pSeries Software Directions

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AIX & Linux for POWER- Operating System

- Industrial strength UNIX product
- IBM optimization for POWER hardware
- High-end Scalability, Reliability, Availability
- Roadmap for Future

Linux Affinity
- "compile and go" applications
- Leverage Linux skill base

- Standard Community-developed Linux
- Open source code
- Strategic application development platform
- Improving scalability and commercial qualities
- Growing market
pSeries/AIX UNIX Revenue Growth

Worldwide UNIX Year to Year Revenue Growth

Source: IDC Worldwide Quarterly Server Tracker

".. There will be only three growth server operating systems (Windows, Linux, AIX) through 2008 (0.8 probability), …“

Gartner Cannes Symposium November 2003
pSeries/AIX Market Share

Benefits
- Independent Software Vendors are moving to pSeries w/AIX&Linux
  IBM tracked a 2x increase in application availability from 3Q02 to 3Q03
- Business Partners are moving to pSeries
- Increased skill pool for customer admin support
- Industry analysts are positive about AIX future growth

Source: IDC Worldwide Quarterly Server Tracker

".. By YE08, AIX will grow market share approaching or passing Solaris as No. 1 Unix operating system (0.8 probability), …“

Gartner Cannes Symposium November 2003
UNIX® History & Evolution

- MIT Project (MULTICS) - 1965
- AT&T (UNIX) - 1969
  - Early UNIX
    - Version 6 - 1975
      - Version 7 - 1979
    - BSD 4.0 - 1980
      - BSD 4.1 - 1981
      - BSD 4.2 - 1982
    - System III - 1981
      - System VR1 - 1983
      - System VR2 - 1984
      - System VR3 - 1987
    - AIX - 1986
      - BSD 4.3 - 1986
      - BSD 4.4 - 1990

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UNIX® History & Evolution

1965 - MULTICS
   • MIT, GE, AT&T 1969 - UNIX Born (UNICS)
     • Ken Thompson & Dennis Ritchie (AT&T)

1975 - IBM Invents RISC Technology

1978 - Berkeley Software Distribution (BSD)

1983 - UNIX System V

1986 - IBM RT PC w/ AIX Versions 1 & 2

1988 - Open Software Foundation

AIX/6000

1990 IBM RS/6000 & AIX Version 3
   • AIX V3: Integration of AT&T System V3.2 & BSD 4.3

1991 - Linux Introduced

1993 - UNIX Trademark transferred to X/Open

1994 - AIX Version 4

2000 - AIX 5L
   • Project Monterey (AIX/POWER&Itanium)
   • AIX 5L Version 5.1 & 5.2 w/POWER4

IBM UNIX OS Development History
   • PCs to Mainframe
   • UNIX Environments: AIX on RISC (RT PC, RS/6000, pSeries), AIX/PS2, AIX/ESA (OSF-1), AIX/Itanium (pre-production)
<table>
<thead>
<tr>
<th>Version</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
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<th>Year 7</th>
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<td>Establishment in the market</td>
<td>UNIX credibility</td>
<td>Open systems stds</td>
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<td>4-way SMP</td>
<td>Client/Server pkg</td>
<td>New Standards compliance</td>
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<td>Common Desktop Environment</td>
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<td>Open Systems</td>
<td>Distributed Client-Server</td>
<td>Network Centric Computing</td>
<td>e-Business Computing</td>
<td>on demand Computing</td>
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### AIX Roadmap Evolution

