (hosted by Infocrossing) to exploit its scalability and reliability of virtual servers under VM. The port of product completed without changing a single line of code, took about 15 minutes. (product base is Perl, javascript, and ACTS proprietary Dynamic HTML)

- One High-end opportunity: ACTS is targeting state-wide public school testing initiatives where learning-standards tests can create workloads in excess of 100,000 concurrent students spread across hundreds or thousands of school campuses taking high-stakes tests. By using S/390 and Linux virtual servers under VM, ACTS can affordably offer state DOEs the same level of service for high-stakes testing as is required for financial industry transactions, and avoid the admin nightmare of scattered computing.

powered by

TestManager

SurveyManager *on*

We WON!

IBM has won two "bests" at LinuxWorld in NYC tonight (2/01/01). The IBM zSeries 900 with z/VM won as the best hardware platform and the IBM Small Business Solutions pack won best application and best of show! Ed Gauthier and I accepted the award for IBM and we hope to have this award (a very heavy glass plaque) installed in the lobby of the briefing center in Pok next to the z900.

The z900 has been one of the hottest exhibits on the show floor and our demo team has been extremely busy. I have pretty much lost my voice talking to so many customers. **In addition to the z/VM demo of cloning Linux images (every 90 seconds all day we add another image), we have a partition running SuSE's Linux with Software AG's Tamino XML database, a partition running TurboLinux, a partition running DB2 and WebSphere AS and a partition running an early version of the Linux for zSeries 64 bit code.** There is also a z/VM image running multiple Linux images for the Developer's Den.

The z900 win would not have been possible without the assistance of Tung-Sing Chong from Endicott who built the primary demo, Rick Roberts, Cindy Dapolite and their team who put the show together, the z900 demo team from Pok (David Share, Andy Ugolino and Ross Waitman) who put the hardware together and were there to answer the hardware questions and of course my partner in the Linux project, Ed Gauthier.

Regards, Jim Elliott
Linux, VM and VSE Product Manager, Enterprise Servers, IBM Americas Group
3600 Steeles Avenue East, Markham, Ontario, Canada L3R 9Z7

Lotus Notes: Jim Elliott/Markham/IBM@IBMCA Internet: jelliott@ca.ibm.com
Internal mail: G5/EP6/3600/MKM
Phone: 905-316-5813 (t/l 886-5813) FAX: 905-316-3737 (t/l 886-3737) Cell: 416-527-0666
http://ibm.com/vm/devpages/jelliott/

What Is Linux for S/390?

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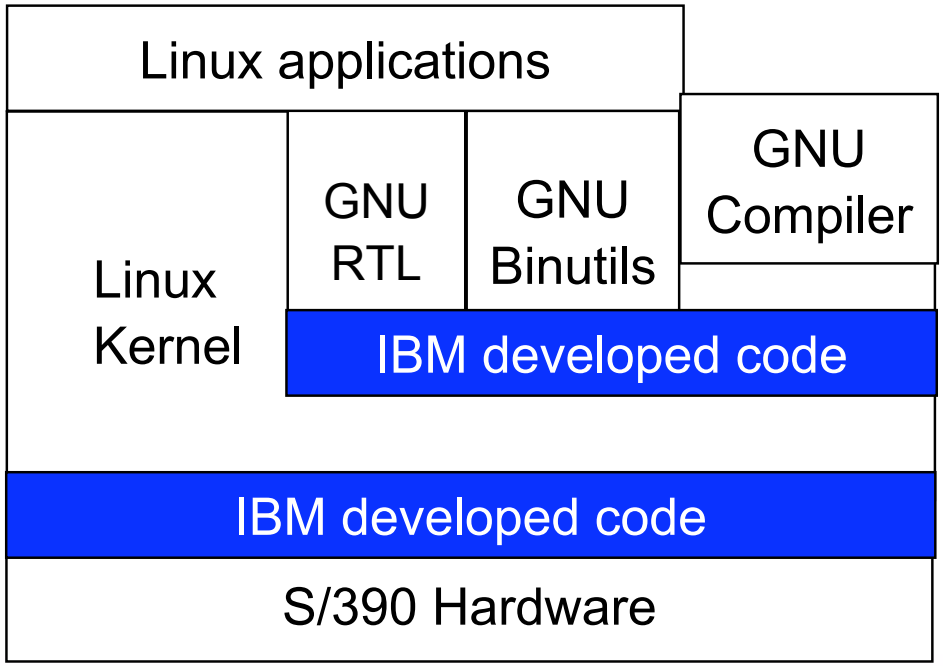
Runs native, in an LPAR, on IBM S/390 Virtual Image Facility for Linux or on VM/ESA

- Pure Linux, an ASCII environment
- Exploits IBM S/390 hardware, including IEEE floating point

Not a unique version of Linux or other operating system

Not a replacement for other IBM S/390 operating systems



Linux for S/390 - S/390 Coding Effort

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	Total Lines of Code	S/390 Enabling Code	Percentage of S/390 Code
Linux Kernel	2,200,000	45,000	2.0
gcc	1,700,000	9,000	0.5
gdb	1,500,000	8,000	0.5
glibc	1,200,000	5,000	0.4
binutils	800,000	6,000	.75
strace	41,000	200	.5

What S/390 Brings To Linux

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The most reliable hardware platform available. Period.

- Availability means no end-user outages on S/390 or zSeries
- Mean time between failure over 60 years

Error detection and correction

Remote Support Facility (RSF)

- Download microcode fixes and updates
- Concurrent microcode updates
- "Phone home"

CP Sparing, Memory Chip Sparing

Centralized Linux systems easier to manage & duplicate

Use management functions from S/390 operating systems for Linux (e.g. backup, autostart, etc.)

Over 35 years of constant innovation

And much more ...

What S/390 Brings To Linux ...

IBM @server zSeries

Scalability

- Physical - scale to very large processor configurations
- Logical - scale to hundreds of Linux images on a single footprint
- Non-disruptive capacity upgrade on demand - CUoD

Designed to support mixed work loads

- Allows consolidation while maintaining one server per application
- Complete work load isolation - LPAR
- High speed inter-server connectivity - (V)CTC, HiperSockets
- Highly efficient memory management

Linux Architecture Comparison

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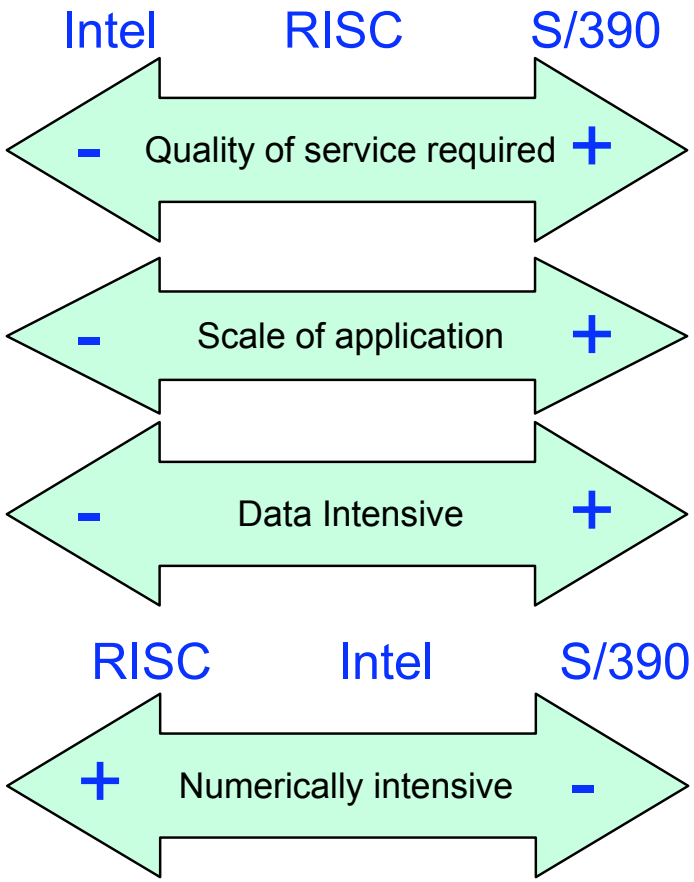
Business considerations

- Existing infrastructure
  - Evaluate current existing capacity
- Expertise
  - Evaluate impact of changing the infrastructure on help desk, systems management etc.
- Long term cost of ownership
  - Systems management costs
  - Growth in number of physical servers
  - Replacement of hardware vs. upgrade

Technical considerations



Application Sourcing Strategy

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- The long-term IBM commitment to OS/390 and z/OS is not affected by this new Linux direction
- S/390 and zSeries customers are offered additional opportunities to leverage their OS/390 and z/OS investments through Linux
- New doors are opening for OS/390 and z/OS customers to bring Linux-centric workloads to the platform
- Application sources
  1. OS/390 and z/OS -- Traditional
  2. OS/390 and z/OS -- UNIX System Services...No Wall
  3. Linux for S/390 and Linux for zSeries
  4. Java2, Enterprise Java Beans (EJB) and WebSphere - Developer Kit for OS/390 & Linux

Native, LPAR, VIF, or VM/ESA?

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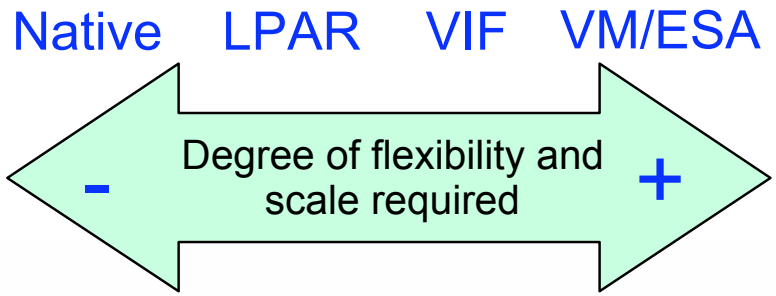
Considerations

- Available expertise (in-house or contracted)
- Co-residence of other servers (VIF is Linux only)
- Frequency of configuration changes
  - Native and LPAR are more cumbersome than VIF and VM
- Numbers of servers required
  - 1 with native, 15 with LPAR (real memory required for each)
  - VIF gives you 10's to 100's
  - VM makes it easier to manage 100's to 1000's
- Inter-server communication
  - Virtual connections with VM and VIF



LPAR, Virtual Image Facility Or VM/ESA

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	LPAR	Virtual Image Facility	VM/ESA z/VM
# of servers	15	Hundreds	Thousands
Servers supported			
• Linux for S/390	✓	✓	✓
• OS/390	✓		✓
• TPF	✓		✓
• VM/ESA	✓		✓
• CMS			✓
• VSE/ESA	✓		✓
TCP/IP		IP only	Optional
High speed memory to memory communications		✓	✓
Channel to channel up to 136 Mb/sec	✓	✓	✓
Add/delete a server	Dynamic	Real-time	Real-time
Shared S/390 processor	✓	✓	✓
IBM S/390 Integrated Facility for Linux		✓	
Shared memory		✓	✓
Shared channel	✓	✓	✓
Shared disk		✓	✓

LPAR, Virtual Image Facility Or VM/ESA ...

