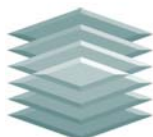


Linux Strategies and Solutions 2003: Linux Server Suppliers Contend for Leadership

Operating Environments for Industry-Standard Servers



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About D.H. Brown Associates, Inc.

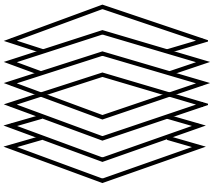
D.H. Brown Associates, Inc., (DHBA) is a leading research and consulting firm that concentrates on the strategic analysis, assessment, and evaluation of technologies, products, and market trends in the Information Industry. DHBA thoroughly understands and continuously updates its knowledge of the core technologies and trends underlying current and future products. DHBA's services enable its customers to consistently fashion well-informed decisions adapted to their needs and processes.

An acceleration in technological innovation has driven price/performance by well over 30% annually for open systems since 1983. This technological explosion allows unprecedented opportunities for world-class corporations, but demands far greater discipline and attention to detail. DHBA provides its clients with a high-level, balanced perspective coupled with the technical depth required for making tactical and strategic decisions that will capitalize on existing and emerging technology. For additional information, contact marketing@dhbrown.com.

About Operating Environments for Industry-Standard Servers

DHBA's Operating Environments for Industry-Standard Servers program focuses on Microsoft's Windows server solutions and Linux-based server solutions. This program examines the capabilities of the software stacks, vendor implementation, user needs, and the ongoing competition between Windows and Linux on Intel-based server systems.

The research analyzes the operating environment's features and functions, addresses deployment challenges, compares and contrasts, and examines software stacks in the Windows and Linux environments.



Linux Strategies and Solutions 2003

Linux Server Suppliers Contend for Leadership

Pierre Fricke, EVP and Research Director

EXECUTIVE SUMMARY

Linux-on-Intel appears likely to emerge as the dominant platform in corporate datacenters. In our view, Linux has evolved into an enterprise-class operating system that will have a significant and lasting presence in the IT landscape.

Goldman Sachs, January 2, 2000

Linux stands out as an industry phenomenon because of its rapid growth and its adoption by enterprise customers, industry pundits, and even the financial analyst community as a mainstream information technology. Linux has moved from a primary reputation as an edge-of-network platform (firewalls, etc.) to a leading operating environment for high-performance technical computing, distributed applications, and enterprise infrastructure such as e-mail and file/print. The largest share of Linux server activity lies in the one- and two-way servers common in these applications. Linux now contends in other higher-value, traditional middleware and application areas.

Building on these achievements, the expected availability of Linux kernel 2.6 appears to be an inflection point. With the delivery of the 2.6 kernel, Linux will embody most of the attributes it needs to be considered for enterprise class environments. Similarly, Linux skills appear to be widely available, especially in larger enterprises. For example, Lehman Brothers reported as they were installing Linux in their datacenter, "Every SA (system analyst) has a Linux box at home and has had for years."

Significant support from the software and systems community fuels this increasing Linux relevance. Dell's, HP's, IBM's, Sun's, and Oracle's commitment and delivery of Linux solutions all serve to make Linux a safe investment. Vendors report a much higher run rate in Linux demand. The Independent Software Vendor (ISV) community is now cognizant of this substantial Linux server opportunity and is following through with investment. This cycle of increasing returns is helping drive Linux into the mainstream. Middleware providers such as Computer Associates, IBM, BEA, Oracle, VERITAS, and enterprise application providers such as SAP and others are delivering Linux offerings to respond to large enterprise deployments. Other ISV application and middleware providers are embracing Linux to compete more effectively with Microsoft as it moves into their domains.

This report reviews the strategies and tactics of four leading Linux system suppliers: Dell, HP, IBM, and Sun Microsystems.

POSITIONING AND STRATEGIES

The IT market is shifting toward a three-pronged emphasis on cost (Total Cost of Ownership [TCO]), flexibility, and diversity of supply. These requirements match well with Linux's attributes and spur Linux deployment in the enterprise. Users are beginning to exploit Linux for a broader application set, though many are waiting for the increased scalability and enterprise features in the Linux 2.6 kernel before committing to the transaction class of enterprise applications. Despite this caution, demand is building. A good measure of Linux acceptance is evidenced by the growth in training and certification requirements from customers, indicating an increasing interest in Linux deployment. Most suppliers report that Linux represents a healthy business today. While Linux is on the move, it must be pointed out that Dell, HP, and IBM are also aggressive Windows suppliers and cannot put their Windows opportunities in jeopardy. However, note that Linux now commands enough marketshare and momentum that all these industry standard system suppliers can be this aggressive with Linux, even with a high level of dependency on Microsoft.

All of the leading system suppliers now market competitive Linux offerings. Most position Linux as a fully supported operating environment, on a par with Windows and their proprietary UNIX systems. All these system suppliers are responding to significant enterprise customer demand and are embracing enterprise editions from the major Linux distributions. While there is still some reticence among the large server hardware vendors to fully embrace Linux and open source because of the potential impact to their existing businesses, all now agree that Linux is past the "tipping point" and that they have no choice but to find a way to integrate it into their product lines with minimal disruption. Linux has already moved into the low-end UNIX environment. While UNIX remains a factor at the high end and will likely remain so, competing with mainframe-class application environments, the issue for the future is where the low end stops on the way up the stack.

In addition to software sales, the system suppliers are responding to the market by offering Linux support across their product and service lines to enable Linux deployments. With Sun's recent announcement of its Tier 1 premier partnership with Red Hat, all the system suppliers have agreed that the leading distributions (e.g., Red Hat, SuSE, etc.) are going to be the primary source of the Linux operating environment, both for desktops and servers. The system suppliers are focusing their competitiveness above that level, assuring compatibility. This bodes well for Linux. The emergence of the Linux Standards Base (LSB) and the existence of two leading distribution suppliers (Red Hat and SuSE) should prevent the kind of kernel divergence seen in UNIX. As a result of the recent Sun agreement, Red Hat will distribute Sun's Java. Red Hat has been delivering IBM's Java as well.

In the enterprise, Linux-based solutions were initially targeted at edge-of-network (e.g., firewall), Internet infrastructure (e.g., web serving), and enterprise infrastructure (e.g., file/print, e-mail) applications. Driven by a desire for cost cutting and a pursuit of supply diversity by customers, Linux has moved into the mainstream and is becoming a significant server system platform in more critical application segments. Financial services firms are leading the way. While Linux is having some affect on Windows enterprise infrastructure installations, its primary impact is to RISC UNIX. In addition, Linux is a force in server consolidation, High-Performance Computing (HPC), distributed applications, server appliances, and enterprise applications (such as those built with Oracle and SAP), as well as its traditional application segments listed above. Dell, HP, and IBM offer active product and services activities targeting these areas. Each provides Linux support throughout its product lines, including server cluster configurations and the new blade server lines. Sun's position differs slightly. While Sun agrees that Linux fits edge applications well, it sees Linux only recently moving to mainstream business applications. Sun's recent announcement with Oracle spanning Linux, Solaris x86, and Solaris supports this strategy. Sun recommends Solaris on SPARC as the choice for more rigorous environments.

IBM has mounted aggressive Linux customer and ISV recruitment programs. HP positions itself as the enterprise alternative to IBM and offers all its Intel Architecture products and services as Linux enabled. HP and IBM have developed turnkey solutions with partners in target segments such as database, ERP, CRM, Mail and Messaging, High Performance Technical and Commercial Computing, Internet infrastructure, and financial services. Dell retains its focused strategy targeting UNIX-to-Linux migration on Dell's IA-32 servers, high-performance clusters, application servers (9iAS), and enterprise Oracle and SAP R/3 applications. Dell and Oracle promote the potential that their Linux combination offers very visibly, contributing to Dell's scale-out strategy. Sun recently demonstrated its view that Linux is a long-term reality by several key actions: its delivery of the LX-50; the Sun Fire V60x/V65x; and embracing the industry-leading Linux distributions. Sun positions Linux in the high-volume, infrastructure application space and is reinvigorating a Solaris on IA-32 strategy to offer an alternative at least for the existing Sun customer. Sun's strategy emphasizes "the right tool for the right job" and now supports three operating environments to make that happen. Sun believes that a customer investment in Java across the product line is most appropriate to gain the greatest benefit from the various operating environments they may deploy. Sun views the operating system below the Java application platform as increasingly less relevant for application development. Sun is, however, positioning itself to lead the Linux client charge.

As things change, much remains the same. IA-32 Intel-based servers remain the primary Linux platform for all of the suppliers studied. HP stands out as the most aggressive with 64-bit Linux on Itanium, positioning it for high-end technical computing and large-memory commercial Linux applications. While some provide Linux support for their RISC systems, this is targeted primarily at 64-bit

Linux solutions, which are anticipated in the near future. HP (PA-RISC/HP-UX, Alpha/TRU64), IBM (pSeries/AIX), and Sun (SPARC/Solaris) are all source compatible with Linux and have established Linux compatibility environments. HP, IBM, and Sun position their UNIX systems to address the high end of technical computing and enterprise applications that Linux is not yet ready to address.

HP and IBM support Linux across their product lines. IBM continues an aggressive stance with Linux on the mainframe, creating competitively priced products specific to Linux. As Dell's UNIX system, Linux becomes Dell's 64-bit UNIX solution when Dell delivers a Linux 64-bit system – planned later in 2003. Sun is expanding its IA-32 presence and has no plans for a 64-bit Intel Linux solution.

Linux has driven both customer and vendor interest. Many see Linux as a way to keep the industry open and to balance what some see as Microsoft's control. Customers increasingly prefer diversity of supply in their IT operations. Vendors want to ensure diversity of choice. Both see Linux helping them achieve their objectives.

LINUX SERVICES

While there is substantial interest in Linux products, most suppliers have been able to port their existing products or exploit open source offerings (e.g., Apache) to satisfy customer needs. There are few new products targeted at Linux alone. However, services for Linux deployments present a significant opportunity. These services tend to revolve around the following key areas:

- Server consolidation
- Linux installation and exploitation
- Migration from UNIX to Linux
- HPC clusters
- Linux support (break/fix, how-to, etc.)

HP and IBM have established substantial services teams to address all of these areas and more. Each essentially places Linux on a par with the other environments they offer, providing the same level of support and breadth of services for Linux that they offer on Windows, their UNIX systems (HP-UX and AIX), and, in IBM's case, its proprietary systems. HP and IBM have invested most heavily, with over 5,000 and 2,500 services specialists respectively available to provide Linux services. These firms offer consulting and assessment services, proactive support, installation and startup services, porting, outsourcing, training, and additional service. While Dell does not provide the same services capabilities as these larger firms, it has established professional services in the key areas above and uses them as part of its focused effort to become an enterprise Linux system provider. Dell's services include assessment, design, deployment, support, and training. In addition, Dell has formed strategic alliances with Red Hat

Professionals Services and Oracle Consulting Services to offer customers these services directly through Dell. Dell, HP, and IBM are exploiting the similarity between Solaris and Linux to drive migration services. Sun maintains a nascent services capability around Linux, most of which targets the LX-50 server. These services focus on support and training. Sun is exploiting the similarity between Solaris and Linux to offer architecture, integration, security, availability, and managed services to help customers construct a Linux and Solaris environment.

LINUX'S IMPACT ON EXISTING PRODUCT LINES

Primarily a hardware supplier, Dell's products are the least affected by the emergence of Linux. All of Dell's product line is Linux enabled. The market positioning is straightforward since Dell offers Windows or Linux on all systems. Linux essentially put Dell into the UNIX business at the low end and in clusters. Dell views Linux as a key part of its "scale out" initiative while it targets proprietary UNIX and enterprise systems with one-way, two-way, and four-way Linux replacement systems. This approach may prove competitive at the low end of the UNIX spectrum. It will be interesting to see what traction it gets at the high-end. HP, IBM, and Sun, with their much larger and broader product lines, face a more interesting positioning challenge as to where Linux fits with their traditional operating environments. Their product lines include multiple server hardware platforms, multiple operating environments, and various middleware and other software.

All of the vendors have worked diligently to incorporate Linux into existing products. HP and IBM have ported the bulk of their middleware products to Linux. IBM has also created aggressive ISV programs to encourage others to port to Linux. IBM actively uses Linux as a key component of its on-demand utility computing strategy. Sun supports its Sun ONE tools on Linux and Sun's Project Orion announcement takes Linux into account as part of its new integrated software offering approach. All of the suppliers enable Linux applications to run on all their operating environments either through recompiling for the specific UNIX (e.g., Solaris, HP-UX, AIX) or through supporting the Linux operating environment in a partition (HP-UX and IBM AIX, zOS, and the iSeries operating system).

Alone among major IT vendors, Microsoft continues to view Linux xenophobically. Yet, despite the hype about Linux competing with Microsoft, Linux is more effectively consolidating and standardizing the UNIX industry. Today, Linux is a highly customizable operating environment augmented by a growing set of open source software. By contrast, Microsoft's Windows operating environment and .NET services offer a tightly integrated, high-value software stack. Microsoft targets the entire software stack up to (and sometimes including) the application layer. Linux competes with Microsoft primarily for infrastructure solutions as the skills needed for Linux application development differ significantly from those needed for Windows development. In fact, none of the Linux operating system distributions are competitive with Microsoft Windows

2003 Server in terms of integration, ease-of-deployment, and built-in capability. While Windows Server 2003 with .NET offers a built-in modern component-based runtime environment, Linux users must assemble their own from open source (such as JBoss) or use ISV offerings. Some vendors, such as IBM, provide a full middleware stack offering for Linux and all will build one as part of their services offerings. To get to a competitive application development and deployment platform, the Linux platform suppliers require a J2EE (Java 2 Enterprise Edition) platform and other elements added to the Linux distributions to bring them to the level of functionality of Windows Server 2003. Despite this, many ISVs choose J2EE over Microsoft .NET to maximize their opportunity to sell into UNIX, Linux, and Windows deployments. (A full analysis of Microsoft Windows competitiveness against Linux is beyond the scope of this report. However, D.H. Brown Associates, Inc. [DHBA] is conducting in-depth analysis of the competitiveness of those environments.)

LINUX DESKTOP/CLIENT

Reducing desktop costs is emerging as a hot topic for IT managers. Dell reports a growing request rate for Linux on the desktop, outside of the technical workstation. HP led Linux into the technical workstation market including high-end animation. IBM actively sells IA-32 Linux IntelliStation workstations as an alternative to UNIX workstations. Microsoft's new licensing model, Microsoft's support for prior versions of Windows, and the issues surrounding the legal licensing of desktop operating systems and personal productivity applications (e.g., Office) have moved enterprise-level clients and government agencies to consider alternatives to the ubiquitous Windows environment. Thin clients have been one response that were introduced into the market with great fanfare and then stabilized at low, but sustained levels. While not enjoying the level of attention given to servers, open source software and Linux on industry-standard hardware are beginning to receive serious consideration for desktop deployments.

The Linux environment is building up its technical ability to address some of the desktop requirements with its improving user interfaces and productivity applications. However, constraints in its office capabilities (especially Microsoft Office compatibility) limit enterprise interest in Linux for the power user or knowledge worker. The attitude seems to be "if it ain't broke, don't fix it." Although there may be a substantial cost advantage in software, other costs include user retraining and overcoming user acceptance. Despite these issues, Linux interest is on the rise for the transactional (e.g., call center) or vertical market users, heavy graphics users, and non-power user environments that do not require complex spreadsheets or other advanced functions. Direct cost savings can be achieved and these users do not require the complexity of the traditional Windows office environment. In this area, IBM has been active as shown in its custom solutions for Sherwin Williams and others and with its IntelliStation workstations. HP was an early supporter of Linux on its high-performance workstations with such highly visible customers as Dreamworks and Disney. HP also offers a Linux option on commercial desktops. Dell supports Linux on its

desktops and workstations and offers a factory install of Linux on the Precision workstation line.

While Linux client alternatives exist in the market, all the major system suppliers follow two alternatives: a) preload Linux distributions or, b) not include an operating system on their desktop systems, which allows the customer to construct their own desktop environment (often aided by services). Oracle, Ximian, and other software providers address Linux desktop capability, but no system vendor has really stepped up to the task of building a Linux desktop environment that can compete directly with Windows in the transactional or vertical markets. However, Sun is on the verge of doing so. Focusing on such key user requirements as office productivity, e-mail, web access, and linking to backend systems, Sun plans to leverage its new StarOffice release featuring its compatibility with Microsoft Office files, the Java development environment, and the ubiquitous open source software (GNOME, Mozilla, etc.) to deliver Madhatter, a complete Linux desktop stack. Madhatter includes both the client stack and the supporting server features – identify, directory, Java, management console, etc. Sun is to be congratulated on its attempt to add coherence to the Linux desktop array. Developing a client stack that competes with Windows – even in a constrained part of this market – forms an attractive goal to ISVs. However, ensuring that the stack remains compatible with the large install base of information is no small task. Linux has demonstrated a substantial and growing server market. It will be interesting to see the desktop story play out and how the other suppliers address it beyond their component offerings.

LINUX-UNIX AFFINITY

Many customers are becoming mixed UNIX-Linux shops, based on investments in their legacy UNIX systems while beginning to grow their Linux systems. In many cases, they are using Linux as their preferred development environment. Similarly, ISVs are embracing Linux as the high-volume UNIX platform. These market activities drive the need to deliver better Linux-UNIX affinity.

Three models of affinity play out in today's market – interoperability, shared environment, and application mobility. Interoperability covers offering common applications and an integrated management model. All vendors reviewed provide some level of this approach. IBM and Sun, as middleware vendors, offer a layer of software that can be delivered on Linux and on their line of UNIX systems.

A shared environment describes a system that can be partitioned to enable both UNIX and Linux concurrently. IBM currently delivers a hypervisor that enables dynamic partitioning of server resources that can be delivered for both AIX and Linux. Similarly, IBM provides Logical Partition (LPAR) support on its proprietary servers enabling them to run their native operating systems and Linux concurrently. HP plans to deliver the ability to run Linux, HP-UX and Windows simultaneously on an Itanium-based HP Superdome system in 2003, making it possible to run all its strategic operating environments concurrently. This shared

environment approach carries the potential to offer HP customers substantial operating environment flexibility.

The vendors provide the following application mobility functions between their respective UNIXs and the leading Linux distributions that function on their UNIX platforms:

- Source code compatibility, essentially common Application Programming Interfaces (APIs) – HP, IBM, Sun
- Linux runtime toolkit (Linux APIs), which enables a user to run Linux binaries on the UNIX system – HP, IBM (this includes workarounds for APIs not supported)
- Binary compatibility to run Linux binaries – HP (Itanium), Sun (x86)
- Library to capture Linux calls and run Linux binaries on UNIX – Sun x86

UNILEVER AS A REPRESENTATIVE LARGE ENTERPRISE

Unilever is committed to open source and will do its own development using Java on Linux and other systems. It has deployed edge servers and web servers on Linux and is beginning to look at using Linux for SAP and other enterprise applications. Cost-performance remains the primary motivation for moving to Linux. Unilever partners with HP and IBM on its Linux strategy and reports that they are “more than active in delivering solutions.” Unilever partners with multiple suppliers to avoid vendor lock-in. Using hardware from either partner reduces costs and resources. Today Unilever supports three versions of UNIX (HP-UX, TRU64, AIX) as well as Windows NT. The ability to get to one UNIX is a significant perceived advantage. For example, Unilever replaced a high-end UNIX system with an Intel Linux box and got 60% capital benefit and three times the performance. Currently focused on 32-bit Linux, Unilever wants to move to 64 bit. But it needs to achieve UNIX technical equivalency to do so. Before Unilever can use Linux for datacenter applications, Linux will have to include some specific enterprise features – full clustering, better scaling, and others. Most of these are found in the Linux kernel 2.6 or will be in 2.8. Unilever (and other large enterprises) are working with the Linux community to ensure that their requirements are addressed.

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EVALUATING THE VENDOR STRATEGIES

The five vendors' strategies are evaluated for differentiation and/or leadership in several key areas. An "XX" in a column indicates that the vendor achieves significant differentiation or leadership against that criterion. An "X" in a column indicates interesting differentiation, perhaps not as striking as the leaders.

DIFFERENTIATION CATEGORIES

The following differentiation categories were chosen based on key requirements for Linux solutions in different market segments, areas of focus by the vendors, and value propositions sought by users and other industry sources. (See *Appendix A* for more details.)

- *Vendor Positioning*: Indicates whether the vendor pursues a broad or a focused Linux strategy. Examples of focused strategies include concentration on market segments or solutions.
- *Product Line Breadth*: Illustrates relative vendor positioning on the breadth of its server product line with some consideration for PCs, embedded, and handhelds.
- *System Pricing*: Highlights server and server appliance pricing leaders.
- *Value Added*: Calls out vendor areas of added value. Indicates focus areas of differentiation and relative positioning in key value added areas.
- *Services and Support*: While all vendors have integrated Linux into their strategic services and support offerings, this criterion positions the breadth and depth of service and technical support offerings.
- *Applications Focus*: Illustrates vendors who are driving Linux into new solution and application segments.
- *Linux Community Involvement*: Highlights community participation and contribution leaders, key factors in the open source world.

VENDOR POSITIONING

TABLE 1
*Vendor Strategy
Positioning*

	Dell	HP	IBM	Sun
<i>Broad Strategy</i>		X	XX	
<i>Focused Strategy</i>	XX	X		XX

The Vendor Positioning criterion describes how Linux fits within the overall product line, focus, and visibility in the Linux market. DHBA notes two different strategies:

- A broad-based approach that stretches across market and solution segments and takes an aggressive position to drive Linux and open source into new segments.

- A focused strategy that targets a company's Linux initiatives around selected products or market segments that are Linux strongholds such as the edge-of-network applications, technical computing, and Internet infrastructure.

Within this framework, IBM and HP follow broad strategies and drive them aggressively. The integration of HP and Compaq gives HP substantial market momentum in addition to a coherent strategic story. Compaq was the market volume leader in IA-32 Linux servers. IBM and HP remain the heavy hitters in the Linux market, competing directly for high-end customers across a broad range of market segments and application environments. They compete to develop new Linux market segments in Grid computing, higher-end clusters, ERP (Enterprise Resource Planning), other business logic applications, and distributed enterprise applications.

IBM pursues the broadest and most aggressive strategy driving Linux into most segments and industries in the enterprise with its large kernel, operating system and middleware investments along with broad ISV programs. HP's strategy embodies significant breadth as described and within that – a tight focus. HP drives aggressively into specific segments. These include edge-of-network, infrastructure (including Internet and telco,) financial services, and compute clusters. HP is also expanding into ERP application and database servers as demand accelerates for these types of Linux solutions.

Dell and Sun reveal focused strategies. Dell's goal is selling systems with Linux as a catalyst. Sun wants to compete with Microsoft and prevent the erosion of the opportunity for Solaris to support Linux on any platform. Sun is focused on edge-of-network applications for Linux and is beginning to look at HPC environments. Sun has made key recent announcements on servers that support this approach: Sun Fire V60x/V65x two-way servers, a relationship with Oracle, and Sun ONE software on Linux. These announcements will potentially extend Sun's solutions beyond the current market focus. Sun positions Solaris on IA-32 and SPARC as the platform of choice for other environments. In addition, Sun is developing a focused strategy for Linux on the desktop. Dell, on the other hand, follows a focused opportunistic strategy targeting responsiveness to customer interest in Linux. Dell has also developed a strong relationship with Oracle, targeting Oracle 9i RAC, high-performance computing, and UNIX-to-Linux migration.

IBM continues to benefit from its Linux-on-mainframe strategy and Linux server consolidation, amassing over seventy Linux-on-mainframe success stories. The visibility of these successes and the perceived benefits of Linux have contributed to mainframe installations. The large enterprise engagements driven by this strategy for both products and services based on Linux provides IBM significant market visibility with its traditional customers. Server consolidation (both on mainframes and IA-32 servers) continues to be a major industry strategy that all vendors embrace. Even Microsoft follows this strategy to compete with Linux, pressed by a market that finds the TCO and operational benefits of Linux too strong to ignore. IBM has major Linux programs in place for all its hardware and

software offerings and a full complement of Linux services. It clearly pursues the broadest strategy and it seems to be paying off in mainframes, software, and services. However, despite gains by IBM in 2002, HP continues its Linux leadership in the high-volume IA-32 platform.

PRODUCT LINE BREADTH

TABLE 2
*Product Line
Breadth Assessment*

Dell	HP	IBM	Sun
	XX	XX	

Table 2 summarizes the breadth of the vendor's Linux server systems offerings. Support of clients and new types of devices forms a secondary consideration.

IBM displays the broadest product line with Linux offerings across Intel-based, RISC-based, and mainframe servers, ranging from server appliances to datacenter consolidation servers. By extending its Linux support to carrier-grade servers, BladeCenter products, 32-bit IntelliStation workstations, and its disk and tape offerings, IBM delivers Linux on virtually all aspects of its hardware product line. In addition, IBM markets the broadest Linux software support in its middleware product line.

HP positions next with its breadth across Alpha, IA-32, and IA-64 systems as well as its StorageWorks, and iPAQ handheld initiatives. HP offers server appliances, server blades, and carrier-grade Linux servers, as well as leading 3D workstations, desktops, and selected laptops with Linux support. Further, HP is driving Linux into printing and other products and initiatives. Most of HP's software (e.g., OpenView, Serviceguard) is also available on Linux.

Dell offers Linux across its server, storage, and client product lines, as well as dedicated network appliances.

Sun currently offers multiple products in the Linux market – the Cobalt appliance server line, the LX50 IA-32 servers, the new Sun Fire V60x/V65x two-way IA-32 servers, and the Sun Fire x86 Blade Server. Sun also plans to target the Linux desktop business.

SYSTEM PRICING

TABLE 3
*System Pricing
Assessment*

Dell	HP	IBM	Sun
X			X (Appliance and rack)

This criterion looks for the lowest overall price of similarly configured systems at the appliance level, as well as at the general-purpose and larger Linux systems. For Linux, the high-end means an eight-way SMP for a single system with the 2.4

kernel. This report looks at the mainstream Linux server offerings including appliances, entry rack, typical two-way Linux systems, and larger four-ways. Dell takes the overall lead in system pricing and includes its Customer Factory Integration services, which offer customized preloads of Red Hat Linux. Sun competes with Dell for appliances and rack systems and, depending on the implementation and pricing of Project Orion, may offer greater capability (e.g., J2EE). However, Sun only offers entry-class Linux systems. IBM and HP depend on high volume system pricing that is higher than Dell's; they also offer preload and other services for a fee above the system price. But, they offer more processor capability with that higher price. Prices begin to converge for larger four-way Linux systems and above with Dell maintaining a small advantage.

VALUE ADDED

TABLE 4
 Value-Added
 Categories and
 Assessment

	Dell	HP	IBM	Sun
<i>Customer Experience</i>	XX			
<i>Desktop</i>		X		XX
<i>Appliance</i>	X	X	X	X
<i>Blades</i>	X	XX	XX	X
<i>Hardware Differentiation</i>		XX	XX	
<i>System Management</i>	X	XX	XX	
<i>Software Portfolio</i>		X	XX	X
<i>Migration Services</i>	X	X	XX	
<i>Partnerships – Open Source Solutions Companies</i>		XX	X	

Value added includes differentiated hardware and software, new methods of distribution, and ease of doing business. Since Linux is open source, it provides an ideal platform for customization, services, and add-on products to increase value to the overall solution.

While all of the vendors studied show positive customer experiences and references, Dell's Custom Factory Integration services continue to offer significant value in the specify, purchase, deploy, and manage phases. A customer can create multiple hardware configurations and software images and store those in a database with Dell for further use and to aid Dell's support efforts. This process also eases the deployment significantly as well as some aspects of manageability.

Sun takes a strong lead for Linux desktops pursuing its strategy to build a complete desktop solution for selected enterprise segments such as vertical

applications and call centers where dependence on deep Microsoft Office features are not heavy.

All of the suppliers offer Linux-based appliances, from Dell's to Sun's Cobalt line. HP has taken the appliance story beyond the predictable firewall and other edge-of-network offerings, achieving differentiation. HP delivers the Application Specific Integration Kit (ASIK) to provide a common set of services for OEM partners to add value and to ease application deployment. HP's integration with Compaq brought significant breadth and depth of cluster offerings including Beowulf, SteelEye, and other clustering technology.

HP established a leadership strategy by achieving significant differentiation in breadth and depth of support for its Intel-based systems including rack, tower, blade, appliance, and 64-bit Itanium platforms. HP has demonstrated Linux partitioning on a 64-way Itanium system along with Windows and HP-UX. In addition, HP has taken a strong position in Linux on its workstation line, including 3D systems and 64-bit Linux workstations. HP supports its storage products aggressively as well as its printers including all-in-one devices for Linux.

IBM offers Linux across its e-Server platforms and has developed significant hardware value added in its xSeries industry-standard servers and its zSeries mainframes. This includes xSeries X-architecture reliability features spanning Light Path Diagnostics, Predictive Failure Analysis, and an Advanced System Management processor. In addition, IBM's high-end IA-32 system, the xSeries 440, supports the highest levels of scalability that Linux supports. Other areas of differentiation include support for zSeries capabilities such as partitioning and hipersockets, which allow these Linux instances to yield high-speed communication with each other without network overhead, as well as the ability to exploit native mainframe services. In addition, IBM's mainframe zVM enables the virtualization of substantial numbers (IBM claims hundreds) of Linux instances that can be independently managed by individual users or as a group.

IBM's software portfolio covers nearly the entire middleware solution space and has been ported to Linux. Beyond this, IBM has ported much of its AIX add-on software, including its SP2 cluster software, its storage management, and other software to Linux. Increasingly, Linux is used as a development platform in IBM for its programmers. Linux has been elevated to a Tier 1 port platform for IBM and may become one of its two primary development platforms, the other being Windows. IBM increasingly considers Linux as a native platform.

HP is bringing most of its software portfolio over to Linux and stocks some interesting offerings for security, high availability, management, utility computing, and telco. HP also partners with BEA Systems and others for its application and integration platform stack on Linux.

Sun supports Sun ONE including its software portfolio and services on Linux. Sun ONE with such programs as iForce ranks among the industry's stronger

application frameworks in several areas such as total system approach, solution lifecycle support, and development methodologies.¹ Sun's forthcoming Project Orion will support both Solaris and Linux environments and is planned to deliver a predictable, pre-integrated software stack for servers. A strong implementation, excellent execution, and an aggressive pricing model for Orion will further strengthen Sun's value proposition in this category.

Dell is targeting all UNIX-based solutions that can be supported on Linux for migration. The focus is the individual customer level and Dell offers migration assessment, planning, and deployment services to support the migration process. Dell is making TCO and ROI tools available to customers to provide personalized estimates of UNIX-to-Linux migration benefits and costs. IBM presents a strong set of migration services from competitors' UNIX offerings to its Linux-based solutions. IBM markets these aggressively even at a customer-by-customer level. HP's professional consulting offers a full set of services to support HP's target markets including migration services and training services for Linux. HP also offers an Express migration service delivering specific migration services for a fixed price. Both IBM and HP also offer TCO and/or ROI tools to help their sales teams and business partners make the case for Linux.

All of the vendors studied possess strong partnerships and community relationships. HP and IBM maintain the strongest Linux community relationships.

SERVICES AND SUPPORT

TABLE 5
 Services and
 Support Assessment

Dell	HP	IBM	Sun
X	XX	XX	

This criterion includes deployment, technical support, and consulting offerings. It also takes into account training and education.

All of the vendors studied exhibit solid services and support programs for their product offerings. Further, all leverage and work with the open source community, adding more support resources to their Linux products that are not available for proprietary offerings. DHBA singles out HP and IBM with their multi-vendor technical support and service offerings as superior examples of leadership support programs. Both also deliver the same level of support for Linux that they do for their proprietary systems. Dell has integrated Linux support into its premier enterprise support agreements where it offers both reactive and proactive support. It offers the same level of support for Linux as for Windows. However, the Linux version is Red Hat only. Dell does not offer volume support for non-Red Hat environments.

¹ See *e-Business Application Frameworks Enter a New Era of Capabilities and Competition*, D.H. Brown Associates, Inc., February 2002.

IBM maintains the largest and deepest services team; HP follows. Both offer the full catalog of professional and technical services for Linux. It is clear from these kinds of services investments that these vendors are committed to Linux.

APPLICATIONS FOCUS

TABLE 6
*Applications
Evaluation*

Dell	HP	IBM	Sun
X	XX	XX	

This criterion includes middleware enablement, ISV programs, classic Linux applications, emerging/new Linux applications, and migration strategies.