- **AIX/6000**
- **AIX V2 & V3**
  - Establishment in the market
  - UNIX credibility
  - Open systems stds
- **AIX V3.2.5**
  - Maturity:
    - Stability
    - Quality
- **AIX V4.1**
  - Scalability:
    - POWERPC spt
    - 4-way SMP
    - Client/Server pkg
  - New Standards compliance
  - Simplicity:
    - Graphical, fast installation
    - Common Desktop Environment
    - HACMP Clustering
- **AIX V4.2**
  - High-end scalability
  - 8-way SMP
  - >2GB memory
  - Standards:
    - UNIX95 brand
    - RAS Enhancements
    - NFS V3
- **AIX V4.3**
  - Scalability, Function, Performance:
    - POWER3 Support
    - 24-way SMP
    - 96 GB memory
    - 32/64-bit API spt
    - UNIX98 Branding Networking/Security:
      - TCP/IP V6
      - IPsec
      - Web Sys Mgt
      - AIX Workload Mgr
      - Java JDT/JIT Exp/Bonus CDs
- **AIX V5.1/5.2**
  - Scalability, Function, Performance:
    - POWER4 Support
    - 32-way SMP
    - 256/512GB mem
    - 16 TB filesystems
    - 64bit kernel/drivers
    - Logical Partitioning
    - eLiza RAS
    - Networking Enh
    - Java 2 support
    - Linux App Support Cluster Mgt (CSM)
    - Grid Toolkit
- **AIX V5.3**
  - TBA

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**Open Systems**

- **Distributed Client-Server**
- **Network Centric Computing**
- **e-Business Computing**
- **on demand Computing**

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AIX 5L Design Overview

- Based on UNIX System 5.2.2
  - Substantial integration of BSD4.3/4.4
- Optimized for POWER processor-based systems
- Fully pageable, pre-emptible kernel design
- Dynamic device drivers and kernel extension interface
- 32 and 64-bit application environments on 64-bit system
- Large number of integrated system features:
  - Journalling Filesystems (JFS, JFS2), Logical Volume Manager (LVM), Object Data Manager (ODM), full ILS-enabling
  - TCP/IPv6, NFS/NIS, 2D & 3D graphic subsystems
  - Web-based System Manager, SMIT Panels-based System Manager, AIX Workload Manager, and more....

Designed for Enterprise Computing

- Reliability, Availability
- Serviceability
- Scalability
- Manageability
- Security
AIX 5L Kernel Overview

- Dynamic fully preemtible kernel design
  - No kernel compiles required
  - Many changes can be made without a system reboot.
- "Plug and Play" Device support
  - Eliminates complex device configuration
  - New devices can be added on the fly
- 32/64-bit coexistence on 64-bit system
  - Open files / process: 32,767
  - Open files / system: 1,048,576
  - Threads / process: 32,767
  - Networking Buffer Pool: 1GB
  - Message queues, semaphores, and shared memory regions: 131,072
- 32-bit or 64-bit kernel can be selected at boot time for performance

32-bit or 64-bit kernel can be selected at boot time for performance

AIX 5L Binary compatibility maintained for all well-behaved 32-bit or 64-bit applications
AIX RAS

- **Hardware error handling enablement**
  - Dynamic CPU deallocation
  - UE-Gard - uncorrectable hardware errors that formerly would result in a system checkstop handled by terminating the affected thread
  - Concurrent diagnostics and error log analysis
  - Enhanced Error Handling - adapter first failure data capture (FFDC)

- **System hang and "Lost I/O" detection/recovery**
  - SMIT-configurable, provides data capture, optional automatic reboot

- **Automatic Dump Analysis tool**
  - Scripting support with samples, improved dump size estimation

- **Error Logging**
  - "Error Storm" log handling by count versus data logging
  - Error Log Retrieval API for diagnostics use
  - Scalability enhancements

- **Graphical trace log viewer**
  - Applications allowed to generate corefiles without reboot
  - **Inventory scout** - for system microcode level checks
AIX Storage Management

- **AIX Logical Volume Manager**
  - Integrated with and included with AIX
  - Dynamically manage logical volumes and file systems.
  - Mirroring and striping support included (RAID 0+1)
  - LVM Mirror Write Consistency, Split mirror backup support
  - Snapshot copy, hot spare, concurrent HA support
  - Hot spot mgt (High IO rate partition)
    - Support to detect and move physical partitions to other disk within volume group
  - Dynamic LUN size – automatically adapts to changing SAN infrastructure

