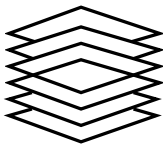

Linux Strategies and Solutions 2003

Linux Server Suppliers Contend for Leadership

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EXECUTIVE SUMMARY - DRAFT

"*Linux-on-Intel appears likely to emerge as the dominant platform in corporate data centers. 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, 2003

Linux is an industry phenomenon. It has grown quickly and been embraced by enterprise customers, industry pundits and even the financial analyst community as a mainstream information technology. Linux has moved from primarily an edge of network platform (firewalls, etc) to being 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 is in the 1- and 2-way servers common in these applications. Linux is now beginning to be a contender in other higher value, traditional middleware and application areas. The availability of Linux kernel 2.6 appears to be an inflection point. With the delivery of the 2.6 kernel, Linux will have most of the attributes it needs to be considered for enterprise class environments. Similarly, Linux skills appear to be available, especially in larger enterprises. As an 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"*.

This increasing Linux relevance has been fueled by significant support from the software and systems community. IBM's, HP's, Dell's, and Oracle's commitment, and Dell and Sun's delivery of Linux solutions all serve to make Linux safe. Vendors are reporting a much higher run rate in Linux demand. The ISV community is now cognizant of this substantial Linux server opportunity and is investing. That virtuous cycle 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.

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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 changing, focusing even more on cost (TCO), flexibility, and diversity of supply. These requirements match well with Linux's attributes and have given impetus to 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 Linux 2.6 kernel before committing beyond Linux's traditional application environments to the transaction class of enterprise applications. A good measure of Linux acceptance is the growth in training and certification requirements from customers. As that demand grows, it indicates an increasing interest in deploying Linux. Most suppliers report this is a healthy business today. It must be pointed out that Dell, HP, and IBM are also aggressive Windows suppliers and cannot put their Windows opportunity in jeopardy. However, it is important to note that Linux now has enough market share and momentum that all these industry standard system suppliers can be this aggressive with Linux, even with the level of dependency they have on Microsoft.

All of the leading system suppliers now have 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 some 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 now occupied the low end UNIX environment. While UNIX is still a factor at the high end and likely will remain so, competing with mainframe class application environments, the issue for the future is where does the low end stop on the way up.

The system suppliers are responding, offering Linux support across their products and complete services to enable Linux deployments. With Sun's recent announcement that it is a tier 1 premier partner 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. The emergence of the Linux Standards Base (LSB) and the existence of 2 leading distribution suppliers (Red Hat and SuSE) should prevent the kind of kernel divergence seen in UNIX. Finally Sun's agreement with Red Hat enables RedHat to distribute Sun'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 customer cost focus

and customer pursuit of diversity of supply, Linux has now moved into the mainstream and is now becoming a significant server system platform in more critical application segments with financial services firms leading the way. While Linux is having some effect on Windows enterprise infrastructure installations, its primary affect is on RISC UNIX. Linux is now a force in Server Consolidation, High Performance Computing (HPC), distributed applications, server appliances, enterprise applications (such as those built with Oracle and SAP) as well as its traditional application segments listed above. Dell, HP, and IBM all have active product and services activities targeting all of these. Each has Linux support throughout their product lines, including server cluster configurations and the new blade server lines. While Sun agrees that Linux is a good fit for edge applications, they see Linux moving to mainstream business applications. Sun's recent announcement with Oracle across Linux, Solaris X86 and Solaris supports that. Sun recommends Solaris on SPARC as the choice for more rigorous environments. IBM has aggressive Linux customer and ISV recruitment programs. HP has positioned 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 have been very visible promoting the potential that their Linux combination offers (Dell/Oracle/RH collaboration demonstrates price/performance scalability w/1&2P IA 32. Part of Dell Scale-out strategy for enterprise replacement for 8-way & higher legacy systems: more processing power for less cost) . Sun's delivery of the LX-50 and its embracing of the industry leading Linux distributions indicate that it recognizes that Linux is more than a short-term phenomenon. Sun positions Linux in the high volume, infrastructure application space and is reinvigorating a Solaris on IA32 strategy to offer an alternative for at least the existing Sun customer. Sun's strategy is "the right tool for the right job" and now supports 3 operating environments to make that happen. Sun's believes that Java across the product line is most appropriate for customers to invest in to gain the most benefit from the various operating environments that they may deploy. They view the OS below as increasingly less relevant. Sun is, however, positioning itself to lead the Linux client charge.