IBM's strategy calls for expanding the application base on Linux and establishing IBM as a leader, enabling the transition for ISVs by means of enablement programs and tools. Enablement program examples cover pretested and optimized solution deployment platforms, such as the Integrated Platform for e-business and the DB2 Linux Cluster Offering – both focused on simplifying the construction of Linux-based solutions. In 2002, IBM continued its investments in key targeted industry segments and turned even more aggressive in driving both ISV and corporate developed applications. IBM is also re-emphasizing application development tools and infrastructure applications where Linux mainstream adoption is already underway. IBM focuses on small and medium-sized businesses through its SMB software suite and the new Express set of middleware offerings, making it easier, and cheaper for SMB customers.

Dell, HP, and IBM support key enterprise applications such as Oracle9i database RAC and SAP solutions. IBM and HP have opened Linux Centers to support the financial services industry to help them exploit Linux more effectively and migrate off their Sun Solaris environments. IBM reveals its aggressive stance in deploying a large range of programs, headlined by “Speed-Start Your Linux App” to attract ISVs, to make it easy for enterprises to exploit IBM Linux middleware, and to help build a Linux application base.

HP delivers a differentiated set of solutions in specialty segments such as telco and financial services. HP has built a significant partner program around its industry-standard blade architecture and has developed a focus, partly developed through partnerships, in web hosting, firewall, messaging, application services, digital content creation, electronic design and automation, and scientific computing. Finally, HP targets the enterprise with Linux and is working with selected leading enterprise applications including BEA, Oracle and SAP R/3. As a result, HP offers integrated support for the solution. Many of these solutions are bundled for ease of purchase, installation and support.

Dell's application strategy is aimed at accelerating the enterprise adoption of Linux. Believing that Linux will replace UNIX, Dell focuses on Oracle database

applications and SAP. For commercial customers, Dell has adopted the Oracle9i database platform, both single-node and RAC clusters. Dell is also building an ISV portfolio and maintains substantial relationships with BEA, BMC, CA, Oracle, VERITAS, and others. With its High Performance Computing Cluster (HPCC) capability Dell has developed and exploited open source Linux cluster services. HPCC represents a substantial growth opportunity in Dell's commercial and technical environments. Dell also offers a retail Point of Purchase product.

LINUX COMMUNITY LEADERSHIP

TABLE 7
 Linux Community
 Leadership Assessment

Dell	HP	IBM	Sun
	XX	XX	X

Linux Community Leadership takes into account participation, leadership, and visibility within the Linux and other open source communities.

IBM employs the largest contingent of open source programmers (over 250) and fields the greatest number of projects as evidenced by the breadth of activity of its Linux Technology Center. Extremely active in most of the open source interest groups (e.g., OSCAR), IBM is regarded as a highly visible contributor. Its standout leadership areas include Apache as part of WebSphere and standalone, the Eclipse development environment initiative, and its work on open sourcing key XML and web services technology to proliferate those standards. IBM also contributes mainframe and AIX enabling technology to the Linux kernel and source base. As part of its business model, IBM is also driving ISV application availability on Linux to overcome one of Linux's larger inhibitors. While this is not a direct technical contribution to the community, it clearly supports the open source initiative.

HP continues with a high level of focus on the open source community with over 45 significant projects (www.opensource.hp.com). Its leadership role spans bringing 64-bit Linux to the Intel Itanium platform, and HP leads the maintenance of the IA-64 Linux kernel at HP Labs. In addition, HP provides a free IA-64 Linux SDK (Software Development Kit) for developers. Its special relationship with the Linux community derives in part from its Debian support. Further, HP has made significant and highly visible contributions for printers and printing technology, scientific computing with Gelato, its Single System Image project, performance tools, Solaris-compatible thread library, Apache, including its Java servlet engine, and Samba. HP brought some of this expertise in house by hiring several of the top Samba developers including Jeremy Allison.

Despite only recently announcing a significant expansion of its Linux strategy, Sun remains a long time contributor to the open source community including the GNOME (GNU Object Model Environment) user interface, NFS (Network File System), Mozilla, and the Java development environment – NetBeans.

Dell's community participation is closely tied to the Dell model of pragmatic customer engagement. Dell facilitates its partner ISVs' development in an open source model and helps them manage the necessary relationships. Dell also focuses on Independent Hardware Vendors (IHVs) to create open source device drivers. Finally, Dell provides equipment to OSCAR and promotes it at trade shows.

CROSS-PLATFORM COMPETITIVE COMPARISONS

COMPETITIVE LANDSCAPE

Based on visible support from the leading system suppliers, Linux has become a mainstream business server environment used by some of the world's largest businesses and laboratories. All of the leading system suppliers – Dell, HP, IBM, and Sun – ship Linux offerings. At this point, Dell, HP, and IBM retain substantial customer installations. Their offerings range from embedded and client systems, server appliances, and commercial servers, to high-end clusters targeting commercial and technical computing and mainframes running Linux. This range of offerings demonstrates Linux's market success. Unthinkable a few years ago, all these suppliers exploit open source solutions integrated into their software offerings (e.g., Apache) or as part of their overall Linux solution (e.g., HPC support). All the suppliers use TCO as a differentiator for their Linux offerings in two areas: to drive UNIX migration to Linux; or to compare their offerings to Windows systems.

Based in part on their ties to the Linux and open source community, each vendor has invested in at least one of the Linux distributions – Red Hat forming the common thread across all the suppliers. Until recently Sun was the one exception. Sun's Linux distribution was a derivative of Red Hat. Rather than invest in a unique Sun offering, Sun decided to embrace Red Hat and possibly other distributions to be part of a larger Linux standard distribution set. The working relationship between the major OEMs and the Linux distributors has tightened as well. All of the vendors are represented and active on the various industry committees (e.g., Linux International). HP and IBM stand out by their leadership, serving on the boards of most organizations and contributing significantly to the technology. Where relevant, they have committed to providing Linux-compatible services or APIs, for example, or run Linux natively on their legacy system environments. They differ, however, in their strategies and in the level of solution enablement, support, and integration they offer.

As Linux is written by the open source community, Linux supplier offerings must maintain consistency in terms of operating system content. Differentiation is achieved primarily through packaging, ease of deployment, support, open source community involvement, application and solution focus, and execution.

The value that these suppliers provide lies in their level of support and services, the ease of configuration and implementation, manageability, and breadth of systems hosting Linux. IBM and HP in particular offer an extensive software portfolio available on Linux or through open source. Sun has added Linux support for its entire Sun ONE application framework and is creating Project Orion, a Solaris and Linux pre-integrated software stack. The entire business model of Sun's Cobalt division depends on Linux and open source. Dell's stance relies on a very effective strategy of bringing its efficiencies of operation and the strength of its direct model to the Linux market.

DELL HIGHLIGHTS

Dell seized on customer requirements. In embracing Linux, Dell was already offering a product line based on Intel processors. Offering Windows together with Linux across its product line provides an effective means to compete with its direct Intel-Windows competitors as well as the UNIX community. Linux represents Dell's UNIX. Dell's strategy is clearly pragmatic, focusing on volume Linux deployments. However, Dell has publicly stated it will launch an Itanium 2-based server in 2003. Given that the bulk of the Linux market is IA-32, this is no real inhibitor. While Dell is not promoting Windows-to-Linux migration, it is not discouraging it either. Typical with its model, Dell will facilitate whatever direction customers choose.

In addition to being pragmatic, Dell's approach to Linux is also opportunistic in that Dell has put itself in a position to respond actively to Linux demand without having to actually create it. Dell's focused strategy, responding to both small and medium-sized business (SMB) and enterprise customer interest, addresses the substantial Linux value proposition of IA-32 cost advantages over more expensive RISC UNIX systems. Dell positions Linux as the low-cost alternative to "proprietary" UNIX. This blends well with Dell's market position as the low-price leader. Linux enables Dell to compete directly with Sun, HP, and IBM in the low-end UNIX environment.

In 2002, Dell shifted its attention to the enterprise. Following an initial focus on the high-volume Linux client and server markets, Dell now targets enterprise applications using Linux as an alternative platform to UNIX for database, HPCC, and application rack servers. Dell's enterprise strategy is to partner with Red Hat, Oracle, and HPCC partners to create a complete Linux enterprise solution, build a strong enterprise application portfolio, and partner to enable enterprise Linux infrastructure software. In addition, Dell plans to change the enterprise focus from "scale up," where Dell is not as strong as its competitors, to "scale out," which provides an opportunity to compete with industry-standard clusters – providing reduced cost-compute power.

While Dell remains impartial on Windows-to-Linux migration, UNIX-to-Linux migration continues to be the primary focus. Dell offers edge-of-network servers and Linux appliances, but Dell has added UNIX (mostly Sun Solaris) migration for enterprise applications such as Oracle 9i and SAP. In addition, Dell is building a Linux HPCC business to attack selected market segments previously locked into UNIX. These segments are bioinformatics and energy. Dell has also built specialized services in server consolidation, distributed applications, and HPCC to support this Linux thrust. Dell has also created a UNIX migration analysis tool illustrating TCO and ROI benefits to justify and promote the UNIX-to-Linux migration effort.

Dell uses Red Hat to certify its hardware recommending Red Hat "professional" for appliances and edge-of-network servers and Advanced Server for enterprise

applications. Dell offers SuSE certified servers and clients leveraging its relationship with SuSE through Dell Europe. At this time, Dell does not certify its clients or servers on UnitedLinux or SuSE, though Dell will preload SuSE and other distributions as part of a custom service offering. Dell provides hardware and some engineering support to SuSE among others to enable these distributions to certify Dell systems themselves. Dell has built ISV relationships with BEA, BMC, Oracle (9i, 11i), SAP (Linux certified), and VERITAS. Dell positions itself as the primary point of contact for Linux service and all the software installed on its servers. It will provide level 1 and 2 support. In addition, Dell will manage more extensive support as well as the interaction with Red Hat and the other software providers on the customer's behalf. Dell Professional Services also resells Red Hat Professional Service and Oracle Consulting Services as part of its Linux offerings.

Dell's strategy positions it well as the high volume, commodity Linux server leader. However, Dell is less prepared to take a leadership enterprise Linux role. Dell's Oracle relationship is highly visible (a focal point at Dell's recent analyst meeting) representing the primary mechanism for Dell to enter the higher value enterprise market. However, some enterprise customers may require additional capability and support to entrust their mainline production systems to a commodity provider. By the end of 2003, Dell plans to drive Linux into the enterprise by focusing on customers' lifecycle management, improved technical support, and more services to meet their customers' immediate needs with Linux. Dell faces a challenge: to communicate its relationships with the ISV community and the services capability it provides to meet the needs of the market. Beyond this, Dell must offer a product line that scales effectively.

HP HIGHLIGHTS

As a full-line system supplier, HP has embraced Linux across its hardware, software, storage, peripherals, and services lines. Its strategy is built on industry-standard platforms, partnerships, enterprise development environments and middleware, and professional services for its target solutions including some enterprise application segments. This framework provides HP's foundation for delivering end-to-end Linux-based solutions for targeted applications. HP's strategy may be summarized as follows:

- Drive support and innovation for industry-standard platforms
- Commit to open source software including Linux
- Develop a Linux industry ecosystem
- Enable enterprise software functionality
- Drive Linux-UNIX affinity
- Create and deliver end-to-end solutions
- Deliver a full line of services and support

HP supports three strategic operating systems: Windows, Linux, and HP-UX. Through this strategy, HP positions Linux as the leading system targeting Internet infrastructure, financial services, and telco solutions for enterprises of all sizes. An early leader in blade servers, HP offers highly scalable blades and carrier-grade Linux systems and also provides a range of Linux-based server appliances. HP is also active in the emerging Linux-based enterprise application servers, database servers, and ERP through its partnership with Oracle and SAP. Finally, HP is leveraging its historical strength in technical computing and delivering solutions for design and visualization, as well as high-performance computing, supporting the traditional technical computing and the commercial numerically intensive customer.

HP offers differentiated solutions with key software in management, security, high availability, and telecommunications. Its services organization has built a portfolio of consulting, services, and support to complement its product and solution offerings. HP also offers a broad portfolio of professional services for the Linux environment including assessment and analysis, integration and migration, technical support, and customer support services. The key message from HP's services and support emphasizes the same level of support for Linux as provided for Windows or HP-UX. HP behavior is consistent with its strategy in this regard.

The Itanium platform stands out as a key element of HP's strategy. HP has committed itself to an industry-standard hardware strategy built on IA-32 and IA-64. According to industry sources, HP enjoys marketshare leadership in both IA-32 and IA-64 Linux shipments and is the most focused supplier for 64-bit Linux-on-Itanium with a full line offering. Itanium has been selected as the future high-end hardware environment for all of HP's operating environments. To this end, an aggressive strategy ensures binary compatibility for applications between HP-UX and Linux. HP furnishes a common Application Binary Interface (ABI) between the HP-UX and Linux operating environments on Itanium. HP has also developed a Linux runtime toolkit (Linux APIs) to enable a user to run Linux binaries on the HP-UX system.

HP has done considerable work to incorporate Linux into existing products, porting most of its middleware products to Linux. HP also offers significant technical support and support services and provides a broad portfolio of professional services for Linux.

HP's acquisition and integration of Compaq's Linux business and strategy creates synergy for the Linux effort. Prior to the acquisition, the strengths of the two companies offered significant complementary value. The new HP Linux strategy delivers value-added focused solutions, and relies on an aggressive push into emerging Linux segments such as application serving, ERP, and database. The ProLiant brand complements the HP solutions focus and provides HP with a large Linux install base and significant customer experience to build on. HP enjoys a broad range of relationships with the open source communities, tying into a large pool of talent and making significant contributions back to the community. This includes its work with the technical computing Gelato effort, the Intel Itanium

Linux project, and Linux printer support. These efforts strengthen HP's experience base, which in turn adds value to its technical support and services. HP is well positioned to deliver robust and value-added Linux solutions.

IBM HIGHLIGHTS

Broad to the extreme, IBM's Linux strategy reveals total commitment. Linux touches all parts of IBM's product lines and businesses, from its entry server environments to its on-demand services offerings. In addition, IBM promotes Linux and open source actively and effectively to its large enterprise customers. Linux has effectively become the *Lingua Franca* across IBM's hardware and software offerings. IBM (and most of the industry) believes that Linux is the only vehicle that prevents Windows from completely dominating the volume server market and thus the software opportunity that comes with it. As a result, Linux (or some other similar development) is key to competing in the sizable volume space above the hardware.

IBM recognizes Linux as an opportunity to move the basis of competition away from commodity hardware and operating environments into higher-value software and services where it retains an advantage. This is not to say that IBM will not continue to invest in delivering leading-edge hardware products or enhance its legacy of operating environments or systems architectures. These developments reveal the extent to which IBM has become a software and services company, focusing on the kinds of customer demand and customer issues that go with the territory. IBM continues to offer leading-edge products such as the 16-way xSeries 440 server and the recently announced IPF-based xSeries 450 built on an industry-standard processor that includes advanced mainframe I/O technology. However, the company's focus on its Linux strategy above the operating environment stands out as a striking aspect of IBM's embracing of Linux. IBM allows (and even helps) customers choose the environment that makes sense for them. As an IBM executive said, "Standard OS, standard hardware. Let's put the money where the value is."

While IBM has positioned its entire e-Server line as Linux capable, the bulk of customer interest and IBM marketing focuses on its IA-32 Intel server line and its zSeries mainframe systems. These products stock the bulk of Linux installations and arguably the greatest customer interest and value. This is based on the idea that cost, flexibility, and diversity of supply form the primary drivers of customer Linux interest. These criteria point toward IA-32. The zSeries ubiquity in large enterprises, the potential cost benefit of virtualization of Linux instances, and the opportunity to better exploit the zSeries infrastructure drives interest in Linux for mainframe customers. Focused on TCO for their overall installation, these customers seek to maximize returns from their zSeries installations.

IBM is moving forward in the 64-bit space as well, recently announcing Linux pSeries offerings and Linux partition support for its iSeries. IBM positions these POWER-based systems as the 64-bit Linux environments. While pSeries Linux

adoption is slow, IBM's recent announcements target Linux on pSeries to improve its positioning and attractiveness. IBM's iSeries is well established and substantial demand exists for IBM's xSeries and zSeries servers. IBM's market success in these areas may reflect Linux's current primary position as an edge-of-network and enterprise infrastructure server. With the availability of the Linux kernel 2.6 and its additional enterprise features and scalability (up to 16-way), Linux's enterprise capability will evolve and may bring added interest for 64-bit systems. However, the xSeries will remain the Linux leader at IBM. It should be pointed out that IBM is making significant efforts to avoid fracturing Linux in the manner of UNIX. There is perhaps a lesson learned here. IBM (as well as HP and Dell) has built relationships with the standard Linux distributions – Red Hat, SuSE, and others – to provide the Linux operating environment. Hence, it avoids distributing its own product or even an enhanced one of the standards, providing instead relevant enhancements into the open source process.

Linux now ranks as a significant component of IBM software. Linux makes it possible to create an alternative platform in the high volume server space that is not under Microsoft's control. As Microsoft enters the cross-industry application software markets, this alternative platform becomes even more attractive to ISVs. To appeal to these various constituencies, IBM has positioned all its middleware on Linux and is building "Express" versions targeting the small and medium-sized business market, not one of its traditional strongholds. IBM makes much of its software portfolio, including enterprise middleware, available on Linux, either as products or as contributions to the open source community. IBM has also embraced Linux in its e-Business Software Strategy (its application framework), one of the industry's leading enterprise application frameworks.² This support enables the creation and deployment of enterprise applications on Linux as the operating system matures. In addition, an aggressive ISV campaign attracts the development community to Linux and specifically to IBM's middleware on Linux. IBM offers a comprehensive development environment and tool set for Linux to enable ISV and corporate application development on all its platforms. Beyond this, the company's programs include "Speed-Start Your Linux App" for greater porting ease. To date, IBM claims that this program has achieved more than 4,000 applications.

Indicative of a full court press, IBM promotes Linux aggressively through its business partners. To accomplish that, the company has created IBM Leadership Edge for Linux. The program features a web-based ROI tool that allows a business partner to input specific characteristics of its business environment and business model and to evaluate the process for building a Linux practice. For example, it helps ISVs evaluate the porting of their applications to Linux. Once a business partner makes the decision to invest in Linux, the program provides enablement programs and resources to help them maximize their investment around Linux – software, technical support, connection to other IBM business partners, access to websites, white papers, sales and technical education, and joint

² See *e-Business Application Frameworks Enter a New Era of Capability and Competition*, D.H. Brown Associates, Inc., February 2002.

demand generation programs. The objective is to help business partners go to market successfully with IBM and Linux.

IBM Services views Linux as a disruptive technology that offers additional opportunities to add value. While IBM Services does not actively sell Linux, it offers a complete line of support and services capability from business and strategy consulting to deployment and outsourcing. Linux plays a significant role in IBM's on-demand service because of the virtualization capability on its zSeries servers. In particular, IBM offers Linux Virtual Services connecting customers with Linux applications to IBM e-business hosting centers. These centers provide managed server processing, storage, and networking capacity on-demand, enabling customers to tap into "virtual servers" on IBM e-Server zSeries mainframes running Linux, paying only for the computing power and capacity they use. IBM staffs a large and fully trained services team to address Linux services opportunities.

In summary, IBM follows a strong Linux strategy and employs Linux as a tool to drive its businesses. Linux is an application source for IBM systems and creates substantial software and services opportunities. To exploit that opportunity, IBM has enabled Linux on all its platforms and integrated its use at the high end of its server line. By applying IBM enterprise technology to Linux and by supporting the community to create robustness and scale, IBM has added value to Linux. These achievements were gained by a significant investment in IBM's Linux Technology Center. IBM has also made its very large middleware portfolio available on Linux and has built a large services infrastructure. Finally, IBM has created a value net around Linux and open source to enable Linux to compete with other value nets such as those surrounding Windows and Solaris.

SUN HIGHLIGHTS

Sun's overall strategy centers on "the right tool for the right job." Until recently, the tool was Solaris on SPARC. Recognizing that the IA-32 server environment with Windows and Linux is too large to ignore, Sun introduced the LX-50 with Linux in 2002, its first general-purpose IA-32 Linux server. With the LX-50, Sun embraced Linux for the low-end and edge-of-network environments, targeting customers with an interest in Linux. Sun delivered the Sun Fire x86 Blade Server this year, which can run both Solaris x86 and Linux and can run in the same blade enclosure as Solaris SPARC blades. Sun also resurrected a better Solaris on IA-32 as a compatible end-to-end Solaris server environment for those customers who wanted the cost benefits of IA-32. Notably, Sun ranks as the only system supplier with multiple IA-32 UNIX operating systems. Drivers for Sun's recognition that IA-32 and Linux had to be part of its repertoire include the IA-32 entry server market opportunity, the need for a high volume platform for Java deployment, and customer demand. The outcome is wider recognition that Sun now operates in a heterogeneous environment.

Sun's Linux strategy recognizes the market relevance of Linux while defending the value proposition of Solaris as an operating environment and SPARC as a

platform. A good part of this strategy targets Microsoft's dominance. Sun positions Linux as part of an overall UNIX thrust into the IA-32 server market, enabling Sun to address a more holistic view of its customers' environment. Sun plans to be the Windows alternative and the UNIX champion. In this vein, its Linux support is burgeoning into more general-purpose solutions. Sun now asserts that Linux is fully integrated into the mainstream of Sun offerings, including support and services, ISV programs, and the recently announced Project Orion. Despite these developments, Solaris remains the preferred UNIX for significant computing environments.

Previously, Sun offered its own Linux distribution as part of its low-end Intel offerings and as part of its Intel appliance partner offerings (e.g., Symantec security). Today, Sun supports the Red Hat Linux distribution and is a Tier 1 premier partner with Red Hat, shipping and supporting Red Hat EL. Sun also provides Linux services on the Red Hat distribution and is a single point of contact for services. This is not an exclusive arrangement and more distributions may be supported. Sun also plans to support Linux application source compatibility on Solaris. Finally, Sun is resurrecting the Solaris on IA-32 strategy, providing Solaris customers (and Linux users) with the ability to exploit a full UNIX environment on IA-32 environments, providing cost-focused customers with an opportunity to stay with Solaris rather than migrate to Linux. Like IBM, Sun positions its proprietary RISC hardware as the strategic 64-bit environment.

Sun deserves recognition for supporting and contributing to Linux and open source, in general. An outspoken advocate of a more open systems environment in general, Sun remains a driving force for Java, which is becoming the standard development environment for Linux systems. Beyond this, its Madhatter program takes note of a Linux market segment in which client systems do not require heavy personal productivity applications. Vertical and transactional applications tender strong potential where Linux may become a leading client platform.

The Project Orion software strategy reveals Sun's plans to deliver software in the future for both Solaris and Linux. The Project Orion objective calls for making the entire stack of operating environment and middleware delivery more predictable (as a stack) and more integrated. While this remains a concept at this writing (no packaging or pricing available), this may well prove to be an attractive solution for customers with significant investments in Sun software and hardware. Linux users who want a pre-integrated, pretested, middleware and application stack to reduce complexity may also latch on. The Linux distributions have been packaging some of the components for some time. Sun is bringing this to a new level in terms of the content, licensing, and a subscription pricing model. The goals are clear: reducing software complexity; achieving predictable delivery; and reducing cost. However, there are no details available at this time. The market will wait to see if Sun can address these better than Microsoft with its licensing and pricing models.

Sun continues to position its Linux strategy as advancing the cause of UNIX and Java at large and against Microsoft and its .NET strategy in particular. Project Orion, Sun

ONE, the repositioning of Solaris on IA-32, and the soon-to-be-announced support for the standard Linux distributions are all manifestations of this thinking. Sun needs to continue to inform and educate its customers that it understands their focus on cost and diversity of supply and that Sun is indeed an open system supplier, not just a Solaris open system supplier. The LX-50 and the Sun Fire x86 Blade Servers (shipping later in 2003) make an interesting entry point into the IA-32 world. Sun has recently announced and shipped new servers to demonstrate its interest and commitment to Linux. The Sun Fire V60x and V65x servers (one-way and two-way Xeon) are higher-end IA-32 Linux servers and continue to flesh out Sun's line of Linux offerings. To fit the plan, these must be part of an ongoing program.

Dell will continue to attack at the low end; IBM will be ever present at the high end of IA-32 systems as Linux matures; and HP will push with 64-bit Linux and the strength of its installed base. Sun needs a competitive plan to bridge the space. That plan starts with positioning of Solaris IA-32 and Linux. While the volume Sun offerings (Sun Fire V210 et al.) may prove attractive to existing Sun and other UNIX customers, a very large and growing IA-32 and Linux-on-IA-32 market cannot be denied. Sun has clearly gotten the message.

As noted in our last report, Sun needed aggressive marketing, product delivery, and better Solaris positioning to mount a visible Linux strategy. Sun's repositioning of Linux, the emergence of its Project Orion with its integration of the Sun ONE development environment, and the Madhatter client present Sun with the ammunition it needs.

OPEN SOURCE MOMENTUM

Linux and the open source movement represent a significant change in the marketplace. According to industry estimates, Linux is the fastest growing operating environment in the industry. It counts millions of users worldwide, is now second in marketshare in the *server operating system* market, and enjoys a leadership position in the edge-of-network (firewalls, proxy servers, DNS servers) and web serving environments. Linux has largely come to dominate the low-end UNIX server opportunity. Linux has opened the door for system suppliers to deliver and for customers to purchase a high-quality, low-cost, "good enough" solution for a significant number of systems needs. It is moving up-market from its traditional server environments, pushing into the enterprise, both as an IA-32 and mainframe server environment. It is becoming a significant force in the distributed and custom application space and represents the target for migration of more traditional UNIX enterprise applications. However, for Linux to be successful in the datacenter, it needs to be able to deliver full clustering, high availability, better scalability, and key kernel-level features such as locking and threading. With the availability of the Linux 2.6 kernel, Linux will be largely able to compete for many of the more advanced enterprise datacenter application environments.

The ease of migration from UNIX to Linux contributes to Linux enterprise growth. Dell and IBM have focused on exploiting that attribute, boring in on

UNIX-to-Linux migration as the vehicle to deliver IA 32 TCO. As Linux's value proposition improves with better enterprise features and scalability, it will compete more effectively with Windows. Even more likely, the Linux juggernaut will pressure UNIX. As one large enterprise customer said, "Linux is the most economically viable option for the broadest range of applications."

Despite these successes, as a *desktop client operating system*, Linux has not been successful. Its less than 5% share falls below the Apple Mac. Desktop operating system growth is slow because of a focus on the knowledge worker market and few compatible productivity applications required to reach that market. Microsoft dominates that market through its ownership of the Office suite. Even so, vertical markets and transactional markets (e.g., call centers) where the user does not need the high levels of features that Office delivers yield a new market segment for Linux. Several providers (Ximian, Lindows, Crossover Office, Sun StarOffice, and others) deliver additional ways to exploit Microsoft applications required for the traditional office user. Sun employs some of these features in its Madhatter project to build a client stack that targets this private (non-office) user environment. A critical success factor is going to be to the ability to use and share Microsoft office documents. The needs of developers and system managers and administrators stand out as the primary reasons for vendor investment in Linux desktop software. A large Linux desktop opportunity may well develop in the open source community.

While Linux has attained marginal traction in the desktop systems segment, it is becoming an operating environment of choice for technical workstations. Linux engineering workstation use has grown, starting first in digital animation, a former SGI stronghold, now moving into all uses. HP has led this market with its 3D workstations, now moving to other markets like electronic design automation and mechanical CAD.

Linux has beefed up its strength in non-desktop clients such as kiosks, PDAs, some embedded devices, and others. These devices typically do not require personal productivity applications or consumer-packaged applications. Rather, they are targeted at specific users for particular applications historically developed for a number of proprietary operating systems. The HP-sponsored handhelds.org is a good example of the growing community around the Linux-on-PDA market. Linux offers the benefits of standardization and customization without royalty fees to the copyright holder. By contrast, Linux and open source have been less successful in pervasive devices since the operating environment and application often must be very close to the hardware. At this point, Linux (and open source) remain the platforms of choice for environments that can be generalized and that can exploit broad industry solutions.

The open source model has created a large, dedicated, distributed development team that creates many of the basic services that enterprises need – web serving, file serving, and e-mail, for example – available at very low acquisition cost and very good quality. The model has also reduced the potential for vendor lock in to

proprietary offerings. Linux and open source embody the first real opportunity for system suppliers and customers to overcome the hegemony of Microsoft in the high-volume IT solution market. None of these developments mean that Windows goes away. Rather, Linux and open source provide a reasonable alternative to the Windows operating environment, especially the Windows application environment for the growing Internet, business-to-business (B2B) networking, and distributed and custom application markets. Finally, Linux pressures the existing UNIX offerings in that it provides a common high-volume application environment, attractive to ISVs.

VENDOR POSITIONING

Given the nature of Linux and open source, all open source solutions from the large, well-established firms can be viewed as “safe bets.” If a given vendor chooses to abandon its open source strategy, others are ready and able to pick up those customers with less disruption than with proprietary software. All the vendors’ marketing materials tout their commitment to Linux, and their websites for the most part communicate their offerings effectively. The following tables provide a summary of each system supplier’s strategy and offerings.

