**Technology Advice.
Business Results.**

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Enterprise Linux on S/390 and eServer zSeries Platforms

David N. Mastrobattista
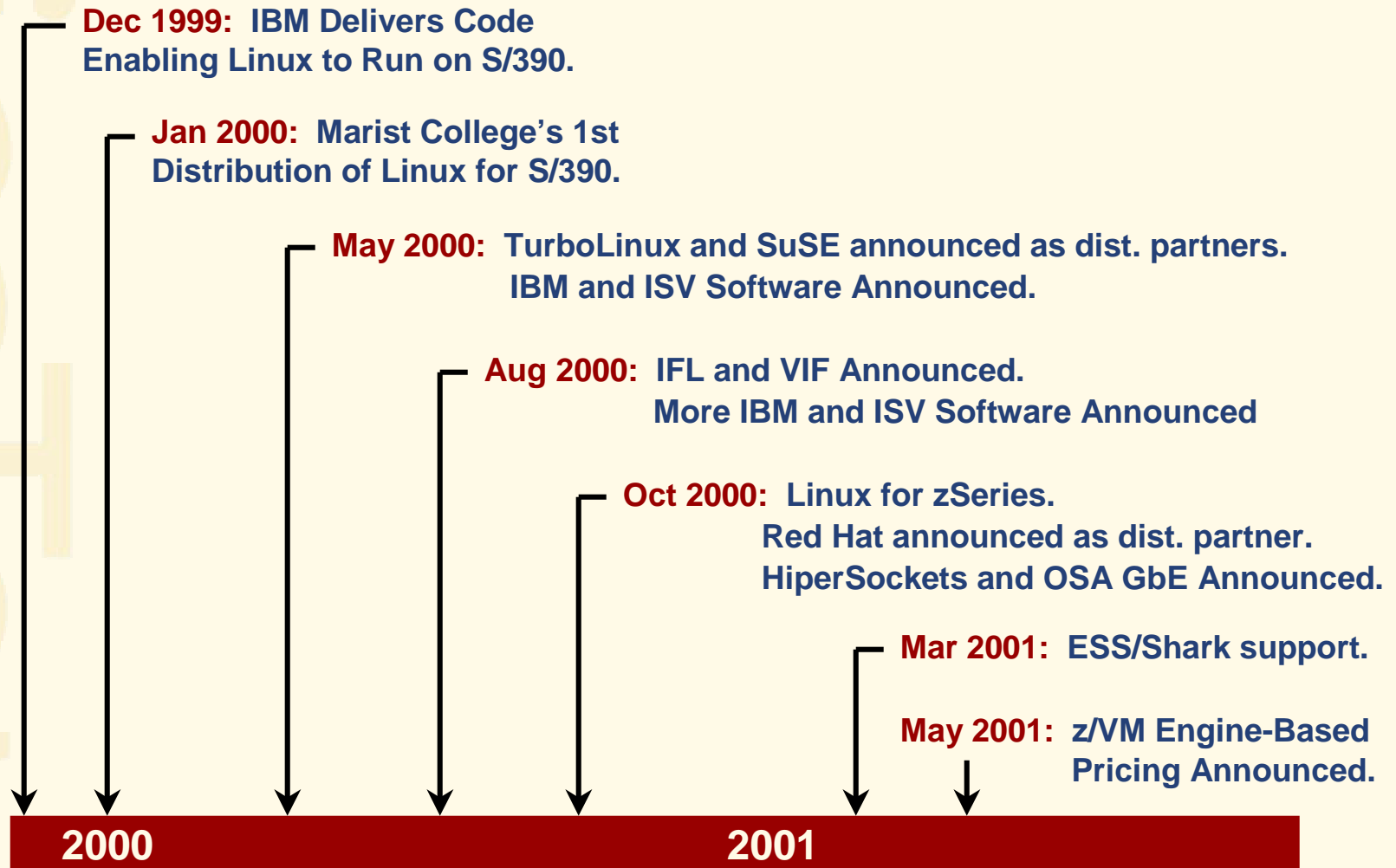*Senior Industry Analyst*