As things change, much remains the same. IA32 Intel-based servers are the primary Linux platform for all of the suppliers studied. HP has been the most aggressive with 64-bit Linux on Itanium, positioning it for high end technical computing and large memory commercial Linux applications. While some have Linux support for their RISC systems, this is primarily targeted to 64-bit Linux solutions, mostly in the future. HP (PA-RISC/HP-UX, Alpaha/TRU64), IBM (pSeries/AIX), and Sun (SPARC/Solaris) all are now source compatible with Linux and have established Linux compatibility environments. HP, IBM, and Sun are positioning 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 to be very aggressive with Linux on the mainframe, creating aggressively priced products specific to Linux. Linux is Dell's UNIX system and thus becomes Dell's 64-bit UNIX solution when Dell delivers a Linux 64-bit system (Dell uses 64-bit Linux as next-generation early adopter HPCC systems using Intel-64b processor due out this summer).. Sun is expanding its IA32 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 want diversity of supply in their IT. Vendors want to ensure diversity of choice. Both see Linux as 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 are a significant opportunity. These services tend to revolve around the following areas:

- Server Consolidation
- Linux installation and exploitation
- Migration from UNIX to Linux
- High Performance Computing clusters
- Linux support (break/fix, how-to, etc.)

HP and IBM have established substantial services teams addressing all of these areas and more. Each has essentially put Linux on a par with the other environments that 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, their proprietary systems. HP and IBM have the largest investments with over 5000 and 2500 services specialists respectively available to provide services for Linux. These firms offer consulting and assessment services, proactive support, installation and startup services, porting, outsourcing, and training and more While Dell doesn't have the services capability that these larger firms have, it also has established professional services in the above areas and is using them as part of its focused effort to be an enterprise Linux system provider. – Dell Services offers a comprehensive suite of services for the above areas. Services include assessment, design, deployment, support and training Dell has formed strategic alliances with Red Hat Professionals Services and Oracle Consulting Services to offer customers these services through Dell. Dell, HP, and IBM are exploiting the similarity between Solaris and Linux to drive migration services. Sun has a nascent services capability around Linux, most of which is targeted at the LX-50 server. This is primarily 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 IMPACT ON EXISTING PRODUCT LINES

Since Dell is primarily a hardware supplier, its products are the least impacted by the emergence of Linux. All of Dell's product line is Linux enabled and the 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 (FOR DELL we would like to point out that part of our emerging 'scale out' initiative, Linux is an integral part of enterprise 1 & 2 & 4P replacement systems for proprietary UNIX & enterprise systems) . HP, IBM, and Sun, having much larger and broader product lines, have a more interesting positioning challenge on where Linux is appropriate versus where their traditional operating environments fit. Their product lines include multiple server hardware platforms, multiple operating environments, and various middleware and other software.

All of the vendors have done considerable work to incorporate Linux into existing products. HP and IBM have ported the bulk of their middleware products to Linux. IBM has created aggressive ISV programs to encourage others to port to Linux. IBM is actively using 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 OS).

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. 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 are significantly different than 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, have 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 it to the level of functionality of Windows Server 2003. Despite this, many ISVs are choosing J2EE over Microsoft .NET to maximize their opportunity to sell into UNIX, Linux and Windows deployments. A full analysis of Microsoft Windows competitiveness vs. Linux is beyond the scope of this report. However, DHBA is conducting in-depth analysis of the competitiveness of those environments.

LINUX DESKTOP/CLIENT

There is an emerging interest in reducing desktop costs. 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 is actively selling IA32 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 just keeping track of the legal licensing of desktop operating systems and personal productivity applications (e.g., Office) have enterprises and governments considering alternatives to the ubiquitous Windows environment. Thin clients have been one response that flared in the market and then stabilized at low, but sustained levels. While not having the level of attention as on servers, Open Source software and Linux on industry standard hardware are beginning to be considered for desktop deployments.