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	LPAR	Virtual Image Facility	VM/ESA z/VM
Performance			
Virtual disk in storage			✓
Minidisk caching		✓	✓
N-way processor exploitation	✓	✓	✓
Transparent S/390 architecture exploitation	✓	✓	✓
Fastpath I/O support		✓	✓
Productivity			
Temporary disks			✓
Resource simulation and virtualization		*	✓
Resource sharing (tapes, printers, disks, I/O)		*	✓
Device independent I/O support		✓	✓

* Partial support in Virtual Image Facility

LPAR, Virtual Image Facility Or VM/ESA ...

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	LPAR	Virtual Image Facility	VM/ESA z/VM
RAS			
S/390 error recovery	✓	✓	✓
Dynamic multi-image support	✓	*	✓
S/390 trace and debug			✓
Operations			
Virtual server controls, scheduling and automation			✓
Performance measurement, reporting and management	✓		✓
VM skills required			✓
Dynamic I/O reconfiguration, FICON, CP Sparing	✓	*	✓

* Partial support in Virtual Image Facility

Native, LPAR or virtual images

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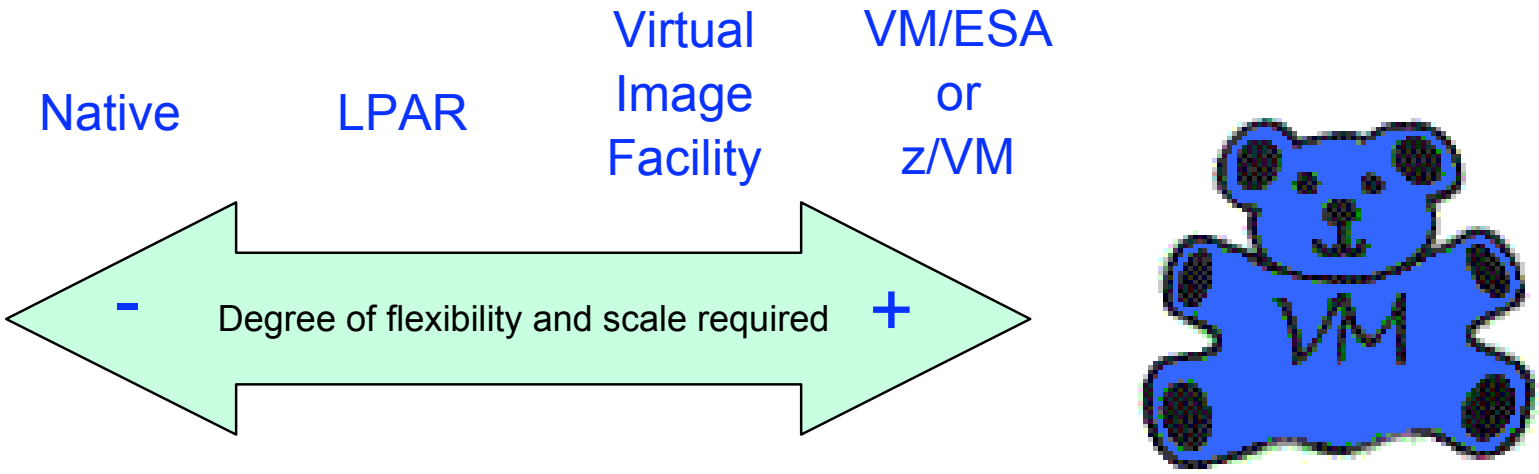

Considerations

- Skills
- S/390 infrastructure
- Frequency of configuration change
- Projected Increase in numbers of servers
- Inter-server communication
- Functionality of VIF vs VM

Note: If you want any of the following today, you need VM:

- Accounting records
- Resource consumption records
- Tuning parameters
- VM userid and password
- GB Ethernet
- Tape drive
- Automation with CMS and Rexx

A New Alternative

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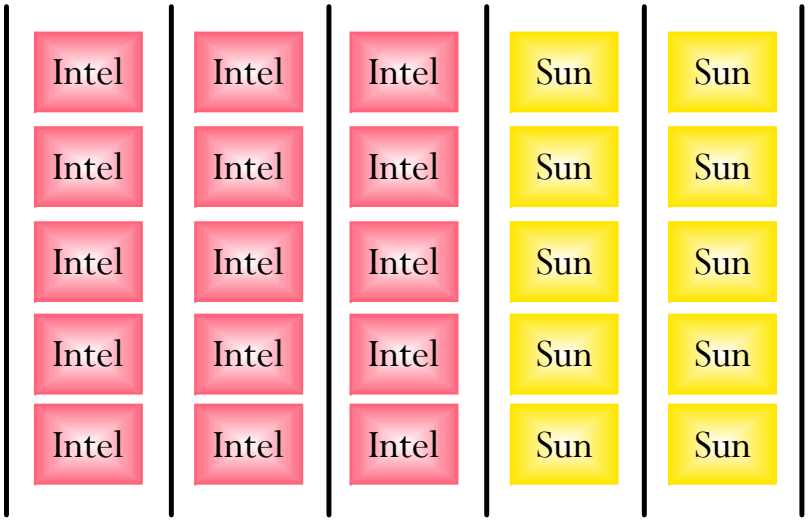
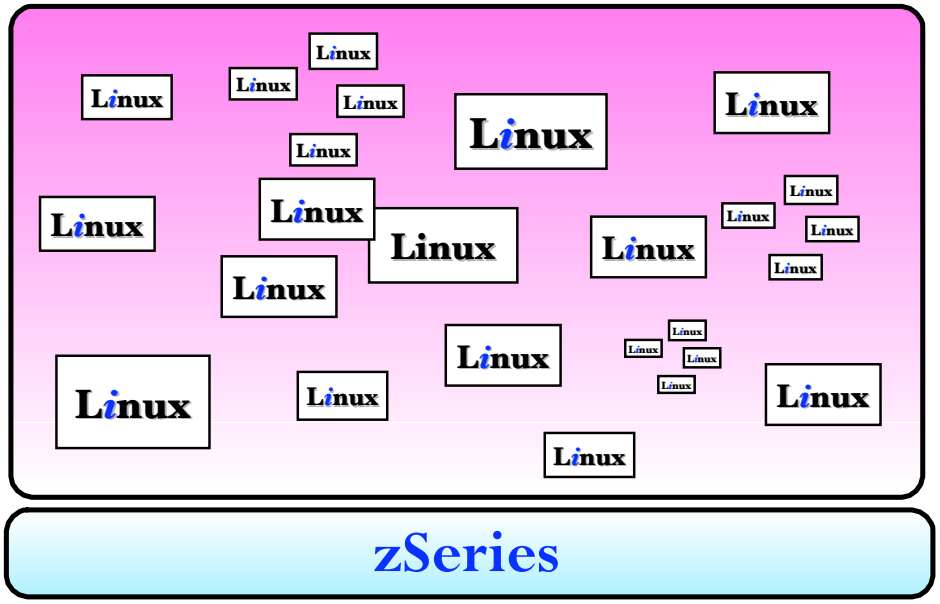
Traditional Server Farm



- Discrete servers consume incremental expense
  - Hardware price and maintenance
  - Power, cooling, floor space
  - People
  - Processor under-utilization
- Connectivity requires kilometers of cables
- Time to deploy new servers requires days/hours
- High availability ensured by spares and re-boots
- Disaster recovery never successfully tested

Server Farm and Network in a Box



- Reduce costs without sacrificing server autonomy
- Virtual, high-speed, inter-server connectivity
- Deploy new servers on-demand - 90 secs
- Architecture designed for high availability
- Mainframe infrastructure & practices, i.e. demonstrable disaster recovery

IBM @server. For the next generation of e-business.

Where is the opportunity?

IBM @server zSeries

Hardware Economy of Scale

- More than 50 Intel or low-end Sun servers
- Aggressive plan to grow in-house servers

Software Candidates

- Open source applications
- Written and maintained by the customer
- Websphere, DB2, Tivoli and IBM middleware
- Growing number of products from independent software vendors

Linux Solutions for ASP models

- xSeries for customer owned and managed asset
- zSeries for large scale centralized hosting

Working with IBM Partners

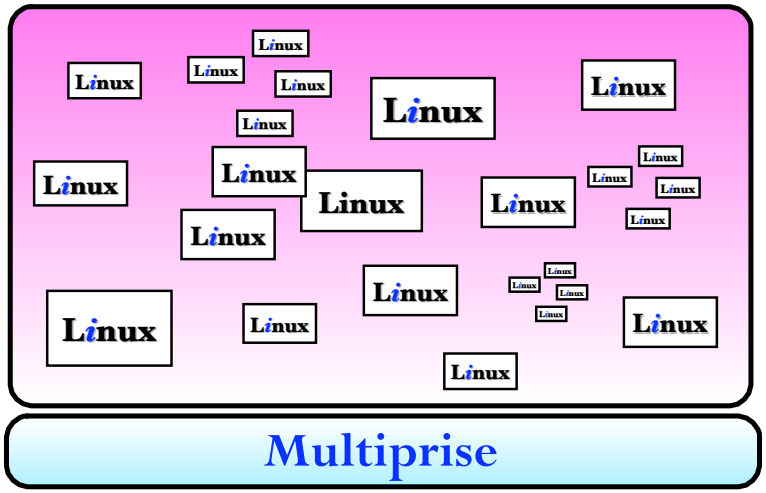
- Distributors: Redhat, SuSe, TurboLinux
- Re-sellers, Systems Integrators & Influencers

What are the components?