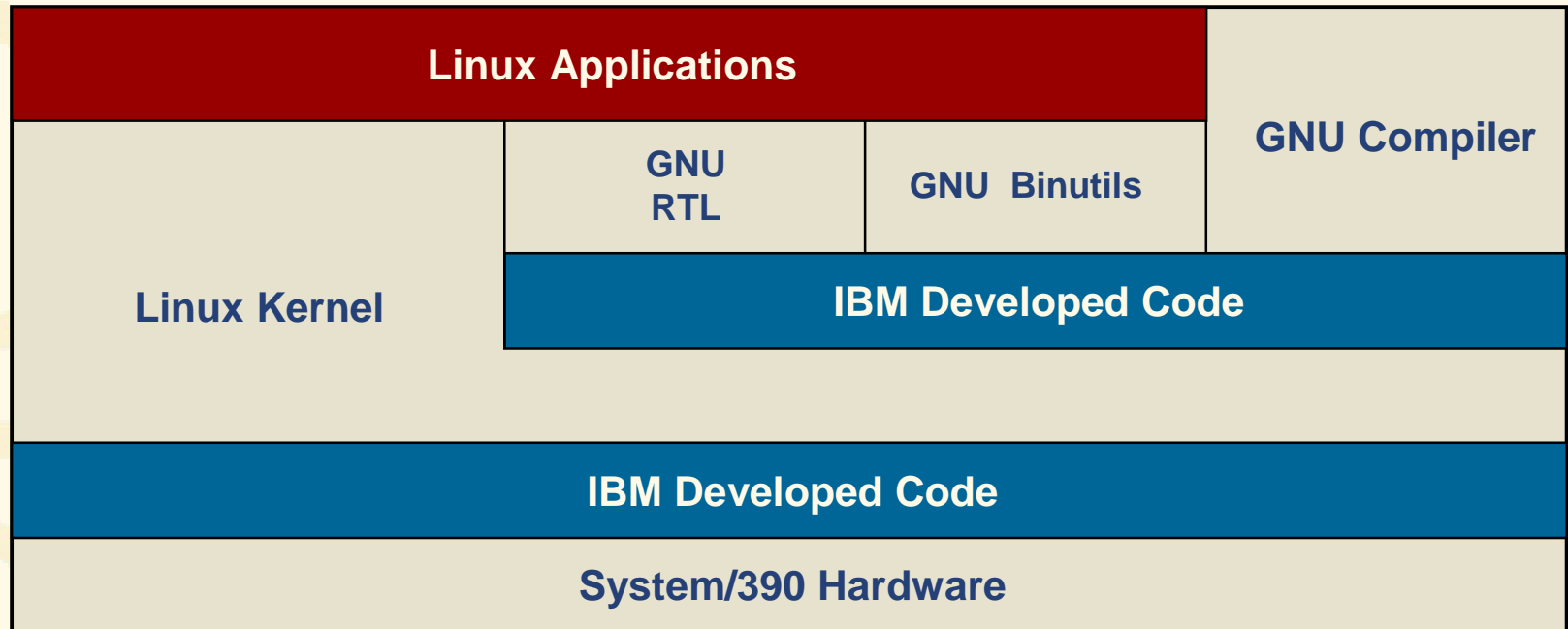**August 8, 2001**

Agenda

- Why all the excitement with Linux on the mainframe?

- Linux distributions and IBM distribution partners

- Real-world mainframe Linux scenarios update

- Software considerations:

  - ✓ New z/VM software pricing

  - ✓ ISV software and trends

- Summary and recommendations

A Brief Timeline for Mainframe Linux

Dec 1999: IBM Delivers Code
Enabling Linux to Run on S/390.

Jan 2000: Marist College's 1st
Distribution of Linux for S/390.

May 2000: TurboLinux and SuSE announced as dist. partners.
IBM and ISV Software Announced.

Aug 2000: IFL and VIF Announced.
More IBM and ISV Software Announced

Oct 2000: Linux for zSeries.
Red Hat announced as dist. partner.
HiperSockets and OSA GbE Announced.

Mar 2001: ESS/Shark support.

May 2001: z/VM Engine-Based
Pricing Announced.

2000   **2001**

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What Is Linux for S/390 and zSeries?

Linux Applications			GNU Compiler
Linux Kernel	GNU RTL	GNU Binutils	
	IBM Developed Code		
IBM Developed Code			
System/390 Hardware			

What Is Linux for S/390 and zSeries?

	Total Lines of Code	S/390 Enabling Code	Percentage of S/390 Code
Linux Kernel	2,200,000	45,000	2.05%
gcc	1,700,000	9,000	0.53%
gdb	1,500,000	8,000	0.53%
glibc	1,200,000	5,000	0.42%
binutils	800,000	6,000	0.75%
strace	41,000	200	0.49%

Source: IBM

- **Pure Linux, ASCII Environment.**

- **Not a unique version of Linux.**

- **Exploits IBM S/390 Hardware, including IEEE floating point.**

- **No intention to replace z/OS or other S/390 operating systems.**

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Convergence of Two Computing Technologies

- **Complete platform independence.**
- **Increasing application portfolio.**
- **Readily ported Unix/NT infrastructure functionality (i.e., Web server, DNS, firewall, e-mail, message collaboration).**
- **Mainstream / University supply of highly skilled programmers.**

