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


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


Mar 2001: ESS/Shark support.

May 2001: z/VM Engine-Based Pricing Announced.
What Is Linux for S/390 and zSeries?

Linux Applications

<table>
<thead>
<tr>
<th>Linux Kernel</th>
<th>GNU RTL</th>
<th>GNU Binutils</th>
<th>IBM Developed Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IBM Developed Code

System/390 Hardware

GNU Compiler
### What Is Linux for S/390 and zSeries?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux Kernel</td>
<td>2,200,000</td>
<td>45,000</td>
<td>2.05%</td>
</tr>
<tr>
<td>gcc</td>
<td>1,700,000</td>
<td>9,000</td>
<td>0.53%</td>
</tr>
<tr>
<td>gdb</td>
<td>1,500,000</td>
<td>8,000</td>
<td>0.53%</td>
</tr>
<tr>
<td>glibc</td>
<td>1,200,000</td>
<td>5,000</td>
<td>0.42%</td>
</tr>
<tr>
<td>binutils</td>
<td>800,000</td>
<td>6,000</td>
<td>0.75%</td>
</tr>
<tr>
<td>strace</td>
<td>41,000</td>
<td>200</td>
<td>0.49%</td>
</tr>
</tbody>
</table>

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.
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.

- 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.

Industrial Strength Linux Environment
&
Potential for Highly Integrated E-Business Solutions
IBM Linux Distribution Partners

SuSE

- 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

- Based on 2.2.16 Kernel.
- Available via download and CD.
- 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
- 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

- 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

Enterprise Linux has crossed the “Technology Chasm”

Early Adopters

Mainstream Users
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

<table>
<thead>
<tr>
<th>Category</th>
<th>IDC / Netgen Customers</th>
<th>Enterprise Customers / Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure Server</strong></td>
<td>• Telia Telecom ISP</td>
<td>• Banco Mercantile</td>
</tr>
<tr>
<td><strong>Consolidation</strong></td>
<td>• CSK Networks</td>
<td>• Rubbermaid</td>
</tr>
<tr>
<td><strong>Webserving</strong></td>
<td>• Telia Telecom ISP</td>
<td>• Grede Foundries</td>
</tr>
<tr>
<td></td>
<td>• DreamBall</td>
<td>• Wall Street Firms</td>
</tr>
<tr>
<td><strong>Email Services and</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Message Collaboration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Enterprise, Core-</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business Applications</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

z/VM

NT

Unix

OS/390 or z/OS

PR / SM
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
Linux and z/OS Hybrid Solutions (cont’d)

Hypersockets, CTC (Inter-LPAR Communication)

OS/390 or z/OS

- DB2
- CICS
- IMS
- MQ Series

Linux Firewall

- Apache
- Samba
- Sendmail
- Customer Linux App.

z/VM

- CICS Connect
- IMS Connect
- DB2 UDB

P R / S M
# New z/VM 4.1 Engine-Based Pricing — zSeries

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

- **z/VM 4.1 Engine-Based OTC** $45,000
- **z/VM 4.1 Eng. Bsd s/w supp.** $11,000
## New z/VM 4.1 Engine-Based Pricing — zSeries

<table>
<thead>
<tr>
<th>Select z900 Models</th>
<th>Engines</th>
<th>MIPS</th>
<th>MP Ratio</th>
<th>Initial OTC Cost</th>
<th>Recurring Annual Cost</th>
<th>1-yr Cost</th>
<th>3-yr Cost</th>
<th>5-yr Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1C1</td>
<td>1</td>
<td>261</td>
<td>1.00</td>
<td>$45,000</td>
<td>$11,000</td>
<td>$56,000</td>
<td>$78,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>1C2</td>
<td>2</td>
<td>496</td>
<td>1.90</td>
<td>$90,000</td>
<td>$22,000</td>
<td>$112,000</td>
<td>$156,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>1C3</td>
<td>3</td>
<td>717</td>
<td>2.75</td>
<td>$135,000</td>
<td>$33,000</td>
<td>$168,000</td>
<td>$234,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>1C4</td>
<td>4</td>
<td>928</td>
<td>3.56</td>
<td>$180,000</td>
<td>$44,000</td>
<td>$224,000</td>
<td>$312,000</td>
<td>$400,000</td>
</tr>
<tr>
<td>1C5</td>
<td>5</td>
<td>1,131</td>
<td>4.33</td>
<td>$225,000</td>
<td>$55,000</td>
<td>$280,000</td>
<td>$390,000</td>
<td>$500,000</td>
</tr>
<tr>
<td>1C6</td>
<td>6</td>
<td>1,325</td>
<td>5.08</td>
<td>$270,000</td>
<td>$66,000</td>
<td>$336,000</td>
<td>$468,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>1C7</td>
<td>7</td>
<td>1,511</td>
<td>5.79</td>
<td>$315,000</td>
<td>$77,000</td>
<td>$392,000</td>
<td>$546,000</td>
<td>$700,000</td>
</tr>
<tr>
<td>1C8</td>
<td>8</td>
<td>1,690</td>
<td>6.48</td>
<td>$360,000</td>
<td>$88,000</td>
<td>$448,000</td>
<td>$624,000</td>
<td>$800,000</td>
</tr>
<tr>
<td>1C9</td>
<td>9</td>
<td>1,858</td>
<td>7.12</td>
<td>$405,000</td>
<td>$99,000</td>
<td>$504,000</td>
<td>$702,000</td>
<td>$900,000</td>
</tr>
<tr>
<td>110</td>
<td>10</td>
<td>2,016</td>
<td>7.72</td>
<td>$450,000</td>
<td>$110,000</td>
<td>$560,000</td>
<td>$780,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>111</td>
<td>11</td>
<td>2,168</td>
<td>8.31</td>
<td>$495,000</td>
<td>$121,000</td>
<td>$616,000</td>
<td>$858,000</td>
<td>$1,100,000</td>
</tr>
<tr>
<td>112</td>
<td>12</td>
<td>2,311</td>
<td>8.85</td>
<td>$540,000</td>
<td>$132,000</td>
<td>$672,000</td>
<td>$936,000</td>
<td>$1,200,000</td>
</tr>
<tr>
<td>113</td>
<td>13</td>
<td>2,447</td>
<td>9.38</td>
<td>$585,000</td>
<td>$143,000</td>
<td>$728,000</td>
<td>$1,014,000</td>
<td>$1,300,000</td>
</tr>
<tr>
<td>114</td>
<td>14</td>
<td>2,576</td>
<td>9.87</td>
<td>$630,000</td>
<td>$154,000</td>
<td>$784,000</td>
<td>$1,092,000</td>
<td>$1,400,000</td>
</tr>
<tr>
<td>115</td>
<td>15</td>
<td>2,696</td>
<td>10.33</td>
<td>$675,000</td>
<td>$165,000</td>
<td>$840,000</td>
<td>$1,170,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>116</td>
<td>16</td>
<td>2,809</td>
<td>10.76</td>
<td>$720,000</td>
<td>$176,000</td>
<td>$896,000</td>
<td>$1,248,000</td>
<td>$1,600,000</td>
</tr>
</tbody>
</table>
### New z/VM 4.1 Engine-Based Pricing — G6