IBM @server zSeries

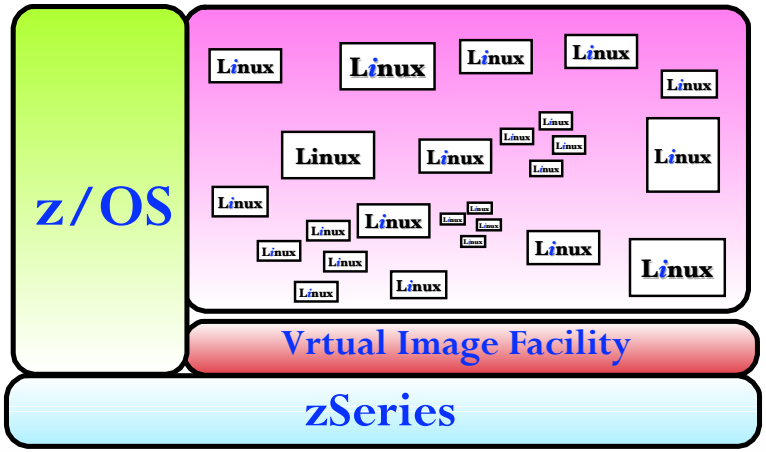
For net new S/390 at Netgens:

- Multiprise 3000
  - Integrated Disk
  - ESCON attached routers
  - SCSI attached tape
- VM/ESA & associated software
- Support from IGS, SuSe, TurboLinux, Redhat



For established S/390 customers:

- 9672 G5/G6 or zSeries
  - Integrated facility for Linux (IFL)
  - Shark external disk
  - ESCON or FICON tape
  - ESCON or GBE routers
- z/OS, OS/390 or VSE/ESA
- Virtual image Facility (VIF)
- Support from IGS, SuSe, TurboLinux, Redhat



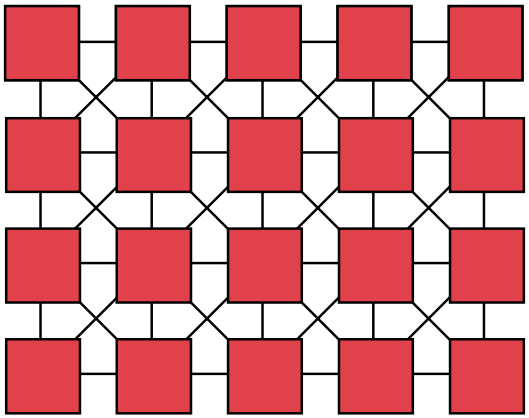
Consolidation Of Servers

IBM @server zSeries

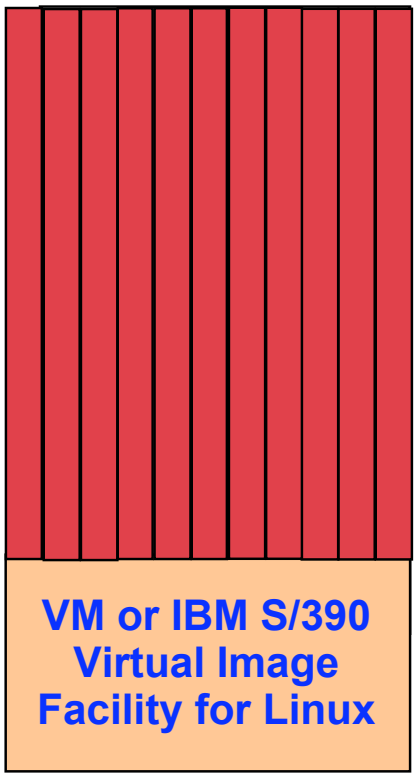
Linux for S/390 images

Cross Memory Network

Server farms



Consolidation e-business



VM or IBM S/390 Virtual Image Facility for Linux

Single purpose Internet-related servers

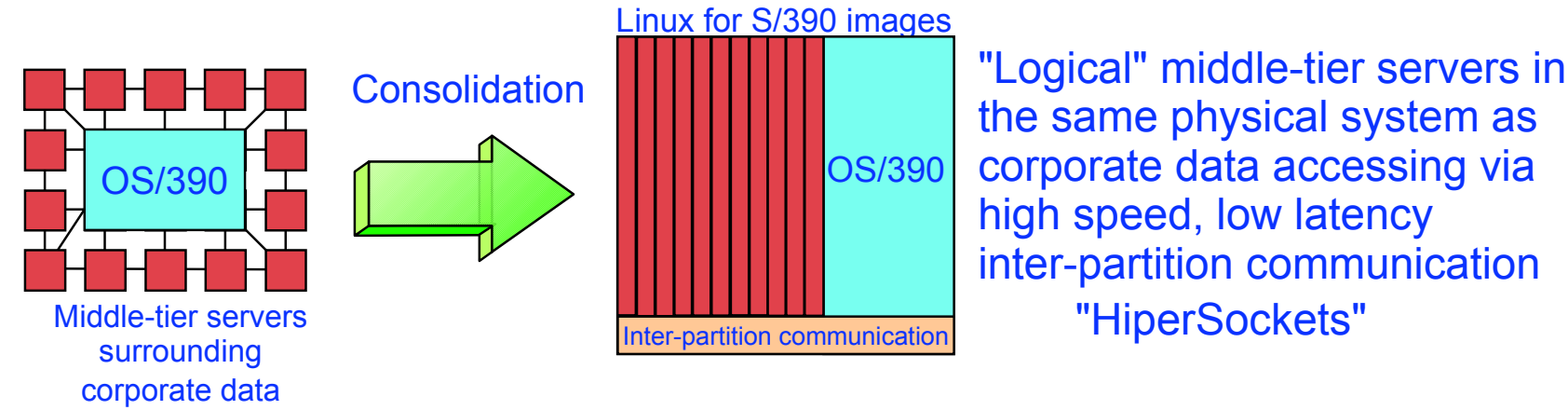
Web servers
Internet new servers
Domain name servers
File/print servers

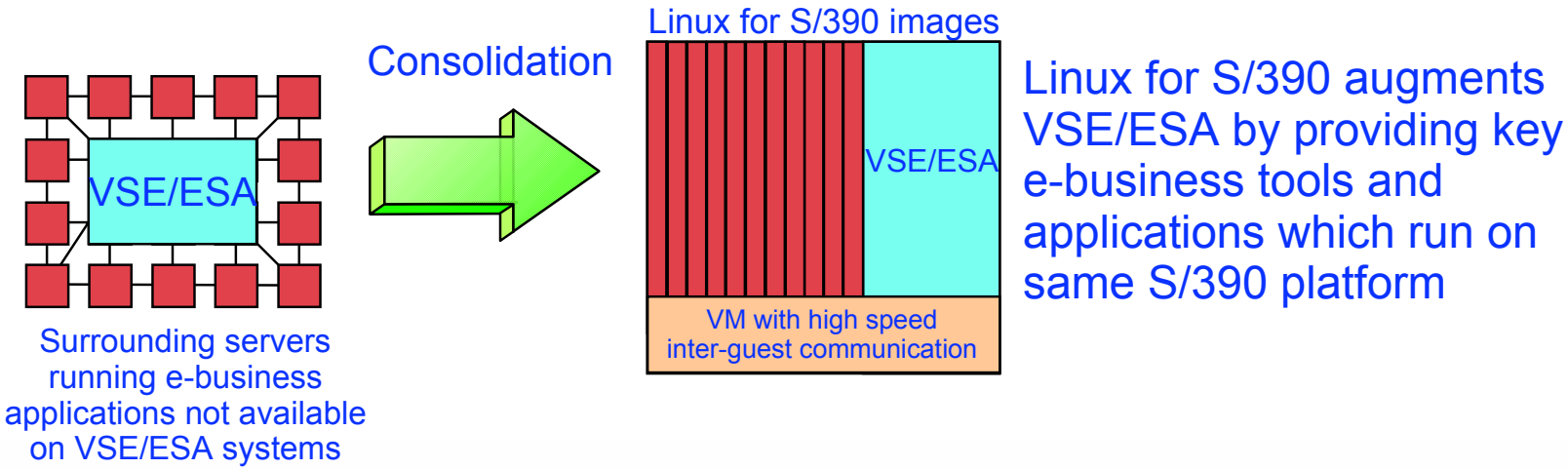
Add Servers In Seconds Not Hours or Days!

IBM @server. For the next generation of e-business.