- **AIX Journaled File System, JFS & JFS2**
  - Integrated and included with AIX
  - J2 High capacity – 16 Terabyte supported, 4 Petabyte architectural limit
  - Protects file systems from inconsistencies
  - Provides rapid recovery from outages
  - High performance
  - Cached, Direct, Concurrent
AIX 5L System Management
Manage multiple AIX systems via Internet on Java-enabled browsers

Comprehensive Web System Manager Applications:
- Backup/Restore
- Custom Tools plug-in
- Devices - config & status
- Filesystems
- Network
- Network Install Manager
- PC Services - FastConnect
- Printers
- Processes
- Software - installed sw
- User/Groups/admin roles
- Logical Volumes
- Workload Manager
- Event Monitoring

System Management tools:
- SMIT panels-based interface
- Network Installation Manager (NIM)
- Resource Monitoring and Control
- Alternate Disk installation migration spt
- compare_report, Ippmgr - tools for centralized install and updates
AIX 5L Web-based System Manager GUI

Manage AIX via Internet "from anywhere" on Java1.1-enabled browsers
AIX 5L WebSM - VPN Task Guides

**Networking plug-in**

Allows configuring and management of TCP/IP, PPP, NIS, NIS+, and VPNs

Additional SNMP plug-in enables SNMP monitoring and managing capabilities
AIX 5L System Management
"Built-in" system monitoring infrastructure

Resource Management and Control (RMC)
  ▪ Common way to start, stop, and collect status information on processes and subsystems
  ▪ Monitors status of all processes in a group and informs members upon failure
    ▷ Harvesting eliminates registering new resources
  ▪ Group Services (HAGS)
    ▷ Distributed coordination and synchronization service
  ▪ Topology Services (HATS) provides
    ▷ Adapter status and node connectivity info using heartbeat
    ▷ Reliable Messaging Service

RMC used by CSM, HACMP, GPFS and other LPPs for high availability services
AIX 5L System Management
"Built-in" system monitoring infrastructure

- **RMC controls**
  - 84 predefined conditions
  - 8 predefined responses
  - Site-defined conditions and responses

- **Resource Monitors**
  - Network adapters
  - Disk, paging and file systems
  - Processor statistics
  - System wide status
  - Program statistics

- **Responses**
  - Run a command
  - Send an e-mail
  - Broadcast a message
  - Log an entry
Planned AIX 5L Workload Management

Allows the efficient allocation of system resources

Features

- Assigns priorities and controls to system resource
  - Overides systems scheduler, fully dynamic operation with passive mode support
  - CPU, Memory and Disk I/O resource mgt independently
  - Launched/managed from command line or GUI

- Resource priorities:
  - 10 tiers, 27 classes, subclasses w/admin roles
  - Application Tag APIs, wildcard pathname spt

- Resource controls:
  - Provides target and limit support
  - Example: amount of connect time, # processeds, # logins, real memory limits per process, etc
AIX Networking

- Robust IPv4, IPv6, Mobile IP support
  - 128-bit IP addressing, Dynamic auto-configuration, Redundant routing/Multihoming
  - Tunnel support, Secure r cmds/Kerberos 5 support, CIDR

- Virtual IP Address (VIPA)
  - Virtual I/P address for system and app usage; provides session preservation

- Virtual Lan Support (VLAN)

- IP Multipath routing, gated multicast routing
  - Load balance between two gateways or two interfaces on the same network
  - Round-robin equal cost routes, Dead gateway detection

- Network Interface Backup
  - Automatic failover between network adapters

- Etherchannel/trunking support

- Dynamic Feedback Protocol Support (DFP)
  - Provide load statistics to a Cisco LocalDirector