TABLE 8: Supplier Summary – Marketing

	Dell	HP	IBM	Sun
<i>Targeted Markets</i>	<ul style="list-style-type: none"> • UNIX-to-Linux migration • Enterprise (Oracle, SAP) • Retail point of purchase • Government • Financial/Banking • HPC/Scientific, Oil/Gas, Imaging) • Volume Linux market • Edge servers • Enterprise infrastructure – file/print, e-mail, etc. 	<ul style="list-style-type: none"> • Enterprise • Edge-of-network • Internet infrastructure • Service providers • Telco • Financial services • Government • Technical/Scientific • Digital content creation • Electronic design • Mechanical design and simulation • Application development 	<ul style="list-style-type: none"> • Enterprise and SMB • Server consolidation • Edge-of-network • Internet infrastructure • Service providers • Telco • Finance • Government • Retail • Technical/ Scientific • Electronic design • Mechanical design and simulation • Application development 	<ul style="list-style-type: none"> • Edge-of-network • Appliances • Internet infrastructure • Application development • Service providers • Commercial enterprise • Technical/Scientific • EDA • Life sciences • Aerospace/Mechanical • Telco • Finance • Government
<i>Channels</i>	<ul style="list-style-type: none"> • Direct sales • Web-direct 	<ul style="list-style-type: none"> • Direct sales • Web-direct • Indirect channel/VAR 	<ul style="list-style-type: none"> • Direct sales • Web-direct • Indirect channel/VAR 	<ul style="list-style-type: none"> • Direct sales • Web-direct • Indirect channel/VAR
<i>Joint Marketing with Linux Distributors</i>	Yes – Red Hat only	Yes	Yes	Yes – Red Hat only

TABLE 9: Supplier Summary – Product Development (Part I)

	Dell	HP	IBM	Sun
<i>Offerings – Server Platforms, Appliances, Clients, Personal Appliances</i>	<ul style="list-style-type: none"> • Supports Red Hat on all PowerEdge tower and rack servers and appliances • SuSE and Turbolinux certify PE and Optiplex systems • Delivers Linux HPCC systems using open source approach • Supports Linux on Precision workstations • Supports Custom Factory Installation for desktop clients • Preloads Linux at customer request 	<ul style="list-style-type: none"> • Supports Red Hat, Debian, SuSE, and UnitedLinux-based distributions such as Turbolinux, on HP rack and tower IA-32 servers, plus Linux on HP blade, and carrier-grade servers • Supports Red Hat on AlphaServer • VMWare supported on selected IA-32 servers • Supports Linux on workstations and selected desktop and laptop clients • Has a Linux port on PA-RISC hardware • Appliances • Supports iPAQ • Linux-on-Itanium workstations and servers • Turnkey performance cluster – ClusterBlocks 	<ul style="list-style-type: none"> • Supports Red Hat, UnitedLinux on xSeries Intel servers, carrier-grade servers, and selected clients • Preloads Red Hat for free on xSeries • SuSE on pSeries • VMWare supported on selected xSeries models • Supports Linux on workstations and selected desktop clients • Red Hat, UnitedLinux, pSeries, iSeries, and zSeries models • Appliances • Supports Linux on IPF servers • Future support for AMD Opteron 	<ul style="list-style-type: none"> • Builds custom, appliance-focused distribution from standard Linux source • Red Hat (and potentially others) as its primary distribution • Plans to deliver a Linux client stack • Plans to deliver a pre-integrated server stack for Solaris and Linux
<i>Modifying Proprietary UNIX to Support Linux</i>	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • Added Linux APIs for source compatibility • Targeting common ABI on IA-64 • Supports open source tools directly on HP-UX for cross development • Providing Tru64 libraries/binaries for Alpha Linux • Common compilers and tools available for Alpha Linux and Tru64 • Common calling standard and kernel services (95% approximately) between Linux and HP-UX/Tru64 • Added GCC (GNU C Compiler) compatibility 	<ul style="list-style-type: none"> • Added Linux APIs for source compatibility • Supports open source tools on AIX for cross-platform development 	<ul style="list-style-type: none"> • Providing Linux source compatibility in Solaris • Supports open source tools on Solaris • GCC compatibility in Sun ONE Studio • Linux API libraries, commands in Solaris • Companion CD with prebuilt applications to run on Solaris

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TABLE 10: Supplier Summary – Product Development (Part II)

	Dell	HP	IBM	Sun
<i>Porting Linux-to-RISC</i>	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • PA-RISC (limited) • Alpha is supported with Red Hat 7.2 	<ul style="list-style-type: none"> • POWER • S/390, zSeries 	<ul style="list-style-type: none"> • To SPARC for embedded market only
<i>Shipping Middleware on Linux</i>	<ul style="list-style-type: none"> • Available through Custom Factory Integration, Dell software and peripherals 	<ul style="list-style-type: none"> • Web JetAdmin • OpenView • Insight Manager • Utility Data Center • TopTools • Service Control Manager and PRM • Rapid deployment • Serviceguard for Linux – SG/LX • Internet Usage Manager • Opencall SS7 • Storage management • Disaster recovery storage software • HP Oracle Parallel Cluster Kit 	<ul style="list-style-type: none"> • DB/2 • Lotus • Tivoli • WebSphere Application Server • WebSphere Portal • WebSphere MQ • WebSphere Application Server Express • DB2 Express • Informix Dynamic Server • Most of IBM's e-Business Software stack (over 60 products) • Cluster Systems Management (CSM) • General Parallel File System • IBM Director 	<ul style="list-style-type: none"> • iPlanet Web, Messaging and Directory Servers • Chili!Soft • Planning to port and support all Sun ONE components including J2ME, J2SE, and J2EE (iPlanet Application Server)
<i>Providing Development Tools on Linux</i>	<ul style="list-style-type: none"> • No • Dell Oracle Deployment CD 	<ul style="list-style-type: none"> • Yes • Programmer's tool kit • OpenCall SS7 SDK • IPF SDK 	<ul style="list-style-type: none"> • Yes • IBM UNIX development tools • WebSphere Studio Application Developer • WebSphere Studio Site Developer • WebSphere SDK • Rational ClearCase • Rational ClearQuest 	<ul style="list-style-type: none"> • Yes • Sun ONE Studio • LinCAT • ABI Check • JXTA

TABLE 11: Supplier Summary – Support (Part I)

	Dell	HP	IBM	Sun
<i>Operating System Preload</i>	<ul style="list-style-type: none"> • Factory preload for Red Hat, Custom Factory Installation (CFI) for other distributions, or user installed 	<ul style="list-style-type: none"> • Factory preload option for IA-32 servers and IA-64 • Pre-installed by the channel • Fully integrated and preloaded on HP 3D Linux workstations • Turnkey cluster configurations 	<ul style="list-style-type: none"> • Not as part of normal order process • Red Hat preloaded by IBM for a fee on xSeries • Preinstalled by channel • Other distributions downloaded or installed in channel (p, i, and xSeries) or on CD (zSeries) • Preload service 	<ul style="list-style-type: none"> • Cobalt operating system preloaded and customized for appliance function • Sun Linux on LX 50 • Red Hat
<i>Application/ Middleware Preload</i>	<ul style="list-style-type: none"> • Appliances • Cache server • Load balancing • Web servers • DellPlus services CFi9iAS, Websphere, through Dell software and peripherals 	<ul style="list-style-type: none"> • Custom integration services available • Appliance specific • Active Answers solutions • Oracle 9i RAC • Sendmail • Cluster software with ClusterBlocks program 	<ul style="list-style-type: none"> • Websphere/DB2 in Integrated Platform Offering for xSeries, zSeries • WebSphere/DB2 Express for Integrated Platform for xSeries • DB2, WebSphere, mySAP CRM, mySAP BI for xSeries cluster offering • Cluster software (CSM) for 1350 cluster product • Specific solutions – Domino • Appliance specific 	<ul style="list-style-type: none"> • Appliance specific
<i>Product Support</i>	<ul style="list-style-type: none"> • Worldwide, provided by Dell and Red Hat for all Dell platforms • Electronic support • Customer mailing lists • Professional services for design validation, installing, deployment, tuning, configuration, technical consulting, benchmarking, etc. • Educational and training services available through Dell Professional Services and Red Hat partnership 	<ul style="list-style-type: none"> • Worldwide, provided by HP (and partners in back end) for multiple vendor platforms and multiple distributions • Electronic support • Professional services for consulting, install, administration, operations, porting, etc. • Education/ training services • High-availability services • Professional services in telco integration • Outsourcing 	<ul style="list-style-type: none"> • Worldwide, provided via IBM Global Services and partners with distribution support • Electronic support • Professional services for consulting, install, administration, operations, porting, etc. • Education/ training services • High-availability services • Security services • Outsourcing 	<ul style="list-style-type: none"> • Worldwide, provided by Sun • Electronic and community support • Appliance-oriented support – warranty and “Spare-in-the-Air” • Education/training services • Professional Services

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TABLE 12: Supplier Summary – Support (Part II)

	Dell	HP	IBM	Sun
<i>Platforms Supported</i>	<ul style="list-style-type: none"> • Intel IA-32 • IA-64 (7150 planned for 2H2003) 	<ul style="list-style-type: none"> • Intel IA-32 and IA-64 • PA-RISC (limited) • RISC (Alpha) • StongArm 	<ul style="list-style-type: none"> • Intel IA-32 and IA-64 • RISC (Power) • S/390 (and zArchitecture) 	<ul style="list-style-type: none"> • x86 • RISC (embedded)
<i>Distribution Supported</i>	<ul style="list-style-type: none"> • Red Hat 	<ul style="list-style-type: none"> • Red Hat, Debian, SuSE, Turbolinux, and UnitedLinux-based distributions • Commercial desktops also support Mandrake 	<ul style="list-style-type: none"> • Red Hat, SuSE, Conectiva, Turbolinux 	<ul style="list-style-type: none"> • Cobalt operating system • Red Hat • Others (future)
<i>Linux Training</i>	<ul style="list-style-type: none"> • Yes 	<ul style="list-style-type: none"> • Yes – • Web-based • Classroom 	<ul style="list-style-type: none"> • Yes – • Web-based • Classroom 	<ul style="list-style-type: none"> • Yes – • Web-based • Self • Classroom

TABLE 13: Supplier Summary – Community Participation (Part I)

	Dell	HP	IBM	Sun
<i>Contribute Open Source Operating System Code to Linux</i>	<ul style="list-style-type: none"> • Device drivers • IPF 	<ul style="list-style-type: none"> • Device drivers, printing, all-in-one drivers, Debian, GNOME, tape drivers • IPF kernel maintainer • Gelato – technical computing • Trusted/secure Linux • Performance tools • Systems imager 	<ul style="list-style-type: none"> • Linux Technology Center (250+ people) – device drivers, journaling file system, cluster install, serviceability tools, web application tools, AFS, GNOME, KDE (K Desktop Environment), and others • IPF • Maintainer of 29 Linux projects 	<ul style="list-style-type: none"> • Device drivers, X Internationalization Framework, GNOME, NFS, ABI Check, scalable type technology
<i>Contribute Open Source Application and Middleware</i>	<ul style="list-style-type: none"> • Linux management software 	<ul style="list-style-type: none"> • Apache • Single System Image – OpenSSI • Large scale modeling software • Java tools • Samba • Chai embedded application server • Intelligent mobile device software 	<ul style="list-style-type: none"> • Apache • Eclipse • Samba • Tool Box for Java • Web Services • NFS 	<ul style="list-style-type: none"> • StarOffice • JXTA • Mozilla • NetBeans • Apache • Gridware • WEBM services

TABLE 14: Supplier Summary – Community Participation (Part II)

	Dell	HP	IBM	Sun
<i>Open Source Development Lab (OSDL) Member</i>	<ul style="list-style-type: none"> • Yes 	<ul style="list-style-type: none"> • Yes • On board 	<ul style="list-style-type: none"> • Yes • On board 	<ul style="list-style-type: none"> • Yes
<i>Community Investments/ Leadership/ Key Relationships</i>	<ul style="list-style-type: none"> • Red Hat – initial investor • Linuxcare – initial investor • VMWare • CollabNet • IHVs • Free Standards Group • OSCAR 	<ul style="list-style-type: none"> • CollabNet investor • Red Hat – through pension fund • SteelEye – investor • Aduva investor • Free Standards Group • Linux International • Turbolinux – investor • Free Standards Group • Free Software Foundation • Open Source Software Institute • GNOME Foundation • Handhelds.org • Sendmail • Covalent • SuSE (NUMA, Alpha) • UnitedLinux 	<ul style="list-style-type: none"> • Red Hat – investor • UnitedLinux • DeveloperWorks • Free Standards Group • Linux International • Free Software Foundation • Globus • Service Availability Forum • VA Software - SourceForge 	<ul style="list-style-type: none"> • Linux International • X.org • OpenOffice.org • CollabNet • Free Standards Group • BigADMIN • Linuxcare • Lineo • Timesys

LINUX PLATFORM OFFERINGS

DELL

Dell provides Linux availability across its full product line – PowerEdge Servers, PowerEdge Blades, appliances, and Precision workstations. Dell will also make Linux available on any system product it builds. Following this approach, Linux preload for Red Hat Linux has been offered for these systems since Linux support began over three years ago. Dell’s Custom Factory Integration (CFI) service is available as well for customers who may request any software configurations preloaded at the factory. This includes applications and covers any Dell system. The flexibility of this program enables customers to define unique configurations for geographic or other distributions and have Dell manage it. Any industry Linux distribution or customer-provided Linux image along with configuration information is covered. Dell’s customer-based model places a premium on speed to customer focused requirements. Customer set up time falls, management issues shrink, and time to production shortens.

Dell continues to build its server management capability. Its “at the box” system management, through its Open Manage offering, focuses on management at the hardware and into the operating system layers to bridge the interface. Relying on partners, higher levels of system management can be achieved. Dell’s server assistant, for example, helps install the operating system, including Linux, and ensures that the right mix of drivers is selected. The OpenManage Server Administrator provides a management console, either directly at the server or remotely through a browser interface, for the server. It also supports hardware setup, event threshold setup, and manages diagnostics for PowerEdge or servers running Linux. The console can be centralized as well. Remote out-of-band management through the Dell Remote Administration Console (RAC) enhances the system. New Dell systems incorporate Embedded Remote Access (ERA). ERA serves as an RAC, but does not require a slot. Dell recently made a major addition to its OpenManage tools, introducing the Dell OpenManage Remote Install software supported first on its PowerEdge 1655MC blade servers. This enhancement allows remote server deployments including installation and configuration of servers using a preconfigured image repository. Dell is working with its UNIX migration customers to deliver a command-line version of its consoles that enables scripting, offering a UNIX-like approach to the management problem.

Targeting High HPCC as a rapidly growing Linux segment, Dell has delivered its own set of integrated HPC products (up to 128-node cluster), as well as an agreement with supercomputer manufacturer, Cray, to provide high-performance clustering solutions based on the PowerEdge servers running Linux. Cray will integrate the Dell offerings with Linux cluster software and libraries in order to provide a turnkey solution to high-end customers. Dell has also established relationships with other suppliers in multiple industries to deliver solutions on its HPCC offerings. These include TurboWorx, Platform, and others. They provide Dell Grid solutions using its HPCC hardware. The Dell’s modular HPCC products can use Dell 1650 and 2650 servers or Dell’s blade servers. Dell employs open source solutions and the accompanying management, such as OSCAR. These in turn are augmented with closed source enhancements in its OpenManage software for clusters as needed. Dell positions clustering as a preferable way to scale. However, Dell’s Linux cluster offerings can change the price/performance dynamic given that price premium customers have to pay for higher end systems. Dell targets its HPCC solutions largely to industry verticals such as bioinformatics and energy services.

Dell continues to address the Linux enterprise market and the UNIX-to-IA-32 Linux migration opportunity with certified and preloaded Oracle9i database and Oracle9i Real Application Cluster (RAC) configurations on PowerEdge servers. Dell supports the Oracle9i RAC configurations of up to four PowerEdge servers, using up to four Intel Xeon MP processors per server with 32 GB of ECC SDRAM per server, along with the Dell/EMC Storage Area Network (SAN) implementations. This cluster supports all Dell servers from the 2650 through the 8450. Dell offers a complete set of services around the Oracle 9i RAC system,

including deployment, support and professional services for design, tuning, etc. As Dell's primary enterprise thrust, Dell's commitment of technical staff to support enterprise pilots and deployments provides substantial visibility.

SAP deployments represent another Dell enterprise focus. Dell has certified its rack servers for SAP solutions on Linux. It has also assigned dedicated technical and engineering resources as part of the SAP Linux Lab development team at SAP headquarters in Waldorf, Germany. Again, this is part of the Dell quick response model to customer requirements. This strategy rests less on interest in the technology of Linux, and more on customer deployment. Dell is establishing a substantial storage business as part of its EMC relationship. To augment that for the Linux space, Dell is partnering with VERITAS and others to position itself well for Linux installations for the enterprise.

Red Hat, Dell's primary Linux distribution, is the primary test vehicle for Dell Linux systems. Dell professional services resell Red Hat services. Dell preloads Red Hat Professional and Advanced Server versions as part of its normal operating system preload process. Depending on geography or customer interest, other Linux distributions need to be available. To address that, Dell provides equipment to SuSE for certification in the European market and has worked with Red Flag for the China and Asian market. Dell will install a custom configured Linux distribution through its CFI process, as noted above.

Finally, Dell has invested in professional services for Linux including Linux business consulting, ROI analysis, customized engagements, and application solution centers to validate and tune solutions, as well as design validation and customized approaches including Dell Custom Integration. Consistent with the Dell model, these services tend to focus narrowly on Dell customer relationship and support. While they are not as broad or as deep as IBM's or HP's services offerings, their purpose clearly diverges.

HP

HP follows a holistic view of Linux across its product line, spanning support across hardware and software offerings. HP has positioned Linux as one of its Tier 1 operating environments – HP-UX, Windows, and Linux – and has structured its support and services to deliver the same level of capability across all three environments. HP enables Linux on its entire product line of Intel architecture-based (IA-32 and IA-64) products including its ProLiant and two blade server architectures, its ProLiant appliances, the Evo desktops, HP workstations, and even the iPAQ handheld. HP also delivers carrier-grade Linux servers designed specifically for the telco market with NEBS compliance and AC/DC power supply options. An early proponent of open sourcing drivers for its proprietary graphics cards, HP now fully supports the Linux drivers on its entire range of graphics cards. HP-UX servers provide source code compatibility and Linux runtime support as well as binary compatibility on HP-UX on Itanium. Given its processor strategy, HP offers aggressive Linux support on the Itanium

architecture for workstations and servers. HP led the port of the Linux kernel to Itanium and the primary maintainers work at HP.

HP recently announced its second-generation blade offering with support for Red Hat Linux and SuSE. The blade servers are targeted for Linux deployment in high-density, rack-optimized environments, and particularly front-end type applications. HP reports that Linux is deployed on 30-50% of the blade shipments depending on model.

HP also offers carrier-grade Linux servers (ccx300) designed specifically for the telco market with NEBS compliance and AC/DC power supply options.

For small- and medium-sized businesses, HP offers an end-user ProLiant package bundled with Mitel Networks' SME Server v5 software. This appliance-type solution based on the ProLiant ML 300 series hardware provides web hosting, e-mail, firewall, remote access, directory services, and file- and print-sharing features, with the flexibility to exploit additional functionality of the Linux platform. The package also includes subscription to a suite of management services for virus protection, IPSEC VPNs (Virtual Private Networks), guaranteed mail delivery, 24x7 monitoring, and DNS (Domain Name Services) configuration.

Many of these developments are not new. HP high-performance workstations running Linux have been on the market for over three years. Among the first suppliers to offer its own Linux drivers for its graphics cards, HP now fully supports the Linux drivers on its entire range of graphics cards. This represents one of the most expansive sets of graphics cards supporting Linux in the industry, managed under its Leadership Graphics Program. HP was also an early supporter of 64-bit Linux on its AlphaServer line. The Linux support on HP's PA-RISC architecture is achieved through a cooperative open source development effort. Given its processor strategy, HP aggressively supports Linux on the Itanium architecture for workstations and servers. And, HP led the port of the Linux kernel to Itanium and some of the primary developers' work at HP.

Supporting its system strategy, HP has ported a broad portfolio of software tools to the Linux environment, including Rapid Deployment software, Insight Manager, ServiceControl Manager, Omniback II, JetAdmin and CPU resource management (Process Resource Manager) to overall system management. HP provides agents that run on Linux servers feeding information to its HP OpenView for a comprehensive management portfolio. This includes HP's full storage management suite for its disk arrays. HP has ported its Serviceguard high-availability software to run on Linux from its successful HP-UX environment. With this software, HP offers a one stop high-availability Linux clustering solution. The cluster levels have been certified: departmental (low entry cost), infrastructure (scalable Fibre Channel [FC] clusters) and enterprise (highly scalable and reliable clusters). All fall under its HP Serviceguard for Linux ProLiant cluster software.

Building on its early achievements, HP has launched an effort to broaden its high-availability Linux cluster solutions through the SteelEye alliance. Recently announcing a packaged server cluster with support for the LifeKeeper software, other solutions include a Linux-based firewall package with CheckPoint, secure web serving with Covalent Enterprise web server software, Zeus high-performance web servers, hosting management solutions with Ensim's WEBpliance and ServerXchange products, and Sendmail Integrated Mail Suite (IMS) for e-mail messaging. HP supports VMWare software for Linux server consolidation. For middleware, HP has also joined with VERITAS's Foundation Suite that includes the VERITAS Volume Manager and the VERITAS File System.

In support of its focus on the telco market, HP has ported its Opencall SS7 software to Linux. A software development kit (SDK) is also available. Also supported is HP's OpenView Internet Usage Manager.

The HP utility datacenter with the utility controller software provides a turnkey offering for datacenter customers whose objective is to optimize their datacenter resources when running Linux (or other operating systems), storage, and networking gear.

Further, HP aggressively pursues enterprise ISVs for its Linux platforms that serve the emerging segment. These companies include BEA Systems for J2EE, Oracle for database and enterprise applications, and SAP for ERP. HP has also teamed with Reuters on its software that is used to deliver information to financial services companies.

Building on its experience in High-Performance Technical Computing (HPTC), HP has extended its portfolio to include Beowulf and other Linux clustering solutions. HP has delivered and supports some of the largest Linux cluster deployments, such as PNNL and Sandia (with over 2,000 nodes), as well as major installations at commercial sites such as BP, Ford, and Toyota. The HP Linux ClusterBlocks products include both Linux 32 (using Intel Xeon processors) and Linux 64 (using 64-bit Itanium 2-based servers) nodes with a choice of management tools from leading ISVs, including Scyld (Beowulf clustering solution), and Scali (Scali Manage and MPI Connect). HP Consulting and Integration Services also supports open source-based options from OSCAR or NPACI Rocks. In addition, MSC.Software and Linux NetworX offer their software suites on HP platforms, as an HP reseller. Through these partnerships with the major cluster software developers in the Linux community, HP is able to deliver and support preconfigured, tested, and performance-optimized high-performance Linux clustering solutions, integrated with a choice of interconnects (HP, Myricom, Cyclades and Extreme Networks), as well as software options for file systems, resource management, and applications.

HP supports Red Hat, SuSE, as well as UnitedLinux-based distributions (including Turbolinux and Connectiva) for its server platforms. HP also offers Mandrake for its commercial desktops.

IBM

IBM supports Linux across its entire server and professional workstation product lines – from entry xSeries servers and IntelliStations to large IA-32 clusters to the zSeries mainframe. This support crosses technologies (IA-32, POWER RISC) and even operating environments (Linux on zVM). Linux is supported across the entire Intel-based xSeries servers, the iSeries integrated servers, pSeries RISC servers, and the zSeries mainframes. IBM has created a Linux version of one of its mainframe models, the z800 server, storage, and z/VM virtualization technology. Support and service are also provided in this package. IBM also offers Linux versions of one of its pSeries RISC systems – the p630 and p650 Express Configurations. In addition, IBM is modifying its proprietary operating environments to support Linux in either an LPAR or in adding Linux APIs to AIX to provide source compatibility.

Most models within the e-Server line support Linux. As does the rest of the industry, IBM targets the xSeries IA-32 servers as its Linux volume server platform. For the xSeries, the IBM Director allows installation and administration of multiple Linux images and runs natively on the server and provides a significant server management capability. Also, IBM recently announced a partnership with VMWare to provide the latter's virtual machine software on the xSeries hardware, enabling partitioning. By positioning its pSeries RISC servers as its high-end 64-bit Linux platforms and POWER4 systems against the IA-64 IPF systems for high-end application requirements, IBM expanded its IPF efforts. The introduction of the xSeries model x450, an Intel Architecture platform positioned for workload consolidation and midrange application processing, expanded the IPF line. For HPC, IBM announced its plans to offer a server product based on the AMD Opteron processor.

Linux is supported on the iSeries in up to 31 Linux partitions. Linux on the zSeries is supported in native mode, in up to 16 LPARs, and as z/VM guests, creating hundreds of Linux images on a single system. IBM has begun to offer preload of SuSE Linux Enterprise Server 8 on its pSeries servers. It is yet to offer similar capability on the IA-32 servers, but does offer it in certain packaged configurations. However, a full set of services and support for Linux installation is available through its services organization and IBM Help Centers. IBM supports Red Hat, SuSE, and Turbolinux distributions.

IBM's client and professional workstations also support Linux, which is certified on all IntelliStation models. In addition, IBM does complete functional and systems testing with the latest versions of RedHat on both the M Pro and Z Pro workstations. Select Z Pro models are available with a RedHat preload. IBM offers Linux-based thin clients with browser-based access to server applications. These thin client systems obtain access to server and basic office applications using IBM's WebSphere Portal Server, portlets (via Mozilla), and Lotus iNotes Web Access. IBM plans to preload Linux (Red Hat or SuSE) on some models of the new ThinkCentre desktop line.

A significant technology for IBM software, Linux allows IBM to create an alternative to Microsoft's platform. The belief is that the Linux market is broadening and that the availability of the Linux 2.6 kernel will spur customers to invest in higher scale servers. This in turn will drive higher value software. To position themselves for today's volume market and the emerging transactional market, IBM has ported its portfolio of software tools, middleware, and system management to Linux. Key software solutions including DB2 Universal Database, WebSphere suite (including MQ), Lotus Domino messaging and collaboration, Rational software tools and the Tivoli product suite are all supported on Linux. IBM has also constructed Express versions of its software appropriate for Linux. Beyond that IBM offers dozens of other solution packages tested and certified for the Linux platform on several of its hardware offerings.

IBM has also moved aggressively in attracting the ISV community to Linux. Multiple programs make it easy to port, and provide no-charge versions of middleware to remove financial inhibitors to porting, and support of various kinds to help ISVs and corporate developers take their applications and subsystems to Linux. The list of ISV applications certified on IBM hardware running Linux is growing; IBM references over 3,000 applications for Linux. A significant list of applications available for Linux appears on IBM's website, which also provides a software compatibility matrix for all of its own middleware showing which distributions and hardware platforms are supported with each offering.

IBM's cluster products fully embrace Linux as well. IBM delivers the Cluster 1350, running on a standard Linux distribution. Its cluster solutions are targeted at both the high performance and commercial computing markets. The 1350 cluster uses IBM xSeries 335 and 345 servers, RedHat or SuSE distributions, and exploits IBM Cluster Systems Management (CSM) and the IBM General Parallel File System (GPFS). These IBM components are based on the IBM Parallel System Support Program (PSSP) for AIX, which enjoys substantial market experience. The fully tested and preconfigured 1,350 cluster solution (up to 512 nodes) carries a full set of integration, setup, installation, and warranty services. Consistent with IBM's server model, the cluster is equipped with an embedded service processor. The CSM provides comprehensive cluster installation, administration, and remote management capabilities through a single point of control. The GPFS provides a Linux shared disk file system that can be configured for availability, and IBM's FastT FC-based storage disk arrays.

IBM's Global Services unit provides a comprehensive set of service offerings targeting Linux. These include business consulting, system implementation, TEchnical support services, education, application development and porting, and outsourcing, including virtual Linux services. The services unit supports all Linux industry system providers, reaching well beyond IBM systems and software for their business. In addition, IBM Global Services developed partnerships with Linux software providers to enable IBM Global Services to deliver a full range of desktop Linux solutions. IBM Global Services formed an agreement with Ximian to resell Ximian management, desktop, and messaging products, providing an integrated,

centrally managed desktop environment. IBM uses these relationships to add services value to UNIX-to-Linux migrations for government, industrial, and telco customers. IBM Global Services offers an Open Client assessment service to help customers assess which user needs can be best met by Linux versus traditional clients.

SUN

Sun currently offers multiple products in the Linux market – the Cobalt appliance server line, the LX50 IA-32 servers, and the recently announced Sun Fire V60x and Sun Fire V65x. In addition, the line includes the Sun Fire Blade Platform and Sun Technical Cluster Products. The Sun LX50 server comes pre-loaded with a rich software stack including Sun ONE ASP for Linux, MySQL database and Sun Grid Engine software, in addition to other tools found commonly on Linux servers. Sun has also introduced a very cost-effective VPN/firewall appliance based on the Sun LX50 server with software from CheckPoint. The Sun LX50 server can also participate in a Linux cluster running Sun's Grid Engine software. Sun plans to offer an x86 blade server running Linux later this year. The Sun Fire V60x and Sun Fire V65x servers deliver a dual Intel Xeon processor-based system with either Red Hat Linux or Solaris 9, x86. The Sun Fire V65 yields more PCI expansion capability and up to 12 GB of SDRAM. The Sun Fire V65x features include additional high availability such as redundant power supplies and optional failover booting to a single CPU. These new systems will be preloaded with Sun's Linux software stack – Red Hat Linux, open source software, Java, and Sun ONE software.

Sun ranks as a long-time contributor to the Linux community and supporter of Linux software. Among the organizations that Sun contributes to in the open source community are OpenOffice.org, GNOME.org, Mozilla.org, Apache.org, NetBeans.org, X.org, WBEMsource Initiative, the University of Michigan NFS version 4 Linux port, the Grid Engine Project, and Project JXTA.

The company plans a more aggressive role in this community, which will take in additional software contributions. It will also lend its expertise to the open source software community, including contributions to the Linux kernel. Some key software solutions from Sun already available on the Linux platform include the Grid Engine, distributed resource management software, StarOffice application, Sun ONE Web Server, Sun ONE ASP, and development tools including Sun ONE Studio for Java, and Java 2 Standard Edition. The Sun StorEdge T3 enterprise disk array is also supported on Linux with device drivers from Linuxcare. Sun recently delivered an application development tool, ABIcheck, to the open source community. The tool helps ensure compatibility between Linux releases.

Sun has adopted Red Hat as the first industry-standard Linux distribution it plans to support to make that mainstream more consistent with the rest of the industry. Sun is developing a new integrated software model using open source and Sun middleware called Project Orion. The plan is for Orion to support Solaris/SPARC, Solaris x86, and Linux with a common software stack. Similarly, Sun plans to apply all of its services to its Linux offerings at the same level it provides for Solaris offerings.

TABLE 15: IA-32 Server Compatibility Matrix

	Dell	HP	IBM	Sun
<i>Processor Speed</i>	2 GHz Xeon MP	2 GHz Xeon MP	2 GHz Xeon MP	3.06 GHz Intel Xeon
<i>No. of CPUs Supported</i>	Up to 8 CPUs	Up to 8 CPUs	Up to 16 CPUs	Up to 2 CPUs
<i>Cluster</i>	<p><i>Building Blocks:</i></p> <ul style="list-style-type: none"> • Yes <p><i>HPC:</i></p> <ul style="list-style-type: none"> • Beowulf Cluster Offerings • Partnership with Cray for high-end and sophisticated HPC deployments <p><i>HA:</i></p> <ul style="list-style-type: none"> • Certified with SteelEye 	<p><i>Building Blocks:</i></p> <ul style="list-style-type: none"> • Yes <p><i>HPC:</i></p> <ul style="list-style-type: none"> • Beowulf Cluster Offerings • Partnership with MSC Software for Beowulf-like Clusters <p><i>HA:</i></p> <ul style="list-style-type: none"> • HP Serviceguard • Certified with SteelEye 	<p><i>Building Blocks:</i></p> <ul style="list-style-type: none"> • Yes <p><i>HPC:</i></p> <ul style="list-style-type: none"> • Beowulf Cluster Offerings • CSM management software • GPFS file system <p><i>HA:</i></p> <ul style="list-style-type: none"> • PolyServe Matrix HA • PolyServe Matrix Cluster File System 	<p><i>Building Blocks:</i></p> <ul style="list-style-type: none"> • Yes <p><i>HPC:</i></p> <ul style="list-style-type: none"> • Beowulf Cluster Offerings • GridEngine software <p><i>HA:</i></p> <ul style="list-style-type: none"> • No
<i>Memory*</i>	Up to 32 GB	Up to 16 GB	Up to 40 GB	Up to 12 GB
<i>Management Tools</i>	<p><i>Installation:</i></p> <ul style="list-style-type: none"> • OpenManage Server Assistant • OpenManage Remote Install <p><i>System Management:</i></p> <ul style="list-style-type: none"> • OpenManage Server Administrator <p><i>Remote Management:</i></p> <ul style="list-style-type: none"> • Dell Remote Access Card 	<p><i>Installation:</i></p> <ul style="list-style-type: none"> • SmartStart • Rapid Deployment Pack <p><i>System Management:</i></p> <ul style="list-style-type: none"> • Insight Manager agents • ServiceControl Manager <p><i>Remote Management:</i></p> <ul style="list-style-type: none"> • Remote Lights-Out Edition 	<p><i>Installation:</i></p> <ul style="list-style-type: none"> • ServerGuide • Remote Deployment Manager <p><i>System Management:</i></p> <ul style="list-style-type: none"> • IBM Director <p><i>Remote Management:</i></p> <ul style="list-style-type: none"> • Remote supervisor adapter 	<p><i>Installation:</i></p> <ul style="list-style-type: none"> • Sun Cobalt Control Station <p><i>System Management:</i></p> <ul style="list-style-type: none"> • Sun Cobalt Control Station <p><i>Remote Management:</i></p> <ul style="list-style-type: none"> • Baseboard Management Controller

* Linux supports up to 64 GB memory on Itanium hardware.