Enhancing Your S/390 Investment

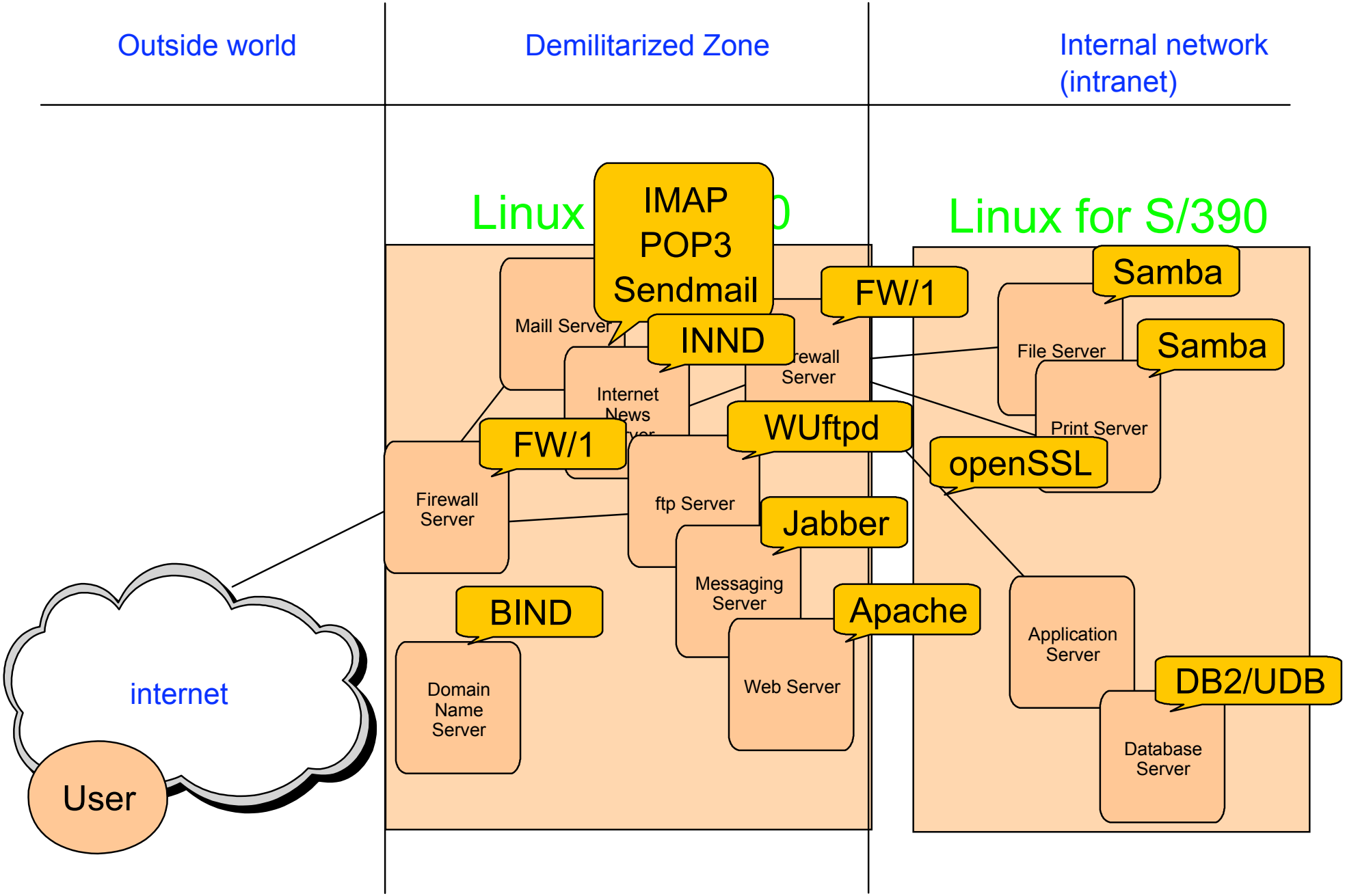
IBM @server zSeries





Function Mapping

host function as separate Linux for S/390 images in an S/390 processor



UNIX Choices on z/Series

IBM @server zSeries

Feature/Function	USS	Linux for S/390
Run under Virtual Image Facility (VIF) and IFL	No	Yes
Run under VM or zVM	Yes	Yes
Port C/C++ Applications	Yes - Moderate Task and OS QoS	Yes - Simple Task and Linux QoS
64bit	No - SOD (z/OS Real, Virtual SOD)	Yes - Linux 2.4 Kernel on z/900 Series (Real/virtual)
Full ASCII Support in OS	No	Yes
Full ANSI C++, incl STL (Standard Template Library)	No - SOD	Yes
New Development Tools and gnu/gcc	Moderate	Yes
QoS z/900 and z/OS RAS, Mixed Workloads, Security, TP, Performance, inherent Functions	Yes	z/900 only
WAS EE w/WLM, EJB, etc	Yes	No
WAS AE w/EJB	No	Yes
DB Access Performance	From / Within same Address - Fastest	inter-LPAR Access - Faster than network link
Application Access to Full WLM, Enclaves, IRD,	Yes	No
Combine z/OS and USS App Components - no wall	Yes	No
Share Files and Data between z/OS and USS	Yes	No - (can implement via NFS)
z/OS ARM, Error Isolation, Multi-CPU Failure Handling	Yes - highest availabilty in the industry	No
Parallel Sysplex Exploitation	Yes	No
Two Phase Transaction Commit of z/OS RRMS	Yes	No
z/OS Security Server Exploitation	Yes	No - (indirect access)
Software Costs	Higher	Lower - OpenSource and Freeware
Skills Base	Scarce	Plentiful - University Mainstream
Applcation Base	ISVs are porting at selective pace (eg SAP App Server, Security First ...50+ Planned over next 4 z/OS Releases)	Large Inventory - develop/admin/deploy

Popular Applications On Linux for S/390

IBM @server zSeries

Samba	CIFS/Windows file and print service for Linux
Apache	Web server
Perl	Programming language
Sendmail	Mail server
FW/1	Firewall construction kit
IMAP	Remote mailbox access system
POP3	Remote mailbox access system
OpenSSL	SSL implementation
OpenLDAP	LDAP implementation
PAM	Authentication system

Popular applications on Linux for S/390

IBM @server zSeries

- Samba (CIPS/Windows file and print service for Linux)
- Apache (WWW server)
- Perl (programming language)
- Emacs (full-featured editor)
- GNU C and development tools (programming tools)
- GNU Fortran (programming tools)
- Sendmail Mail Server (mail transport)
- Squid (WWW cache)
- FW/1 Firewall Construction Kit (firewall system)
- GNU C++ (C++ compiler)
- X Window support (remote graphics and GUI support)
- NETWHERE (Netware 4 emulator) (Novell Netware emulation)
- Bochs (Intel 486) (runs NT)
- Merit SNMP toolkit (allows writing large scale net mgmt apps)
- UW IMAP server (popular remote mailbox access system)
- UC Berkeley POP3 server (popular remote mailbox access system)
- WUftpd (secure FTP server)
- OpenSSL (PD SSL implementation)
- OpenLDAP (PD LDAP implementation)
- PAM (authentication system for multiple OSes - common userid/password for multiple systems)

IBM Software On Linux for S/390

IBM @server zSeries

DB2 Universal Database

WebSphere Application Server Advanced Edition

- Java Development Kit 1.2.2 (JDK 1.3 SOD)
- AFS

Connectors

- DB2 Connect
- CICS Transaction Gateway
- IMS Connect
- MQSeries client

Tivoli

- Tivoli Framework
- Tivoli Storage Manager client

IBM S/390 Virtual Image Facility for Linux

IBM @server zSeries

Enables multiple Linux images to run on a single S/390 system

- Natively or in an LPAR
- Does not require VM skills
- Supports tens to hundreds of images, depending on workload

Complements the S/390 Integrated Facility for Linux

- Attractive pricing terms and conditions

Only supports the Linux for S/390 operating system

- SuSE and TurboLinux distributions for S/390 supported
- On zSeries processors supports 31 bit mode

IBM Integrated Facility for Linux

IBM @server zSeries

Additional engines dedicated to Linux workloads

IBM S/390 Integrated Facility for Linux on 9672 G5/G6

- Supports Linux for S/390 and the IBM S/390 Virtual Image Facility for Linux

IBM zSeries Integrated Facility for Linux available for zSeries

- Supports Linux for S/390 (31 bit), Linux for zSeries (64 bit) and the IBM S/390 Virtual Image Facility for Linux (31 bit)

Begin deployment or consolidation of Linux, UNIX and NT workloads to S/390 immediately

Traditional S/390 software charges unaffected

- IBM S/390 software and middleware
- Independent Software Vendor products

z/VM

IBM @server zSeries

z/Architecture exploitation

- 64-bit real storage support - real storage constraint relief
- 64-bit virtual support - run 64-bit guest systems on zSeries

Supports Linux for S/390 and Linux for zSeries guests

New Attractive Flat Price When Run Alongside z/OS

Native FlashCopy support for the Enterprise Storage Server

Tivoli Storage Manager server pre-installed for high performance file level backup of Linux data

Connectivity enhancements for TCP/IP

- Native QDIO enabling exploitation of Gigabit Ethernet
- HiperSockets (SOD)

zVM for Linux (SOD)

- Runs on IFL
- $40K per IFL engine and $10K per engine/yr maintenance

Linux for zSeries

IBM @server zSeries

Open source 64 bit contributions for zSeries forthcoming

- 64 bit version of the kernel
- Key device drivers
- Compiler (gcc)
- Runtime Library (glibc)