+ ⟶ **=**

Industrial Strength Linux Environment

&

Potential for Highly Integrated E-Business Solutions

- **Best platform for reliability and continuous availability.**
  - ✓ **Error detection and correction.**
  - ✓ **Remote diagnostics and "call-home".**
  - ✓ **Concurrent firmware maintenance.**
  - ✓ **Dynamic CPU / channel sparing.**
  - ✓ **Memory patrol and chip sparing.**
- **Dynamic workload LPAR management.**
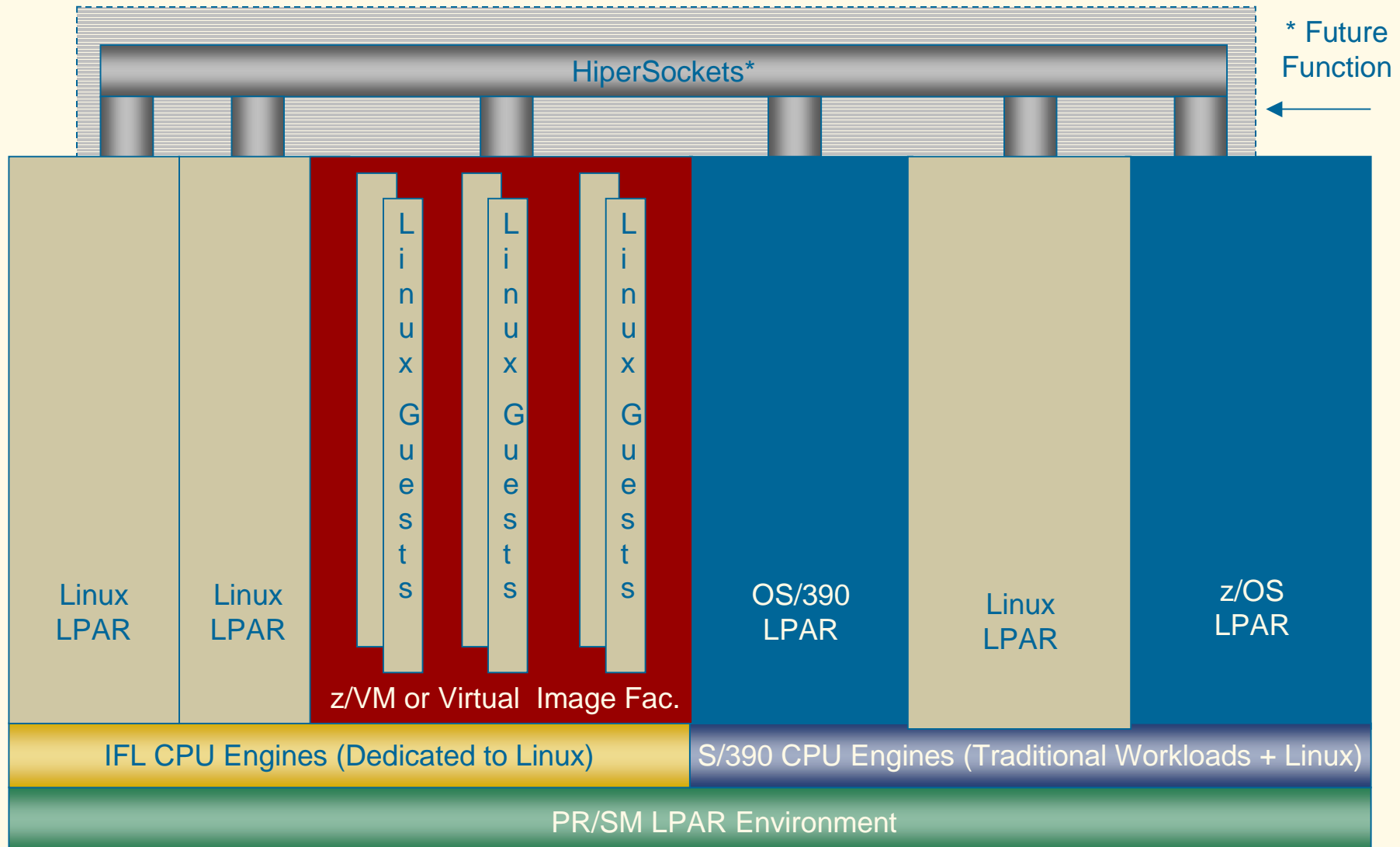- **VM virtual server management.**
- **Supports horizontal and vertical scaling.**

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Mainframe Linux Implementation Options

* Future Function

HiperSockets*

Linux LPAR

Linux LPAR

Linux Guests

Linux Guests

Linux Guests

z/VM or Virtual Image Fac.

OS/390 LPAR

Linux LPAR

z/OS LPAR

IFL CPU Engines (Dedicated to Linux)

S/390 CPU Engines (Traditional Workloads + Linux)

PR/SM LPAR Environment

IBM Linux Distribution Partners

SuSE

- GA Release in Nov 2000.

- Based on 2.2.16 Kernel.

- Available via download and CDs.

  – Largest selection of software packages for an S/390 distribution.

- Professional services available for installation, training, customization and support.

- YaST: Set-up tool and admin.

- Supports Logical Volume Manager.

- Currently, the only trouble-free distribution that supports Websphere for Linux 3.5 AE.

IBM Linux Distribution Partners (cont'd)

TurboLinux

- GA Release in October 2000.

- Based on 2.2.16 Kernel.

- Available via download and CD.

- V6.0 for zSeries and S/390 — Available Jan 2001 (No LVM Support).

- V6.5 Alpha Release — Available June 2001 (with LVM Support).

- Script-based installation process.

- Professional services available for installation, training, customization and support.

IBM Linux Distribution Partners (cont'd)

Red Hat

- Beta Release in Feb 2001. No GA Release Yet.
- Releases based on 2.2.19 kernel and 2.4.3 kernel.
- Currently only available via download.
- Incorporates more recent glibc modules (v2.2) that don't coexist well with DB2.
- No Logical Volume Manager support.
- Professional Services available.

Caldera

- Currently no S/390 or zSeries distribution available — only xSeries.

Other Mainframe Linux Distributions

Marist College

- First available S/390 Linux offering — Jan 2000.