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Linux Server Suppliers Contend for Leadership*
Operating Environments for Industry-Standard Servers, August 2003

TABLE 16: Examples of Linux System Pricing as of June 3, 2003

	Dell	HP	IBM	Sun
<i>Appliance</i>	\$1,657	N/A	N/A	\$2,298
<ul style="list-style-type: none"> • 1U web hosting 	<ul style="list-style-type: none"> • PowerEdge Web 1650 • 1.26 GHz PIII • 256 MB RAM • 80 GB IDE 			<ul style="list-style-type: none"> • Cobalt RaQ 550 • 1.26 GHz PIII • 256 MB RAM • 80 GB IDE
<i>Entry Rack System</i>	\$4,047	\$4,326	\$4,466	\$3,772
<ul style="list-style-type: none"> • CPU • 512 MB • 2x36 GB mirrored SCSI disk • Remote management • 2xGbE NICs 	<ul style="list-style-type: none"> • PowerEdge 1750 • 3.0 GHz Intel Xeon • Embedded PERC4/Di RAID • Embedded remote access • Dual GbE NICs (2 PCI slots) 	<ul style="list-style-type: none"> • ProLiant DL360-G3 • 3.06 GHz Intel Xeon • Embedded Smart Array 5i+ plus RAID • iLO Advanced Pack • Embedded dual GbE NICs 	<ul style="list-style-type: none"> • xSeries 335 • 3.06 GHz Intel Xeon • Integrated RAID-1 • Remote supervisor adapter • Embedded dual GbE NICs 	<ul style="list-style-type: none"> • Sun Fire V60x • 2.8 GHz Intel Xeon • PCI RAID • Embedded dual GbE NICs (limited remote management)
<i>Midrange System</i>	\$4,989	\$6,429	\$6,223	\$5,922
<ul style="list-style-type: none"> • 2x2.8 GHz Intel Xeon • 2 GB • 2x72 GB Mirrored SCSI disk with hardware RAID • Remote management • 2xGbE NICs 	<ul style="list-style-type: none"> • PowerEdge 2650 • Embedded PERC3/Di RAID • Embedded remote access 	<ul style="list-style-type: none"> • ProLiant DL380-G3 • Embedded Smart Array 5i+ plus RAID • Integrated Lights-Out Management 	<ul style="list-style-type: none"> • xSeries 345 • Integrated RAID-1 • Remote supervisor adapter 	<ul style="list-style-type: none"> • Sun Fire V65x • PCI RAID (limited remote management)
<i>High-End System</i>	\$27,064	\$31,844	\$31,173	N/A
<ul style="list-style-type: none"> • 4x2.0 GHz Xeon MP • 4 GB • 2x73 GB mirrored SCSI disk • Hot-plug, RAID 1 • 2xGbE NICs 	<ul style="list-style-type: none"> • PowerEdge 6650 • PCI RAID • PCI Remote access card • Embedded dual GbE NICs 	<ul style="list-style-type: none"> • ProLiant DL560 • Embedded Smart Array 5i+ plus RAID • Integrated Lights-Out Management • Embedded dual GbE NICs 	<ul style="list-style-type: none"> • xSeries 360 • PCI RAID • Integrated remote supervisor adapter • Dual GbE NICs (2 PCI slots) 	
<i>Itanium 2</i>	N/A	\$81,886	\$73,295	N/A
<ul style="list-style-type: none"> • 2x1.0 GHz Itanium 2 • 8 GB RAM • 2x73 GB mirrored SCSI disk • RAID, DVD • 2xGbE NICs • 3 yr 24x7x4 hardware warranty • Linux operating system 		<ul style="list-style-type: none"> • HP Server rx5670 	<ul style="list-style-type: none"> • xSeries 450 	

SYSTEM PRICING: COMPARISON OF ENTRY AND CONFIGURED PRICES

All the traditional system suppliers offer a full range of Intel system server offerings, from entry to high-end eight-way SMP systems, with IBM offering up to a 16-way SMP server. The configurations below are priced independently of the operating system except in the appliance category where the Linux operating system has been added to the Dell configuration. This was done because Sun bundles the operating system as part of its standard configuration. The table above represents list pricing for the configurations shown. These configurations are meant to be demonstrative and do not address specific application requirements, although they were derived from other sources that reflect entry, midrange, and high-end system usage. They do not reflect volume pricing that these suppliers may offer.³ Systems with the Itanium 2 processor follow a different discount structure than typical IA-32 servers.

Note: A feature set comparison of the above systems is beyond the scope of this report. Users may check the underlying features such as integrated remote management adapters, RAID controllers, redundant power supplies, and cooling fans, in addition to pricing before making their decision. The DHBA Industry-Standard Server Pricing and Configuration Monitor provides extensive detail and analysis on the leading offerings in the market.

³ For pricing on specific configurations, please see the D.H. Brown Associates, Inc. Industry-Standard Server Pricing and Configuration Monitor.

DELL: TACTICS AND STRATEGIES

OVERVIEW

While Dell employs its fair share of engineers and technologists, its focus remains customer requirements rather than technologies. Dell delivers significant cost advantages, competing very effectively on price. Thus, when Dell embraced Linux, it signaled the market that customer demand was evident. Dell's entire product line is based on Intel processors. Offering Windows and Linux across its product line gave Dell an effective way to compete with both its direct Intel Windows competitors as well as the UNIX community. Linux is Dell's UNIX.

In effect, Dell operates as an Intel systems hardware supplier with an emphasis on speed, in response to focused customer requirements. A customer-satisfaction machine that exploits standards to deliver pragmatic customer solutions, Dell's approach to Linux extends that pragmatic and opportunistic strategy. Pragmatic in that Dell is responding to real customer demand, opportunistic in that Dell has put itself in position to actively respond to Linux demand without having to actually create that demand, Dell's strategy is highly focused. Responding both to SMB and enterprise customer interest, this approach addresses the substantial Linux value proposition of IA-32 cost advantages over more expensive RISC UNIX systems. Dell positions Linux as the low cost alternative to "proprietary" UNIX. A practical advocate for Linux, the model is applied by reacting quickly to market changes and demand and by focusing on cost and TCO. Linux enables Dell to take its business model to the UNIX environment. The close affinity between Linux and Solaris (and UNIX in general), allows Dell to target Sun and to compete with HP and IBM. In addition, Dell wants to change the enterprise focus from *scale up*, where Dell is not as strong as its competitors, to *scale out*, where it has an opportunity to compete by means of industry-standard clusters.

The initial focus was the high-volume Linux client and server markets. In 2002, Dell started focusing on the enterprise. In 2003, Dell is moving up the value chain, targeting enterprise applications using Linux as an alternative platform to UNIX for database rack servers. Dell's overarching focus remains UNIX-to-Linux migration. While Dell retains edge-of-network servers in its overall product portfolio, it is adding UNIX (mostly Sun Solaris) migration to Linux using Dell's ISV relationships (Oracle and SAP), and Linux clusters for the HPCC opportunity. Further, Dell targets migration enterprise custom solutions that began on RISC/UNIX. Dell has built specialized services in server consolidation, distributed applications, and HPCC to support this Linux thrust. Dell is creating TCO and ROI analysis tools to justify and promote this UNIX-to-Linux migration effort and to support the other key parts of its strategy.

Red Hat remains the primary Linux distribution for certifying its hardware. There is a strong partnership between the two companies that stretches beyond hardware into professional services. Dell recommends Red Hat "professional" for appliances and edge-of-network servers and Advanced Server for enterprise

applications. At this time, Dell Europe does not certify its clients or servers on UnitedLinux or SuSE, but is actively working on certification. Dell has also built ISV relationships with BEA, BMC, Oracle (9i, 11i), SAP (Linux certified), and VERITAS. With a special concentration on Oracle 9i rack servers, its goal is to drive its participation in enterprise Linux engagements. Positioning itself as the primary point of contact for service for Linux, all the software is installed on its servers. Dell provides level 1, level 2, and advanced software support. Dell also manages level 3 escalations and owns the resolutions when the customer signs a support agreement through Dell. Dell manages the interaction with Red Hat and the other software providers on the customer's behalf. (How well this kind of front-end management process works will be discussed as part of the Dell customer interview later in this document.) Dell offers Linux services from per-incident support to fully customized support packages providing 24x7 support and Linux Consulting Services from Dell Professional Services. Dell Professional Services also resells Red Hat Professional Service as part of its Linux offerings.

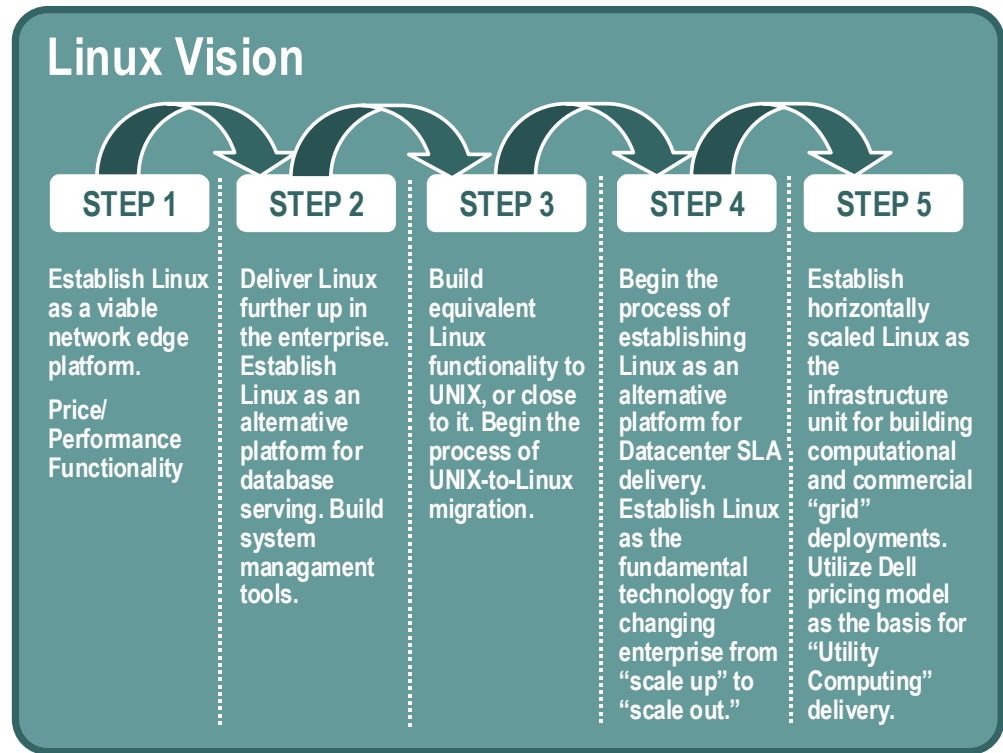
With its entire product line enabled for Linux, Dell will preload Linux on any client or server to meet customer requirements. Other vendors view that as a services opportunity. Dell uses this approach as part of its customer responsiveness and to communicate the "Dell model." The enabled systems comprise the Precision workstations and PowerEdge servers, with custom availability on its notebook and desktop systems. Dell also offers Linux server appliances for file/print, directory, networking services, and web servers. The strategy centers on the IA-32 architecture for its Linux-based systems. In keeping with its pragmatic approach, Dell concentrates on the high volume areas and offers no Linux-on-IA-64 products. Dell has provided support on the PE7150 since its launch in 2001 and used Red Hat 7.1 and 7.2 64-bit support on IA-64. As the bulk of the Linux market is IA-32, this is no real inhibitor. Dell has publicly announced plans to introduce an Itanium 2-based server later in 2003.

Dell's strategy positions it well to be the high volume, commodity Linux server leader. A price leader for one-way and two-way commodity servers in a market where cost is critical, the company recognizes that the customer is prepared to use existing well-defined open source solutions, such as SAMBA, to build Linux solutions. By beginning to target the enterprise Linux opportunity, Dell takes a visible position with its Oracle relationship (highlighted at Dell's recent analyst meeting). Oracle stands out as the primary mechanism for Dell to enter the higher value enterprise market. Enterprise customers may require additional capability and support to entrust their mainline production systems to a commodity provider. These customers often look beyond the hardware provided to a full development and production solution environment. The challenge for Dell is to communicate both its relationships with the ISV community and its services capability. Dell does not have to create a software infrastructure itself to be a viable provider and partner for enterprises, but it must communicate its understanding of the issues and that it has offerings available from leaders in the industry to support enterprise Linux exploitation. Dell uses Linux internally in its manufacturing operations and to manage the installation of customers' system

images. Dell claims that the combination of deploying Linux and Dell PowerVault storage worldwide saves several million dollars per factory per year. That experience proves the need to share with its enterprise customers.

By leveraging its brand, the company is well positioned in its worldwide Linux market share. Its focus on speed to customer requirements and the entire customer experience, from purchase through deployment, yields significant customer satisfaction. Dell's Customer Factory Integration process delivers significant value to customers with large and diverse deployments. Dell views itself as a hardware supplier and does not maintain its own software stack. However, the situation provides an advantage in that Dell can form deep relationships with leading ISVs. Dell offers them a high-volume industry-standard market with no fear of competition. Dell is well positioned to profit from Linux. With a broader enterprise thrust and a larger solutions portfolio, Dell can expand its Linux position substantially. The following figure describes Dell's vision to exploit Linux:

FIGURE 1
 Linux Vision



INDUSTRY RELATIONSHIPS

Dell's partnership activity is targeted at "close to the box" enterprise infrastructure. As a pragmatic Linux supplier, Dell is most interested in meeting immediate and near term customer requirements.

Given Red Hat's dominance in the U.S. market on IA-32 servers, Dell experiences no disadvantage in not developing strong relationships with other

Linux distributions. Dell has established a relationship with SuSE in Germany for the European market and with Red Flag in Asia. These are opportunistic relationships driven by customer demand or geographic market entry requirements. Dell believes its close partnership with Red Hat in the One Source Alliance provides a time-to-market advantage in offering the latest versions of Red Hat Linux. Each of the suppliers we talked to claims a strong Red Hat relationship. So, it is not clear if the strength of One Source brings that about. However, Dell uses Red Hat Linux in its manufacturing operations. That real time usage likely yields value in helping Dell meet its commitment to deliver an integrated and assured operating system and hardware combination.

The One Source Alliance, along with Dell's Oracle relationship, provides the following benefits:

- Collaborative development of products between Dell and Red Hat, and between Dell and Oracle
- Co-development and delivery of Red Hat-certified enterprise-ready global-service offerings and solutions
- Co-development of tools and test suites for open source
- Promoting the adoption of Linux
- Offering services and solutions – Dell resells Red Hat services and exploits Red Hat technical support
- Driving future technology innovations to support Internet infrastructure needs
- Working jointly on Oracle deployments
- Supporting Dell partners and ISVs to work more effectively with the open source community

By building partnerships with the software community, Dell is mounting a strong Linux middleware and infrastructure portfolio. These events reveal the shift in Dell's focus from Linux in the infrastructure to Linux in the enterprise – both large enterprises and SMB. Dell is also partnering with Cray and others to deliver a more robust HPC solution that can address grid and high performance opportunities in many industries. Dell highlights bioinformatics and energy systems and has installed large clusters in universities, energy companies, and biotech. Dell's partners in this space include Fluent, Platform, and TurboWorx.

Finally, as a very large volume system supplier, Dell oversees significant relationships with the IHV community to provide drivers and other software to support their unique hardware components. By working with them to ship their software in an open source model, Dell benefits. This makes it easier to support their systems using Linux and it stands to the IHV's benefit because it makes it easier to support their components across the broad range of Linux-enabled equipment.

DELL AND THE LINUX COMMUNITY

A participant or board member on most of the open source community's organizations, Dell stands as a frequent promoter of Linux in its target market. This is not completely altruistic. Linux and open source have enabled Dell to attack the UNIX market with its low cost, high customer focus model. Dell's Linux community participation includes,

- Sponsor of the Open Source Development Lab (OSDL), whose mission is to provide open source developers with computing resources to build datacenter and telco class enhancements into Linux and its open source software stack.
- Member of the Free Standards Group for the Linux Standards Base, a joint contributor to LSB 1.1 and a reviewer of Li18N.
- Member of the Open Cluster Group, an informal consortium of commercial and research organizations involved with cluster computing.
- Provides equipment to the Open Source Cluster Application Resources (OSCAR) and promotes OSCAR at trade shows. Does joint testing to ensure clustering remains competitive on Dell systems.
- Participates at an engineering level in the open source community on projects such as the Linux kernel port to the Intel IA-64 architecture and on open source device drivers.
- Offers open source SSL off-load card and all versions of DRAC remote access card support.
- Provided its Linux platform management code and interfaces to open source to facilitate system management software development in the community.
- Maintains public mailing lists to promote community involvement between Linux users of Dell servers. Customers are encouraged to sign up and participate in any lists they find interesting.
- Supports the Linux-Dell-Laptops group at Yahoo! – community-based support for running Linux on Dell Inspiron and Latitude notebook products.

A leading vendor driving Linux adoption and support by IHVs, Dell provides the volume and commands the relationships with these companies through its Windows-based business, now extended to Linux. Dell facilitates open technical discussions with multiple parties including orchestrating n-way NDAs. Dell also leads the active development of drivers with participation from Red Hat and the IHVs, which extends to getting Linux support “in the box.” All IHV suppliers are required to provide open source device drivers. All of Dell's factory installation is open source as well.

OFFERINGS

Linux is available on Dell servers, workstations, and selected client offerings. Selecting, configuring, and ordering Intel-Linux servers on Dell's website is quick and largely error resistant for rack-mounted, desk/floor models, and blades. Dell supports Linux-on-Intel systems up to eight-way SMP and in large clusters of up

to 1,000 nodes. In addition, Dell has built its appliances on a Linux base. Its products are primarily hardware and operating systems. In addition, Dell has begun to offer certified enterprise solutions such as Oracle 9i. As Dell continues to target the enterprise with Linux, it will continue to build its “close to the box” solution portfolio. Dell also offers Linux design, migration, hosting, high-availability, and solution-development services. This is especially important for corporate accounts that do their own software development. Given Dell’s aggressive price leadership and the attractiveness of the Linux value proposition, Dell’s offerings remain very competitive.

The currently developing standards-based modular servers appear ideal for Linux-based applications. Dell recently launched a blade server offering that includes a 3U modular system that packages the performance of six servers in the space of one. This format simplifies and helps lower the costs of enterprise computing. Comprised of high-performance server blades designed by Dell, the PowerEdge 1655MC accommodates up to six servers with two Intel Pentium III processors in a single enclosure. This design – the first in Dell’s modular server line – offers increased density and simplified server management that targets server consolidation, thin client computing, and high-performance clustering.

The new line of Linux appliance servers is multi-functional, built on an open configuration, targeting specific application areas – web serving, mail serving, load balancing, caching, etc.

Dell’s Precision workstations address the current Linux client market with factory installation of Linux on platforms targeted at power users. Dell’s Custom Factory Integration offers factory installation of a customer’s image on business desktops and notebooks. Further, Dell provides a one-stop shopping experience for retail versions of popular distributions and other Linux titles.

CUSTOM FACTORY INTEGRATION (CFI)

Dell’s Custom Factory Integration service provides a range of custom-built, factory-installed solutions. After determining user needs, Dell performs the custom configuration during the initial system build, a “one-touch,” custom integration. This approach avoids the typical customer-built scenario in which systems are twice built and twice shipped via the channel. These services are provided as part of CFI:

- *Hardware Integration:* Custom hardware configurations are preserved for repeat orders and are maintained for integrity of hardware and software upgrades. Higher levels of standardization may simplify deployment and management.
- *Software Integration:* Enterprise Custom Factory Integration provides custom configuration and installation of software (standard, custom, or proprietary), in the factory environment. With Enterprise Custom Factory Integration, each customer can control its server deployments to ensure that every system operates with the same version of the software, without any variations due to

- old versions of the same application. CFI software integration services include,
- *Scripted Operating System Integration*. Maintains users' custom software images across orders as desired.
 - *Custom Application Solutions* including DBMS (Database Management Service), ERP (SAP), disaster recovery and backup, and proprietary and third-party application installs.
 - *Asset Data Services*: Asset tagging and labeling. Application of standard or custom asset tags for systems and monitors, and labels for packing boxes. Information gathered and reported on asset tags can include customer name, service tag, purchase order number, order number, order date, model number, shipping address, system component data, and/or customer-supplied information.
 - *Parts Replacement Program*: If anything goes wrong with a CFI system, one call to one vendor to get the replacement parts required. A replacement of the original hard drive image can also be obtained.
 - *Preconfigured "Rack 'n Stack" Option*: The ability to load operating environment (e.g., Linux), configuration, cable and rack servers into Dell racks and ship directly to customers (U.S. only). Targets HPCC in education and/or in large metropolitan areas with limited dock capabilities.

SERVICES AND SUPPORT

The Dell/Red Hat partnership provides support for Linux-on-Dell platforms. Dell now provides full end-to-end Linux support without a "warm transfer" to Red Hat. While Red Hat provides substantial advanced level and back-end level 3 support in its technical support structure, Dell remains the customer interface. The level of service can be ordered through Dell as part of the server purchase and includes per-incident support as well as an annual fee-based contract. Dell delivers the same support levels for Linux as it does for Windows and Netware. Linux support is integrated into its Premier Enterprise Support Gold and Platinum Agreements, which include reactive and proactive support as well as entry-level planning services. Dell's Linux Premier Enterprise Support includes four levels positioned as:

- *Platinum* for mission-critical environments. This includes High Availability Option Services, the broadest customized support (training, call priority, account team, etc.), proactive support (includes change management), and rapid resolution services (two-hour response/six-hour repair, Enterprise Expert Center Direct).
- *Gold* for production servers. The Gold level includes customized support, proactive support (less change management), and rapid resolution services (four-hour response). This also includes Technical Account Management and Advanced Software Resolutions plus direct access to Enterprise Expert Center technicians.

- *Silver* for development servers. Includes rapid resolution services offered in resolution packs.
- *Bronze* for testing and file/print servers. Resolution services with response and software support options.
- *Directline Plus* – incident-based fee support for advanced software resolutions available in one to thirty incident packs. Full support for Red Hat Linux by Dell's top support technicians.

Linuxcare also provides support for older Dell Linux-based systems. All Linuxcare-supported configurations come with Linuxcare 90-day installation support.

Dell also offers its own Dell Professional Services and resells Red Hat Services. Among Dell's professional services for Linux are,

- Application development and integration
- Enterprise migration and consolidation
 - UNIX migration
 - Fast track to Linux
- Infrastructure consolidation
- High performance and high availability
 - Linux HPC design and deployment
- Customer training and certification services
- Oracle *9i* and *9i* RAC migration, implementation, and optimization

Included in the above are a set of modular service packages to speed Linux installation. These are well-defined services that include specific deliverables, time frames, and expectations. They include,

- Fast start to Linux for web applications
- Fast start to Linux for Java
- Fast start to Linux for Oracle

Dell supports open mailing lists for customer questions, which includes direct access to the Dell development team. There is voluntary participation from leading Linux developers as well as active participation and support from Dell customers. This open forum includes questions on all Linux distributions.

VALUE ADDED

Dell's Custom Factory Integration includes worldwide hardware and software configuration and installation, asset data services, and support services. Follow-on ordering may be simplified using stored configurations and images. Further, these services offer standardization benefits that add value downstream in deployment

and management cost reduction and simplification. Other value is created with the asset tracking services that simplify a necessary user-driven task.

OpenManage for Linux provides lifecycle management of Dell Enterprise systems and is designed to build on the benefits offered by CFI. OpenManage is not an enterprise-systems management framework like Tivoli. Its focus takes in basic system administration tasks such as:

- *Deployment* – factory, local and remote installation.
- *Operations* – administration, central monitoring and integration (connection management).
- *Serviceability* – remote access, diagnostics, and software updates.

Dell provides its own Linux services including Linux business consulting through its Dell Professional Services group. These include customized engagements, applications solution centers to validate and tune solutions, as well as design validation and Dell Custom Integration for custom-built needs. Dell is collaborating with Red Hat to facilitate the migration of Linux into higher-end systems based on Intel's IA-64 architecture.

APPLICATIONS FOCUS

In light of Linux's move into the application and solutions space beyond "edge-of-network" infrastructure, Dell has chosen certain solution segments. Dell's Custom Solution Engineering includes Technology Showcase and Custom Solutions. The Technology Showcase offers "show-me, hands-on" opportunities for customers and includes technology briefings, live solution demos, and best-practices white papers targeted to IT professionals considering Linux. Pre-sales support occurs through Custom Solutions – a consulting team working with Dell's Advanced Systems Group.

These solutions are based on:

- UNIX-to-Linux migration
- Oracle (and SAP)
- HPCC
- Custom applications
- EMC

Dell underscores its commitment to SAP solutions on Linux in the enterprise, for example, with dedicated technical and engineering resources as part of the SAP Linux Lab development team at SAP headquarters in Waldorf, Germany. The Dell engagement ensures that the entire Linux solution stack is optimized for the Intel-based platform – including work with SAP and Red Hat Linux on Intel's Itanium processor-based platform. Several large global companies, small-to-medium-sized businesses, and public customers now deploy SAP and Linux on Dell.

FUTURE ACTIVITY

Dell's strategy entails delivering Linux as an alternative to UNIX, continuing to drive the volume acceptance of Dell Linux offerings, and becoming a primary Linux provider into the enterprise. It also wishes to change the enterprise focus from *scale up* to *scale out* with industry standard clusters. To achieve this plan, Dell is going to continue to build up a "close to the box" software portfolio and additional clustering capability. The following are the areas that Dell will focus on to achieve these objectives:

- High-availability configurations for business continuity using industry standard technology
- Additional cluster management
- Continue its focus on storage management from such partners as EMC and VERITAS
- Additional enterprise software to drive Linux enterprise growth
- Continued focus on server consolidation programs for UNIX
- SMB customers

CUSTOMER SUCCESS STORY: PRECISION RESPONSE CORPORATION (PRC) – A DELL LINUX CUSTOMER

COMPANY OVERVIEW

Precision Response Corporation (PRC) provides outsourced customer relationship management services for large corporations and other organizations. As a worldwide provider with offices in the U.S., the Philippines, India, and other locations, PRC offers a broad range of services including inbound and outbound teleservices, e-mail management, fulfillment, e-learning, employee training and care, and more. PRC's objectives are to deliver world class customer care for their clients and at least "four nines" of availability. PRC considers itself an "on-demand" customer. Cost, flexibility, and technology are key ingredients in delivering the level of trusted service and high-availability that is central to PRC's value proposition. PRC was a Sun and Windows user prior to the Linux installation and currently uses all three for various application environments.

"In our business, the ability to quickly respond to our client needs, and in many cases, unforeseen needs, is key," said Bill Hicks, PRC's CIO. "One of the things that PRC prides itself on is our proficiency in rapidly responding to client needs, particularly from a technology standpoint."

PROBLEM

PRC's challenge is to deliver the level of service described above while managing costs and using its infrastructure and asset base most effectively. PRC has been a large Sun shop for many years. As with many UNIX customers, they are concerned with the costs of what they call proprietary UNIX systems and the lack of compatible hardware flexibility across vendors. PRC wants to be in a position where they are not dependent on Solaris and SPARC and can exploit the cost benefits and flexibility of industry standard (Intel) hardware. The following are the primary drivers for considering Linux:

- Significant cost of UNIX RISC system maintenance
- Need for a more granular way to grow capacity than large UNIX servers
- Flexibility at a lower price point enables PRC to respond more effectively to customer demand.

An example is the situation that emerges when a current or new PRC CRM client needs additional capacity. PRC may have three servers deployed to support existing clients. It is important to note that the client selects the CRM software used and different clients may use different software. Server 1 may have 20% capacity left, server 2 may have 10% capacity left, while server 3 has 20% capacity remaining. The problem occurs when the new client needs more capacity than any single existing server has available. In this example, if the new client requires 40% server capacity, that capacity cannot be satisfied on an existing server even though 50% aggregate capacity is available across the existing servers. Also, with

the existing system environment, PRC must substantially forecast its needs, limiting its responsiveness. “By definition, we are an on-demand company as a service agency,” added Bill Hicks.

WHY LINUX

The primary drivers of Linux at PRC are cost, flexibility, and asset utilization. The important cost elements are server acquisition costs versus UNIX. UNIX maintenance costs are substantially higher than Intel systems. Transitioning to Linux on industry standard hardware made a significant difference and created a “huge reduction” in cost.

PRC achieves improved flexibility by exploiting clustering and by the ability to redeploy servers. Clustering gave PRC more ways to respond to their customers’ requirements and capacity needs. Going to an Intel strategy enabled PRC to redeploy servers with either Linux or Windows, depending on the need. They were no longer constrained by the unique hardware dependencies of their UNIX environment. The result is a much better asset management model for IT servers. An example is being able to redeploy a database server that is being replaced into other areas of the business, such as an exchange server or web server. This is not easily possible with the Sun servers. A big part of this benefit is PRC’s commitment to Windows as well. Sun could deliver a mail server, but cannot deliver Exchange. In summary, using industry standard platforms (Intel) makes possible broader use of an existing asset.

INSTALLATION EXPERIENCE

Staffing was not an issue for PRC: They already had a UNIX team. As with many Linux users, PRC also employs a staff who had already dabbled in Linux. As a result, they were able to accommodate the Linux transition with no staffing increase by using the existing UNIX team. PRC put together a cohesive education and training strategy, employing local hands and formal classroom education. The transition from UNIX to Linux was straightforward and proved a lot easier than from UNIX to Windows.

“In our experience, UNIX administrators can move to Linux quickly,” PRC management reported. “Our view is that UNIX will be impacted far greater than Windows” by Linux.

Most people who are Microsoft Windows users have a dependency on all the Wizards and other Windows unique features which makes it more difficult to move from Windows to Linux.

DATABASE FIRST

PRC’s initial focus was putting Oracle on an Intel environment to achieve cost benefits. The biggest return for PRC was to migrate its Oracle database servers

from Solaris/SPARC to Linux Intel. By choosing Linux as its UNIX operating environment, they obtained the benefit of Intel system cost advantages, both initial purchase as well as maintenance. Oracle's release of the Real Application Cluster (RAC) on Red Hat proved a PRC enabler. PRC also evaluated Oracle RAC on Windows; however, they were concentrating on their UNIX environment costs. Because of the above focus and Oracle's share on Red Hat, they decided to go to Linux.

Clustering enables PRC to address the type of problem described in the example given above. They could put the fourth CRM services customer's workload in the existing environment by using existing capacity. The result is that PRC gains value from clustering as well as from being more responsive to its clients.

The following figure describes PRC's Linux deployment strategy. As noted above, Databases have been moved from Solaris/SPARC to Linux/Dell-Intel. The next target is to move its application servers from Solaris/SPARC to Linux and/or Windows. The platform selected will depend on the application. PRC is using BEA WebLogic today and is testing it with Red Hat.



PRC reports that there have been no major problems going into production. While they measure major issues and concerns and manage them, they report quick resolution of all issues. PRC is working with a consortium of partners – Dell, Oracle, Intel, and EMC. All participants were motivated to make this work well and quickly. As a result, PRC received extra attention in the planning and deployment phases. The problems they experienced were the kind typically expected in introducing new technology.

MEASURABLE BENEFITS

PRC experienced a nine-month ROI transition from UNIX to a more granular Intel environment. They also experienced improved flexibility – and are now able to respond more quickly to changes in demand. The biggest measurable financial gains are reduced maintenance costs, plus avoiding the purchase of large servers. PRC believes it is possible to apply capacity and stretch investment out over a longer period of time as a result of the Linux transition. Finally, the exploitation of clustering enabled PRC to address some of the costs associated with the Oracle environment, especially capacity planning and usage.

LESSONS LEARNED

PRC went through a formal evaluation process before committing to Linux. The company measured itself in this investment. Calculating the project's ROA and demonstrating how that was going to be achieved added credibilyt with senior management. As part of that process, PRC built a plan and made sure that the commitments were in place to make the project successful. PRC put its best people on the project and provided the necessary education. The technical team was given hands on experience before formal education to ensure that the training augmented what the staff already knew. As a result, the staff felt comfortable that the transition from UNIX to Linux was manageable.

Following the shift, UNIX-to-Linux proved not to be such a dramatic change. PRC noted the importance of forming peer groups and having constituents understand the change being made, so that everyone felt comfortable it would not affect the quality of service.

WHY DELL

SPECIFIC VALUES, SKILLS, BENEFITS BROUGHT BY DELL

In the past, PRC ran a plethora of Intel servers from multiple manufacturers. Over the last four years, PRC began a strategic alliance with Dell in the Windows-based environments. "We like the way Dell does business. Their customer service is excellent." PRC especially liked Dell's attention to detail for customer-related issues. About three years ago, PRC made a positional decision that changed its desktop systems to Dell and made Dell a strategic partner, not just a vendor. The objectives were price, customer support, and speed of delivery. As a result, Dell became the natural supplier of Intel IA-32 servers for the PRC open source initiative. Once the decision was made to transition from UNIX to Linux, Dell's role fell into place.

PRC viewed Dell as a supportive business partner, which helped alleviate the risk in the UNIX-to-Linux transition. PRC used Dell to help manage the relationship between all the participants – Dell, Intel, Oracle, Red Hat, EMC. Especially important was the match in strategies. Dell's "UNIX is Linux" strategy fit well with PRC's approach. Also, Dell was committed to the Microsoft relationship and environment. PRC felt that the motivation of other suppliers was to use Linux on Intel as a strategy to replace Microsoft Windows. PRC found Dell had a more thoughtful approach to the business that more closely matched its own objectives.

PRC believed that Dell had a high level of commitment to Linux, which was reflected in the various clustering options Dell offered. By contrast, Sun, limited to a two-way environment, did not meet PRC needs. Especially important to PRC was access to Dell's experience running Oracle and Red Hat for Dell's own internal implementations. Dell made it possible for the people at PRC, who had responsibility for installing and testing the systems, to access Dell's own IT staff without sales acting as a filter. As a result, PRC claimed the following benefits:

1. Avoided pitfalls
2. Helped make people comfortable with the risks of the project
3. Benefited from Dell's learning and experience

Dell stands out in PRC's customer experience. According to PRC, Dell always delivers in the timeframe promised with quality at a good price.