Support for 64 bit real

- Greater than 2 GB real storage
  - Reduction in pageing
  - Large buffers

Support for 64 bit virtual

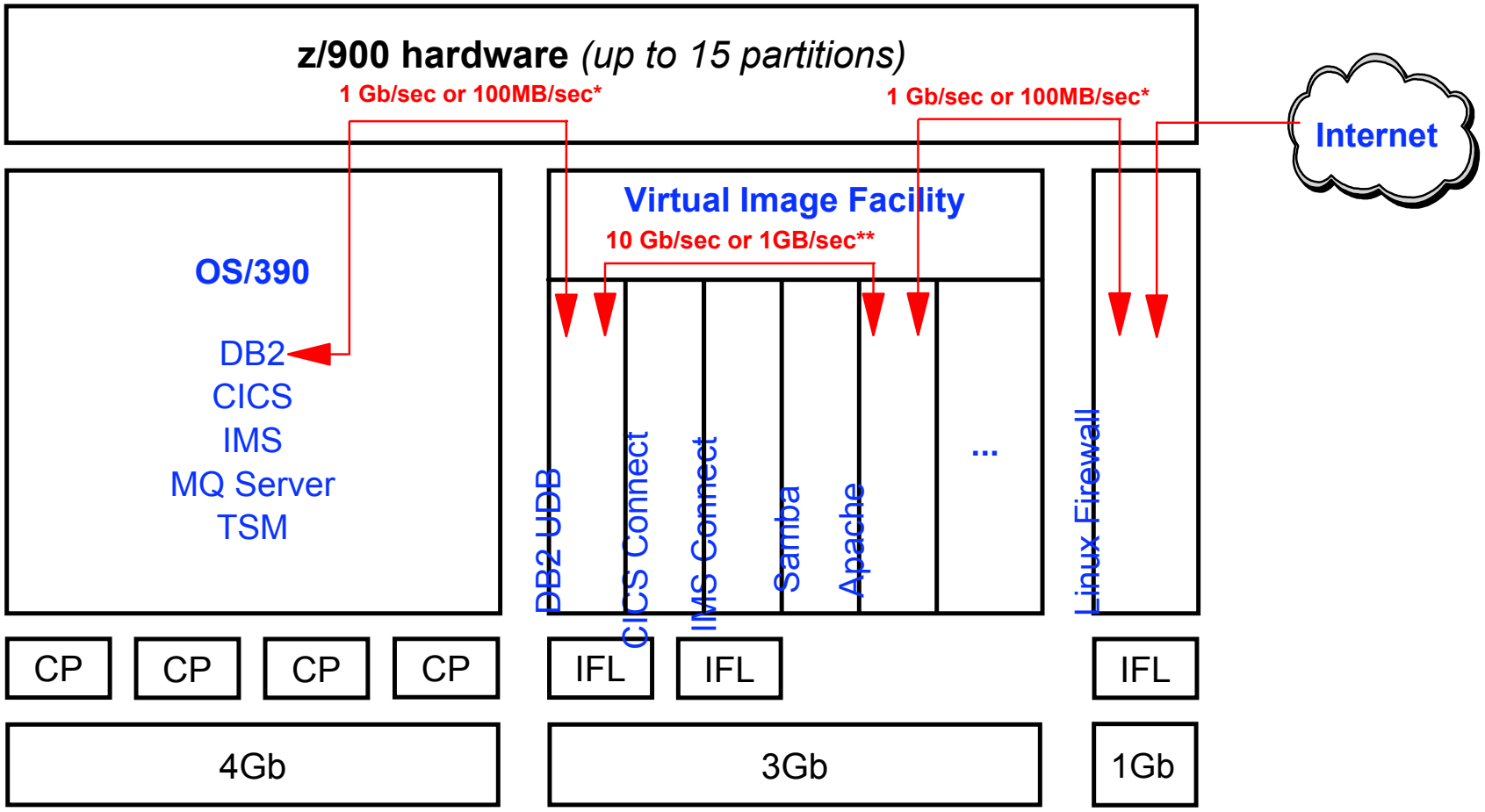
- Application may exploit larger virtual storage sizes

Based on Linux 2.4

Release to Open Source anticipated for early 2001

Example of Linux on an established S/390

IBM @server zSeries

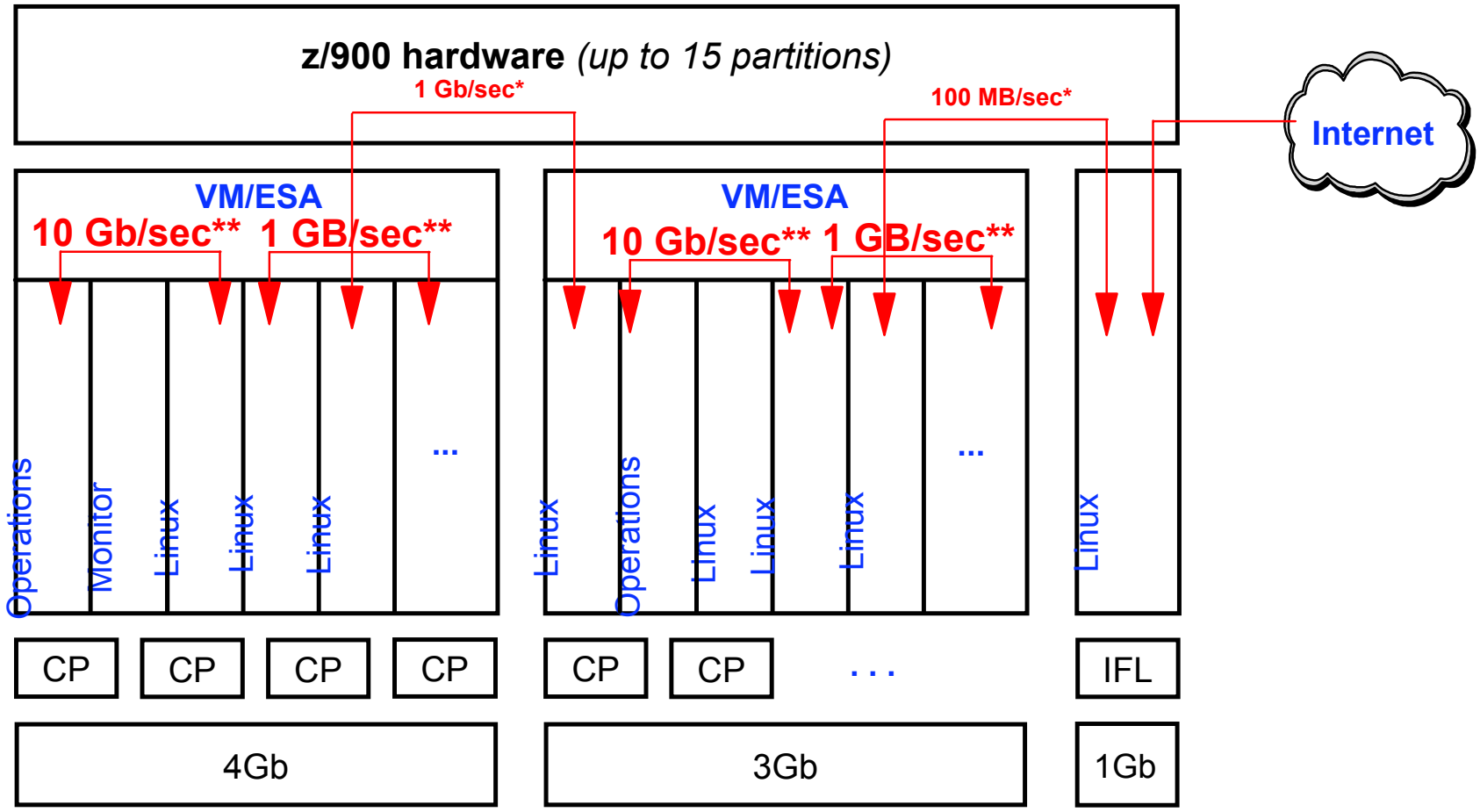


* FICON CTC

** z/900 STI/Hipersocket

Example of Linux for S/390 at an ASP

IBM @server zSeries



* FICON CTC

** z/900 STI/Hipersocket

VM/ESA hypervisor utility value

IBM @server zSeries

The Value of Running Linux on VM

	OS/390	VSE	TPF	Linux
Performance				
Virtual Disks in Storage		✓		✓
Minidisk cache	✓	✓	✓	✓
DB2 Guest Sharing (S/390 Dataspace exploitaiton)		✓		
High-performance virtual machine networking	✓	✓	✓	✓
N-way processor exploitation	✓	✓	✓	✓
Transparent S/390 architecture exploitation (native code not req'd)	✓	✓	✓	✓
Fastpath CCW support	✓	✓	✓	
Productivity				
Temporary Disks (TDISK)		✓		✓
Resource simulation and virtualization	✓	✓	✓	✓
Complex environment testing without duplicating real hardware	✓	✓	✓	✓
Virtual processor support for SMP testing	✓	✓	✓	✓
Resource sharing (DASD, printers, I/O, memory, processors, etc.)	✓	✓	✓	✓
Device-independent I/O support				✓
Guest Coupling Facility	✓		✓	
RAS				
S/390 error recovery (processors, I/O, etc)	✓	✓	✓	✓
Dynamic multi-image support for scaleability, hot backup, debug, etc	✓	✓	✓	✓
Operations				
Guest system controls, scheduling and automation	✓	✓	✓	✓
Performance measurement, reporting and management	✓	✓	✓	✓
Rapid creation and deletion of guest images	✓	✓	✓	✓
Dynamic I/O reconfiguration, CP Sparing, FICON	✓	✓	✓	✓

Virtual Server Technology for Linux

IBM @server zSeries

	VM/ESA	VIF
Architecture and Hardware Exploitation		
- Large n-way SMP exploitation (capable of supporting 32 processors)	✓	✓
- Expanded storage support	✓	
- Dynamic I/O (re-)configuration	✓	
- CP sparing	✓	✓
- Processor and I/O error recovery support	✓	
- Virtual Disks in Storage (VDISK)	✓	
- Minidisk cache	✓	✓
- CLAW attachment support	✓	
- SNA and local 3270 terminal support via virtual 3215 console support	✓	✓
- Support for S/390 Integrated Facility for Linux		✓
Resource Simulation and Virtualization		
- Virtual n-way processors (up to 64 processors)	✓	
- Disk partitioning among Linux images (Minidisk support)	✓	✓
- Temporary Disks (TDISK)	✓	
- Boot Linux from the virtual card reader	✓	
- High-speed virtual channel-to-channel adapters	✓	
- Shared memory, channels, disk	✓	✓