- TCP Explicit Congestion Notification
  - Active “pacing” for network traffic

- IPsec security - options for IPv4 and IPv5
  - Secure tunnelling, strong encryption, dynamic loading of crypto extensions, etc
pSeries - AIX 5L Security

**ICSA Certified Virtual Private Network (VPN)**
- IPv6 / IPv4
- Authenticated Headers / Encapsulated Security Payload support
- IKE support
- MD5/ SHA-1, DES, TDES Crypto Algorithms

**Security and Directory**
- Integrated Kerberos V5
- Pluggable Auth Mechanism (PAM)
- GSSAPI library
- LDAP V3 Server & Client
- Open SSH (Bonus Pack)
- User/Group security
- Admin roles support
- QoS, IKE, DNS, sendmail
- Integrated security auditing
- Fine-grained access controls
- Strong, per-user configurable identification & Authentication
- Account / Password management

**PCI H/W Crypto Adapter(s)**
- DES, Triple DES, RSA and more
- FIPS 140-1 Level 4 certified
- PKCS-11 support

**pSeries Hardware Security**
- Address Spaces
- Data Spaces
- LPAR

**Evaluated Security**
- ICSA VPN / IPSec certification
- Common Criteria (CAPP/EAL4+) AIX5.2

**JAVA Support**
- Java Crypto Architecture (JCA)
- Java Crypto Enablement (JCE)
- Java Authentication/Authorization Services (JAAS)

**WEB/ HTTP Security**
- SSL v3
- Digital Certificates
- PKCS-11 consumption

**Tivoli Ready**
- TMA out-of-box support
- Risk Manager IDS 'adapter'
- User Administration
- Security Management
AIX 5L Performance Tools

Native AIX tools to monitor and tune system performance in distributed environments

- Native performance tools
  - `truss` - debugging and trace of all system calls
  - `/proc` - debug filesystem
  - `curt` and `splat` - thread and lock analysis tools
  - `topas` - enhanced for NFS and SMP stats and wlm support
  - `tprof` - enhanced for Java profiling
  - `vmstat` - virtual memory acnew I/O activity view
  - PM (Performance Management) APIs - for custom analysis

- Template-based AIX performance tuning via a stanza based file: `/etc/tunables`
  - Supports `no`, `nfso`, `schedo (schedtune)`, and `vmo (vmtune)`
  - Supports persistent values for `no` and `nfso` across reboot
  - File can be exported and imported to multiple servers

- Performance Toolbox LPP
  - `xmtrend` - longterm recording (24x7) of performance statistics
  - `jazizo` - post-processing GUI for viewing or analyzing PTX recording files. Allows customizing statistics, time period, view
  - `wlmperf` - workload mgt trend analysis tool
  - `Top viewer` - Integrated GUI version of topas tool for monitoring or viewing overall system status
AIX 5L Java Technology

Java™ 2 compliant environment enabling to "Write Once Run Anywhere"

AIX 5L Java environment spt: v1.3, v1.3.1, v1.4, v1.4.1

- IBM AIX Developer Kit, Java 2 Technology Edition
  Version 1.3.1 - 32 bit & 64 bit
  - Appletviewer, Opt. Java Interpreter, Java class compiler
  - Source-level debugger, Java Runtime Interpreter
  - Java Classes (JDBC, Java IDL, RMI, JNDI)
  - Tools for automatic generation of html docs for applets,
    Runtime libs for Java Multimedia links, Java AWT (draw/fill
    perf, colormap init.)
  - Tools to Build Secure Java Applications
  - XML for Java Version 2.1.1 (XML parser)
- Java 3D Version 1.2.1
## AIX 5L Version 5.2 Overview