- Latest release (May 2001) based on 2.2.16 Kernel.

- Technically NOT a distribution, but rather a copy of a running Linux system.

  - Advantages:

    - Easy installation.

    - Relatively small compared to other distributions.

    - Requires little knowledge of Linux/390.

  - Disadvantages:

    - Can't select software packages to install.

    - No system administration tool.

Other Mainframe Linux Distributions (cont'd)

Think Blue 64 Linux for zSeries

- Distributed by Millenux (Germany).

- Provided second S/390 Linux offering after Marist College.

- Provides 31-bit (Linux for S/390) and 64-bit (Linux for zSeries).

- First available 64-bit Linux for zSeries.
    - Based on 2.4.3 Kernel.

- Supports Logical Volume Manager.

- Professional Services available.

Technology Adoption Curve… And Linux
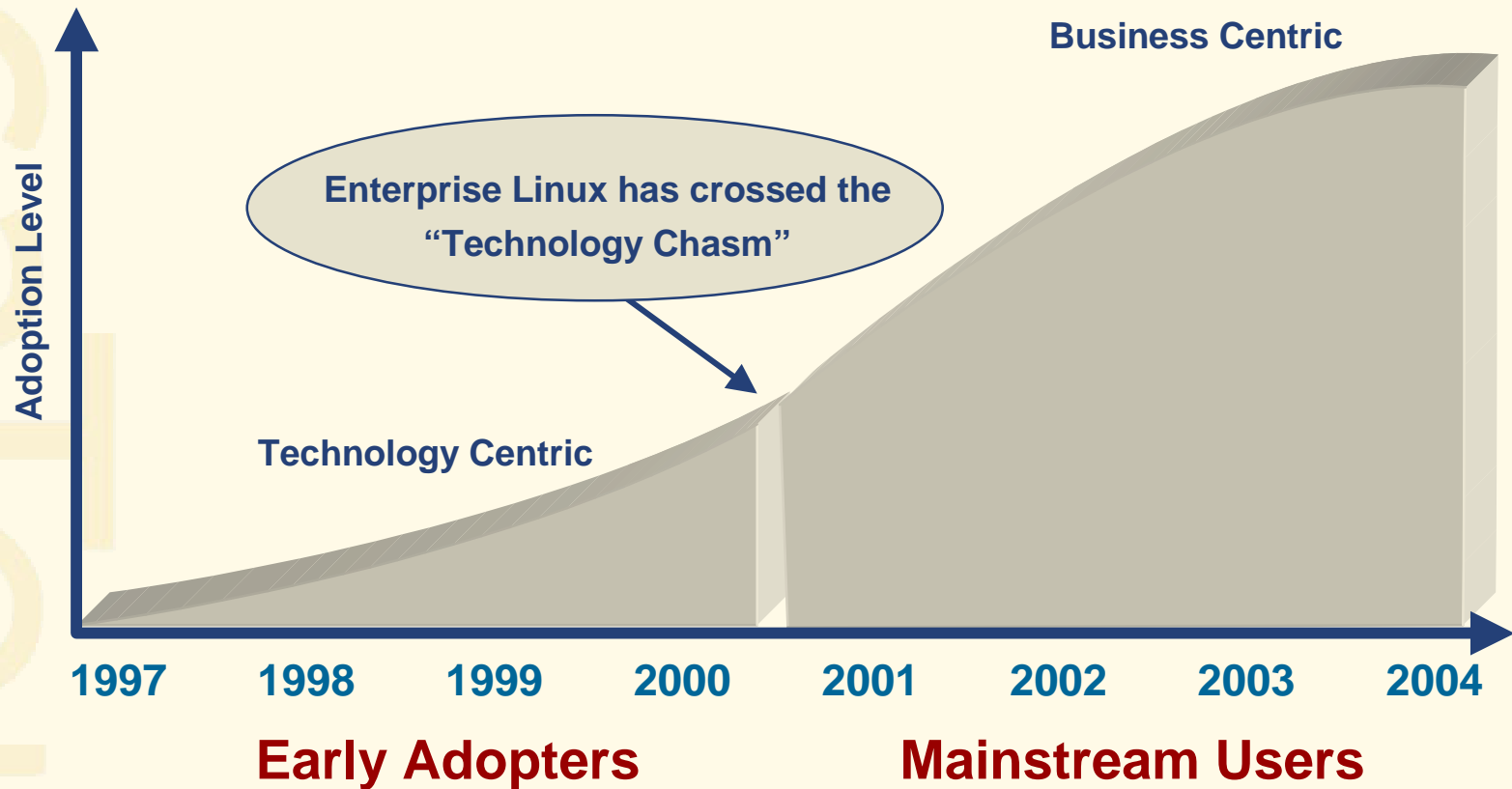
Typical Customer Profiles …

- **Current S/390 or eServer zSeries customer**
  - Used VM in the past. Now it's back!
  - Never used VM. Installing VM for the first time.
    - VIF
    - z/VM
  - Likely to use Integrated Facility for Linux (IFL) feature.
  - Some may elect special "G6 Linux-only" offering.

- **New to System/390**
  - Likely to use Multiprise 3000 or special "G6 Linux-only" offering.