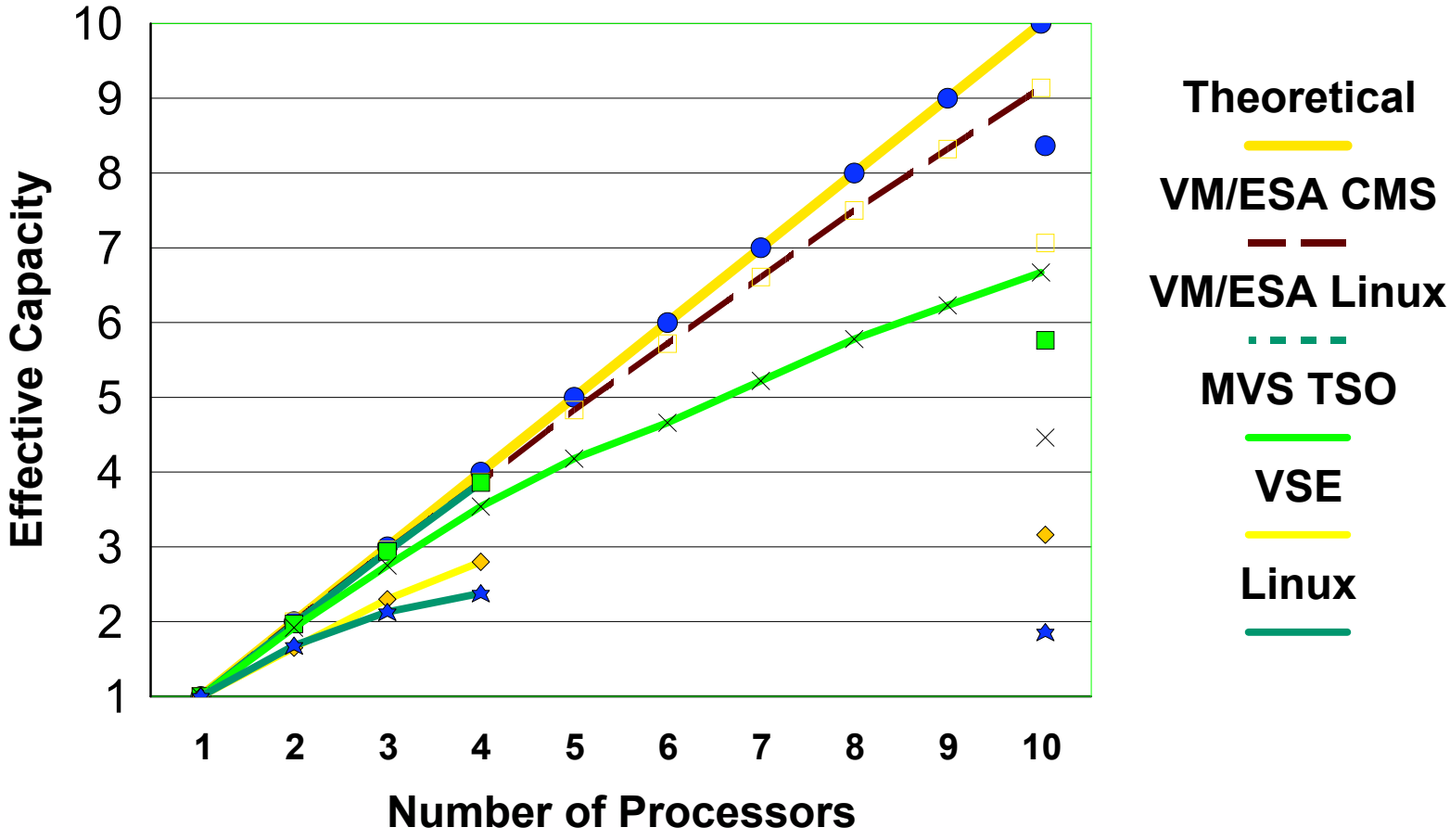
Virtual Server Technology for Linux

IBM @server zSeries

	VM/ESA	VIF
Hypervisor Services		
- Collection and reporting of accounting data (charge-back support)	✓	
- Automation and scheduling of Linux images	✓	Partial
- Performance measurement and reporting	✓	
- Processor utilization control (priority and capping)	✓	
- Proportional distribution of unused processor capacity	✓	
- I/O Throttle	✓	
- Single Console Image Facility (SCIF)	✓	
- High-speed cross-image connectivity (IUCV)	✓	✓
- Read-only file access among Linux images	✓	✓
- Device-independent I/O support (Diagnose 250)	✓	✓
- S/390 debug facilities	✓	
- Named Saved Systems (NSS) support	✓	
- Error recording and reporting (EREP)	✓	
- Rapid creation and deletion of guest images	✓	
- Support for OS/390, VSE, TPF, CMS, VM/ESA, ...	✓	
- Workload isolation	✓	✓

Linux under VM Scalability

IBM @server zSeries



IBM Global Services and Education

IBM @server zSeries

IBM Global Services

- Consulting and Planning
- Design and Implementation
- Database, Application, Cluster enablement

IBM Technology Services

- How To and Defect Support

IBM Learning Services

- Classroom and web-based courses
- Linux Professional Institute
- Red Hat Certified Engineer

Education

- Linux Enablement Class in WSC
- Linux Competency Center in Poughkeepsie

Linux Enablement - Global Services

IBM @server zSeries

Service & Support

- One-stop prime shift or full shift (24 X 7) enterprise level support
- Support for major Linux distributions
- Toll-free Phone & electronic access
- How-to & defect-level support
- zSeries, xSeries, pSeries servers
- 90-day no-charge start-up support (iSeries only)
- Account Advocate, Advanced Support and Consult Line service options

Education & Training

- Full portfolio of courses: Via classroom - 13, Via web - 13
- Available in 20 countries
- Available in 5 languages
- Linux server operators and end-users, including Linux basics, awareness for managers, system administration, and e-business
- How-to (Redbooks) for Linux
- Linux Professional Institute (LPI) sponsor for certification

Professional Services

- Comprehensive services offerings for Linux
  - Server Consolidation
  - e-business Enablement
  - Open Source Consulting & Education
  - Application Migration
  - Clustering Offerings

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IBM Operational Support Service Offerings

IBM @server zSeries

Advanced Support

Customized Service Solution.

- Focused Support Team
- Accelerated Response
- Customized Reporting
- Proactive Recommendations/Support

Account Advocate

Assigned Technical Specialist/Team

- Tracks, Reviews & Escalates Problems as Required
- Available 9X5
- Reviews Support Activity with Customer Monthly

Support Line

Fee Service for How To/Usage Questions

- 800# and Electronic Access
- 9X5 or 24X7 Coverage
- Response Time: 2 Hours Primeshift, 2-4 Hours Offshift

IBM Consulting & Implementation Services

Consulting & Education

- Open Source Consulting
- Linux Infrastructure Assessment
- Class room and Web-based courses
- Red-books

Implementation

- System installation and configuration
- e-business e-server solutions
- Cluster solutions
- Platform Migrations

Application

- Installation Services for Websphere
- Installation Services for MQ Series
- DB2 Migration
- Server Consolidation

Supported Products - Linux

IBM @server zSeries

Linux Operating Systems (incl Apache, Samba)

Red Hat:	Version
Red Hat	6.x, 7.x
Red Hat HA Srv	1.0
Red Hat Enterp .	6.e
Caldera:	
Caldera OpenLinux	1.3
Caldera OpenLinux eSrv	2.3
OpenLinux eDesktop	2.4
SuSE:	
SuSE Linux	6.x, 7.0
SuSE Linux	7.0 (390)
SuSE Linux	6.4 (PPC)
Turbo:	
TurboLinux	3.6
TurboLinux Cluster Srv	4.0, 6.0
TurboLinux Wskt	4.0, 6.0

(October 31, 2000)

Application Product Groups

Application Development and Enabling
- VisualAge for Java, Professional Edition
- VisualAge for Java, Enterprise Edition

Communications
- SecureWay Host On-Demand
- SecureWay Screen Customizer for Host Integration

Data Management
- DB2 Connect Enterprise Edition
- DB2 Connect Personal Edition
- DB2 Personal Developer's Edition
- DB2 Universal Database Enterprise Edition
- DB2 Universal Database Personal Edition
- DB2 Universal Database Workgroup Edition
- DB2 Universal Developer's Edition

Internet
- WebSphere Performance Pack for Multiplatforms
- WebSphere Application Server Standard Edition for Linux

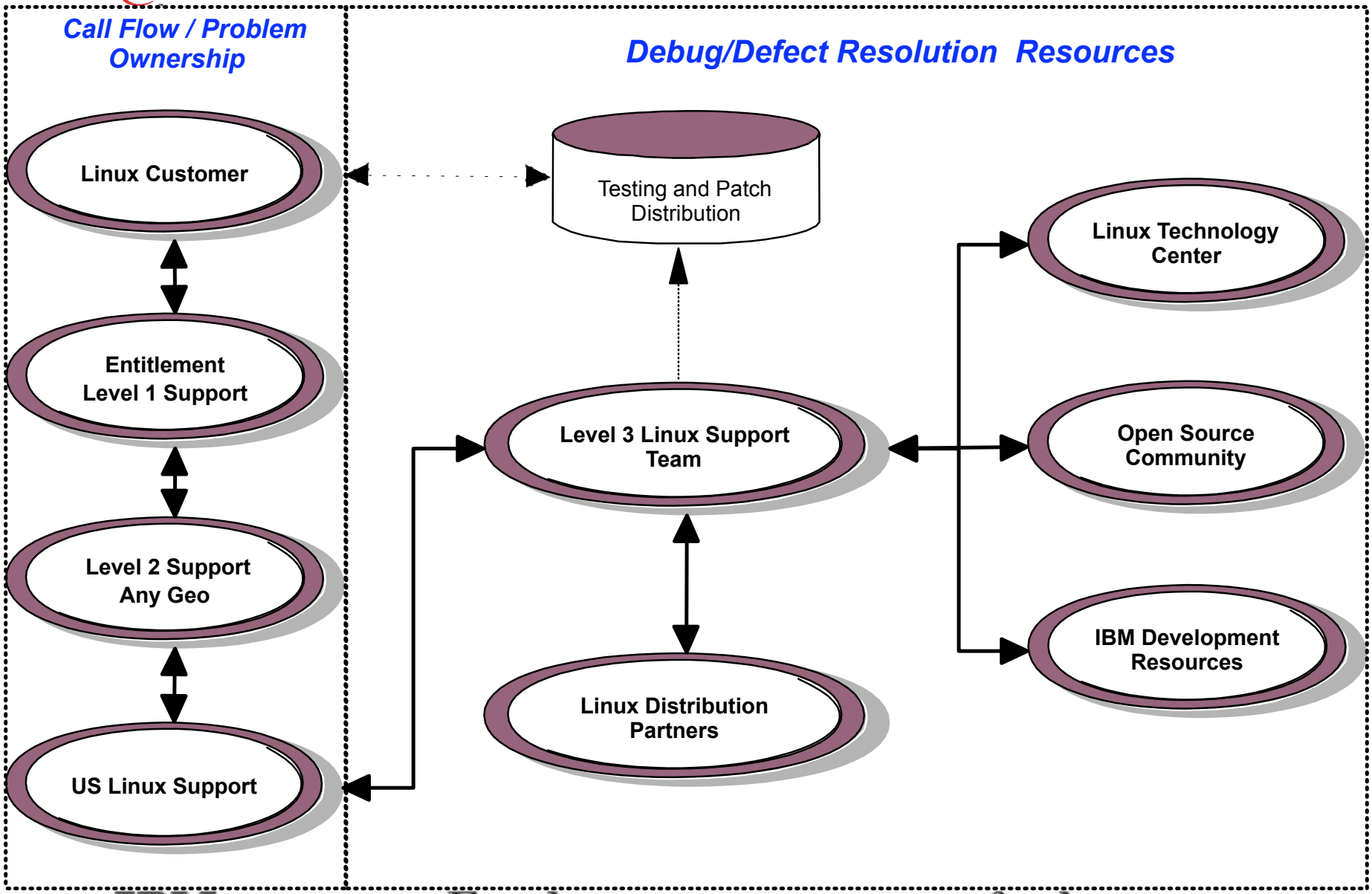
Network and Systems Management
- WebSphere Performance Pack Cache Manager

Independent Group 12 - DB2 UDB EE
- DB2 Universal Database Enterprise Edition

Independent Group 13 - WebSphere
- WebSphere Performance Pack for Multiplatforms
- WebSphere Application Server Standard Edition for Linux

IBM Linux Support Structure

IBM @server zSeries



IBM Propels Linux for Real e-Business

IBM @server zSeries

Announces Multi-Million Dollar Investment In Linux Services

NEW YORK--(BUSINESS WIRE)--Jan. 31, 2001--IBM today announced a range of new Linux(1) services as well as plans to invest more than $300 million in additional Linux services over the next three years. The services are designed to help customers install and implement commercial e-business solutions using Linux.