<table>
<thead>
<tr>
<th>Integrated 32-bit/64-bit application and system support</th>
</tr>
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<tbody>
<tr>
<td>✓ 32-bit Binary compatibility for all AIX Versions 4 and 5L releases</td>
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<tr>
<td>✓ 64-bit Binary compatibility for all AIX 5L releases</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Enhanced scalability, ease-of-use, security, performance</th>
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<tbody>
<tr>
<td>✓ 32-way SMP, 1TB memory, Dynamic LPAR/CUoD</td>
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<tr>
<td>✓ Autonomic computing support, self-managing features</td>
</tr>
<tr>
<td>✓ High perf. Journaling Filesystem (JFS2 - 16TB capacity), Native MPIO</td>
</tr>
<tr>
<td>✓ AIX Workload Mgr, IBM LDAP Directory, Kerberos Authentication server</td>
</tr>
<tr>
<td>✓ Linux interoperability and AIX Toolbox for Linux Applications</td>
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<tr>
<td>✓ Integrated SVR4 Affinity services</td>
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<tr>
<td>✓ Formal security certification (Common Criteria CAPP/EAL4+)</td>
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<tr>
<th>Value-Add layered software</th>
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<tbody>
<tr>
<td>✓ HACMP Version 5.1 for system and application failover</td>
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<tr>
<td>✓ Cluster Systems Manager (CSM) for AIX and Linux</td>
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<tr>
<td>✓ Grid Toolkit, and more....</td>
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AIX 5L 5.2 Linux and SVR4 Services

Increased productivity for pSeries administrators and developers facilitating migration and co-existence

Quick Reference Material
- AIX, Solaris and Linux cross-reference data sheet

Linux Affinity
- AIX Toolbox for Linux Applications
  - Now over 380 applications, tools, and utilities
- Linux-AIX distributed cluster systems management (CSM)
  - Common management for up to 128 AIX and Linux on pSeries and Linux on xSeries systems/LPARs/nodes from single interface

SVR4 Affinity
- AIX-Solaris Interoperability features
  - LDAP client support for RFC2307 based schema
  - Run level scripts options for both Solaris and Linux compatibility
- UNIX System VR4 commands
  - Native SVR4 admin tools: print, pkgadd, truss/proc, >30 new cmds
pSeries Layered Software Products

Add value to pSeries environments above the OS

Support for AIX environments:
- HACMP Version 5.1 (07/03)
  - Fast Disk Takeover and Improved security
  - XD (Extended Distance) features:
    - PPRC support, unlimited distance IP data mirroring

Support for AIX and Linux for POWER environments:
- Cluster System Management (CSM) Version 1.3.2
  - Common cluster management on AIX and Linux on xSeries;
    CSM support for Linux on pSeries added in 9/03
  - Supports managing heterogeneous clusters of
    up to 128 pSeries and xSeries servers/nodes
  - AIX, Linux on xSeries, and new Linux on pSeries support
- GRID Toolkit Version 3
AIX 5.2 Summary

✓ PERFORMANCE and new system support!
  ▶ Optimized performance and scalability enhancements for POWER4 systems
  ▶ Seamless support for future POWER5 systems and Blades with added performance

✓ New Functional enhancements
  ▶ Dynamic Logical Partitions
  ▶ Dynamic Capacity Upgrade on Demand flexibility
  ▶ CUoD Hot sparing
  ▶ 16 TB JFS2 large files/filesystem capacity and scaling
  ▶ Linux and UNIX SVR4 compatibility features for administrators
  ▶ ....and many more enhancements in all technology areas

Cluster Management flexibility with CSM
  ▶ Common management for AIX and Linux on pSeries and Linux and xSeries

For a whitepaper overview of AIX 5.2 features-

LINUX for pSeries
Linux for pSeries - Strategy

*Add IBM Value Above and Below the OS*

- Leverage investments above the OS
- Continue accelerating Linux source code evolution
- Enable value of pSeries Hardware