Initial Linux Customers and Workloads

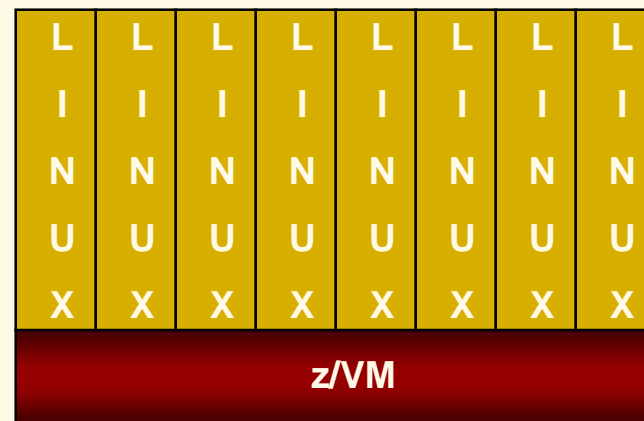|	IDC / Netgen Customers	Enterprise Customers / *Vendors*
Infrastructure Server Consolidation	• **Telia Telecom ISP** • **CSK Networks**	• **Banco Mercantile** • **Rubbermaid** • **Grede Foundries** • **Wall Street Firms**
Webserving	• **Telia Telecom ISP** • **DreamBall**	• **Banca Intesa** • **Marist College** • **Price Chopper** • **Energy Ltd. Germany (EAM)**
Email Services and Message Collaboration		• **Winnebago** • *SendMail (Early-Ship / Beta)*
Enterprise, Core-Business Applications		• **Marist College** • **ACTS Corp.** • **Korean Air Lines (KAL)** • *Sanchez (Field-Test / Beta)* • *SAP (Beta)*

**Source of Customer Names: IBM.
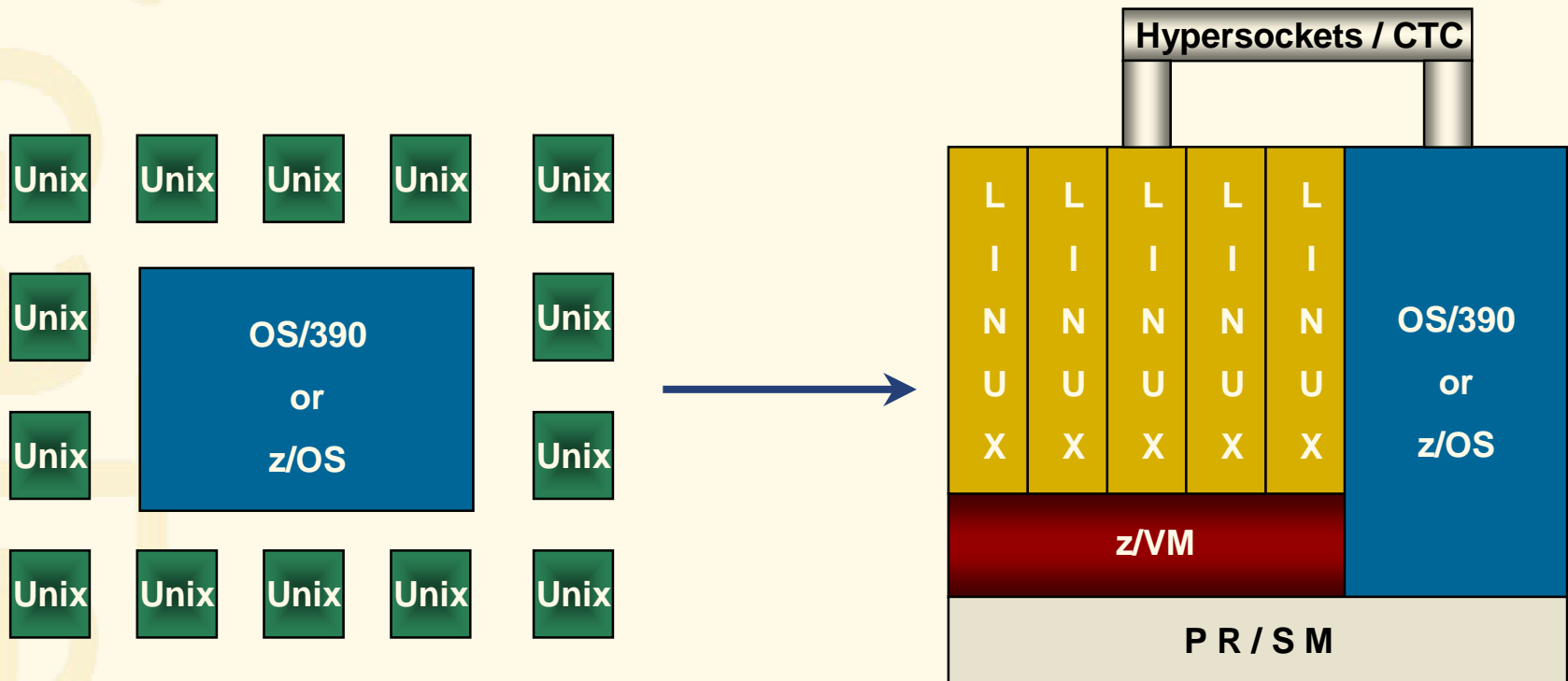Used with permission.**

Server Consolidation
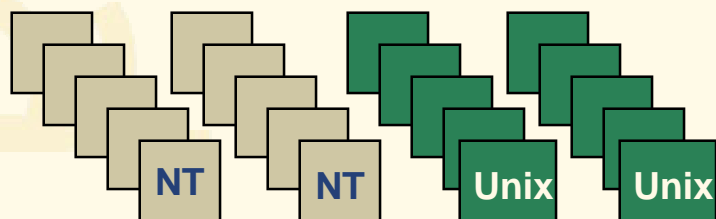
Single-Function Internet Servers