<table>
<thead>
<tr>
<th>Product Description</th>
<th>MLC</th>
<th>Initial OTC Cost</th>
<th>Recurring Annual Cost</th>
<th>1-yr Cost</th>
<th>3-yr Cost</th>
<th>5-yr Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>z/VM Package (Grp 50)</td>
<td>$10,303</td>
<td>n/a</td>
<td>$123,636</td>
<td>$123,636</td>
<td>$370,908</td>
<td>$618,180</td>
</tr>
<tr>
<td>z/VM Package (Grp 60)</td>
<td>$12,744</td>
<td>n/a</td>
<td>$152,928</td>
<td>$152,928</td>
<td>$458,784</td>
<td>$764,640</td>
</tr>
<tr>
<td>z/VM Package (Grp 70)</td>
<td>$15,781</td>
<td>n/a</td>
<td>$189,372</td>
<td>$189,372</td>
<td>$568,116</td>
<td>$946,860</td>
</tr>
<tr>
<td>z/VM Package (Grp 80)</td>
<td>$19,462</td>
<td>n/a</td>
<td>$233,544</td>
<td>$233,544</td>
<td>$700,632</td>
<td>$1,167,720</td>
</tr>
<tr>
<td>z/VM Pkg (ELC Base, 80 MSU)</td>
<td>$14,084</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>z/VM Pkg (ELC, 1 MSU)</td>
<td>$97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>z/VM Pkg (ELC, 50 MSU)</td>
<td>$4,891</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Select G6 Models</th>
<th>MSU</th>
<th>MLC</th>
<th>Initial OTC Cost</th>
<th>Recurring Annual Cost</th>
<th>1-yr Cost</th>
<th>3-yr Cost</th>
<th>5-yr Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z37</td>
<td>93</td>
<td>$15,345</td>
<td>n/a</td>
<td>$184,140</td>
<td>$184,140</td>
<td>$552,420</td>
<td>$920,700</td>
</tr>
<tr>
<td>Z47</td>
<td>123</td>
<td>$18,255</td>
<td>n/a</td>
<td>$219,060</td>
<td>$219,060</td>
<td>$657,180</td>
<td>$1,095,300</td>
</tr>
<tr>
<td>Z57</td>
<td>149</td>
<td>$20,818</td>
<td>n/a</td>
<td>$249,816</td>
<td>$249,816</td>
<td>$749,448</td>
<td>$1,249,080</td>
</tr>
<tr>
<td>Z67</td>
<td>174</td>
<td>$23,243</td>
<td>n/a</td>
<td>$278,916</td>
<td>$278,916</td>
<td>$836,748</td>
<td>$1,394,580</td>
</tr>
<tr>
<td>Z77</td>
<td>197</td>
<td>$25,515</td>
<td>n/a</td>
<td>$306,180</td>
<td>$306,180</td>
<td>$918,540</td>
<td>$1,530,900</td>
</tr>
<tr>
<td>Z87</td>
<td>217</td>
<td>$27,455</td>
<td>n/a</td>
<td>$329,460</td>
<td>$329,460</td>
<td>$988,380</td>
<td>$1,647,300</td>
</tr>
<tr>
<td>Z97</td>
<td>236</td>
<td>$29,339</td>
<td>n/a</td>
<td>$352,068</td>
<td>$352,068</td>
<td>$1,056,204</td>
<td>$1,760,340</td>
</tr>
<tr>
<td>ZX7</td>
<td>254</td>
<td>$31,085</td>
<td>n/a</td>
<td>$373,020</td>
<td>$373,020</td>
<td>$1,119,060</td>
<td>$1,865,100</td>
</tr>
<tr>
<td>ZY7</td>
<td>270</td>
<td>$32,637</td>
<td>n/a</td>
<td>$391,644</td>
<td>$391,644</td>
<td>$1,174,932</td>
<td>$1,958,220</td>
</tr>
<tr>
<td>ZZ7</td>
<td>285</td>
<td>$34,133</td>
<td>n/a</td>
<td>$409,596</td>
<td>$409,596</td>
<td>$1,228,788</td>
<td>$2,047,980</td>
</tr>
</tbody>
</table>
## 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

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

- Linux Distributions
  - www.suse.com
  - www.turbolinux.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