IBM S/390 IFL - Committed Independent Software Vendors

IBM @server zSeries

- BMC SOFTWARE
- CANDLE
- COMPUTER ASSOCIATES
- COMPUWARE
- ISOGON
- SAGA SOFTWARE

IBM Middleware On Linux For S/390

IBM @server zSeries

Product	Availability	Comments
CICS Transaction Gateway, Version 3.1	Available	Integrated In next version
MQSeries Client, Version 5.2	Available	Download only
WebSphere Advanced Edition, Version 3.5 with Java JDK Version 1.2.2	Available	
DB2 UDB Enterprise Edition for Linux, Version 7	Available	Additional CD with DB2 UDB
DB2 Connect Unlimited Edition, Version 7	Available	Function in DB2 UDB
IMS Connect, Version 7	Available	

Tivoli Products On Linux For S/390 ...

IBM @server zSeries

Product	General Availability
Tivoli Framework (server, gateway and endpoint)	TBD
Tivoli Inventory (endpoint)	TBD
Tivoli Software Distribution (server and endpoint)	TBD
Tivoli Distributed Monitoring (endpoint)	TBD
Tivoli Enterprise Console (endpoint)	TBD
Tivoli SecureWay User Administration and Security Management (endpoint)	TBD
Tivoli Storage Manager Client	Available

BMC Software - Middleware for Linux for S/390

IBM @server zSeries

- Patrol for Linux for S/390
- GA version scheduled for October, 2000
- Patrol for Linux for S/390 preview allows customers to evaluate management of the Linux for S/390 environment with Patrol
- BMC Software will follow with additional management solutions

Computer Associates

IBM @server zSeries

Product	Status
Unicenter TNG Framework	available
Apache Agent	available
Unicenter Systems Management	available
MasterIT	available
Ingres II	available
Ingres II Agent	available
eTrust Access Control	available
eTrust InoculateIT	available
XCOM	available
Unicenter TNG Full Product	Planned Availability 1Q 2001
WebSphere Agent	Planned Availability 1Q 2001
eTrust VPN	Planned Availability 1Q 2001
eTrust Directory	Planned Availability 1Q 2001
EDBC	Planned Availability 1Q 2001

Availability controlled through CA sales reps through 1Q 2001

Compuware SOD - Middleware for Linux for S/390

IBM @server zSeries

- Application development & application solutions from the following families of products:
  - UNIFACE
  - File-AID
  - NuMega
  - Expediter
- Application quality assurance solutions from the QACenter family of products:
- Application production readiness solutions from the following families of products:
  - QACenter
  - EcoSYSTEMS
- Application performance management solutions from the following families of products
  - EcoSYSTEMS
  - Abend-Aid
  - Strobe/APM

Software AG - Middleware for Linux for S/390

IBM @server zSeries

- Tamino
- GA version scheduled for 4Q 2000
- XML Database

IBM Application Developer's Kit for Linux

Available Today from:

- ✓ **www.ibm.com/linux**
- ✓ OVER 20,000 KITS SHIPPED

No charge for development use

Includes full function, market-available products:

- ✓ *IBM WebSphere Application Server **Advanced** Edition*
- ✓ *IBM DB2 **Universal Database** Enterprise Edition V7.1*
- ✓ *Lotus Domino Application Server **5.0.4***
- ✓ ***Visual Age for Java** for Linux development tools*
- ✓ IBM Development Kit, Java Technology Edition ***(IBM JVM V1.1.8 and JRE)***
- ✓ *New - MQSeries Technology Release*
- ✓ *New - WebSphere HomePage Builder V4*
- ✓ *DB2 and WebSphere Redbook*

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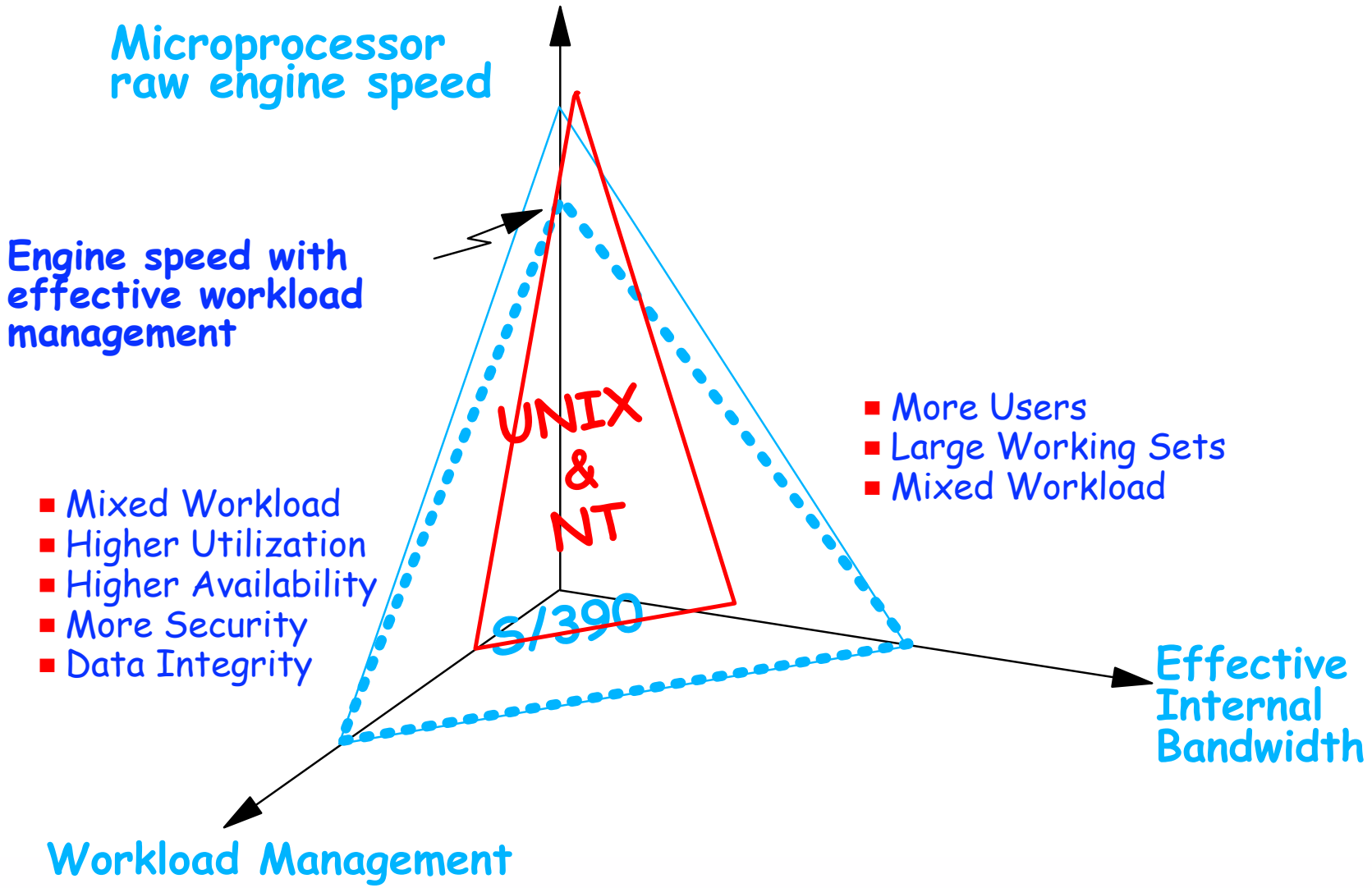
The 3 Axis of Capacity/Performance

IBM @server zSeries



Two Very Different Paradigms ...

IBM @server zSeries

Unix and NT approach- Single function per server

OS/390 approach- Many functions per server

- 10's to 100's of servers, many racks
- 10-70% used capacity (average 30%)
- complexity of data/application sharing
- recovery often based on "re-booting"..
- high number of support people

- difficult to change rapidly
- TCO - increases when "scaling-up"

- very few servers (<10)
- 70-"100"% used capacity
- "supports" application integration
- highly stable, secure platform
- efficient automated system mgnt

- deliberately "slow to change"
- TCO - decreases when "scaling-up"

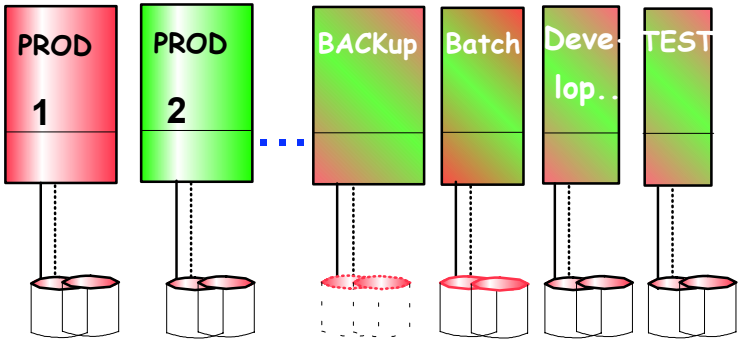
Other platforms & S/390 - *the BASIC BUSINESS difference*

IBM @server zSeries

Other Platforms...