- **File / Print Servers**
- **Web Servers**
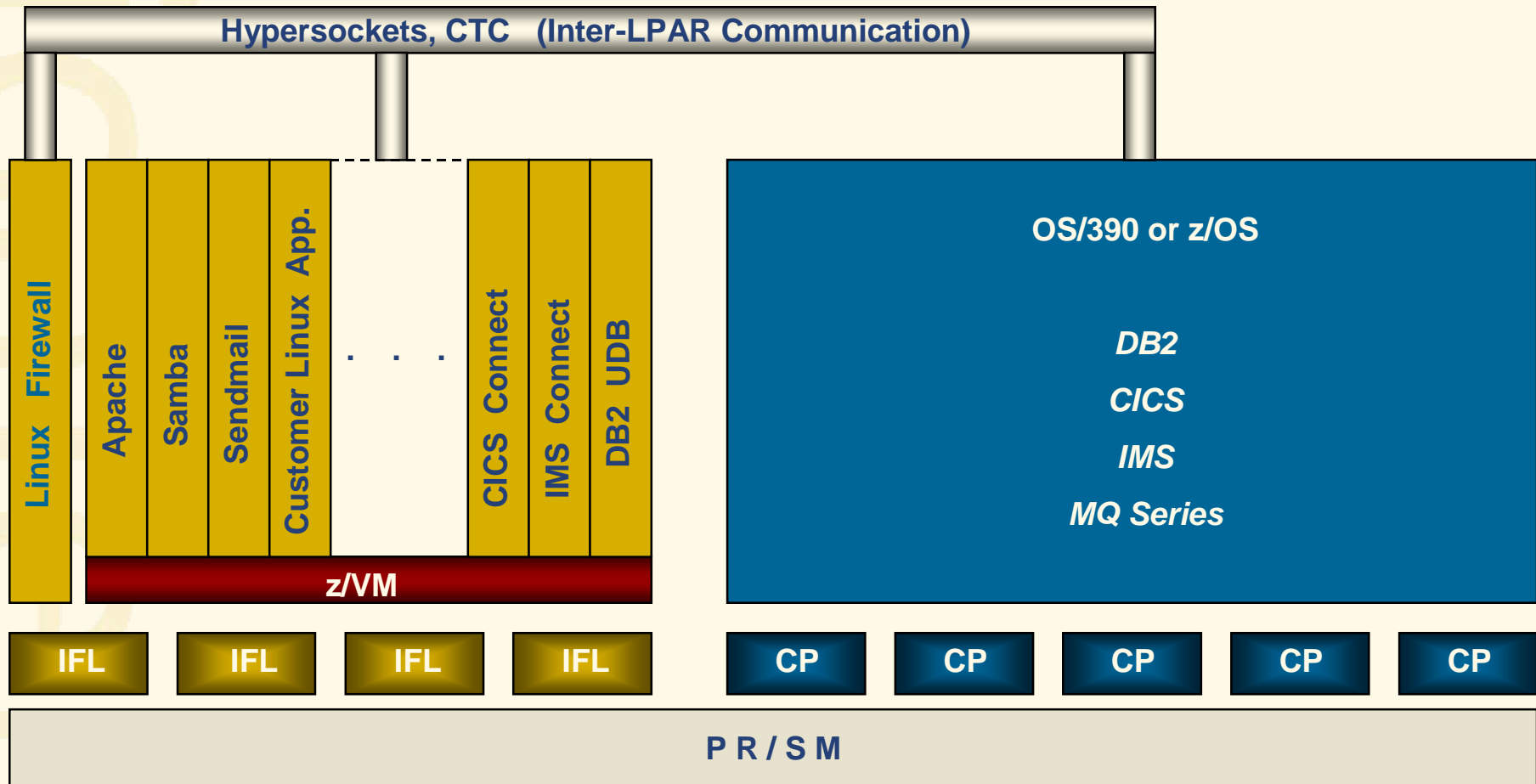- **DHCP, DNS Servers**
- **Internet News Servers**
- **Mail Servers**