The Linux environment is increasingly becoming technically capable of addressing some of the desktop requirement with improving user interfaces and productivity applications. However, constraints in its office capabilities (especially Office compatibility) limit the enterprise interest in Linux for the power or knowledge worker user. The attitude seems to be 'don't fix what isn't broken'. Although there may be a substantial cost advantage in software, there are other costs in user retraining and overcoming user acceptance. However, there is increasing interest in Linux for the transactional (e.g., call center) or vertical market users, heavy graphics users, and non-power user environments that don't require complex spreadsheets or other advanced function. There are direct cost savings and these users don't require the complexity of the traditional Windows Office environment. IBM has been active in this area with custom solutions for Sherwin Williams and others. HP was an early supporter of Linux on its high-performance workstations with visible customers in Dreamworks and Disney. HP also offers a Linux option on commercial desktops (Dell offers factory install of Linux on all its Precision WS, plus Dell is the W/S volume leader WW.)

While there are Linux client alternatives in the market, all the major system suppliers have been content to either preload Linux distributions or not include an OS on their desktop systems and allow the customer to construct the desktop environment (often aided by services). Oracle, Ximian, and other software providers are being active in addressing the 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. Sun is about to do just that. Focusing on these user requirements of office productivity, e-mail, web access and linking to backend systems, Sun is going to leverage its new StarOffice release, 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 their attempt to add coherence to the Linux desktop story. Developing a client stack that competes with Windows even in a constrained part of the opportunity, is attractive to ISV's, and is 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, having 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, ISV's are embracing Linux as the high volume UNIX platform. All this is driving a need to deliver better Linux-UNIX affinity.

There are 3 models of affinity - interoperability, application mobility, and shared environment. Interoperability consists of offering common applications and an integrated management model. All vendors reviewed provide some level of this. IBM and Sun, as middleware vendors, are offering a layer of software that can be delivered on Linux and their UNIX systems.

A shared environment is where the system can be partitioned to enable both UNIX and Linux concurrently. IBM currently leads and delivers a hypervisor that enables dynamic partitioning of server resources that can be delivered for both AIX and Linux. Similarly, IBM supports LPAR support on its proprietary servers enabling them to run their native OS's 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. By making it possible to run all its strategic operating environments concurrently, HP will take the leading position in shared environments.

The following application mobility functions are provided by the vendors between their respective UNIX's and the leading Linux distributions on their Unix platforms :

- Source code compatibility, essentially common API's - HP, IBM, Sun
- Linux runtime toolkit (Linux API's) This enables a user to run Linux binaries on the UNIX system - HP, IBM (this includes workarounds for API's 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. They have deployed edge servers and web servers on Linux and are beginning to look at using Linux for SAP and other enterprise applications. The primary motivation for moving to Linux is cost-performance. 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 has 3 versions of UNIX that they support (HP-UX, TRU64, AIX) plus Windows NT. The ability to get to 1 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 3X performance. Unilever is currently focused on 32 bit Linux. They want to move to 64bit, but need to get to UNIX technical equivalency to do it. Before Unilever can use Linux for datacenter applications, it requires that Linux include some specific enterprise features - Full clustering, better scaling, and other features. Most of these are in Linux kernel 2.6 or 2.8. Unilever (and other large enterprises) are working with the Linux community to ensure that their requirements are addressed.

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 has significant differentiation or leadership in 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 is pursuing a broad or a focused Linux strategy. Concentration on market segments or solutions are examples of focused strategies.
- Product Line Breadth: Illustrates relative vendor positioning on the breadth of their 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 value added. 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, which are key factors in the open source world.

VENDOR POSITIONING

TABLE 1: Vendor Strategy Positioning

	Dell	HP	IBM	Sun
Broad Strategy		X	XX	
Focused Strategy	XX	X		XX

[1] Table 1: Vendor Strategy Positioning

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

[1] HP gets credit for having the most clearly communicated Linux strategy to its customers and the industry.

- 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 have broad strategies and are aggressively driving them. The integration of HP and Compaq gives HP substantial market momentum in addition to the coherent strategic story. Compaq was the market volume leader in Linux. IBM and HP are the "heavy hitters" in the Linux market, competing directly for high-end customers across a broad range of market segments and application environments. They are competing 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 has the broadest and most aggressive strategy driving Linux into most segments and industries in the enterprise with its large kernel, OS and middleware investments along with broad ISV programs. HP's strategy has significant breadth as described and within that – focus. HP targets specific segments and drives aggressively into those. These include: edge-of-network, infrastructure including Internet and Telco, financial services, and compute clusters. HP is expanding into ERP application and database servers as demand accelerates for these types of Linux solutions.