FUTURE LINUX ACTIVITY

PRC does not plan to move from Windows to Linux – PRC believes it can get some of the same benefits of cost and flexibility from Windows by more aggressive use of cluster technologies. PRC anticipates doing more with Dell and Linux. While PRC focused its first Linux installations on its Oracle database servers, it is now considering a similar move with its application servers. The two critical areas of investigation are,

- Firewalls (appliances)
- Moving the application server environment to Linux

PRC is using BEA WebLogic now and is testing it on Red Hat. The goal is to move from Solaris/SPARC to Linux and Windows, continuing its strategy of exploiting industry-standard servers versus proprietary UNIX systems.

PRC has no plans for Linux on the desktop either. The desktop operating environment is often driven by the software specified by the PRC client. As a result, PRC projects that Linux on the desktop is farther down the road than its Linux server investments. No immediate business value is seen.

SUMMARY AND OVERALL PERSPECTIVE

According to PRC, a substantial cost benefit awaits from the Intel approach. In addition, the granularity benefit from clustering is considerable. These are tied together with Linux as an operating environment. Thus, cost and flexibility benefits are gained along with an opportunity to respond more effectively to clients. PRC follows a broad focus on how they can move more of their applications and services to an Intel platform. PRC reports that they are very pleased with the result and the process of getting there and would do it again.

PRC offers several lessons learned: Ensure that there is a substantial business case; get commitments from all those needed; put your best people on the project; and plan effectively.

HP: TACTICS AND STRATEGIES

OVERVIEW

HP ranks among the early Linux supporters. As Linux gained a higher profile, HP upgraded its Linux strategy by means of active marketing and support. It created a Linux Program Office and a Linux and Open Source Lab. Since then, HP has expanded its Linux and open source commitment substantially.

HP delivers three strategic operating environments in various ways to its customers – HP-UX, Windows, and Linux. The company's objective is that the trio of operating environments provides complete solutions to customers. HP supports Linux across its entire industry-standard server family and Itanium-based server family, HP commercial business PCs, and its 3D Linux graphics workstations, selected consumer PCs and laptops as well as its growing mobile line of iPAQ products. The company will take a consultative role in recommending which operating environment is appropriate for the customers' environment.

By porting its manageability, high-availability, storage, utility computing, quality-of-service, and telco software to Linux, HP demonstrated its equally strong software commitment. In addition, HP made its printer drivers available on Linux to the open source community and continues to evaluate its software portfolio, looking for open source candidates where it makes business sense.

HP is bringing the HP-UX and Tru64 UNIX enterprise experience to Linux with a focused strategy and added value on segments where Linux is growing, plus driving core new functionality in such emerging areas as manageability, 64-bit Linux, 3D, and carrier grade applications. Based on a clear vision that Linux is moving beyond the edge of the network and into emerging mid-tier and business applications such as distributed databases, Java application servers, and mail servers, its Linux strategy has widened. HP's strategy covers working with commercial ISVs and partners to offer configured and supported solutions, and its Linux strategy supports new areas such as database deployments with Oracle and ERP with SAP. Financial services are another key area and HP has teamed with Reuters to deliver financial information to the market based on a Linux solution. HP continues to focus on ISVs and maintains relationships with leading open source companies such as Covalent and Sendmail to further strengthen its marketing and support position. A part of HP's strategy is to provide integrated HP-UX/Linux deployment with common tools, shared data, and common interfaces, yielding a sense of family between the operating environments.

A key strategy is to ensure commonality/affinity between Linux and HP's UNIX including HP-UX and Tru64. This will allow development of new applications on Linux and deployment on HP-UX to exploit Linux's emerging position as the UNIX-based development platform of choice. This also allows Tru64 customers

to migrate to Linux or HP-UX (HP's strategic UNIX offering) if and when they choose to do so. HP has delivered toolkits for Linux compatibility and porting including a Linux Porting Guide and support services, an Open Source Developers Toolkit, and a Linux Software Transition Kit. To accomplish this, HP supports Linux APIs on HP-UX and Tru64. HP will also support binary compatibility with Linux on Itanium-based systems with HP-UX sometime in 2003. HP's focus remains the Linux Standards Base (LSB) – the emerging standard interfaces for Linux (and UNIX) development. HP chairs the Futures subcommittee within LSB. Basing this commonality on open source standards and involving the Linux community heightens the attraction of HP's offerings.

INDUSTRY RELATIONSHIPS

By pursuing and building relationships with a wide array of open source community, ISV, hardware, and service communities, HP has developed an ecosystem that surrounds its Linux solutions. Of particular note are the relationships and communities focused on specific solutions such as Sendmail, VMWare, and other partnerships. Further, the company has been driving new application deployments such as working with Oracle on database and enterprise application solutions.

HP has partnered with the leading Linux distributions – Red Hat, SuSE, and the other UnitedLinux-based distributions – to satisfy customer demand and to reach the worldwide market. For its Evo PCs and e-PCs, HP also works very closely with Mandrake.

Thanks to its strong relationship with Red Hat, HP resells Red Hat enterprise products and support services. Red Hat also provides level 3 support in conjunction with HP, which maintains a full-time engineer at Red Hat to help optimize HP ProLiant servers for the Red Hat distribution. HP and Red Hat certify HP's ProLiant servers and have been bundling Red Hat Linux with HP's 3D graphics Linux workstations for over three years. HP was the first to offer 64-bit Red Hat Advanced Server with shipments starting in 2002. This is available preloaded on the HP Itanium 2-based servers and workstations. HP also works with SuSE to certify HP's Itanium systems.

Another ally is Linuxcare, which provides back-line support for some level 3 and 4 support calls and is involved with the port of Linux to PA-RISC.

HP remains a leader for the Linux IPF port. These efforts include working with Intel and others to improve the Linux kernel scalability and to add support for future IPF processors and enhancements to GCC, the main open source compiler for IPF. HP continues to work to advance Linux and Itanium2 through new university grants totalling one million dollars each for research. Further leadership for Linux on IPF is illustrated by the formation of the Gelato Federation, co-founded by HP and seven leading research institutions. Gelato develops software to enable researchers to advance their studies using Linux and Itanium-based systems

in such areas as life sciences and physical sciences. Gelato will provide the research community with software downloads, including new solutions developed by Gelato members. Gelato will focus on open source technologies across all levels, including compilers and programming tools, Linux kernel performance, middleware services, security, software support for interconnects, and application-specific tools. Technical solutions will be optimized for the Itanium 64-bit architecture and for performance scalability, from single-node processors to Linux clusters to grid computing.

In a collaborative gesture, HP is providing its printer drivers to the open source community, released under the pure Berkeley Software Distribution (BSD) open source license. Along with this, HP has separated the proprietary color-rendering technology from the driver and added it to ROM (read-only memory) such that both Linux and Windows achieve the same level of support. Note that HP made an extra effort to perform a thorough patent review to protect open source developers, its IP, and others who may use or contribute to them.

BUILDING AN ECOSYSTEM

Building focused solutions above the open source platforms is important to HP, other infrastructure and solution providers, and users. Linux is now integrated into HP's Developer and Solution Partner Program (since 1999). Linux ISVs enjoy access to HP discounted systems, technical consulting, catalog listings, marketing services, course discounts, and more. And HP operates a special partner program for its blade servers.

Building on this, HP has taken the following steps:

- Partnered with the ISV community – Oracle, BEA Systems, SAP, and others – to deliver commercial Linux offerings to its resellers.
 - The BEA relationship is a recent addition focused on optimizing a leading J2EE environment on HP Linux platforms. The focus of the efforts is ProLiant and Itanium 2.
 - The Oracle relationship includes the entire Oracle portfolio: Oracle9i database, RAC, Application Server (AS), and the Oracle11i suite of enterprise applications.
 - HP and VMWare will test, co-market, and provide integrated support for IA-32-based partitioning solutions. VMWare GSX and ESX have been certified on HP ProLiant systems.
 - The VERITAS Foundation Suite has been certified with HP ProLiant Linux platforms and includes volume manager and file-system software.
- Partnered with Linux ISVs and service providers – such as Sendmail, Jabber, Zeus, and Covalent – to establish channels and support for leading Linux open source infrastructure solutions on ProLiant servers and for HP's Itanium 2-based systems. HP has published impressive Zeus specweb_SSL benchmarks.

- Generation Linux is a free program for Linux developers to help get applications optimized for HP servers.
- Established a relationship with Mitel to market a small and medium-sized business server platform.
- With its strategic partner, SteelEye Technology, HP offers high-availability Linux clusters for the ProLiant server and a storage suite of offerings. HP and SteelEye continue to work together and have just announced support for the DL380G3 Packaged Cluster as well as three additional Packaged Cluster Solutions for Oracle 9i, SAP, and Sendmail. Combined with the previously announced Apache and Samba solution offerings, this package yields a suite of easy to order and install customer solutions for general Linux usage. HP and SteelEye have also extended support for HP SecurePath, which covers a dual-path, high-availability connection for the Modular Storage Array 1000, MA8000 Enterprise Storage Subsystem, as well as Enterprise Virtual Array 3000 and 5000.
- HP and Ensim maintain a partnership to offer a service provider solution based on ServerXchange, which is a hosting-operations platform designed to enable hosting providers, including ISPs, ASPs, and datacenter operators, to operate large-scale hosting businesses.
- Testdrive is an online service that provides free access to HP Linux systems for testing – functional, not performance – applications. Performance testing is available for HP Solutions Alliance members. The Testdrive site adds new versions as they become available as well as new applications.
- HPC Clustering Partnerships. The company is working very closely with the leaders in Linux cluster software development, including Scyld Computing, Scali, Platform Computing, MSC.Software, Linux NetworX, and NPACI/SDSC freeware offering – ROCKS. MSC.Software’s HPC division offers turnkey Linux clusters designed for computationally intensive environments, and released the first Linux distribution tuned for HP’s Itanium2 portfolio. HP also works closely with Cluster File System providers as well – Sistina Software and PolyServe both provide Clustered File System support across the IA-32 ProLiant Brand. HP works very closely with the software providers to ensure seamless operation between applications.
- Intel. HP holds joint leadership of the Linux-on-IPF effort and the joint telco solutions center. Joint research grants from HP and Intel spur the advancement of the Itanium system by universities.
- Open Source Development Lab (OSDL). A member of the Board of Directors, HP actively supports the datacenter and carrier-grade (telco-focused) effort at OSDL. This includes developing the “telephone” APIs and hardening of the Linux kernel for carrier environments – “carrier-grade Linux.”
- HP is a member of Linux International since 1995.
- Ximian. An effort which includes a focus on the GNOME desktop and the Microsoft calendaring connector.

WORKING WITH THE OPEN SOURCE COMMUNITY

The open source community remains the foundation for Linux, Apache, and other key project development and support efforts. This group of talented, dedicated developers and programmers works well with those who embrace the community by contributing to current technical challenges as well as building on initial solutions. HP's extensive experience working in the open source community has led to the following joint Linux projects:

- HP assigned engineers to kernel development, benchmarking and optimization, and other areas to improve Linux and open source solutions.
- HP has completed over 44 open source projects that can be found at opensource.hp.com.
- HP released its single-system image clustering technology to open source as well as many other projects including the Solaris-to-Linux Threads porting libraries.
- A charter member of the Free Standards Group (FSG) and an active participant in the LSB specification, HP chairs the Futures group for LSB.
- HP chairs the Open Printing Workgroup within FSG, and works with the open source community to advance the state of Linux printing.
- HP is implementing broad support for its hardcopy devices employing open source technologies, and hosting the Open Software Developers Network printer summit.
- Several core Debian team members are on the HP staff. Debian represents a non-commercial Linux preferred by some customers and developers. Through HP's efforts, Debian was one of the first distributions available for HP's Itanium 2-based systems.
- Samba is the leading UNIX-based file/print software that interoperates with Windows desktops and servers. Several principal Samba developers are on the HP staff to further optimize Samba for HP customers.
- A major contributor to Apache 2.0, HP carries fifteen to twenty people on its programming staff.
- Compartment Guard for Linux: HP has worked on process improvements and compartmentalization to further improve Linux security in this focused Linux base. Currently available only in Japan, the project consists of defining the communications policies for subsystem calls and flows. HP has made several kernel enhancements available as open source.
- The Gelato Federation, co-founded by HP and seven leading research institutions, develops software to enable researchers to advance their studies using Linux and Itanium-based systems.
- HP is a key developer for the Lustre file system, a project focused on high performance clusters, which is being deployed by the Department of Energy at several national laboratories with HP support.
- A charter member of the Open Software Developers Network (OSDN), an industry-wide organization. HP also maintains a relationship with a large-scale

- open source community service provider – SourceForge. HP sponsors the clustering open source foundry, and hosts its internally developed open source projects at SourceForge.
- HP ported Linux to the iPAQ Pocket PC, and sponsors the handheld.org open source project to foster innovation on handheld devices.
 - The company's support for the Open Source Software Institute focuses on research and education to help accelerate the use of open source software in government information technology.
 - HP teamed up with Collab.net to create a collaborative development environment for internal and partner use for both proprietary and open source software.
 - Cooltown offers HP open source software for the development of intelligent devices that are location and context aware.
 - HP is a founding member of the GNOME foundation.
 - HP is also a founding member of the Linux Tape Certification standard (linuxtapecert.org).

OFFERINGS

Now an integral component across HP's broad product portfolio, Linux ranges from handheld to multi-node clusters, from servers to storage and software.

SERVERS

The HP ProLiant server product line includes a primary set of Linux offerings, which spans Red Hat, SuSE, and UnitedLinux-based distributions, and the full range of Linux applications. HP's Linux support across its ProLiant servers covers eight-way SMP servers, as well as its entry tc servers. The company also offers Linux on its Itanium2-based servers. The Itanium servers target compute-intensive workloads in markets such as technical computing and financial services and high compute-based encryption services for Internet infrastructure workloads as well as large memory commercial applications. HP has also demonstrated Linux partitions on a 64-CPU Itanium Superdome along with Windows and HP-UX running simultaneously. HP also supports Linux across its workstations, most HP Evo PCs, e-PCs, selected laptops, and HP's iPAQ personal computers.

HP services will preload and preconfigure Linux on any of the HP platforms, e.g., Red Hat Linux on select ProLiant ML, ProLiant DL models, and ProLiant BL blade models. Custom integration is available from HP using standard or customer golden images and company-specific settings in order to provide a fully integrated solution for servers, workstations, storage, and networking. This customized approach resembles the services Dell offers.

The following are significant Linux features found in HP's systems:

- A Remote Insight Lights-Out Edition Management Option Card. The hardware-based graphical remote console capability provides access to the Linux server console in a standard browser interface. Using the Virtual Floppy Drive capability of the Remote Insight Lights-Out Edition, the local server can be booted remotely with a Linux bootable floppy diskette, allowing remote deployment of the operating system. On many HP systems, this functionality is integrated into the motherboard at no additional cost.
- HP has adopted Insight Manager for device management of HP ProLiant servers. This feature automatically discovers, identifies, and manages all of the ProLiant servers' reporting potential and actual problems before they result in unplanned server downtime.
- The HP Management Agents (HPMA) provide the instrumentation to enable fault, performance, and configuration management on HP ProLiant servers. Beyond providing server-level administration capability and predictive management, the HPMA may also be integrated into popular enterprise and systems management platforms such as CA Unicenter TNG, Tivoli Enterprise, HP OpenView, Microsoft SMS, Novell Manage Wise, and Novell Zen Works. This enhancement allows for a stronger, integrated administration into enterprise-wide frameworks. (HP offers a Server Health driver that provides a system monitoring utility to deliver operational data to improve the availability and performance of ProLiant servers.)
- HP's Servicecontrol Manager 3.0 offers a multi-system management solution together with web-enabled and command-line interfaces. HP Servicecontrol Manager delivers multi-system access to all key system administration tools for fault monitoring, configuration, and workload management.
- HP's online ROM Flash component provides system administrators the ability to upgrade systems firmware images whether locally or remotely across the network.
- The HP Array Configuration Utility (ACU-XE) delivers a web-based disk configuration utility for Integrated Smart Array Controllers, which are used on the ProLiant DL 360 and DL 380 server lines.

BLADE SERVERS

The ProLiant brand now includes HP's line of blade servers. These all-inclusive computing systems allow users to provision server or other compute resources on individual cards, or blades. Blades cover a wide range of applications – servers, storage, network, and more. HP offers two blade design centers, the HP bl e-class and p-class. The e-class blades target static web hosting, utility applications and HPTC clusters where integer performance can be applied on a massive scale specifically in bio informatics and life science applications. The p-class blades, designed for enterprise applications, yield higher performance and availability. The p-class blades embrace either two-way or four-way servers. The two-way p-class BL20P G2 has been used extensively in HPTC projects. HP positions these servers as part of a three-tier network where the four-way blade is a back-end server and the others are appropriate as front-end and mid-tier servers. The BL20P G2, designed for high-performance computing, provides up to 96 2.8

GHz processors per 42U Rack. These blades are housed together with shared resources such as power supplies and cooling fans in the HP blade server chassis, creating high-density systems with a modular architecture. Blade servers provide high-density, lower-cost infrastructure solutions, matching the values of the Linux operating environment. HP supports its blade server family with both Red Hat and SuSE Linux distributions. HP claims that Linux is deployed on 30 - 50% of blade shipments depending on model. This reveals rapid market growth following the initial blade high-availability solution demonstrated at LinuxWorld January 2003, using SteelEye's LifeKeeper for Linux Cluster Manager operating on two BL20P G2 Blades and one BL40P Blade. All accessed data through a Modular Array 1000 Fibre Array.

CARRIER-GRADE SERVERS

HP's cc2300 and cc3300 carrier-grade servers are designed for telco and support Linux. Several technologies combine to build a focused telco solution, which calls for high availability and reliability. HP has worked with Go Ahead to make use of its telco-focused high-availability solution. HP is working with several more ISVs dealing with edge-of-network applications. These efforts to deliver a total solution to this market include working on carrier-grade features for Linux through the OSDL Carrier-Grade Linux Working Group.

APPLIANCES

HP has broadened Linux's reach into the appliance market, offering a Linux operating system-based printing appliance, the print server appliance 4200. With a 6 GB spool capacity, NT domain support, and appliance approach, the HP print server appliance 4200 offloads print tasks from general-purpose file and print servers, allowing consolidation of printing resources. It includes software developed by the Samba group (Jeremy Allison, Samba leader, was involved in the product development), the GNU project, and other open source developers. The file and print market represents a lucrative opportunity for Linux and HP has tapped into this potential by leveraging its expertise in printing devices to create a print server appliance. Beyond all of these efforts, the HP server appliance offerings include a firewall appliance with Checkpoint based on ProLiant servers. HP also offers a SAN head based on Linux and a document router. HP bases some of its consumer appliances (e.g., HP Media Receiver) on Linux as well.

64 BIT – ITANIUM AND RISC

HP fully supports Linux on the Itanium-based HP servers and HP workstations. HP offers two-way and four-way servers (rx2600 and rx5680) as well as one-way and two-way workstations (zx2000 and zx6000). Multiple versions of Linux are available for HP Itanium2 systems, including Red Hat Enterprise Linux AS, SuSE Enterprise Linux, and MSC.Linux, a distribution tailored to the needs of high-performance cluster customers. HP's key role in developing Linux for Itanium stretches back to 1998. With Intel, CERN, and others, HP co-founded the open

source consortium to bring Linux to Itanium. David Mosberger of HP Labs is the lead architect, gatekeeper, and maintainer of the open source Itanium Linux kernel.

HP's 64-bit Linux experience started with Alpha servers in 1995. The company now certifies Red Hat on all one- to four-way AlphaServer systems; HP Services offers support for Alpha Linux software. Along with Red Hat, HP released Red Hat 7.2 for Alpha, and the media kit is now available. HP 64-bit compilers for Alpha are available for Linux including C, C++, and FORTRAN, as well as Java.

HP also maintains a relationship with the open source PA-RISC communities to provide a Linux offering on selected PA-RISC platforms for customers looking to migrate to Linux or redeploy existing HP assets.

WORKSTATIONS AND PCs

HP's high-end 3D Linux graphics workstations (targeting digital content creation and design visualization) fully integrate Red Hat, which is preloaded on the following models: HP x1100, x2100, and x4000. HP supports a menu of the leading graphics accelerators including selected offerings from Matrox, nVidia, and ATI. Price incentives make these offerings even more attractive. HP now offers Itanium 2-based workstations with Linux and with the option to preload Red Hat Linux.

Certification is offered on HP's commercial business PCs (Evo and ePC) for Red Hat, Mandrake, and SuSE distributions. HP Evo customers can order some models with Linux (Mandrake) including direct orders from the web. HP also supports some laptops for Linux embracing the high-end HP N800W laptop.

STORAGE

The new HP maintains a focus on Linux storage solutions. The HP StorageWorks family supports an end-to-end, multi-terabyte solution for Linux on its XP and VA disk arrays as well as the entry-level DS and MA disk systems. Employing high-speed, secure Fibre Channel connections, the solution package comprises path and application failover mechanisms, as well as a set of management and performance monitoring tools, which provide load-balancing, capacity usage monitors, billing, replication, and automated disaster recovery in dispersed environments. Integration with HP's OpenView and Business Copy products allows for remote backup management and response to alarm conditions from secure management stations located on the Internet. Beyond this, a Linux boot-over-SAN capability has been developed, and HP is increasingly tailoring its Linux storage certifications toward compatibility with SAP and Oracle application environments. All HP tape drive data protection units are certified as Linux compatible.

HIGH AVAILABILITY

With over 60,000 licenses of MC/Serviceguard sold on HP-UX, the company applies its expertise in high availability to the Linux environment.

MC/Serviceguard high-availability software runs on Linux. The high-availability portfolio covers the ProLiant DL380 and DL580 servers and Smart Array Cluster Storage and StorageWorks VA and XP Storage subsystems in two-to eight-node cluster configurations. An optional offering has expanded the product to include a Linux disaster-tolerant solution, integrating Serviceguard for Linux and HP StorageWorks Cluster Extension with HP StorageWorks XP Disk Arrays to protect geographically dispersed datacenters (up to 100 km) from unplanned downtime caused by system and application failures, operator error, and natural disasters. In addition, an embedded high-availability solution for HP StorageWorks NAS8000 solutions combines Serviceguard for Linux clustering with the management of the NAS8000 to provide a highly available and manageable NAS solution.

SteelEye Technology's LifeKeeper for Linux Clusters, a high-availability application and data cluster solution, is now supported on HP ProLiant servers and StorageWorks storage systems. This partnership product provides two- to 16-node application and data fault resilience. The ProLiant servers and storage can be combined with SteelEye Technology's LifeKeeper for Linux software and a choice of several leading Linux distributions. HP has fully tested and certified LifeKeeper for Linux on ProLiant for optimal performance on Red Hat and SuSE. In addition to the base Cluster Manager, HP certifies the full range of SteelEye Application Recovery Kits (ARKs). These kits range from edge-of-the-web with Apache and encrypted Apache (SSL) to Mail and Messaging with Sendmail and Sendmail Advanced Message Server, File Print and Samba, Oracle 8i and 9i, and IBM DB2 failover, as well as MySQL and PostgreSQL database support, SAP R3, NAS, IP@, and IP Local NIC recovery. HP offers high-availability solutions around LifeKeeper for Linux and the ProLiant DL380G3 Packaged Cluster and Apache, Samba, Sendmail, Oracle, and SAP solution bundles. HP and SteelEye have developed a Single Point of Contact (SPOC) for one-stop service and support offerings from HP Global Services to minimize solution integration and operations issues. HP adds even greater customer value by providing ProLiant Cluster Install Guides for the most popular Linux solutions including DBMS products and commercial applications across a range of Linux distribution offerings.

HIGH-PERFORMANCE COMPUTING

HP offers Linux platforms, factory integrated, and preloaded with the Linux distribution of one's choice. Base platforms deliver a choice of nodes from across the HP portfolio, including new Itanium2 2U servers, ProLiant and AlphaServer thin servers, or ProLiant blade servers. A choice of options, such as high-performance system area networking equipment like Myrinet and Quadrics, and external SCSI or FC RAID storage, creates a supercomputer Linux cluster.

As noted earlier, HP works actively with the major developers of Linux cluster management software, embracing ISVs and resellers such as MSC.Linux, Scyld, SCALI, Sistina (file system), Platform Computing (LSF), and Etnus (TotalView).

The high-performance technical resources at HP also work with and contribute to open source projects for high-performance computing, such as the ROCKS project led by NPACI/SDSC and the Lustre program.

PRINTERS

HP is investing resources in open source efforts to improve support for devices within Linux, including HP printers. HP now supports over 200 raster-type printers (ink and laser), plus 40 PostScript LaserJet printers and multiple all-in-one devices including scanning support. As a recognized market leader, HP maintains a leadership printer strategy with significant differentiation in breadth and depth.

SOFTWARE

HP's infrastructure management platform, OpenView, handles customer solutions running on Linux and through its partners program, and supports the management of a significant number of applications, including Oracle and SAP, running on Linux using Smart Plug-Ins. HP OpenView, an end-to-end management solution, oversees networks, systems, storage, applications, databases, and services. HP OpenView Operations Application staffs agents who monitor the health and performance of Linux systems. HP OpenView Network Node Manager discovers Linux devices; HP OpenView Internet Services monitors Linux-based services. The company's OpenView Omniback II provides support for data backup and recovery protection of Linux systems. HP's strategy in managing enterprise IT assets covers those based on Linux. HP OpenView includes software to manage fault, performance, and services across voice and IT infrastructures.

HP's Opencall product line provides telecom operators and service providers with a platform for developing and deploying new revenue-generating voice services along with a set of pre-integrated solutions that speed time to revenue. In November 2001, HP delivered a Linux version of its SS7 Software Developer Kit. This hardware and software combination platform actually provides a live SS7 test environment and can be connected to the telephone network and employed by developers using the HP Opencall SS7 Linux SDK to test their solutions. In December of 2002, HP began support for a complete Linux deployment on its OpenCall SS7 platform.

An upgraded Serviceguard for Linux SG/LX yields such enhancements as the ability to support eight nodes and disaster recovery support up to 100 km of separation, journal file system support (ext3fs and Reiser), and Linux GUI and templates for Samba, Apache, and Sendmail.

Other HP software products include,

- HP Compartment Guard for Linux, currently available only in Japan, which helps businesses protect their Linux environments by offering intrusion

prevention; real-time protection against attacks, and damage containment. New product releases include integration with key subsystems such as Sendmail, ftp, DNS, LDAP, Apache, Tomcat, Struts, NFS, SNMP, and Samba.

- HP ServiceControl Manager provides a single point of administration for Linux and HP-UX. This manageability tool provides multi-system management capabilities such as group operations and role-based management, user authentication before performing any management tasks, and ensured accountability through audit logging of changes across the IT environment. Several Linux management ISVs have integrated with ServiceControl Manager including Aduva, Bladelogic, TOLIS Group, Turbolinux's PowerCockpit, Symark, and Integrated Research software.
- The ProLiant Essentials Initiative now includes HP Rapid Deployment for Linux. Based on Altirus, it now supports Linux Image Management and deployment from a Windows console. The full Linux version will be available later in 2003, affording customers with a choice from a mixed Windows and/or Linux environment. This choice allows them to install, configure, and deploy their HP servers remotely and get them up and running quickly.
- Process Resource Manager brings CPU resource management to Linux, enabling system administrators to monitor, control, and optimize system resources.
- Web JetAdmin for printing installation and management.
- OpenMail – now HP supported – sold and licensed by Samsung.
- HP Storage software including disaster recovery and high-availability features.

SERVICES AND SUPPORT

HP positions itself as a single point of accountability for customers who are embracing Linux solutions. This accountability extends to Linux in heterogeneous, multi-technology, multi-vendor environments. The company's services framework intends to deliver end-to-end Linux solutions, including technology, support, partnerships, applications, and services.

Specific support is now available in the following Linux relevant technologies – Beowulf, IT consolidation, ERP, web services, high availability and disaster recovery. HP has also developed strategic relationships and support agreements with the key ISVs. HP services target the financial services and telco industries, and claims to have 5,000 trained Linux professionals in place. A major focus of the HP Linux services portfolio is to make Linux an equal player with HP's multi-platform environments.

Enterprise-level 24x7 global support for Linux and open source applications are included with distributions, as well as HP Linux applications on HP, Dell, and IBM systems. The company supports Red Hat, SuSE, other UnitedLinux-based Linux distributions, and Debian. The support ranges from electronic help, and

software phone-in assistance, to a proactive onsite presence with a dedicated support staff. HP has recently announced an agreement with Red Hat that enables HP to provide a single-point fulfillment and service for the complete Red Hat Enterprise Linux product line on HP industry-standard hardware. IBM's agreement with Red Hat resembles this approach. HP's arrangement embodies Red Hat Enterprise Linux AS, Enterprise Linux ES, and Enterprise Linux WS and fulfills HP's goal of being able to bring the same level of service and support to Linux that it makes available on all its other operating environments.

HP also provides high-availability support and proactive services to prevent downtime and a six hour call-to-repair commitment for hardware. In addition, HP provides a full range of integration, installation, and project management services. HP outsourcing services takes into account Linux for running and managing customer operations and IT infrastructures. The company's IT infrastructure consulting incorporates the Linux platform porting and migration services, and security services. HP also offers a web-based and classroom Linux curriculum that includes training for Linux administrators in installation, configuration, troubleshooting, and security, as well as application management. Twenty-four Linux classes are offered in worldwide learning centers with two courses leading to Linux Professional Institute (LPI) certification. This includes cross-training for UNIX and Windows NT users.

HP services for Linux environments include,

CONSULTING

- Infrastructure and architecture analysis, assessment, design, and implementation; infrastructure transition assistance; security infrastructure design and implementation; and availability review.
- Telecom-specific consulting embodying telecommunications application and communication integration services.
- Financial services-specific consulting through a center of expertise with branches in London and New York.
- Linux high-performance clusters.
- High-availability clustering services (Lifekeeper for Linux and Serviceguard for Linux SG/LX).
- Lifecycle web server services.
- Oracle e-Business Solution services.
- Network security – Check Point Solution Paq.

PORTING AND MIGRATION SERVICES

- Porting and migration services spanning UNIX/Solaris/Windows-to-Linux cover transition analysis services and application porting and migration assistance (including custom application integration services). HP offers an

Express Service that provides a porting assessment for a fixed fee based on the number of lines of code.

INSTALLATION, INTEGRATION, AND PROJECT MANAGEMENT SERVICES

- Fully configured and tested solutions are delivered to a customer's site with optional onsite installation; delivered from seven HP Integration Centers worldwide; and multi-region, multi-system rollout assistance. These solutions embrace Linux, Windows, and UNIX-based platforms (HP and selected multi-vendor platforms).
- Start-up services for Itanium 2 servers – an optimized portfolio of factory integration and onsite consulting services.

DEVELOPER SUPPORT

- New services for developers include fast access to technical experts and an HP white paper on a model for using open source software for development.
- HP offers Linux information for developers on its developer portal.
- Periodic Linux training is offered through the HP Invent online webinars.

OUTSOURCING

- Infrastructure management services for Linux provide an alternative to staffing and managing a customer's own infrastructure in-house. HP owns special asset management software that the company uses for deployment and updating of Linux systems. This software manages over 3,000 internal Linux systems at HP.

MULTI-VENDOR NETWORK SERVICES

- Multi-vendor network design, deployment, operation, and support for LAN, WAN, and Access IP infrastructures for both service providers and enterprise customers.

SYSTEMS SUPPORT

- High-availability support aimed at reducing the frequency and duration of downtime through proactive and preventive services and specialized resources for recovery. Includes the industry-leading standard six-hour call-to-repair commitment for hardware. Proactive services include patch reviews, configuration, operational health checks, security reviews, and network assessments.
- Proactive support provides a single point of contact for customers spanning the technical assistance required, establishing an account plan, phone-in software service, and onsite hardware support (optional).

- Phone-in software assistance provides unlimited and incident-based software and telephone information services. Customer may call in their questions or use the electronic software-call submittal system to address defects and how-to questions. HP's engineers are able to access HP's diagnostic centers for the replication of software issues for problem solving. An upgrade to 24x7 service is available. Coverage includes the open source applications incorporated in the distribution.
- Hardware support with flexible hardware response times and coverage periods to meet customers' multi-platform hardware support needs.