NT NT Unix Unix

L	L	L	L	L	L	L	L
I	I	I	I	I	I	I	I
N	N	N	N	N	N	N	N
U	U	U	U	U	U	U	U
X	X	X	X	X	X	X	X

z/VM

L	L	L	L	L	
I	I	I	I	I	**OS/390**
N	N	N	N	N	**or**
U	U	U	U	U	**z/OS**
X	X	X	X	X	

z/VM

P R / S M

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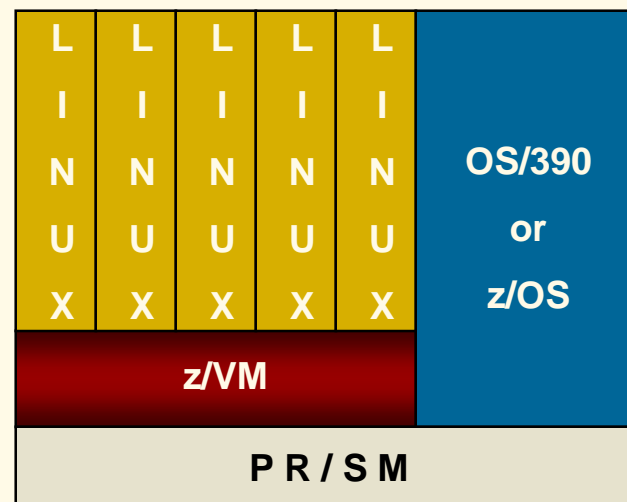
Linux and z/OS Hybrid Solutions

- **Consolidation of Mid-Tier Unix Servers**

- **Leverage z/OS Data Server "Back-End"**

- **Bring Application Server Function Closer to DB Function**

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Linux and z/OS Hybrid Solutions (cont'd)

Hypersockets, CTC   (Inter-LPAR Communication)

Linux Firewall

Apache

Samba

Sendmail

Customer Linux App.

. . .

CICS Connect

IMS Connect

DB2 UDB

z/VM

OS/390 or z/OS

DB2

CICS

IMS

MQ Series

| IFL | IFL | IFL | IFL | | CP | CP | CP | CP | CP |

P R / S M

New z/VM 4.1 Engine-Based Pricing — zSeries

Product Description	Flat Wkld MLC (any z900)	Initial OTC Cost	Recurring Annual Cost	1-yr Cost	3-yr Cost	5-yr Cost
z/VM V3R1	$14,025					
CMS Utilities Feature	$531					
TCP/IP for z/VM	$952					
TCP/IP NFS Feature	$190					
z/VM V3R1 Package (above software):	$15,698	n/a	$188,376	$188,376	$565,128	$941,880
z/VM 4.1 Engine-Based OTC	**$45,000**					
z/VM 4.1 Eng. Bsd s/w supp.	**$11,000**					

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New z/VM 4.1 Engine-Based Pricing — zSeries

Select z900 Models	Engines	MIPS	MP Ratio	Initial OTC Cost	Recurring Annual Cost	1-yr Cost	3-yr Cost	5-yr Cost
1C1	1	261	1.00	$45,000	$11,000	$56,000	$78,000	$100,000
1C2	2	496	1.90	$90,000	$22,000	$112,000	$156,000	$200,000
1C3	3	717	2.75	$135,000	$33,000	$168,000	$234,000	$300,000
1C4	4	928	3.56	$180,000	$44,000	$224,000	$312,000	$400,000
1C5	5	1,131	4.33	$225,000	$55,000	$280,000	$390,000	$500,000
1C6	6	1,325	5.08	$270,000	$66,000	$336,000	$468,000	$600,000
1C7	7	1,511	5.79	$315,000	$77,000	$392,000	$546,000	$700,000
1C8	8	1,690	6.48	$360,000	$88,000	$448,000	$624,000	$800,000
1C9	9	1,858	7.12	$405,000	$99,000	$504,000	$702,000	$900,000
110	10	2,016	7.72	$450,000	$110,000	$560,000	$780,000	$1,000,000
111	11	2,168	8.31	$495,000	$121,000	$616,000	$858,000	$1,100,000
112	12	2,311	8.85	$540,000	$132,000	$672,000	$936,000	$1,200,000
113	13	2,447	9.38	$585,000	$143,000	$728,000	$1,014,000	$1,300,000
114	14	2,576	9.87	$630,000	$154,000	$784,000	$1,092,000	$1,400,000
115	15	2,696	10.33	$675,000	$165,000	$840,000	$1,170,000	$1,500,000
116	16	2,809	10.76	$720,000	$176,000	$896,000	$1,248,000	$1,600,000

New z/VM 4.1 Engine-Based Pricing — G6

Product Description		MLC	Initial OTC Cost	Recurring Annual Cost	1-yr Cost	3-yr Cost	5-yr Cost
z/VM Package (Grp 50)		$10,303	n/a	$123,636	$123,636	$370,908	$618,180
z/VM Package (Grp 60)		$12,744	n/a	$152,928	$152,928	$458,784	$764,640
z/VM Package (Grp 70)		$15,781	n/a	$189,372	$189,372	$568,116	$946,860
z/VM Package (Grp 80)		$19,462	n/a	$233,544	$233,544	$700,632	$1,167,720
z/VM Pkg (ELC Base, 80 MSU)		$14,084					
z/VM Pkg (ELC, 1 MSU)		$97					
z/VM Pkg (ELC, 50 MSU)		$4,891					
Select G6 Models	**MSU**						
Z37	93	$15,345	n/a	$184,140	$184,140	$552,420	$920,700
Z47	123	$18,255	n/a	$219,060	$219,060	$657,180	$1,095,300
Z57	149	$20,818	n/a	$249,816	$249,816	$749,448	$1,249,080
Z67	174	$23,243	n/a	$278,916	$278,916	$836,748	$1,394,580
Z77	197	$25,515	n/a	$306,180	$306,180	$918,540	$1,530,900
Z87	217	$27,455	n/a	$329,460	$329,460	$988,380	$1,647,300
Z97	236	$29,339	n/a	$352,068	$352,068	$1,056,204	$1,760,340
ZX7	254	$31,085	n/a	$373,020	$373,020	$1,119,060	$1,865,100
ZY7	270	$32,637	n/a	$391,644	$391,644	$1,174,932	$1,958,220
ZZ7	285	$34,133	n/a	$409,596	$409,596	$1,228,788	$2,047,980