Dell and Sun have focused strategies. Dell's interest is in selling systems and Linux is a catalyst. Sun's interest is in competing with Microsoft and preventing the erosion of the Solaris opportunity to Linux on any platform. Sun is focused on "edge of network" applications for Linux and is beginning to look at HPC environments. It positions Solaris on IA32 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, has a focused opportunistic strategy targeting responsiveness to customer interest in Linux. Dell has developed a strong relationship with Oracle and targets Oracle 9i RAC, high-performance computing, and UNIX to Linux migration.

IBM continues to benefit from its Linux on the mainframe strategy and Linux server consolidation. IBM has over 70 Linux on mainframe success stories and the visibility of these successes and the perceived benefits of Linux have been actually contributing to mainframe installations. The large enterprise engagements driven by this strategy for both products and services based on Linux has given IBM significant market visibility with its traditional customers. Server Consolidation (on both mainframes and IA32 servers) is still a major industry strategy that all vendors are embracing. Even Microsoft is embracing this strategy to compete with Linux. The TCO and operational benefits are too strong to be ignored. IBM has major Linux programs in place for all its hardware and software offerings and a full complement of Linux services. It clearly has the

broadest strategy and it seems to be paying off in mainframes, software, and services. However, despite gains by IBM in 2002, HP and Dell continue to have Linux leadership in the high volume IA32 platform.

PRODUCT LINE BREADTH

TABLE 2: Product Line Breadth Assessment

Dell	HP	IBM	Sun
	XX	XX	

Table 2: Product Line Breadth Assessment

Table 2 summarizes the breadth of the vendor's Linux server systems offerings. A secondary consideration is support of clients and new types of devices.

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 their disk and tape offerings, IBM delivers Linux on virtually all aspects of their hardware product line. In addition, IBM has the broadest Linux software support in its middleware product line.

HP is next with its breadth across Alpha, IA32, and IA64 systems as well as its StorageWorks storage, and iPAQ handheld initiatives. It 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 has 3 primary offerings in the Linux market - the Cobalt appliance server line, the LX50 IA32 servers, and the Sun Fire x86 Blade Server**.** Sun plans to expand its x86-based server line for Linux and plans to target the Linux desktop business.

SYSTEM PRICING

TABLE 3: System Pricing Assessment

Dell	HP	IBM	Sun
X			X (appliance and rack)

Table 3: System Pricing Assessment

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

offerings including appliances, entry rack, typical 2-way Linux systems and larger 4-ways.

Dell takes the overall lead on system pricing and includes its Customer Factory Integration services, which offer customized preloads of Red Hat Linux. Sun is competitive 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 have high volume system pricing that is higher than Dell and they 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 4-way Linux systems and above with Dell having a small advantage.

VALUE ADDED

TABLE 4: Value-Added Categories and Assessment

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

Table 4: Value-Added Categories and Assessment

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 can 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 support. This process also eases the deployment significantly as well as and some aspects of manageability.

Sun takes a strong lead for Linux desktops with 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, earning it differentiation. HP delivers the Application Specific Integration Kit (ASIK) to provide a common set of services for OEM partners to add value and 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 with 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 systems along with Windows and HP-UX. In addition, HP has taken a strong position in Linux on its workstation line. 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 IA32 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 and 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 has some interesting offerings for security, high availability, management, utility computing, and Telco. HP 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 is among the industry's stronger application frameworks in several areas such as a total system approach, solution lifecycle support, and development methodologies.[2] Sun's forthcoming Project

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

Orion will support both Solaris and Linux environments and 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. and offers migration assessment, planning and deployments services to support this initiative. Also, Dell offers an on-line TCO calculator and ROI analysis tools to provide personalized estimates of UNIX to Linux migration benefits and costsIt is focused at the individual customer level. IBM has a strong set of migration services from competitors' UNIX offerings to its Linux-based solutions. IBM is aggressively marketing these 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.