EDUCATION AND TRAINING

A portfolio of educational services spans a variety of media. Instructor-led online training, self-paced web classes include,

- Linux for experienced Windows NT administrators
- Linux troubleshooting
- Linux security
- Linux installation, configuration, and administration
- Linux cluster training
- Managing Linux web servers
- Managing Linux mail servers
- Managing Linux file and printer servers
- Two courses leading to LPI certification
- Accelerated Linux training for HP-UX experienced professionals

VALUE ADDED

As a full-line system supplier, HP has embraced Linux across its hardware, software, and services lines. Armed with a strategy built on industry standard platforms, partnerships, enterprise development environments and middleware, and professional services HP targets the Linux market. HP adds value to Linux in the following categories:

- *Managed Linux.* Provisioning, deploying, monitoring, and more using OpenView, Insight Manager, Utility Computing Software, and other HP server and system management offerings. HP's integrated offering spans multiple operating systems and can even provide levels of service across vendors.
- *Pervasive Linux.* Putting Linux to work in embedded intelligent appliances.
- *Rapid deployment services and products.* The service takes the operating system and application image, preloads it on the hardware, and delivers a complete ready-to-run server. Take, for example, the integrated Linux print servers; this product can be used in commercial or even personal computing environments.

- *Clustered Linux.* Delivering high availability for Linux clusters through HP's Serviceguard; high-performance compute clusters with HP's ClusterBlocks program; and load balancing appliances for web clusters. HP ranks as a leader in Linux supercomputing.
- *Standard Linux.* Supporting the Linux Standards Base for a common framework for developers and ISVs. Providing support for Linux across all of its server lines and hardware platforms.
- *Carrier Grade Linux* is a focus area for HP products and services. Based on its strong relationships with the telco industry, the company has created Linux servers directly targeting the needs of that industry. Also, HP's Opencall SS7 on Linux allows live testing and deployment of telecom applications in real ss7 networks.

HP has evaluated all its software products for Linux. Of special note, Serviceguard failover software is now available on Linux, as well as OpenView agents (for backup, network management and operations management), Insight Manager for desktop and server device management, and rapid deployment software as well as storage management software including disaster-recovery storage software. The objective for the management software is to target the multi-operating-system environment (Linux, Windows and HP-UX) with a common offering. Other HP software supporting Linux embodies Opencall SS7 telco software, Internet Usage Manager, and WebJetAdmin.

APPLICATIONS FOCUS

HP targets specific industry segments to exploit Linux acceptance outside the edge server and Internet infrastructure environments. These segments are typically served by custom, in-house UNIX-based applications. Consistent with Linux's value proposition, the customers in these segments are looking for Linux to deliver a lower cost standard deployment platform. The segments of special interest to HP comprise,

- Financial Services and Banking
- Telco, Network Equipment Providers, and Service Providers
- Manufacturing Engineering (CAE and SAP)
- Oil and Gas
- Pharmaceuticals/Life Sciences
- Entertainment Industry
- Government Research Computing

An example of HP's attention to Financial Services is the creation of a Linux center of competency for financial services. The objective is to make it easier for ISVs and integrators targeting Linux in that industry to meet and support the goals of interested customers. All are to be implemented on HP equipment.

HP is focused on the following enterprise solutions:

- Mail and messaging. The company has formed a partnership with Sendmail and offers its Mailstream Manager and Integration Mail Suite.
- Apache-based web server solutions building on a Covalent partnership.
- Databases including Oracle9i RAC.
- Enterprise applications such as the e-business suite Oracle 11i.
- Business continuity and security covers several offerings including the CheckPoint Solution Paq.
- Disaster Tolerant Solution with the HP StorageWorks Cluster Extension for Serviceguard for Linux.
- Embedded high availability with HP StorageWorks NAS8000 solution.
- In the partnership with SteelEye Technology, HP has chosen to focus on:
 - Emerging and small-to-medium business high availability solutions as well as storage migration from existing MSA1000, MA8000, RA4100 storage subsystems.
- Reuters RMDS solution for delivering financial information to financial services companies.
- Application servers including BEA, Oracle, SAP, and Hyperion.
- UNIX-to-Linux migration.

HP is exploiting the successful Active Answers concept developed by Compaq. Active Answers are pre-structured solutions encompassing a set of tools and solutions to support rapid deployment. These solutions are targeted to the channel or end users to plan, deploy, and operate enterprise solutions. Examples available for Linux include,

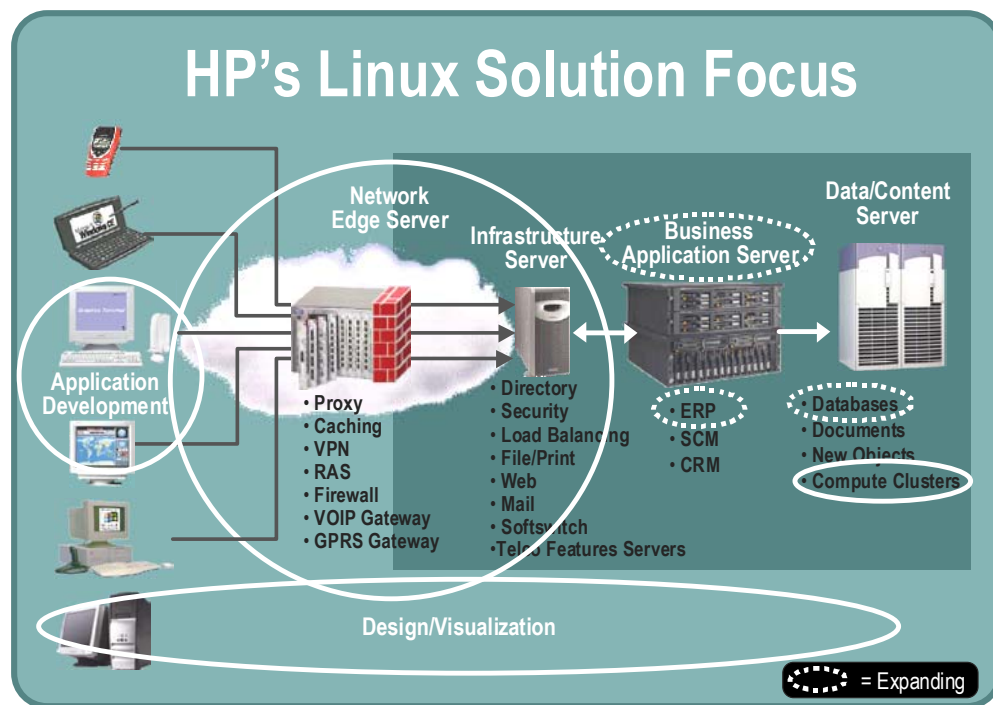
- Apache web server on Linux
- Covalent web servers powered by Apache
- Ensim hosting automation
- Internet infrastructure

In addition to the enterprise solutions focus described above, HP oversees five additional application segments oriented toward traditional Linux strengths:

- Application development.
- Design and visualization
- Network edge servers provide access and gateways for users and other networks.
- Infrastructure servers, typically reside behind edge servers and provide network, basic infrastructure, or departmental services such as:
 - Compute clusters for technical workloads covering life sciences, research, and financial analysis.

A related focal point takes into account building and offering end-to-end business solutions based on Linux through the HP sales process. It offers total solutions by following a thread through application, deployment, management, middleware, Linux distribution, product, and chipset, as well as another thread through services that embody porting, architecting, tuning, installation, project management, and repair. The following illustrates HP's end-to-end solution strategy.

FIGURE 2
 HP's Linux
 Solution Focus



HP's active ISV enablement program for Linux solutions includes the following:

- Solution Centers for porting, migration, and proof of concept
- A developer solutions partner program that provides marketing and technology to solicit ISV solutions
- Developer's kits for Linux on x86 and IA-64 as well as development tools for HP-UX Linux deployment
- HP consulting to create LSB-compliant code or platform independent code
- Preload for strategic ISVs (e.g., Oracle)

FUTURE ACTIVITY

Solutions and services for target Linux markets will continue to expand. New services will take into account additional ISV and integrator partners as well as HP's internal professional services offering. Emerging markets may also join the effort, including broader government and retail focus.

Look for HP's Itanium-based workstations and servers based on Linux to grow significantly with the introduction of Madison-based Itanium2 chips. HP has

announced a new core processor chipset, the HP sx1000, which will optimize the performance for HP Itanium high-end servers. HP has demonstrated Linux partitions along with Windows and UNIX on a 64-CPU Itanium2 system. The market can expect additional levels of Linux scalability and manageability.

HP's strong commitment to the blade architecture means that new blades and Linux solution support partners are likely. Also, look for HP Linux manageability and utility computing software to continue to grow as a key part of HP's strategy.

With the HP/Compaq merger completed, the strategies, offerings, and teams have been integrated. The company's focus on 64-bit Linux on Itanium systems, combined with pre-merger Compaq's market leadership in 32-bit industry standard ProLiant systems, create an opportunity for HP to consolidate and grow its market share. Along with the focus on services to deliver solutions based on Linux, HP's software offers clear differentiated value. Mainstream customers looking for reduced cost with value-added Linux-based solutions and ISVs seeking a strong partner both benefit.

CUSTOMER SUCCESS STORY: HP AND AMAZON.COM EXPLOIT LINUX

COMPANY OVERVIEW

COMPANY DESCRIPTION

Amazon.com, Inc., an online retailer offering a broad range of items including books, music/video, electronics, apparel, office products, and services, also offers home products and services via its international websites. Amazon.com's model is heavily customer-centric; its customers can find virtually anything they may want to buy. As an international online retailer, Amazon.com is critically dependent on its systems to deliver a customer-centric experience in a cost-managed delivery environment. The model depends heavily on the availability and stability of its systems. Always-on reliability and trouble-free browsing and shopping are essential to its market leadership. The company's dramatic growth in the size of its customer base and the variety of its services depends in large measure on its ability to accommodate growth and change while managing cost. Flexibility is critical to its continued success; its hardware infrastructure is no exception.

PROBLEM

Amazon.com focuses on the same issues of cost, flexibility, and control benefits that other Linux users deal with. As an online retailer, Amazon.com constantly manages its costs, seeking to improve its reliability and flexibility. The transition to Linux was driven by the need to manage cost while maintaining market reliability. Its customers use multiple features that do not necessarily map to specific single servers. As a result, Amazon.com does not want the customer's experience to be affected by idiosyncrasies of system outage, system growth, or reassignment of server assets to different services. Beyond these issues, Amazon.com needs a coherent infrastructure to help maintain flexibility of customer services while meeting business model requirements.

As Jacob Levanon, Amazon.com's Director of Systems Engineering, explains, "Because we have so many business requirements and so many services we want to provide our customers, it's especially important that we have a uniform underlying infrastructure."

WHY LINUX

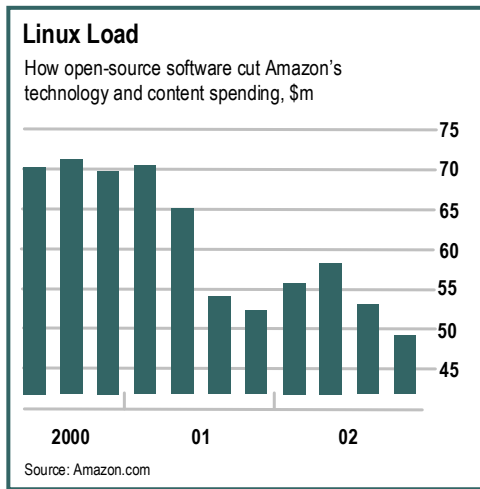
Amazon.com's greatest ongoing challenge lies in the process of deploying and maintaining large numbers of servers delivering a wide range of services/functions. The size and scope of its environment with its substantial growth profile requires consistency – so that each server not vary much in the demand it puts on the IT staff and infrastructure. To the maximum extent possible, each server must look and work alike. As noted above, a key requirement is the development of a uniform underlying infrastructure. Linux

enables Amazon.com to create that infrastructure because it is extremely good at supporting horizontal scalability. Levanon adds, "...with a correctly designed architecture, almost all problems can be solved with cookie-cutter solutions."

INSTALLATION EXPERIENCE

MEASURABLE BENEFITS

Levanon cites several long-term benefits of Linux. The most obvious is financial. Amazon.com undertook extensive cost analysis before switching to Linux. It found that Linux could deliver significant savings, in part by cutting licensing fees and enabling the company to use less expensive, industry-standard hardware. But the company has also realized substantial savings in personnel. "Linux puts us in a great position on the hiring side," Levanon explains, "since so many potential tech employees already have years of Linux expertise under their belts." When new hires come on board, there is virtually no learning curve – they do not have to be trained to use a proprietary or specialized platform. This benefit should become increasingly significant as Linux usage spreads.



As stated above, a key benefit of Linux for Amazon.com is cost reduction. As with most companies that have switched to industry-standard and open source solutions, Amazon.com has experienced a substantial reduction in information technology spending. The chart at the left from *The Economist*, May 8, 2003, shows that Amazon.com has cut its quarterly technology

spending by almost \$20M as a result of using open source software. In a CNET article, Rick Dalzell, Amazon.com's CIO, commented on the effect of Linux: "The cost to serve a web page is going down faster than the demand is rising." Amazon.com's experience provides the Linux community with supporting evidence that Linux can save money.

A second Linux benefit relates to creating a more flexible and reliable environment for Amazon.com. The company's Linux-based architecture prevents hardware problems and changes from reaching customers. According to Levanon, "Each feature a customer uses doesn't necessarily map to a single server. So, if one unit fails, or if you need ten more right away, or if you need to reassign a server to a different service, you can do that quickly, inexpensively, and transparently. It never affects the customer's experience." Almost every system element can be moved in or out of service without affecting overall functionality. As a result, Linux has enabled Amazon.com to achieve greater stability of service than ever before. And because it is so inexpensive to implement each Linux server, Amazon.com has done it at a new cost point.

Amazon.com has also realized greater strategic flexibility and control with Linux. Because of the communal support for Linux and the use of industry standard servers, there is no dependency on a single hardware supplier. Amazon.com may choose any vendor based on its products, pricing, and track record.

WHY HP

The Amazon.com and Hewlett-Packard partnership began in 1999, when HP helped Amazon.com make the transition to a new back-end system in preparation for the demanding holiday season. When Amazon.com decided to move to Linux servers (Red Hat), it needed to quickly receive and deploy a significant number of new Pentium-based Linux systems. It turned to HP to implement a Linux infrastructure. HP delivered the new systems and had Amazon.com deployed and ready to run in a very condensed time frame. HP now fills nearly all of the company's hardware needs, including desktop PCs and laptops, server hardware, and supercomputers. Increasingly, Linux can be found at the heart of those solutions.

As Jacob Levanon, Amazon.com's Director of Systems Engineering, explains, "We team with HP partly because of its great variety of first-tier products, but also because HP has been so proactive in addressing any challenge that's arisen, from small glitches to major logistical obstacles. Its onsite team responds immediately to solve any problem in the area they're responsible for." Amazon.com's decision to partner with HP was based in part on its experience working with HP on several large, logistically complicated, time-intensive projects that helped keep Amazon.com's infrastructure a step ahead of the company's growing needs.

As noted earlier, Linux on industry-standard hardware gives customers substantial control over their supplier relationships. Customers enjoy the flexibility to choose their suppliers to meet their specific criteria. This feature has built a powerful allegiance to HP. As Levanon puts it, "Quite simply, we continue to choose HP because of the concrete benefits it has provided us: reliable products, a real commitment to Linux, and quick, responsive support."

SPECIFIC VALUES, SKILLS, BENEFITS HP BROUGHT

HP's support in building Amazon.com's warehousing system to meet accelerated growth has driven its choice of HP as a Linux supplier. Amazon.com considered a wide range of options, but concluded that HP systems delivered the most substantial benefits; its experience with HP carried a record of responsive support. The company selected HP Superdome systems for the data warehouse project. Amazon.com is very complimentary of HP's efforts in handling the transition to the new system. In addition, Charlie Bell, Vice President of Technology Infrastructure, says, "HP Services came in and did a stellar job of making sure that every aspect of this migration was successful. Their onsite people were second-to-none. They did a great job of meeting our time-to-market demands. We had a tight working relationship between our team and HP's. In the end, the conversion went off without a hitch and we hit the milestone perfectly." Amazon.com uses HP industry-standard servers with Linux for the front end of the data warehouse.

FUTURE LINUX ACTIVITY

Amazon.com achieved its migration to a Linux-based technology platform. This migration helped solidify the company's HP partnership. Linux has continued to reduce costs while providing a more efficient and flexible software base. "Amazon.com's new rule of thumb," says Levanon, "is 'If it can be run on Linux, it will be deployed on Linux.' Not because we're fanatical, but because Linux has consistently done the job for us."

SUMMARY AND OVERALL PERSPECTIVE

Amazon.com achieved all its objectives in migrating to Linux. It experienced substantial IT spending reductions, a more flexible system infrastructure, and control over which system suppliers to use and partner with. Amazon.com recognized HP's commitment to Linux and especially the responsiveness of the HP team in helping it build the kind of infrastructure that would be responsive to the explosive growth Amazon.com was experiencing. That combination of events made it possible for Linux to become the virtual standard for new application deployments at Amazon.com.

IBM: TACTICS AND STRATEGIES

OVERVIEW

IBM is actively riding the Linux wave and building credibility both for itself as an “open systems” supplier and for Linux. IBM’s endorsement of Linux lends credibility with large enterprises for this open-source-developed software. Recognizing Linux as an opportunity for customer choice to keep the server market and the Internet open and heterogeneous, IBM sees an opportunity to create an alternative high volume platform that can effectively compete with Microsoft’s Windows 2003 platform and .NET. Achieving this has been IBM’s goal for the last two-to-three years. Following significant investments in promoting Linux demand, soliciting ISV middleware and applications, and encouraging business partner participation in Linux and open source, IBM is now moving on to capitalize on its new image through its on-demand initiative. Linux is no longer treated as a separate service by IBM. It has moved into the realm of the on-demand enablers – Linux, Grid computing, autonomic computing, and other technologies. IBM’s message for 2003 presses on-demand and Linux forms a part of that. IBM continues the programs of 2002 to promote Linux and enlist ISVs and business partners.

IBM embraces all major Linux distributions – Red Hat and UnitedLinux (SuSE, Conectiva, and Turbolinux). Each of these distributions provides a unique geographic strength and targets specific market segments. The strategy is to partner with each of these distributions in its area of strength.

IBM reached a decision to actively promote Linux more than five years ago and Linux has since become an integral part of IBM’s overall strategy. The following are specific actions IBM has taken to support Linux and promote its use:

- Research and development funding
- Contributing software and talent to the open source movement
- Establishing dedicated Linux advocates within each product group
- Maintaining a large force of technical experts within IBM Global Services available for Linux deployments
- Recruiting high-visibility customers for testimonials
- Cultivating the community of analysts and journalists
- Aggressively recruiting developers
- Active participation in Linux-oriented events

While IBM does not sell Linux directly, it partners with the Linux distributions to become the Linux source. Linux provides leverage to IBM for the following:

- On-Demand – Linux is an enabler, creating lower cost, platform independent solutions

- Servers – enables new application growth, competitiveness
- Software – supports a middleware operating environment modeled on Linux across hardware systems and creates an alternative to Microsoft's development model
- Services – reduces IBM cost, creates new customer services opportunities

The bulk of IBM's (and the industry's) Linux activity has occurred in a few segments:

- Server consolidation (cross industry)
- HPCC – both technical and commercial
- Distributed vertical applications (retail, distribution)
- Edge-of-network and enterprise infrastructure servers – security (e.g., firewall), file/print, e-mail, etc.
- Appliance Servers – a packaging model

IBM's comprehensive Linux strategy stretches across all elements from hardware and software through services and partner programs. IBM supports Linux across all e-Server hardware platforms and has ported most of its middleware to Linux to enable a competitive enterprise operating environment. Active in the open source community, IBM has contributed substantial enterprise kernel improvements and other open source offerings including the Eclipse development environment foundation.

Linux has been fully integrated into IBM's Global Services offerings. In addition, IBM is investing in Linux for the embedded market, laptops and desktop clients, and server appliances. Significant investments continue in the Linux and open source communities through its Linux Technology Center. From IBM's point of view, Linux and open source offer the same market potential the Internet did a few years ago.

IBM's server strategy consists of Linux ports and optimization to its varied server platforms. The emergence of Linux as a key application standard for e-business environments and applications consolidates the IBM server strategy around a common development environment. The existing operating environments are enhanced with the flexibility and openness of a strong Linux affinity (e.g., AIX 5L). This enables the company to focus on Linux as the development platform for all its server operating systems. By providing Linux runtime capability for each of these operating systems, IBM is able to deliver a common operating environment and a common application base across its server lines.

Embracing Linux as a common application development and deployment platform across all IBM environments facilitates ISV development for the installed base. IBM is investing in Linux on the e-Server xSeries. For its other server platforms, the focus is cost of ownership and integration. The application environment yields the greatest Linux value for IBM. IBM's zSeries experienced

an application drain in recent years that impeded its competitiveness. Linux creates an opportunity to exploit a growing application base on a platform, which, according to IBM, provides unique scalability, reliability, and availability attributes. In effect, Linux and the TCO a Linux server environment delivers help make these installed servers more interesting to the customer. IBM's customer experience bears this out since its customers are exploiting Linux on its mainframe systems.

An industry-wide, standards-based application development and execution environment stands out among Linux and open source attributes. This new Linux role complements IBM's efforts with Java. By making Linux and Java available on all its platforms, IBM offers Linux users very high-scaling environments and integration with the largest server install base in the industry. In the process, IBM provides a new and very fast-growing application base for its traditional server customers.

IBM originally positioned Linux in the software program's early strongholds – edge-of-network servers, enterprise Internet infrastructure, appliances, and technical/scientific segments. The technical/scientific opportunity exploited Beowulf clustering and the opportunity to create a powerful computing platform using small (usually one-to-two-way SMP) systems. These same Linux systems delivered a very cost effective platform for these other workloads. These were largely infrastructure systems that did not require enterprise class scalability and performance. In 2002, IBM focused on commercial application servers, including web application serving, ERP, and business intelligence, all of which require significantly greater scalability and operating environment characteristics.

From a systems point of view, Linux is positioned as IBM's high-volume, mainstream UNIX, targeting such high-volume environments as appliance and web-application servers, running primarily on Intel processors. Further, IBM targets server consolidation opportunities, and distributed applications, and works with the open source community to prepare Linux to be a strong mid-tier server platform. IBM positions its traditional proprietary servers for the higher-end data transaction servers and enterprise markets as well as continuing to add value for existing customers.

In 2003 - 2004, with the availability of the Linux 2.6 kernel, IBM is focusing on bringing Linux to the transactional database workloads, using it to compete with Windows and the other UNIX environments.

While IBM has achieved success with Linux on the mainframe zSeries platform and at the high end of the xSeries IA-32 platform, it is not the market volume leader in Linux. It is probably the market mind share leader, however. Most of the Linux market remains in the IA-32 server space and will continue there for the foreseeable future. In response, IBM is working to raise the visibility of its Linux on xSeries efforts significantly, so that it can more effectively compete with Dell and HP for the Linux-based IA-32 server business. IBM is bringing technology

from the mainframe to make its xSeries systems more robust and more scalable. In addition, IBM is driving a more comprehensive xSeries marketing program and is achieving a better balance in its market communications. The company is building on its efforts in 2002 to drive xSeries-based ServerProven ISV partnerships and growth and more focused application development tools and infrastructure applications where Linux mainstream adoption is already underway. To do this IBM formed a dedicated organization in the xSeries brand for Linux on xSeries, which falls under the xSeries Brand General Manager.

INDUSTRY RELATIONSHIPS

IBM's highly active participation within the Linux community makes it possible to exercise increasingly greater influence on its evolution. Its strategy is to actively support Linux, but not as the owner.

To help customers in specific industries exploit Linux and open source in their enterprise and datacenter environments, IBM has created industry-focused Linux centers of competency. The program began with a Financial Services Linux Center of Competency in NYC. These centers consist of hardware, software, and technical staff. The goal of the centers is to support customers in sharing Linux products, concepts, and applications with other customers in the same industry. The centers provide courses, events, and activities. They also serve as a showcase for ISV applications and to help customers build prototypes. IBM has solicited ISVs to participate in these Linux centers of competency to either demonstrate complete Linux solutions or help customers build customer or industry-specific solutions. The ISVs gain access to hardware and other resources and visibility to enterprise customers. The value to the customer lies in the creation of an industry-specific ecosystem. The open source community gets "glue" to tie together technology into specific solutions. Recently opened centers include Linux Centre for Financial Services in London, E-Government Center in Germany, Linux Integration Center in Germany, Energy Competency Center in United Arab Emirates, China-IBM Linux Solution Cooperation Center, Open Computing Center in Singapore, and Linux Hub Center of Seoul National University.

IBM maintains strong industry relationships with Linux distributors and other industry organizations. In addition to partnering with the four major Linux distributions, IBM remains an active player in the open source community, providing new operating system features for Linux such as a Journaled File System (JFS) and Logical Volume Manager (LVM). A variety of open source projects covering scalability (e.g., kernel locking, process scheduling), RAS (e.g., event logging, device driver hardening, crash dump), file systems (e.g., JFS), printing (e.g., OmniPrint), testing (e.g., Linux Test Project), system management (e.g., LUI [Linux Utility for cluster Installation]) and OSCAR (Open Source Cluster Application Resources), performance standards (e.g., LSB, Internationalization), and others owe a part of their development to IBM. Further, parts of IBM's software portfolio contain open source components and

IBM donates significant software to the open source community, for example, Apache in Websphere and IBM's base WebSphere Studio development environment in Eclipse. IBM remains a leading member of the LSB and is a co-founder of LI18NUX. In addition, the following specific efforts should be noted:

- *Eclipse* – IBM donated a significant part of the foundation software and seeded a new open source community with Eclipse. A Java-based open source software, Eclipse enables developers to use software development tools from multiple suppliers together. This effort may become the “Apache” of software development tools and strengthen the Java development community as well as IBM's WebSphere Studio (and others) that leverage Eclipse.
- *Apache* – IBM was the first major Linux platform and software vendor to embrace the Apache web server and set it in place as a fundamental foundation element of its larger WebSphere strategy. IBM has expanded this relationship to cover work with the Apache XML projects including web services.
- IBM announced the creation of a *Linux Testing Lab for Telecom Services Providers*. The key components of the Lab include,
 - The Linux Service Provider Lab (LSPL) offers an environment to test and validate applications including voice-over IP, softswitch, next-generation wireless applications, unified messaging, and network services.
 - The lab's signature open platforms allow service providers to enjoy a greater range of equipment suppliers to help improve the competitive environment and reduce equipment costs.
 - The lab provides a next-generation network environment, allowing application providers access to technology that will simulate “real world” network operations and enable the testing and verification of these solutions.
- *Open Source Developer Lab (OSDL)* – “OSDL is dedicated to enabling Linux and Linux-based applications for datacenter and carrier-class deployment. It provides the crucial hardware for testing and development at this level, giving open source developers around the world the resources needed to bring Linux further into telecommunications and the enterprise.” – www.osdl.org
- IBM and SuSE jointly market, distribute, and support IBM middleware and SuSE software products. Offerings include SuSE Groupware Server with Lotus Domino, and SuSE Database Server with DB2.
- IBM has launched a Linux community portal to enable Linux developers and ISVs to access the systems, software, and technical skills.

Beyond these developments, IBM's Linux and open source support stretches to the following:

- OSDN
- Open Source Initiative
- Free Software Foundation

- GNOME Foundation – Linux object-oriented user interface
- KDE League – Linux Windows-like user interface
- Extreme Blue – summer intern employment at IBM including its Linux Technology Center
- OSDL
- FSG
- LSB
- LI (Linux International)
- USENIX
- Kernel Developers' Summit

LINUX TECHNOLOGY CENTER

The IBM Linux Technology Center (LTC), IBM's "face" to the open source community, consists of 250 software engineers around the world whose mission is to "make Linux better." The LTC accelerates the growth of Linux as an enterprise operating system and works as a trusted, valued member of the Linux community. The LTC's work products are made available to the Linux open source community, to Linux distributors, as well as back to IBM for product enablement and differentiation. Ultimately, the objective is to bring the improvements that the LTC develops to customers through these various channels. Among the LTC focus areas are scalability, networking, security, file systems, serviceability, globalization, systems management, and performance. Among the areas that the LTC influenced in the 2.5 kernel are improved resource locking, VMM enhancements, hot-plug CPU and I/O, and other file system improvements. The LTC now focuses on the 2.7-2.8 kernel. This level of technical participation measures the degree to which IBM's strategy supports competition on middleware, servers, and services; it is in IBM's interest to build a solid operating environment as a base.

The LTC provides a key differentiator for IBM in that it enables skill building, increases visibility, and helps drive Linux and open source in directions that solve IBM's customers' problems. An added benefit of the LTC is that it improves IBM's image with potential employees and opens IBM to internships from university students who will become familiar with IBM and open source.

PARTNER RELATIONSHIPS

IBM supports the industry by providing access to discounted systems and other technical support. The company has developed a comprehensive set of programs targeting ISVs and business partners to encourage their developing new applications or porting their applications to Linux. These programs include support through IBM porting centers, services such as support, education, and design skills, and marketing programs that embody web catalog visibility, IBM

joint marketing, and other market-facing programs. IBM has structured these programs for all of its server hardware and software middleware brands.

OFFERINGS

All of IBM's servers support Linux as an operating environment and virtually all of IBM's middleware has been ported to Linux. Each of the IBM server brands is supported by specific Linux distributions. All four major Linux distributions are certified on the xSeries industry-standard Intel-based servers. SuSE and Turbolinux are certified for the pSeries and iSeries. SuSE and Turbolinux are supported on the zSeries with Red Hat planned for certification. SuSE is the primary distribution for many zSeries workload consolidation installations.

xSERIES

All models of IBM's xSeries IA-32 servers support Linux. In addition, on selected configurations, IBM offers VMWare, a system software partitioning product that makes it possible for users to run multiple operating environments concurrently. While IBM does not preload Linux on any system as part of its normal business, IBM will preinstall Red Hat Linux on xSeries for a fee. The other Linux distributions are certified on most xSeries systems and may be user or channel-installed.

IBM positions its xSeries servers for the following Linux opportunities:

- Server consolidation (VMWare partitioning)
- Edge servers (firewall, DNS, etc.)
- Enterprise infrastructure (high availability, e-mail, file/print, etc.)
- HPC
- Application-specific environments – Oracle 9i RAC, SAP, horizontal, and vertical applications.

IBM's xSeries servers range from rack-mounted configurations to large clusters. The company offers xSeries servers ranging from 1U (1.75" high) to 8U rack-mounted servers with one to 16 processors and up to 42 servers in an industry-standard rack. The low-end servers employ Intel Celeron; the high-end servers are up to 16-way SMP Xeon systems. IBM is bringing technology from its higher-capable mainframe and RISC systems to these IA-32 servers. It calls this transfer of technology the X-architecture and it includes reliability features such as Light Path Diagnostics, Predictive Failure Analysis, and an Advanced System Management processor as well as performance features such as high-performance IO. All of the X-architecture features support both Windows and Linux. For the high end of the xSeries range, IBM delivers hardware-level partitioning, allowing each node to run its own combination of operating systems and applications. This enables hardware consolidation and software migration. It also creates the ability to operate virtual servers that can be used to deliver a failover for application

failures. In combination with VMWare virtual partitioning, users get a very high level of dynamic partitioning and multiple-operating-system capability.

IBM supports clusters of xSeries servers using Linux with the e-Server Cluster 1350 targeted at intensive computing and web-intensive (e-mail, file-sharing, and web serving) environments, as well as scientific/technical workloads. These user-configurable servers are based on Red Hat Linux and IBM's Cluster Management Software (CSM) for Linux. The CSM is based on technology from IBM's highly successful RS/6000 SP2 cluster platform. The company also optionally includes the IBM GPFS for Linux. IBM offers services for base system integration and setup, installation services, and warranty support as well as professional services for design, planning, and other services. As with the other suppliers, IBM employs SteelEye technology to deliver high-availability Linux solutions.

IBM has refocused its solution packaging to be not only a software package, but also a complete offering. As a result, the company is growing its StartNow Linux offerings and pretesting them with the hardware. This is especially important for xSeries since it creates complete integrated Linux development environments that are largely ready for production applications. All are packaged with the necessary middleware, tools, and applications. IBM is building some of these and is working with its business partners and system integrators to build others in their particular application domains.

IBM has expanded the ServerProven Program to Linux to identify applications and solutions that have been validated on xSeries servers and IntelliStations. This includes third-party hardware and software. The company is also delivering Linux for its client platforms, certifying selected ThinkPad commercial models, as well as IBM Network Station, and selected desktop systems.

xSERIES VALUE ADD

Value-added differentiation in IBM's xSeries includes IBM's X-architecture, Autonomic features, IBM Director system management, advanced system management services, and high availability services. All of the following features are supported for Linux:

- *X-Architecture* – server technologies leveraged from other IBM server brands.
- *Autonomic Features* – Chipkill, Light Path Diagnostics, Pre-Failure Analysis (PFA), Active PCI Software Rejuvenation, Real Time Diagnostics help avoid failure conditions and hasten problem resolution.
- *IBM Director* – automates IT tasks such as inventory, monitoring and alerting, event actions, help desk and system health status. Provides a framework that can be extended with “plug-ins” for advanced management. Enables integration into other management products such as Tivoli, CA, HP OpenView, MS SMS, BMC, NetIQ.