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New z/VM 4.1 Engine-Based Pricing — G6

z/VM 4.1 Engine-Based OTC (per engine) $45,000

z/VM 4.1 Engine-Based s/w support (per engine) $11,000

Select G6 Models	# Eng.	MIPS	SW Grp	Initial OTC Cost	Recurring Annual Cost	1-yr Cost	3-yr Cost	5-yr Cost
X17	1	176	60	$45,000	$11,000	$56,000	$78,000	$100,000
Z17	1	200	70	$45,000	$11,000	$56,000	$78,000	$100,000
Z27	2	376	80	$90,000	$22,000	$112,000	$156,000	$200,000
Z37	3	542	IMLC	$135,000	$33,000	$168,000	$234,000	$300,000
Z47	4	697	IMLC	$180,000	$44,000	$224,000	$312,000	$400,000
Z57	5	844	IMLC	$225,000	$55,000	$280,000	$390,000	$500,000
Z67	6	981	IMLC	$270,000	$66,000	$336,000	$468,000	$600,000
Z77	7	1,106	IMLC	$315,000	$77,000	$392,000	$546,000	$700,000
Z87	8	1,221	IMLC	$360,000	$88,000	$448,000	$624,000	$800,000
X97	9	1,328	IMLC	$405,000	$99,000	$504,000	$702,000	$900,000
ZX7	10	1,427	IMLC	$450,000	$110,000	$560,000	$780,000	$1,000,000
ZY7	11	1,520	IMLC	$495,000	$121,000	$616,000	$858,000	$1,100,000
ZZ7	12	1,606	IMLC	$540,000	$132,000	$672,000	$936,000	$1,200,000

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Linux Software … IBM and ISV

- Many IBM middleware products available now.
- Most Tivoli products are under evaluation — (TBD).
- BMC — Patrol, systems management.
- CA — systems management
- Compuware — most products have SOD.
- SAP — ERP products, mySAP.com support.
- Software AG — database products

- Bynari — messaging / collaboration software (GA).
- SendMail — e-mail / messaging (early-ship status).
- Sanchez — core banking software (field-test / beta).
- UTS Global — international porting center for Linux/390.

Summary and Recommendations

- Key Mainframe Linux opportunities in the enterprise:
  - Hardware economies of scale
    - Look for more than 50 Intel or "low-end" Unix servers.
    - Watch for aggressive plans for departmental server growth.
  - Workload consolidation
    - Reduced total cost of ownership.
    - Better resource utilization.
    - Improved time-to-market, speed of deployment.
  - Application integration
    - Consolidate middle tier of Unix application servers.
    - Leverage z/OS database server capabilities and quality of service.
  - Distributed enterprise model
    - Central management of geographically dispersed, replicated servers.

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Summary and Recommendations (cont'd)

- Choose a Linux distribution partner carefully.
  - Include the following criteria:
    - Stability / reputation of the vendor.
    - Solid maintenance plan(s).
    - Possible installation and training, if you're currently low on Linux expertise.
    - Track record with current mainframe Linux middleware and applications.

- For existing S/390 customers with little excess mainframe capacity, explore the IFL route for additional CPU engines.
  - Keeps OS/390 and z/OS software costs stable.
  - Alternative is a small, stand-alone G5/G6 system.

Summary and Recommendations (cont'd)

- For new S/390 customers, explore IBM's "G6+Linux" special offering.
  - Alternative is a Multiprise 3000 system.

- If you're going to use VM to seriously manage your Linux environment, use z/VM.
  - VIF is a streamlined VM, lacking many of z/VM's performance and system management capabilities.
  - VIF will not be enhanced beyond its initial offering.

- 64-bit Linux distributions — based on the 2.4 kernel — are just now becoming available.
  - Let them stabilize before undertaking a serious implementation.

- 31-bit Linux distributions — based on the 2.2.16-19 kernels — appear much more stable at this time.

Stay Tuned…

- **Additional Linux Research**
  - www.gigaweb.com
- **IBM and Linux**
  - www.ibm.com/linux/
  - www.ibm.com/s390/linux/
  - www.redbooks.ibm.com
  - http://www-1.ibm.com/servers/eserver/zseries/os/linux/lcds/
- **Linux Distributions**
  - www.suse.com
  - www.turblolinux.com
  - www.redhat.com
  - www.marist.edu/linuxvm/
  - www.millenux.com
- **Linux for S/390 Discussion Group**
  - Send email to listserv@marist.edu with the following in the body: SUBSCRIBE LINUX-390 name, organization