**GRID**  Autonomic Computing  **Clustering**

**Multi-system**
- Clustering(CSM)
- GPFS
- HA
- WLM
- GRID

**Middleware & Tools**
- JAVA/J2EE
- WebSphere enabled
- ADE, IDE

**Autonomic Computing**
- Multi-workload mgt
- LPAR, CUoD
- RAS
- Provisioning

**Value-Add Technology**
- Performance
- Service & Support

**Standard 64-bit Linux Distributor Code**
- LPAR
- CoD

**POWER Hypervisor**
- Hardware Feature Enablement

**pSeries**
- RAS
- I/O
# Linux on pSeries - System Support 2003

<table>
<thead>
<tr>
<th>Mode</th>
<th>SMP</th>
<th>SMP</th>
<th>SMP LPAR</th>
<th>SMP</th>
<th>SMP LPAR</th>
<th>SMP LPAR</th>
<th>LPAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat RHEL 3</td>
<td>redhat</td>
<td>redhat</td>
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<td>redhat</td>
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<tr>
<td>SuSE SLES 8</td>
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</table>
Linux on pSeries - Growing Customer Base

Linux Scale Out - Linux Scale Up - Linux in an LPAR
# How Customers are Deploying Linux on pSeries

## Recent Customers

<table>
<thead>
<tr>
<th>Infrastructure Solutions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library of Congress and University of Washington, Rutgers &amp; Georgia Tech</td>
<td>Lower cost</td>
</tr>
<tr>
<td>LexCom GmbH</td>
<td>Easy to maintain</td>
</tr>
<tr>
<td>Saturn (Italian retailer)</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td>Scalable</td>
</tr>
<tr>
<td></td>
<td>Reliable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distributed Enterprise</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Ministry of Railways</td>
<td>Highly reliable and secure</td>
</tr>
<tr>
<td>HeNan Government</td>
<td>Lower cost</td>
</tr>
<tr>
<td>National Assembly Library</td>
<td>Range of small footprint servers</td>
</tr>
<tr>
<td></td>
<td>Easily replicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linux Clusters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munich University</td>
<td>Proven roadmap</td>
</tr>
<tr>
<td>Russia Joint Supercomp. Ctr.</td>
<td>Price/performance</td>
</tr>
<tr>
<td>National Institute of Health</td>
<td>Scale out or scale up</td>
</tr>
<tr>
<td>Center for Development of Advanced Computing</td>
<td>Efficient cluster management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload Consolidation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Unicom</td>
<td>Reduce cost of ongoing operations</td>
</tr>
<tr>
<td>Lotto.com</td>
<td>Dramatically improve TCO</td>
</tr>
<tr>
<td>Standard Life</td>
<td>Increase flexibility &amp; speed of deployment</td>
</tr>
<tr>
<td>Deutche Bank</td>
<td>Increase reliability, availability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Solutions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM eServer Integrated Platform for e-business</td>
<td>Integrated, tested, proven</td>
</tr>
<tr>
<td>IBM SWG products</td>
<td>Optimized for Java applications</td>
</tr>
<tr>
<td>Selectica</td>
<td>Reduced implementation time</td>
</tr>
<tr>
<td>Foedero</td>
<td>Base platform for ISV applications</td>
</tr>
<tr>
<td>DataSynapse</td>
<td></td>
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</table>
Gartner’s Evaluation of Linux Vendors

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Platforms</th>
<th>Partnering</th>
<th>Stack</th>
<th>Open Source Collaboration</th>
<th>Services/Support</th>
<th>Programs/Markets</th>
<th>Weighted Total</th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
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<td>8</td>
<td>9</td>
<td>8</td>
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<td>184</td>
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<tr>
<td>Hewlett-Packard</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>169</td>
<td>7.3</td>
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<tr>
<td>Novell/SUSE</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>113</td>
<td>4.9</td>
</tr>
<tr>
<td>Sun Microsystems</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>82</td>
<td>3.6</td>
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<tr>
<td>Dell</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>65</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Source: Gartner Research (February 2004)

10 = best
1 = worst
flexibility and choice: AIX 5L and/or Linux

and LPARs allow mix and match......