- *Software Rejuvenation* – monitors the software for evidence of resource exhaustion. Predicts time period when software aging will bring down a server. Proactively alerts in advance to avoid unplanned outages.
- *Real Time Diagnostics* – industry-standards based; supports all CIM (Common Information Model) enabled operating systems. Performs diagnostics on all system and subsystem components. Conducts health check of PFA and fault isolation systems.
- *System Availability Tool* – Integrated IBM Director “task” that determines system availability. Variety of graphical views of outages with the ability to customize a range of dates. Can be used on both a single node or a set of nodes.
- *Capacity Manager* – Performance Analysis Tool. Identifies bottlenecks and makes performance recommendations.
- *Advanced System Management* – Integrated Management Processor Assistant for select servers. Optional IBM Remote Supervisor Adapter. Works with IBM Director. Provides greater system availability and allows remote management and control of server.

HIGH AVAILABILITY

IBM's xSeries servers deliver high availability through application, database, and system failover. IBM partners with others to offer many of the technologies employed to deliver high availability. The following are the providers and products used,

- VERITAS
- VERITAS Foundation Suite – file system recovery through proactive storage management
- VERITAS FlashSnap – volume mirroring
- VERITAS ClusterServer – application service group oriented failover solution for up to 16 nodes
- VERITAS NetBackup DataCenter – centralized management for consistent backup policy management, including automated disaster recovery preparation
- SteelEye LifeKeeper – detects failures, restarts applications on alternate systems, transfers network addresses, and returns the recovered system back into the cluster. ServerProven and ClusterProven certifications.

IBM and SteelEye have created predefined high-availability configurations that support Red Hat and SuSE. All these use Tivoli monitoring to detect bottlenecks and potential problems and recover from critical situations. These configurations include the following:

- Database cluster for Oracle or DB2
- SAP R/3 cluster with Oracle or DB/2
- Mail/messaging cluster with Sendmail, Bynari

IBM xSERIES BLADES

IBM launched the e-Server BladeCenter in 2002. This product represents a shared infrastructure with no single point of failure in a very dense form factor with up to 168 processors per frame. It includes network and storage integration. The blades themselves are one or two Xeon DP processors per blade with up to 8 GB of ECC DDR Chipkill memory per blade. The blades come with Integrated System Management Processor, Light Path Diagnostics, Predictive Failure Analysis, and IBM Director to provide server management capabilities. IBM's key advantages with its approach comprise hot swapping; easy remote server deployment due to the system management tools; and especially the reduced cabling that makes the blade center more physically manageable. IBM plans POWER-based blades that support Linux later in 2003.

CLIENT SYSTEMS

As stated earlier, IBM supports Linux across its client systems lines – from commercial desktops to application development workstations to professional workstations and pervasive systems. The company targets IntelliStation workstations with Linux as replacements for UNIX workstations by adding ISV applications, e.g., 3D animation. IBM IntelliStation offers a large selection of graphics accelerators (2D to extreme 3D) that are tested and certified for Linux. The IntelliStation workstations target digital content creation and high-performance computing with Linux certifications. The IntelliStation Z Pro 6221 models 91 and 92 are targeted at the Oil and Gas segments with a RedHat Linux preload for the Landmark suite of Oil and Gas exploration products. The RedHat preload on these models is tested and verified by both IBM and Landmark. The IBM Digital Content Creation offering allows 2D/3D rendering, animation, and non-linear editing based on open-technology platforms. The IBM Image Technology Center works with customers to build and test customer-specific Linux images.

IBM introduced an entry-level Linux desktop in India, targeting small- and medium-sized businesses and home offices. Finally, models of the new ThinkCentre desktop line provide Linux preload options. In addition, IBM maintains an active internal Linux client user community. These internal users employ Acrobat Reader, Tivoli Storage Management Backup, MTS Dialer, IBM's Java, Lotus Notes, Lotus SameTime and SmartSuite viewers, RealPlayer, and Microsoft Office (via WINE). IBM claims 12,000 installs of this Linux stack.

pSERIES

IBM supports Linux across most of its pSeries line, from 32- and 64-bit uniprocessors to logical partitions in the POWER4-based p690. The pSeries targets large commercial applications, the scientific/technical market, and the service provider market. UnitedLinux (SuSE) offers the broadest support for the pSeries servers. Red Hat will deliver pSeries support in the second half of 2003 with its new advanced server product. The Linux support on the pSeries

comprises native support, native Linux support in pSeries partitions, and mixed partitions of AIX and Linux. Partitioning is only supported on the POWER4 systems. The company positions the pSeries as the primary UNIX and Linux 64-bit computing environment.

IBM delivers Linux-ready Express configurations for the p630 and p650 models. These Express configurations are priced to reflect Linux as the primary operating system on the platform. These systems include 64-bit native Linux on two-, four-, or eight-way systems. IBM plans to bring cluster support to the pSeries systems in 2003.

In addition to native Linux, the company provides strong Linux affinity with AIX 5L. This affinity enables faster and less costly deployment of multi-platform, integrated solutions across AIX and Linux platforms. The primary focus for the pSeries continues to be AIX – IBM’s proprietary UNIX. AIX has been the top-rated UNIX in the industry for a number of years and IBM leads with AIX for high-end business logic and data-tier solutions. The Linux affinity capability (<http://www.ibm.com/servers/aix/overview/linux.html>) enables Linux applications to scale up to higher-performing pSeries systems. This environment includes Linux APIs on AIX so that a Linux application can recompile in order to execute on AIX. This enables many open source applications to migrate to the platform. The objectives of this operating environment include,

- Linux source compatibility,
- enterprise environment for Linux applications,
- standards compliance, and
- build-time environment (e.g., GNU tools).

In addition, IBM has delivered a common systems administration environment for mixed Linux and AIX installations.

iSERIES

IBM has invested in Linux on the POWER-based iSeries to bring additional applications to the midrange platform. Linux enables clients to consolidate infrastructure workloads and to integrate and extend OS/400 applications by means of Linux applications on the same server. Linux also offers clients application flexibility by adding its environments to the existing OS/400, Java, Domino, WebSphere, DB2 UDB, and Windows application suite.

Red Hat, SuSE, and Turbolinux – the three leading Linux distributions – are available for iSeries. SuSE and Turbolinux currently offer 64-bit distributions for iSeries. Red Hat has announced its intention to deliver Red Hat EL AS3.0, a full 64-bit distribution. Linux is supported across the iSeries product line from the entry iSeries Model 800 with one processor; the 810 with one to two processors; the 825 with three to six processors; the 870 with eight to sixteen processors; up to the 890 with sixteen to thirty-two processors. With its logical partitioning

technology, iSeries supports Linux in a secondary partition. iSeries is able to consolidate a number of servers and workloads that depend on the iSeries model.

At the high end, iSeries supports up to 31 Linux partitions. At the low end, nine Linux partitions are supported on a one-way server. Hence, customers gain the flexibility to create Linux partitions with one tenth of a processor allocated and to dynamically expand the processing power with a granularity of one one-hundredth of a processor. Logical partitioning carries an interesting advantage: processor, memory, and I/O resources can be moved independently between partitions.

iSeries shares resources between OS/400 and Linux partitions. Logical partitioning supports the sharing of processors between OS/400 and Linux. Partitioning also offers the Virtual Ethernet LAN facilities to support partition-to-partition communication. iSeries can also consolidate the I/O resources for the multiple Linux servers by supporting virtual I/O devices such as disk, tape, CD-ROM, and DVD that can be shared between OS/400 and multiple Linux partitions. Through this virtual I/O support, iSeries provides SAN facilities for the Linux partitions by automatically spreading the data across the iSeries disk drives. In this way, iSeries offers RAID protection and consolidates backup operations. Virtual storage resources can be dynamically added to Linux partitions. Each of the Linux partitions can also benefit from direct I/O resources.

An integrated system, the iSeries provides various benefits including exploitation of the backup and recovery facilities of OS/400 such that the Linux partitions data is automatically protected. The iSeries also offers shared storage such that storage spaces can be read from multiple partitions. Linux applications can access the OS/400 DB2 UDB database and OS/400 files and printers.

IBM's investments are designed to support workload consolidation, integration, and application flexibility for Linux on iSeries. With partitioning, customers can consolidate web, file, print, e-mail, and networking applications. IBM has introduced Linux on iSeries to target the consolidation market for small and medium-sized business. The company is also working with Solution Providers to deliver new business applications to iSeries customers ranging from e-mail, to commerce, financials, and ERP solutions. To enable additional business applications, IBM recently announced DB2 UDB and WebSphere for Linux on iSeries.

IBM also offers Capacity Upgrade on Demand support for the iSeries, shipping a full complement of processors on the i825, i870, and i890. The additional processors in the servers can be activated by the customer permanently or temporarily. After the dynamic activation, the processor resources can be moved dynamically to running Linux and OS/400 partitions, which provides additional capacity to critical Linux or OS/400 applications. Capacity Upgrade on Demand enables the iSeries to quickly react to changes in e-business workloads.

Several IBM programs help iSeries customers get started with Linux. For example, when customers purchase an Enterprise Edition package on the higher-end models, they also receive vouchers for Linux education and Quickstart services for no additional charge. With some models, IBM also includes an additional processor in the package to run Linux; there is no additional charge.

zSERIES

Linux is now available on the IBM mainframe. This represents a significant solution for existing zSeries customers to exploit the Linux application base in a highly scalable and robust environment at a relatively modest cost. It has also given IBM a way to introduce mainframe computing to customers who have never had a mainframe before. The dominant volume of Linux zSeries installations covers existing zSeries customers, according to industry analysts.

Linux provides an opportunity to blend the traditional values of mainframes (economies of scale, reliability, availability, etc.) with the benefits of the distributed world (flexibility, distributed control, ease of development, etc.). Linux on zSeries proves most cost effective when compared with multiple distributed servers in larger configurations and is easier to manage using datacenter policies and procedures. IBM positions Linux on zSeries as a tool to give the CIO an opportunity to regain control of the IT environment and a better handle on overall costs.

IBM's zSeries Linux strategy covers three key points:

- Obtain new application source
- Demonstrate relevance in growth of the "e" market
- Support existing customer base

There are three ways to run Linux on a zSeries:

- *Native*: Linux can run on the entire machine, with no other operating system.
- *In a Logical Partition (LPAR)*: The zSeries hardware can be divided into a maximum of 15 separate LPARs. A single zSeries, for example, can host z/OS applications in one partition, VSE/ESA or TPF applications in others, and Linux applications in additional partitions.
- *z/VM Guest Support*: A customer can also run Linux as a virtual machine using z/VM, which provides virtualization of CPU processors, I/O subsystems, and memory. z/VM also allows for the sharing of applications and data between virtual Linux servers. A customer running z/VM can have hundreds of Linux systems run on a single zSeries. With z/VM, for instance, a customer can offer a complete Linux server environment to each of its application developers and host production systems all on the same zSeries. IBM's business partner, LinuxCare, delivers a system management tool, Levanta, which makes it easier to provision and manage Linux instances on zVM.

All zSeries processors currently in production are available with a hardware feature called an Integrated Facility for Linux (IFL), which is a processor that supports Linux workloads exclusively. They may be run in native modes or as guests of z/VM. Since the IFL does not support traditional S/390 or zSeries software, processing power for Linux can be added without affecting the charge for traditional software. Since IFL engines are low cost, they offer a solid value proposition: They give customers a way to expand processing capacity for Linux without affecting the charges for traditional S/390 software from IBM and other vendors.

IBM's Linux strategy on zSeries includes Linux for workload consolidation for web serving, Internet infrastructure, file/print, enterprise applications, and online applications, while running the primary enterprise database in a traditional S/390 partition. The approach integrates the two in a common operating environment. Further, IBM now offers its e-Server zSeries for Linux, a package that includes hardware, z/VM virtualization technology, and support. It is designed to enable customers to consolidate a larger number of UNIX or Windows servers onto a single or small number of zSeries servers.

IBM's Managed Hosting – Linux virtual services plays a vital role in integrating Linux into the on-demand environment. This is targeted at customers with large server farms. IBM delivers a server consolidation service to help these customers improve their TCO by consolidating distributed server workloads onto IBM zSeries servers. These servers in turn run Linux without the up-front expense of buying the physical hardware. IBM Managed Hosting is positioned as an IBM e-business-on-demand solution. The Linux virtual services solution is delivered like a utility: The customer pays for the processing, storage, and network capacity required and can add for peaks or as needs grow. Instead of physical web, database, and application servers, the customer runs these operations on virtual servers, hosted and managed by IBM. IBM targets the e-business-on-demand concept and the underlying technology to help improve the availability and reliability of IT environments while simplifying the infrastructures.

IBM has dedicated one of its largest mainframes, the Linux Community Development System, for use by developers worldwide to bring Linux applications to the zSeries platform. Use of a dedicated Linux server on the mainframe platform is provided for the applicant at no charge.

SOFTWARE

IBM has ported much of its software portfolio to Linux, leading with the key IBM middleware brands – DB2, WebSphere, Lotus, Rational, and Tivoli. The company's primary Linux software development and deployment platform is xSeries followed closely by zSeries for key middleware that enables or benefits from workload consolidation. This middleware on Linux for zSeries includes a significant subset of the IBM software portfolio covering products from all five software brands. In 2003, some IBM middleware support is planned for pSeries

and iSeries with a focus on supporting a complete J2EE and web services environment on these platforms as well as workload consolidation on iSeries.

IBM inaugurated Eclipse, a major open source software initiative to provide an open foundation for next-generation development J2EE tools.⁴ A new version of WebSphere Studio (built on Eclipse) allows developers to write modern, J2EE-based applications. IBM is making its development tools for all platforms available on Linux as well as providing extensions to complement open source and any distribution-specific tools. Besides improving the application availability for IBM servers, this strategy addresses the maturation of Linux as a standard development platform for e-business and promotes IBM's middleware, targeting IT developers, traditional ISVs, Net generation ISVs, service providers, and others who drive product development.

IBM is aggressively soliciting ISVs and corporate developers to focus on Linux and has created programs to help them port to Linux. A key program is "Speed Start Your Linux App." The target audience is Windows developers and SMB IT decision makers. The objective is to make it easy for developers to use Linux as the development/deployment environment. IBM claims that thus far the program has worked with 33,000 developers and created over 4,000 solutions. IBM is now adding Linux integration centers for customers to attract additional corporate developers to exploit Linux. The process the program follows covers,

- Workshops for IT managers to understand the Linux value proposition
- Provide downloadable and online development resources
- Provide ISVs with a complete support structure

IBM delivers a complete toolkit, including IBM middleware, tools, and support to make it easy for ISVs and corporate developers to port their Linux applications from their current environment.

IBM lists over 4,600 Linux applications in its Global Solutions Directory, available on the IBM website.

SERVICES AND SUPPORT

IBM GLOBAL SERVICES AND TRAINING

IBM's Global Services (IGS) views Linux as a "disruptive" technology, which creates new opportunities for service. To exploit these opportunities, IGS has added Linux to its services portfolio, specifically falling under Business Consulting Services to IBM's Strategic Outsourcing. IGS provides comprehensive worldwide Linux services that include infrastructure consulting and planning, installation, configuration, and application enablement. The group also provides support consulting and implementation services for Linux, delivered by a staff of more than 2,500 Linux specialists. The services cover,

⁴ Eclipse is covered in more detail in the "Industry Relationships" section above.

- *Clusters* – design, integration, and support for Linux high-performance clusters
- *Distributed Enterprise* – application design and rollout services for distributed retail enterprises
- *Workload Consolidation* – targeted to reduce TCO and server proliferation
- *Strategy* – develop a Linux plan to meet customer business needs, including ROI analysis

IBM also provides a full portfolio of education and training courses via classroom and the web. These courses are available in twenty countries, consistent with IBM's global marketing and support of Linux systems. These classes target users, administrators, and developers, and address Linux basics, awareness for managers, developers, and system administration.

IBM Redbooks has proven to be one of IBM's most valuable training tools. Its tutorials and how-to guides written by experienced professionals explain in detail how to install, tune, and operate systems. Anyone considering IBM systems with Linux should download or purchase the appropriate Redbooks, which now cover all the IBM server platforms and middleware. These documents allow the IT team to plan for Linux and guide the installation, and the entire process of creating an operational Linux environment. The books include sample scripts and other tools so that the user gets the benefit of the writers' experience.

Finally, IBM sponsors the Linux Professional Institute to certify Linux professionals. In addition to education, IBM enables Linux in its worldwide Solution Partnership Centers to facilitate application development on all IBM servers. These centers focus on software and server specialists with Linux-ready servers, storage, and middleware.

TECHNICAL SUPPORT

IBM supports Linux as a native IBM environment with the same terms and structure that it provides other IBM operating environments. Several distributions of Linux receive the same level of technical support given to other IBM operating systems. IBM provides direct telephone and e-mail help center support for Linux on IA-32 in 164 countries, 24x7, with the first ninety days free. Start-up support is now available from IBM Help Centers around the world. Customers purchasing certified xSeries servers receive installation, setup, and configuration support for a period of ninety days from the first call to the Help Center.

IGS provides one-stop prime shift or full shift (24x7) enterprise-level support for the Linux distributions included – UnitedLinux (Conectiva, SuSE, and Turbolinux) – with either toll-free phone or electronic access. Support embodies both defect and “how-to” support for all e-Server platforms, including the e-Server Linux Cluster 1300 and 1350. In addition, IGS offers advanced support. (An Account Advocate program assigns a single point of contact that is familiar

with the customer's environment and Consult Line provides assistance beyond the normal defect and basic usage support.)

The following services are offered for Linux:

- *IBM Operational Support Services.* This support line for the Linux operating system offers 7x24 enterprise-level remote support for the Linux operating system environment and covers problem resolution. This takes into account supplementing customer internal staff with IBM's service specialists, defect support for supported distributions of the Linux operating system and Linux applications, and electronic support and problem submission to improve productivity. For all eligible distributions of the Linux operating system, this service addresses,
 - usage and installation questions,
 - product compatibility and interoperability,
 - interpretation of product documentation, and
 - integrated Linux cluster support.

A diagnostic information review to help isolate the cause of a problem:

- configuration samples,
 - IBM and multi-vendor database searches,
 - planning information for software fixes, and
 - defect support.
- *Electronic Support* allows electronic responses to such basic questions as "Which operating system distributions are supported?"
 - IBM provides how-to and defect support for the four major distributions of the Linux operating system (noted above).
 - *Standard Coverage.* Basic prime shift support includes coverage during normal business hours, Monday through Friday, excluding national holidays. No restrictions are placed on the individuals at the customer's facility as to who may call to access support services. With the standard coverage option, a customer can submit unlimited service requests for the products covered by the agreement.
 - *Coverage Options:*
 - *Full Shift Coverage* (where available) provides service 24 hours a day, seven days a week.
 - *IBM Operational Support Services – Account Advocate* provides a single support interface for remote support. With this service, an Account Advocate team is assigned that becomes thoroughly familiar with the customer's business and systems environment. This team serves as the single interface for IBM software support.
 - *IBM Operational Support Services – Advanced Support* is the highest level of remote support provided by IBM. This service is tailored to meet the unique needs of continuous, business-critical system operation.

- *IBM Operational Support Services – Consult Line* lets customers schedule telephone discussions with IBM technical experts to resolve in-depth issues important to the business.

Many of the above services are available for IBM and multi-vendor environments.

VALUE ADDED

IBM has applied value add to Linux as rigorously as it has to its other system environments. This reflects IBM's search for an alternative to Windows as well as the market reality of customer acceptance for Linux. IBM brings significant value to Linux, making it ready for the enterprise customer by providing Linux application environments across its server brands, and by preparing enterprise middleware and management software for Linux. IBM also provides Linux with the same level of support it offers its other server systems. Key highlights include,

- IBM provides its *ServerProven Solutions on Linux*, opening its eleven Solution Porting Centers and providing ServerProven program support.
- *Hipersockets* – allows Linux instances running on zSeries hardware to communicate with each other without using an external network, and without the latency associated with external networks.
- *Virtualization Technology* – IBM offers the technology to create and manage multiple Linux servers on a single zSeries server.
- *iSeries Linux Test Drive* – ISVs now enjoy an option for porting and testing their Linux applications on iSeries. The iSeries Linux Test Drive enables ISVs to access Linux running in a partition on iSeries via the Internet.
- IBM offers *Cluster Systems Management (CSM)*, an advanced cluster management software that allows a cluster of Linux systems to be managed from a single point of control.
- *IBM Director for IBM xSeries* provides management features that include SNMP and CIM-compliant, multi-operating-system support, multi-protocol support, single-click management GUI, integrated SQL database, remote control, process management, event logging, automatic responses, inventory management, and group management.
- IBM is contributing skills and resources, including numerous software contributions, to assist the open source community in developing an enterprise-class Linux operating system. A major IBM investment in open source underlies the *Linux Technology Center*.
- IBM has ported most of its middleware on Linux to provide high-quality solutions. Much of the IBM e-Business software portfolio has been implemented on Linux including such offerings as *IBM's StartNow* development patterns, which clearly move beyond software products.
- The *Linux Software Integration Center* helps customers create and optimize integrated solutions based on IBM's middleware across all hardware platforms and Linux distributions. Professionals with expertise in IBM and non-IBM

software assist customers with technical consulting, proof of concept, and benchmarks as well as integrating middleware and applications.

- IBM launched a middleware-based ISV worldwide program to drive high-visibility partnerships in finance, retail, accounting, and commerce. As a result, IBM has created a substantial volume for both horizontal and vertical application solutions on Linux.
- IBM is continuing other demand generation campaigns around Linux to help ISVs and IBM partners sell Linux-based IBM software solutions. Also, the IBM “Ready, Set, Linux and – GO!” program offers technical and sales enablement from IBM.
- *The IBM Web Portal* proves an excellent resource for information regarding IBM, customers, partners, the community, and the industry.

IBM’s e-Business Software Strategy provides a software and services structure to support the development of e-business applications using IBM, open source, and industry infrastructure. The company has also positioned its Linux middleware to enable Linux applications to connect and manage business process flow, to deploy collaborative applications, and to speed the transition from web serving to transaction intensive environments for Linux-based systems. Beyond this, it defines a multi-platform environment.

APPLICATION FOCUS

Mimicking the growth of Linux itself, IBM’s Linux application offerings have grown from edge servers and enterprise infrastructure applications (e.g., firewall, print/file, web server, e-mail, technical clusters) to embrace more integrating applications (e.g., software development, database server, web hosting, branch automation, e-commerce, ERP, small business, and industry applications). Customers are deploying distributed enterprise applications, branch office solutions, small business applications, and Linux has become a deployment platform for UNIX-based custom solutions.

With its investments to improve the Linux kernel and the ecosystem around it, IBM views Linux as reaching a new strategic position: ready to be a viable platform for more mainstream and transactional commercial applications (e.g., commercial clusters, ERP, CRM, SCM, vertical industry applications). IBM continues investments in key targeted industry segments for enterprise and SMB deployment – financial services, communications, distribution, industrial, and public sectors. Since Linux is pervasive across IBM servers and is supported by IBM’s middleware, the company is able to position this full range of applications and solutions across all its server brands, all with the same level of services and support.

As with the other system suppliers, IBM delivers a full range of applications on its IA-32 xSeries servers. These high-availability solutions employ SteelEye, VERITAS, and Tivoli, which support application, database, and system failover. IBM also supports the Oracle 9i RAC infrastructure. The IBM-Oracle 9i solution

is certified with both Red Hat and SuSE. IBM also offers mySAP R/3, CRM, and BI (Business Intelligence) on Linux. Also offered is a high-availability version of mySAP using SteelEye LifeKeeper. IBM is proving very aggressive in driving ISV and corporate-developed applications for its server systems and middleware software. IBM has established low (or no) cost programs to help ISVs and corporate developers use IBM application development tools and infrastructure middleware (e.g., Websphere, DB2). In concert with contributions to the Eclipse project, IBM is working with key third-party application development tool vendors to ensure availability of its products on IBM's strategic middleware suites and entire e-Server line. IBM believes that the availability of a broad range of robust development tools will make it easier to develop on Linux and thus spur Linux adoption. IBM has gone through significant activity to create a more solutions-oriented approach for all its operating environments, especially Linux. The company now sees a critical mass in the market, which permits IBM to target the solution-oriented mid-market with Linux.

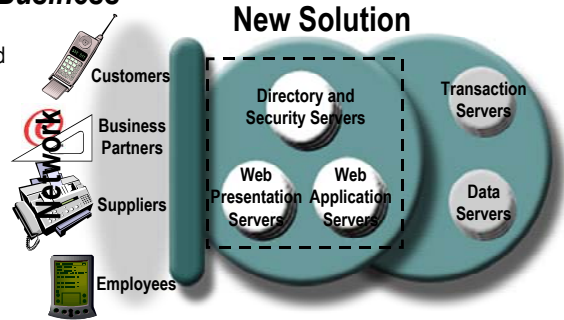
For IBM servers that support Linux, Windows, and AIX, IBM is partnering with its ISVs and business partners to deliver integrated solutions called StartNow solutions. They are targeted to mid-market customers and are pre-architected and tested for particular application environments and workloads. The objective is to enlist ISVs and business partners in not only delivering solutions on Linux (in this case), but to do it using IBM middleware, targeting IBM servers in the high volume markets. The objective is to create rapid deployment of these solutions and to remove inhibitors to installations. Solution areas include BI, collaboration, content management, e-commerce, infrastructure and infrastructure management, portal, and wireless. The following graphic shows the components and benefits of a StartNow solution.

FIGURE 3
*IBM Integrates Linux
for e-Business*

e-Business with Linux Just Got Easier...

IBM[®] Integrated Platform for e-Business

- Linux-based platform for Java applications and web services
- Pre-architected, tested and optimized for popular e-business workloads (based on IBM patterns for e-business)
- Dramatically reduced time to solution
- IBM engineered security and reliability
- Uses WebSphere Studio for development
- An IBM StartNow solution



What You Can Do...

- Take your applications to the web
- Interact with customers over the web
- Conduct e-commerce
- Deploy new web services



Solution Components

- WebSphere Application Server
- DB2 (Optional)
- Security and directory software
- Firewalls
- xSeries servers (other[®] series in future)
- Blueprints or pre-assembled by select partners

FUTURE ACTIVITY

Linux creates new opportunities for all of IBM's businesses. It is in IBM's interest for Linux to continue to evolve into a competitive industry-standard platform in competition with Microsoft's Windows 2003 and .NET and Sun's Solaris. IBM wants to compete above the operating environment with its middleware and services. IBM can afford to invest to ensure that Linux reaches the required critical mass.

On-demand is the new IBM strategy. To make that strategy work, IBM needs Linux to be robust, scalable, and available. IBM is going to continue to invest in Linux. By working through the community to add high-end features to the kernel and by soliciting the necessary tools and middleware to support corporate development of Linux applications, IBM will drive Linux into the enterprise and the datacenter. Among these are scalability, better I/O and file system support, and system management. IBM will continue to drive Grid clusters with customized industry solutions, building on risk management and others already in the market. IBM will also continue to feature Linux as a premier development and deployment platform for web services, using the WebSphere product family.

IBM is expanding ServerProven to other e-Servers, which will aid ISVs in leveraging their porting and development efforts to all of IBM's e-Server series. The company will also continue its efforts to partner with vertical application and cross-industry ISVs to deliver Linux-based solutions in the market. IBM will also continue to roll out programs to help its business partners become proficient in delivering Linux solutions to the mid-market. And, it will continue to actively promote Linux, primarily to the mid-market.

IBM's objective is to increase Linux server volumes, but also to position IBM middleware and build a viable platform alternative to Windows 2003 and .NET.

IBM plans to improve its blade offerings by making them heterogeneous, enabling Linux-based IA-32, Linux-based POWER, and AIX-based blades together to populate the same blade center. Similarly, IBM plans to include the IBM Blade Center in the 1350 cluster offering.

CUSTOMER SUCCESS STORY: TOMMY HILFIGER, IBM, AND eONE GROUP LINUX INSTALLATION

COMPANY OVERVIEW

COMPANY DESCRIPTION

Tommy Hilfiger Corporation (Tommy), through its subsidiaries, designs, sources, and markets men's and women's sportswear, jeanswear, and children's wear under the Tommy Hilfiger trademarks. Through a range of strategic licensing agreements, the company also offers a broad array of related apparel, accessories, footwear, fragrance and home furnishings. The company's products are found in leading department and specialty stores throughout the world, as well as the company's own network of specialty and outlet stores in the United States, Canada, and Europe.

PROBLEM

Tommy Hilfiger's direct sales targets national large retailers for resale of the Tommy lines of apparel and maintains EDI relationships with these large retailers to place orders, manage inventory, etc. Tommy is targeting improved sales and service for smaller, newer specialty stores to better enable these stores to purchase from Tommy. Typically, these stores cannot afford or do not have the capability to implement their own EDI solutions and Tommy cannot create a dedicated sales force to service these widely distributed stores. Tommy needed a solution to enable specialty resellers to access the clothing product lines. In addition, the solution had to ensure that Tommy's segmentation was observed so that stores contracted to the children's line did not have access to the other clothing product lines. The resellers needed the ability to view merchandise, reserve inventory, place orders, and track orders.

A second target is Tommy Hilfiger factories. Today, Tommy communicates garment information to factories via fax and express mail. These methods are costly and not as timely as interactive solutions. Tommy wanted to give the factories easy access to the technical specifications of a garment and provide immediate access to garment changes (fabric, processes, etc.).

Tommy Hilfiger had a requirement that any solution must be integrated with the existing back-end systems – a multi-platform product database (Sybase/IBM AS400) and an in-house inventory management system.

As a secondary consideration, Tommy wanted to provide a way for employees to purchase. However, setting up an employee store is expensive. If a lower cost alternative could be found, then a store would be launched.

WHY LINUX

Tommy Hilfiger's primary objective was to create a website that would improve the company's sales relationships with specialty retailers and reduce the cost and improve the flexibility of its manufacturing. Tommy did not undertake intensive analysis over a long period. Rather, it focused on getting a solution in place as quickly as possible. So, the company looked at what others in the industry were doing (e.g., Omaha Steaks – two million hits a day on Intel servers).

Tommy chose eOne Group, an IBM business partner, to help it construct the solution. Linux is the platform of choice for eOne Group – it has fourteen Linux customers (e.g., Omaha Steaks, YKK [U.S.A.], etc.). Tommy selected eOne Group's eOneCommerce product as the technology to drive the website and integrate with the back-end systems. While Linux was an underlying technology and Linux reliability and system cost were important considerations, Tommy was focused on the value that it was going to get. The eOneCommerce offering drove the adoption of Linux.

Tommy did not consider Microsoft Windows NT because of perceived Windows NT stability problems. UNIX systems were not considered because of cost. Tommy wanted to go to a Java solution because of the disparate systems it has and its view that Java is the *Lingua Franca* for getting the same code to run across all of them. An important factor for Tommy was its in-house UNIX expertise. The company thought its current staff had the required skills for Linux.

Tommy decided that the eOneCommerce and Linux approach yielded a low cost approach to driving the Tommy Hilfiger website. eOneCommerce is all Java, but it is not EJB driven, so it does not require a great deal of specific unique development.

INSTALLATION EXPERIENCE

Installation was straightforward and relatively easy. This was not a transition from UNIX to Linux; it was a new installation. The process proved less expensive on Linux than on the UNIX systems installed previously. Tommy started designing in November, coding in late January, testing in April, and production took place in May.

Tommy chose to implement the eOneCommerce portal solution from IBM Business Partner eOne Group. Rather than having to support separate functionality for individual departmental functions, eOneCommerce alone provided the necessary capability. The following portals were deployed – supplier portal, specialty retailer portal, manufacturing portal, and employee portal (for discount merchandise sold to employees).

Tommy implemented the system using multiple (3) servers on a load balancer. Each server runs the eOneCommerce portal on Tomcat/Apache, the DB2 database, and an HTTP server. The portals run on Red Hat Linux, using two of

the systems for production and the third for test, though the third can be put into production immediately if needed.