Multiple FOOTPRINTS/ Domains to run the BUSINESS

Non-Shared Resources



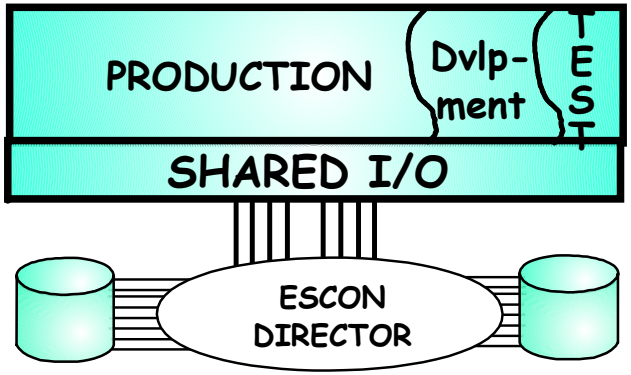
- SEPARATE VIEWS of the DATA
- LOW Resource utilization
- Complex System Mgnt
- HIGH overall costs

MULTIPLE FOOTPRINTS
running the Production, means
separation of Enterprise in smaller units

COMPLEX TO INTEGRATE

S/390...

Single Footprint (Single Resource Space) Shared Everything



- SINGLE VIEW of the DATA
- Mainframe platform strengths
- Higher Resource utilization
- Lower overall costs

SINGLE VIEW of DATA and RESOURCES,
means flexibility to
Respond Quickly to new business needs

THE BASIC BUSINESS DIFFERENCE

... and that's why the platform matters

IBM @server. For the next generation of e-business.

Consolidation of servers

Total cost of ownership

East coast telco requires large server farm to provide basic internet services

Dedicated servers required for each customer

- Performance
- Security
- Charge-back capability

Planned customer base is 250 customers

- Three servers per customer

Telco engages consultant to evaluate SUN solution vs Linux for S/390 solution

A Telecommunications Carrier Real World Example Deploying a Virtual System Solution on Linux zSeries versus a Traditional Discrete Solution on Sun

Solution Area	Discrete Solution	zSeries Solution
Space Facilities		
Floor Space	10,000 sq ft for up to 7,000 servers	400 sq ft for up to 40,000 Linux servers (1 zSeries server)
Rack Space	125 Racks	2 Racks/2 Cabinets
UPS Installation	750,000	135,000
Operations and Support Systems		
Tivoli TME 10 Suite and Applications	$650,K	N/A
Additional Systems and Network Mgt Servers	20@ $30K/Server	N/A
Additional NOC Staff	100 FTE	3 FTE
Operating License	$545/copy for NT, included with Sun Systems	$34K Year VM NA for Linux for S/390
Deployment/Time to Market		
Time to Operationalize Server Farm	180-200 Days	48 Days
Staffing for Server Deployment and Configuration	100 FTE	0
Average Time to Deploy Customer Servers	11 Days	90 Secs Server/3 Minutes Total
Total Costs		
Server Hardware	$10.9M (Sun)	$676K
Network Hardware	$1.2M	$375K
Facilities Rental	$270K/Month	N/A - No Add'l Space Needed
Facilities Hardward	$585K	$12K
Management Servers	$1.5M	$34K/Year
Salaries	$1.6M/Month	$60K/Month
Startup Costs	**$40M**	**$1.6M - $5M (processor config)**
On-Going Costs	**$12M/Year**	**$1M/Year**

Source: "Linux for S/390 Scalability and Competitive Advantage", David Boyes, Sine Nomine Associates

Typical server farm solution...

TCO for typical server farm solution using Intel or SUN servers

$1500/sq ft/month

Total operational cost, including staff, environmentals, operation and mgmt software, etc.

Averages:

3500-7000 discrete systems
15,000-20,000 square feet
3500-7000 network cables and LAN ports at $150/port
3500-7000 power cables
Time to market: 4-7 days

Source: "Linux Scalability and ISP Productivity", David Boyes, VM/VSE Tech Conference, June 2000

Linux for S/390 Server Farm - Real business value...

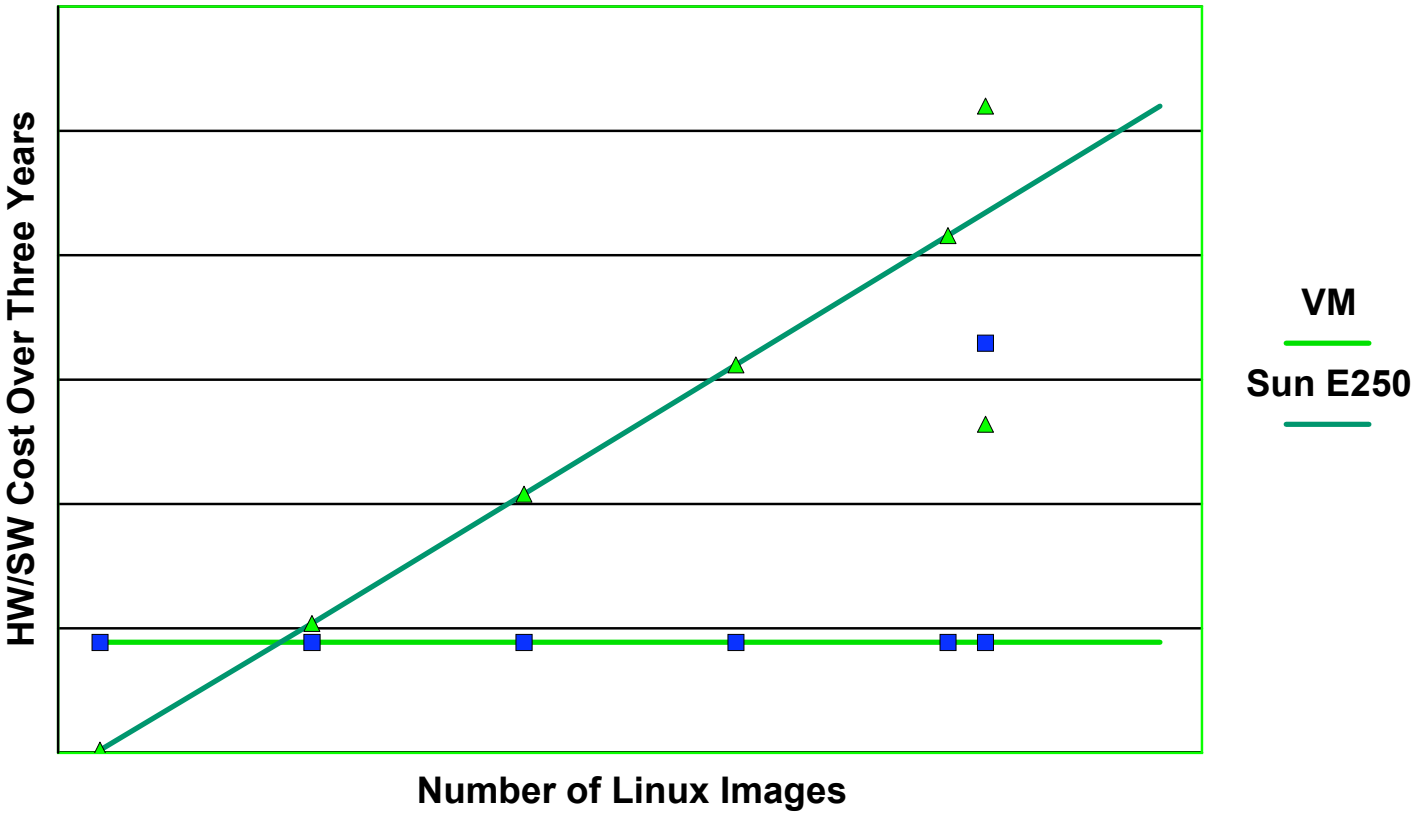
IBM @server zSeries

- 1 to hundreds (or thousands) of systems:
  - 400 square feet
  - G5 + Shark/EMC cabinet + misc routers
- 1 high capacity network cable
  - DS3/OC3/OC12 plus ESCON cabling to Cisco 7xxx+CIPS
- 1 power cable per cabinet
- Time to Market
  - about 90 seconds for each new Linux for S/390 image

Source: "Linux Scalability and ISP Productivity", David Boyes, VM/VSE Tech Conference, June 2000

Linux under VM - 3 Year cost projection

IBM @server zSeries



Note: **3-year lease**
Multiprise 3000 + VM V2 + TCP/IP
Sun E250

There are some things Linux just doesn't do

IBM @server zSeries

There are some things Linux just doesn't do

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Some Important Web Sites

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IBM Linux
- **ibm.com**/linux/

IBM developerWorks
- **ibm.com**/developerworks/linux/

Linux Deployment Tools and Enablers
- www.s390.ibm.com/linux/ldt/

Linux ISV Applications and Tools Available on S/390
- http://www-1.ibm.com/servers/eserver/zseries/solutions/s390da/linuxisv.html

IBM Linux for S/390
- **ibm.com**/s390/linux/

IBM VM/ESA and Linux Resources site
- **ibm.com**/s390/vm/linux/

SuSE
- suse.com

TurboLinux
- turbolinux.com

Some Important Websites (con'td)

IBM @server zSeries

Free Linux Community Development System....zSeriesPenguins....
http://www.ibm.com/servers/eserver/zseries/os/linux/freeaccess.html

Linux for S/390 discussion group

Send a note to listserv@marist.edu, the body should contain
SUBSCRIBE LINUX-390 your name, organization

Len Santalucia
Senior Consulting Specialist
Certified Professional
Americas Linux Sales & Marketing

IBM Corporation
12th FLoor
33 Maiden Lane
New York, NY 10038

Telephone: 212-493-5957
e-mail LSANTALU@us.ibm.com