Performance to date has been satisfactory. Each user is authorized to separate application capability. The website systems are closely integrated with all of Tommy's back-end systems. Backend wholesale processing is done on an IBM iSeries server. Almost everything done from the website touches the iSeries system. For example, the iSeries checks authority in real time, and checks browsing to see what items are in stock. When the user goes to an item, the system checks which sizes and colors are in stock, all in real time. The portal connects with back-end systems through stored procedures, XML, and JDBC connections. eOneConnector provides the system with the capability to replicate data with the DB2 database running on IBM iSeries, as well as with Windows NT and HP/9000 servers.

As a result of the Linux installation, Tommy has integrated multiple servers into a system with eOneCommerce playing a key role. Tommy uses Linux for B2B; the HP-UX system for its heavy graphics systems for designers; iSeries for wholesale systems, production orders, customer orders, inventory, etc.; and the AIX system for its retail division – company store and specialty stores. In real time, the website will go to a particular system depending on the information it wants to pull back. It goes to the HP for design data, to the iSeries for business data, and to an NT system for PDF image data. All the data, from multiple systems, is integrated well with a common view to the people who have to use it.

MEASURABLE BENEFITS

Since this was a new application, Tommy had no prior experience to measure it against. However, based on Tommy's objectives of improved sales relationships with specialty retail customers, reduced cost and increased flexibility in manufacturing, and end user interest and exploitation, Tommy believes that the company has achieved the benefits identified in the business case presented to senior executives justifying the project. In particular, it must be noted that the system is delivering outstanding reliability: The system has been up for two years with few problems. The system is doing what Tommy expected at the planned cost point.

Tommy reports that the benefit of the system was two-fold: better relationship and coverage of small specialty retailers; also the cost savings in putting technical specifications online. The employee portal was opportunistic. The manufacturing portal and access to employee stores will produce a 20% reduction in costs and design-to-product time. The employee store website allows employee purchases and represents an 80% reduction in the cost of a physical employee store while improving employee satisfaction.

In its first month, the new website added 400 new customers and allowed Tommy to hold its margin on seasonal products. Tommy pointed out its satisfaction with

the reliability, increased performance and scalability of the xSeries/eOneCommerce platform.

Tommy pointed out that Linux was a means to an end, not an end in itself. The application delivered the value. The Linux environment created the lower cost, reliable infrastructure.

LESSONS LEARNED

The Tommy IT staff created a business case for the project for the Senior Executives. By creating the business case, it was able to get executive buy-in to the benefits: reaching the specialty retailers via the web; reducing costs and improving flexibility by communicating garment information to the factories over the web. As a result, when the system started delivering, the executives became interested in expanding the capability beyond the initial objectives to the employee sales site.

One of the keys to success for Tommy is that it does things in a methodical, step-by-step way. For the Linux installation, Tommy used eOne Group to initially get the system up and running as quickly as possible. (eOne Group had a strong relationship with Tommy, built on eOne Group's strong background in ERP, retail and distribution, iSeries, and web software.) This approach avoided having to build a large team at Tommy; it developed quick value for the system; and it helped the Tommy staff learning curve since they could use eOne Group's experience as a lever and something real and concrete to work with. The Tommy team then took advantage of more formal education with a background in Linux and the application already in place. This step-by-step approach gave them an opportunity to take ownership of the application and Linux when they were ready. Tommy now maintains complete ownership of the Linux environment, applying patches, Apache management, etc. With this kind of planned approach, Tommy believes that it reaches its goal of a value producing system for production management more quickly and with less pain. This is the model that Tommy applies to all its projects.

WHY IBM AND eONE GROUP

Tommy selected IBM hardware because of its strong feeling for IBM hardware. The company also felt that it would not have any problems running IBM hardware with Linux.

eOne Group comes from an ERP background, so its software is designed to integrate with back-end systems, making it very attractive to Tommy Hilfiger and other companies who have significant historical investments in back-end applications. Tommy has been very pleased with the eOne Group relationship. An example of what eOne Group brought to the engagement was the ability mentioned above to get the system up and running quickly. In addition, eOne Group serves as a mentor to the Tommy team for the eOneCommerce

application, Linux, and for integrating the systems. Through the use of eOne-supplied templates, the Tommy staff is able to develop code in RPG and send XML to the eOneCommerce application.

FUTURE LINUX ACTIVITY

Tommy is planning to expand the website's functionality. For example, today the company's QA staff in Hong Kong write up inspection reports and fax them to the main office. Tommy plans to let them enter inspection results directly into the website. Tommy also wants to implement a proof of delivery system for customers. Today customers can e-mail using an in-house imaging system. In the future, Tommy is going to connect the website directly to the imaging system to let customers pull their own invoices, bills of lading, etc. It plans to image their documents and make those available on the website as well. Tommy is using Linux because it now has the experience with it and can build on a reliable environment. "We are going to do it right on what we have, it's working very well."

SUMMARY AND OVERALL PERSPECTIVE

Tommy summarizes its overall experience as follows – as Ally Woo from Tommy Hilfiger said, "It went very well. It is hard to say what we would do differently. We made the right decision to go with eOne. They have done a tremendous job of building the right foundation for us." This succinctly describes the level of satisfaction with eOne Group, Linux, and IBM.

Tommy achieved all its objectives in the deployment of its website and portals. They are now able to more effectively reach and support its specialty retailers; the company enjoys a faster, lower-cost way of sharing critical manufacturing information with its factories; and it was able to opportunistically develop an employee website, building on the technology deployed for the mainstream business objectives. Tommy is achieving measurable benefit from using eOneCommerce and Linux on the IBM systems. Users are actively buying in to the deployment of the system – it has become part of the fabric of normal operations as new seasons drive requests for access to the website for product information. Perhaps most important, the company achieved the business case objectives it promised to senior management and are now receiving requests to expand and extend the website's capabilities. That, in itself, is a strong vote of confidence for the Tommy IT team.

SUN: TACTICS AND STRATEGIES

OVERVIEW

Sun perceives two key trends in the IT server industry. The high end experiences consolidation and the exploitation of 64-bit platforms. Sun believes it is positioned to do well in that environment. However, at the low end (entry servers), Sun sees the same changes that the rest of the market sees – the increasing economic influence of industry-standard IA-32 servers along with Linux capturing an economic advantage. These trends are significant, since, in Sun's view, the entry server market in network and business services and HPTC amounts to \$30 billion. The company recognizes an increasing focus on low cost computing, low-cost solutions, and TCO. All of these drive the open source and Linux phenomenon.

Sun views Linux as another UNIX derivative that is largely compatible with Solaris. However, it recognizes that Linux is now not only mainstream, but a high-volume platform. For some time, Sun has been promoting Java and web services for Java as an alternative to Windows 2003 and .NET. Given these recent market developments, Sun recognizes that Java must be linked with a volume platform to be successful and IA-32 with Linux is the only viable option. Sun's view resembles IBM's view that establishing a volume alternative to Windows 2003 and .NET is critical to maintaining a viable software business. In addition, Sun has experienced substantial customer demand for x86 (IA-32) offerings and for Linux. Hence, the company appreciates that it must operate in a heterogeneous market. Doing it with a set of compatible Linux offerings is the least disruptive approach.

Sun reached a strategic decision to include Linux on IA-32 platforms in its product mainstream. It is building consistent business models across Linux and Solaris in terms of how it delivers systems, services, and software with the Java layer on top as the primary API set. The objective is to create an end-to-end datacenter model with Java as the API and a range of systems underneath. The strategy is to target Solaris for SPARC, Linux for IA-32, and expand the functionality of its Solaris x86 operating environment for Solaris customers who wish to include IA-32 servers in their environment. Sun's specific objective is to deliver Solaris x86 feature/performance parity with Solaris/SPARC. This would deliver a multi-platform architecture with the "right tool for the right job." Sun is prioritizing its Linux solutions around the high-volume opportunities of edge servers, web servers, application servers, and enterprise infrastructure servers, as well as desktops and the heterogeneous blade environment.

Sun believes that this strategy recognizes the market relevance of Linux while defending the value proposition of Solaris as an operating environment and SPARC as a platform. Previously, Sun offered its own Linux distribution as part of its low-end Intel offerings and as part of its Intel appliance partner offerings (e.g., Symantec security). In order to enter the Linux mainstream, Sun is

supporting Red Hat. Other distributions are expected in the near future. It is also going to support Linux applications (Source) on Solaris. Finally, Sun is resurrecting the Solaris on IA-32 strategy, providing Solaris customers (and Linux users) the ability to exploit a full UNIX environment on IA-32 environments, giving cost-focused customers an opportunity to stay with Solaris rather than migrate to Linux. The company positions its RISC hardware as the strategic 64-bit environment.

Sun's current strategy positions Linux at the low end of solution offerings while attempting to establish Solaris on Intel as an alternative for higher value applications. At the same time, the company preserves the SPARC Solaris value proposition. Sun is attempting to perform the same kind of positioning that IBM and HP followed up until two years ago. Both IBM and HP figured out that the task was impossible and shifted to a "Linux everywhere" strategy. It will be interesting to see what success Sun experiences. There is one definite advantage: an existing Solaris for IA-32, soon to be as functional as Solaris on SPARC. Neither HP nor IBM made the investment to move its UNIX to IA-32. Also, the others marketed a broad range of platforms they had to defend and position. Sun can still make the claim that UNIX is the answer; it is just a matter of which compatible UNIX is appropriate for the task. It will be interesting to see if the market embraces this approach. Customers generally seek low cost, flexibility, and diversity of supply. If they perceive this approach doing that, it can succeed. If they view this as another attempt to constrain their ability to achieve substantial cost savings, it will not reach Sun's expectations. We suspect that Sun will eventually conclude that stronger support for Linux on SPARC will likely drive more Solaris (on any platform) and more SPARC.

One thing is clear: Sun has long supported and contributed to Linux and open source. An outspoken advocate of a more open systems environment, in general, Sun remains a driving force for Java, which is becoming the standard development environment for Linux systems. Sun also supported and contributed to certain Linux and open source projects such as OpenOffice, an open source Microsoft Office competitor, and GNOME, the object-oriented Windows-like user interface for Linux. Finally, Sun is proving more aggressive with Linux clients, recognizing that there are large business opportunities for client systems that do not require heavy personal productivity applications. Vertical applications yield the potential for a significant market and Linux has an opportunity to be a major player there.

Sun's Project Orion software strategy reveals an interesting development in Sun's plans to deliver software in the future for both Solaris and Linux. Project Orion's objective is to make the entire stack of operating environment and middleware delivery more predictable (as a stack) and more integrated. This covers an integrated testing model that includes operating environment (Solaris, Linux) and middleware (cluster, storage, directory, and web serving/services) all tested in end-to-end customer environment scenarios. The Sun model is to create a "Software System." A key element of this strategy is to make this stack open (over

time) by enabling ISVs to offer competitive elements for those customers who have either already invested in ISV software or who choose ISV offerings over Sun's prepackaged components. While this remains a concept at the time of this writing, the approach is likely to prove attractive to Sun's customers with significant investments in Sun software and hardware.

Sun claims its approach will enable it to deliver software on a predictable "software train" that customers can plan on and that will be less complex and more cost effective. This resembles the model IBM has followed for mainframe environments. IBM's large system customers found this approach a requirement for their complex systems environments. DHBA expects the same to be true for Sun's large system customers equipped with significant Sun software investments. However, it is unclear how all of this sorts out since the ISV community holds dominant positions on many middleware solutions. It is also not clear how interesting ISVs will find this approach since they will now face a new competitor and another architecture and set of technologies to exploit. Similarly, there is little information at this time on what the Linux stack will look like and how it will be integrated with the Red Hat and UnitedLinux (SuSE) distribution schedules. Sun is offering essentially the same software stack on Linux as on Solaris 9, x86. The Linux offering consists of Red Hat Linux (preloaded), open source software, Java, Sun ONE, and Sun Services. The Solaris x86 stack consists of Solaris 9, open source software, Java, Sun ONE, and Sun Services.

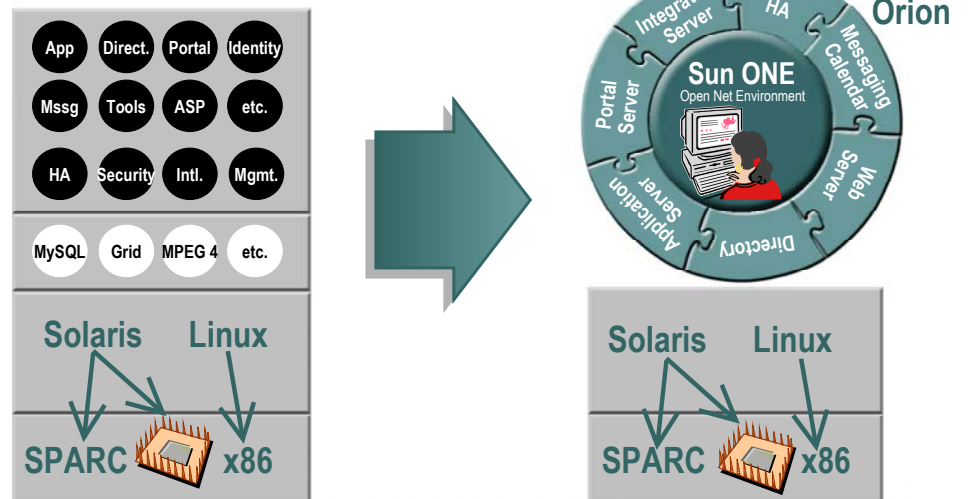
Sun continues to position its Linux strategy as advancing the cause of UNIX at large against Microsoft and its .NET strategy. Project Orion, Sun ONE, the repositioning of Solaris on IA-32, and the soon-to-be-announced support for the standard Linux distributions are all manifestations of that thinking.

Sun needs to continue to inform and educate its customers. The key issue is to demonstrate that it understands the focus of its customers on cost and diversity of supply and that Sun is indeed an open system supplier, not just a Solaris open system supplier. The LX-50 marks an interesting first foray into the IA-32 world. The company has since announced the V60x and V65x dual-processor systems, a blade platform, and cluster products that support the x86 environment. The market is tightening. Dell will continue to attack at the low end and IBM will be ever present at the high end of IA-32 systems. Sun is currently targeting Dell with low-cost systems and solutions, a strategy consistent with Sun's view that Linux and x86 address a low-end TCO-driven market. The positioning of Solaris IA-32 and Linux starts to address that situation. While the volume Sun offerings (Sun Fire V210 et. al.) may be attractive to existing Sun and other UNIX customers, there is a very large and growing IA 32 and Linux on IA-32 market that cannot be denied, and is beginning to move into a higher value space. While Sun's positioning of Linux at the low end may address today's volume environments, the company also needs to articulate a more complete overall product strategy to address what may be an emerging higher-end market.

FIGURE 4
Sun's Project Orion
Combines Linux
and Solaris

The following figure describes the positioning of Solaris, Linux, and the value of Orion that Sun is trying to deliver.

Increasing Value The Integrated Platform



INDUSTRY RELATIONSHIPS

Sun contributes significantly to the intellectual property in the open source development effort. The following are among the organizations that Sun participates with:

- *Free Standards Group.* Sun is a member supporting the LSB, which provides the Solaris-Linux cross-platform compatibility base.
- *Linux International.*
- *The Linux Internationalization Effort (Li18nux).* Sun is a co-founding chair of this effort.
- *X.org.* The home of open source XFree86 and other X-Windows-based technologies.
- *OSDN.* Sun is a charter member.
- *GNOME.* Sun supports GNOME as its x-platform user interface and is involved in its development. Sun is also a founding member of the GNOME Organization.
- *OpenOffice.org* is the open source home and foundation for Sun StarOffice, the Microsoft Office competitor that runs on Linux and UNIX. Its mission is to “create, as a community, the leading international office suite that will run on all major platforms and provide access to all functionality and data through open component-based APIs and an XML-based file format.”
- *Apache.org.*

- *CollabNet.* Sun works with CollabNet on open source project JXTA, which is a peer-to-peer framework. Also, CollabNet hosts other Sun open-source-led projects such as NetBeans.
- *Mozilla.* Sun participates in and contributes to this open source browser effort. (Mozilla is an open source web browser, designed for standards-compliance, performance, and portability.)
- *NetBeans.org,* a highly popular open source Java development environment based on the Sun ONE Studio development environment (or vice-versa).
- The *University of Michigan NFS* version 4 Linux port.
- The *Grid Engine Project*

OFFERINGS

Sun maintains multiple offerings in the Linux market – the Cobalt appliance server line, the LX50 IA-32 servers, the V60x and V65x servers, and the Sun Fire x86 Blade Server. Sun has been shipping its Cobalt product for four years; both the LX50 and the blade server are 2002 offerings. The blade server offering stands out because it demonstrates Sun’s response to a heterogeneous computing world. The x86 blade server supports both Solaris x86 and Linux. The x86 blade server operates in a blade enclosure that supports both the x86 blades, but also SPARC blades concurrently. All these systems are supported equally by Linux and Solaris 9 x86 with a common software stack.

Sun holds a vested interest in Java support on high-volume platforms. After Windows, Linux ranks as the highest volume server platform in the industry. Sun’s Java products for Linux include,

- *Java 2 Platform, Standard Edition (J2SE)* – the Java 2 SDK, tools, runtimes, and APIs.
- *Java 2 Platform, Micro Edition (J2ME)* – a highly optimized Java runtime environment for a wide range of consumer products.
- *Java 2 Platform, Enterprise Edition (J2EE)* – an environment targeting enterprise applications.

Sun also provides the following on Linux:

- *Sun ONE Grid Engine Software* exploits idle compute resources and delivers network-wide compute power to the desktop. The engine can be used in Solaris or Linux environments, as well as mixed Solaris and Linux environments.
- *Sun ONE Studio Integrated Development Environment (IDE)* provides development tools and productivity wizards and templates, as well as the latest Java technologies. It is open to work with tools from third-party vendors.

Sun is becoming a leader in contributing desktop client technologies including its support for GNOME and especially StarOffice. Sun is currently developing the

Madhatter desktop Linux environment that integrates StarOffice and other Linux technologies into a coherent desktop offering.

COBALT

Cobalt offers several form factors targeted for different solutions:

- The Sun Cobalt RaQ XTR server appliance is designed to meet the needs of service providers and customers requiring higher performance in a 1U rack-mounted package.
- The RaQ sever may be home to as many as 200 websites or a single dedicated server in a 1U rack-mounted package.
- The CacheRaQ 4 supplies a specialized server for networks where traffic occasionally exceeds the capacity. Rather than increasing bandwidth, the Sun Cobalt CacheRaQ appliance stores frequently requested files, freeing bandwidth for new requests and other traffic.
- The Sun Cobalt Qube 3 Appliance was designed for small businesses, departments, or individuals with a network. This product provides an Internet and intranet server in a box. It possesses the ability to connect and serve up to 150 user accounts and millions of web items and e-mails every day.
- The Sun Cobalt Control Station furnishes an aggregated management and service delivery solution that allows administrators to handle applications to large numbers of Sun Cobalt appliances.
- OEM relationships have also delivered additional appliances – Symantec VelociRaptor Firewall, Seagate NASRaQ (Storage), Progressive Adaptive Firewall, Intershop CommerceRaQ, and Miva CommerceRaQ.

SUN LX50

Sun's LX50 provides a one- or two-processor entry-level server, which supports either Linux or Solaris x86. It is targeted at edge-of-network application environments, such as firewalls, web servers, DNS servers, as well as compute farms, or custom applications. Sun also offers a firewall appliance using the LX50 and Check Point VPN-1/FireWall-1 software pre-installed. The following are the primary applications for the LX50 – integrated web server, streaming media server, e-mail server, FTP server, Grid computing, software development tools, dynamic content (Java, ASP, XML) hosting, VPN/firewall. The LX50 is targeted at the following markets:

- Internet service providers
- Application service providers
- Enterprises
- Life Sciences
- Scientific computing
- Media
- Content delivery

SUN FIRE x86 BLADE SERVER

The Sun Fire x86 Blade Server targets 32-bit applications. Supported by both Solaris x86 and Linux, the x86 blade joins other blades running Solaris x86 or Solaris/SPARC to form Sun's heterogeneous blade platform.

SUN FIRE V60x AND V65x SERVERS

The Sun Fire V60x and Sun Fire V65x servers supply dual-processor Intel Xeon rack systems. The V60x is positioned as an inexpensive platform for network computing and targets the web serving, compute farm, and security application environments. It forms the low end of the line with two-PCI-X slots. The V65x is positioned as a two-way performance server and targets the workgroup server, application server, and database server environments. Positioned as more flexible, it carries six PCI-X slots and up to 12 GB of SDRAM. Both systems support dual 2.8 GHz Xeon processors, a high-speed bus, SCSI drives, and integrated 2x Gigabit Ethernet.

SOFTWARE

Project Orion offers the market a new software delivery strategy from Sun. This strategy stands as a model for delivering systems on Linux and Solaris. The objective is to solve the complexity that users experience when building systems. Orion's model offers a tightly integrated middleware stack on all platforms Sun sells. This stack is consistently delivered on predefined release cycles. Sun claims that this will reduce software costs. While it is still at a concept stage (no packaging, licensing, or pricing details), the design embodies an insightful concept: a pre-integrated, pretested software stack constructed using open source and available on Solaris and Linux. Java holds it together, providing the primary environment included in the stack. Project Orion could prove a differentiator for Sun. At some level, it competes with the various Linux advanced server offerings in that they also include many of these same components (though not in an integrated way).

Sun's Linux community contributions cover several years, offering Linux supporting software. Some key software solutions from Sun already available on the Linux platform include the Grid Engine, distributed resource management software, StarOffice application, iPlanet Web Server, Chili!Soft ASP, and development tools that include Sun ONE Studio for Java, Java 2 Enterprise Edition, and Java 2 Standard Edition (currently in beta).

The Blackdown Porting team took the lead, porting J2SE to Linux and maintains Java on non-Intel Linux platforms.

Sun ONE Studio for Java software offers a development environment enabling programmers to build Java applications, and is based on the open source NetBeans Tools Platform. The Sun ONE Studio for Java Internet Development Environment (IDE) enables a programmer to create Internet services and

solutions with 100% pure Java code on Linux. Depending on development needs, one can choose from two editions of the Sun ONE Studio for Java product:

- *The Community Edition* product is offered at no charge and includes a complete and highly integrated set of tools – supplying a web browser and a web server. With this edition, any developer can build stand-alone applications, applets, JavaBeans, and Java clients.
- *The Enterprise Edition* product covers all the functionality in the Community Edition plus support for teams of developers building database-aware web applications. This edition offers integration with Tomcat (a Java Server Pages 1.1/Servlets 2.2 open source implementation), and it expands on the functionalities of the web browser and web server in the Community Edition.

The Sun ONE Studio development environment is based on the open source NetBeans Tool Platform. What exactly is NetBeans ?

- An open source IDE written in the Java programming language
- A tools platform – other tools and functionality can be seamlessly integrated by writing and incorporating modules
- An application core that can be used as a generic framework to build any kind of application

The Sun ONE Web Server, Messaging Server, and Directory Server are supported on Linux and provide infrastructure services for HTTP, mail, and messaging, and an LDAP-based directory to Linux customers and ISVs.

Also supported on Linux, Chili!Soft is a web development and hosting solution, which provides developers with the means to develop dynamic web applications and deploy and host them. Chili!Soft assembles a group of technologies that work together to speed the development of web applications. It starts with Chili!Soft ASP, a cross-platform implementation of the Microsoft Active Server Pages (ASP) architecture. Chili!Soft lets developers use visual tools, ASP, and Java programming skills to design web applications that can be deployed to and/or hosted on multiple platforms, including Linux and Solaris.

Also available on Linux, the Sun Grid Engine software is designed to harness idle compute resources, match them to individual job requirements, and deliver network-wide compute power to the desktop, thus speeding time-to-market and fundamentally changing the economics of technical computing. Sun foresees “compute farms” – the architecture created using Distributed Resource Management (DRM) software such as Sun Grid Engine software – as the platform of choice for high-performance computing. Sun Grid Engine software helps solve the problem of how to apply maximum resources to a single compute-intensive problem, and achieve massive scalability within the technical marketplace.

StarOffice software makes an office productivity suite available on Solaris, Linux, and Microsoft Windows platforms. The StarOffice suite delivers a set of tools, including word processing, spreadsheet, presentations, graphics, database, mail, scheduling, and more in an integrated, desktop environment compatible with Microsoft Office files. In a market dominated by Microsoft Office, StarOffice was the first productivity suite available on Linux, and comes pre-installed on many popular Linux systems. The StarOffice productivity suite is available free as a download to users, service providers, and educational institutions.

STORAGE

The Sun StorEdge T3 enterprise disk array is also supported on Linux with device drivers provided by Linuxcare. This workgroup storage system delivers linear increases in performance as capacity is added. It relies on a single console, which controls, monitors, and diagnoses any number of Sun StorEdge T3 arrays via its built-in Ethernet ports. The Sun StorEdge T3 array for the workgroup is available in tabletop, rack-ready, or rack-installed configurations, and is scalable from 327 GB to 5.2 TB per rack cabinet. Up to 32 racks (32 racks times eight controller units per rack equals 256 controller units) can be connected to a single server.

Sun HighGround Storage Resource Manager Enterprise Edition (Sun HighGround SRM affords IT managers with a web-based management application providing usage, consumption, and availability data about enterprise storage. Sun HighGround SRM's management takes in support for storage residing on a number of system hosts, including Red Hat Linux, as well as support for a number of storage networking architectures, including SANs and Network Attached Storage (NAS). Sun HighGround SRM automates the discovery and collection of this information across an enterprise and provides monitoring and alerting on a number of storage events.

SERVICES AND SUPPORT

Sun claims to offer equivalent support across its product line, including Linux. Sun Linux supplies both integrated support and software-only service options allowing customers to purchase support for either the hardware, software or both. Customers can also contact Sun either by phone or electronically. The software support services include,

- *SunSpectrum Software-Only Support.* Four levels (Bronze to Platinum) of comprehensive support for Sun systems driven by unique requirements – from proactive, mission-critical services to basic self-maintenance support.
- *Online Support Center* provides 24x7 access to resources, tools, and answers. The Support Center offers anywhere, anytime access to web-based support, similar to Dell's offering.
- The hardware offerings (Cobalt, LX50) are covered by various hardware support options, onsite spares, and warranty extensions consistent with services delivered by other vendors.

- Several community sites offer support and help including BigAdmin, Sun Dot-Com Builder, and the Linux Developer Network.

Sun's services team has built up significant Linux experience and Sun offers services for Linux to customers who want a single point of accountability for the enterprise infrastructure. This has been largely done on an account accommodation basis. With Sun delivering Linux-based hardware and software, these will become mainline services.

Sun also offers a reasonably complete set of training services focused on Linux, the bulk of which targets the administrator. These services consist of introductions to Linux through customizing and configuring Linux and Linux networks. Sun also offers similar administration courses for Red Hat Linux and a migration course for Solaris 8 system administrators who will be Linux administrators. This training is available on the web or in a classroom setting.

Beyond this, Sun offers consulting services targeting Linux. While not as broad as IBM's, they provide a reasonable range for the primary customers of Sun's low-cost Linux x86 systems. The services take into account advanced architecture services, implementation and integration services, availability programs, etc.

VALUE ADDED

Sun adds value to Linux primarily through its software and iForce partners program. Java is a primary programming environment for Linux. Sun has put all of its Java offerings on Linux and has enhanced them through NetBeans and Sun ONE Studio for Linux, which brings Java development to students and other individual programmers. These enhancements increase the size of the Java community.

Sun systems furnish built-in compatibility with Linux, so that any Solaris-based system can also run Linux applications. Sun's approach to Solaris Linux compatibility can be summed up as:

- Java/J2xE (Sun ONE) compatibility across Solaris and Linux
- Support for open source applications including precompiled, rebuilt applications for Solaris; supported applications including Apache, Samba, and Sendmail
- Source compatibility; adhering to industry standards of UNIX, Linux API, and LinCAT (Linux Compatibility Assessment Toolkit)

The company's iForce partners program for Linux claims to have partners in each of 52 application or industry portfolios. However, a cursory check indicates that these are all tied to Java and are not necessarily specific to Linux. However, the fact that Linux supports Java (or has a JVM) is a significant statement of the application availability now connected with Linux. To the extent that they are J2EE-specific applications, they are Linux applications as well. Sun remains very

focused on driving Java volumes. Linux is a high-volume platform, creating a win-win for Sun and the Linux community.

Sun is also adding value to Linux through the Madhatter integrated desktop solution using open source and through the Project Orion integrated software environment. Both will support Linux when available.

Sun is likely to add significant value to Linux when it embraces the standard Linux distributions such as Red Hat, a situation which will assure that there is little likelihood of the kind of kernel fracture that occurred with UNIX. Sun plans to announce the specific distributions it will support later in 2003.

APPLICATIONS FOCUS

Sun's Linux offerings target low cost 32-bit systems. The application set includes the following – web server, streaming media server, e-mail server, FTP server, Grid Computing, software development tools, dynamic content (Java, ASP, XML) hosting, VPN/firewall, DNS server, etc. Beyond these, the portfolio covers the edge of the carrier network, the customer premise edge, as well as the edge of the datacenter. Sun is tying Linux into its Liberty customer identity initiative as well. The edge of the network is evolving rapidly with content and applications being driven closer to the customer. Building these edge solutions with Linux and Solaris offers customers a choice of industry-standard or higher-value solutions.

Sun positions Solaris as Sun's primary business logic and database server platform and industrial-strength platform for high-value 64-bit solutions.

Sun offers a set of applications and compatibility tools for Linux embracing,

- *Sun ONE Studio* (formerly Forte for Java), an integrated development environment (IDE) for Java technology.
- *StarOffice*, office productivity suite; supports XML file formats.
- The *Linux Compatibility Assurance Toolkit (LinCAT)*, free software development tools and how-to documents that simplify and streamline the process of developing applications that are source-code compatible across both the Linux and Solaris platforms.

Sun also offers a set of Java tools to enable maintaining a single code base for both Linux and Solaris. J2SE v1.3.1 is downloadable from the Sun website.

FUTURE ACTIVITY

Sun is integrating Linux into the mainstream of its business. In addition to building Linux edge-of-network servers, its products reckon among them a Linux blade server and Linux appliances. Sun plans to add to this inventory of products with additional higher-performing servers.

To keep current with the rest of the market, Sun plans to embrace the industry standard Linux distributions. It may still retain its current distribution for some of its products, but offering the industry standards benefits both Sun and its customers.

Sun ONE will be fully supported on Linux. As Sun's application framework, Sun ONE offers an industry-leading software and services platform.⁵ Its major product components encompass the Solaris operating system and will soon include Linux, the Forte development tools, and the iPlanet J2EE-based software stack. Sun ONE is a full services platform on which to build solutions. Its service components comprise SunTone, iForce, and Professional Services. Sun ONE is rounded out with partnerships including such leading ISVs as Oracle.

Sun plans to participate more aggressively in the Linux developer community by offering key components of Solaris and by releasing tools to help developers ensure compatibility between Solaris and Linux.

⁵ See *e-Business Application Frameworks Enter New Era of Capability and Competition*, D.H. Brown Associates, Inc., February 2002.

APPENDIX A: CRITERIA FOR EVALUATION

VENDOR POSITIONING

- Breadth of market segments addressed
- Extent of solutions offered
- Relevance of Linux and open source to supplier strategy
- **Sub-Areas:**
 - Wide Strategy – many market segments and leadership in new areas
 - Focused Strategy – targeted segments and solutions

PRODUCT LINE

- Product line coverage
- Level of scalability
 - Functional tradeoffs
 - Maximum memory
 - Maximum disk
 - Rack configuration
 - Resiliency features
 - Clustering
 - High availability

SYSTEM PRICING

- Intel server systems
- Entry costs
- Configured costs

VALUE ADDED

- Linux preloads – ease of doing business and deployment
- Partnerships with key Linux distributions and other open source supplier companies
- Availability of proprietary add-ons
- Services value added
- High-availability, technical clusters, management software
- Differentiated appliances
- UNIX- and Microsoft-based application migration services

- **Sub-Areas:**
 - Customer experience
 - Appliances
 - Hardware differentiation
 - Software portfolio
 - Migration services

SERVICES AND SUPPORT CAPABILITIES

- Standard support offerings
- Add-on support offerings
- Mission-critical support (e.g., 7x24)

APPLICATIONS FOCUS

- Application enablement (e.g., J2EE, servlet engine, open source supplier middleware, etc.)
- ISV Programs targeted to Linux
- Small business (e.g., SCO applications)
- e-Business/Commerce
- Technical computing
- Mid-tier Business logic (CRM, ERP, SCM, etc.)

LINUX COMMUNITY AND DEVELOPMENT INVOLVEMENT

- Contributions to core Linux development
- Employment of Linux developers
- Participation in Linux development projects and other community efforts
- Leadership of new open source software projects