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

SERVICES AND SUPPORT

TABLE 5: Services and Support Assessment

Dell	HP	IBM	Sun
X	XX	XX	

Table 5: Services and Support Assessment

This criterion includes deployment, technical support, and consulting offerings. It also includes 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 additional support resources to their Linux products that is 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 their premier enterprise support agreements where they offer both reactive and proactive support. It offers the same level of support for Linux as for Windows. However, this is Red Hat only. Dell does not offer volume support for non-Red Hat environments.

IBM has the largest and deepest services team with HP next. Both offer the full catalog of both professional and technical services for Linux. It is clear from these kinds of services investments, that these vendors believe that the Linux opportunity is significant.

APPLICATIONS FOCUS

TABLE 6: Applications Evaluation

Dell	HP	IBM	Sun
X	XX	XX	

Table 6: Applications Evaluation

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 with enablement programs and tools. Examples of enablement programs are pre-tested 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 was even more aggressive in driving both ISV and corporate developed applications. Additionally, IBM is re-emphasizing application development tools and infrastructure applications where Linux mainstream adoption is already underway. IBM also 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 Oracle9*i* 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 has been very aggressive in deploying a large range of programs, headlined by "Speed-start your Linux app" to attract ISV's, made it easy for enterprises to exploit IBM Linux middleware, and 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, including partnerships, in web hosting, firewall, messaging, application services, digital content creation, electronic design and automation, and scientific computing. Finally, HP is targeting the enterprise with Linux and is working with selected leading enterprise applications including BEA, Oracle and SAP R/3 and is offering integrated support for the solution. Many of these solutions are bundled for easy of purchase, installation and support.
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Dell's application focus is aimed at enterprise adoption of Linux. Dell believes that Linux will be a replacement for UNIX and is focusing on Oracle database applications and SAP. For commercial customers, Dell has adopted the Oracle9*i* database platform, both single node and RAC clusters. Dell is building an ISV portfolio and has substantial relationships with BEA, BMC, CA, Oracle, Veritas, and others. Dell also has a high performance computing cluster capability

(HPCC) and has developed and exploited open source Linux cluster services. Dell views HPCC as a substantial growth opportunity in commercial and technical environments (Dell now has a retail Point of Purchase offering. This is one of the areas that Dell integrates other Linux vendors in addition to RH on both the Client & Server Side).

LINUX COMMUNITY LEADERSHIP

TABLE 7: Linux Community Leadership Assessment

Dell	HP	IBM	Sun
	XX	XX	X

Table 7: Linux Community Leadership Assessment

"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 projects as evidenced by the breadth of activity of its Linux Technology Center. IBM is also extremely active in most of the open source interest groups (e.g., OSCAR), being visible contributors. IBM's 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 is also contributing 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 technical contribution to the community, it clearly is in the community's interest.

HP continues with a high level of focus on the open source community with over 45 significant projects (www.opensource.hp.com). HP has also played a leadership role in bringing 64-bit Linux to the Intel Itanium platform and 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. HP has a special relationship with the Linux community with 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 hired 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 user interface, NFS, Mozilla, and the Java development environment – NetBeans.

Dell's community participation is closely tied to the Dell model of pragmatic customer engagement. Dell facilitates their partner ISV's development in an open

source model and helps them manage the necessary relationships. Dell also focuses on IHVs (independent hardware vendors) to create open-source device drivers. Finally, Dell provides equipment to OSCAR and promotes it at trade shows.

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CROSS-PLATFORM COMPETITIVE COMPARISONS

COMPETITIVE LANDSCAPE

With the visible support of the leading system suppliers, Linux has become a mainstream business server environment used by some of the largest businesses and laboratories in the world. All of the leading system suppliers – Dell, HP, IBM, and Sun – ship Linux offerings with Dell, HP, and IBM having substantial customer installations. Their offerings range from embedded and client systems, server appliances, commercial servers, to high-end clusters targeting commercial and technical computing and mainframes running Linux. This range of offerings demonstrates the success of Linux in the market. All these suppliers exploit open source solutions (OSS) 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 offering to drive UNIX migration to Linux or to compare 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 being the common thread across all the suppliers, except, until recently, Sun. Sun's Linux distribution was a derivative of Red Hat, but rather than investing in a unique Sun offering, Sun is embracing Red Hat and possibly other distributions to be part of a larger Linux standard distribution set. All of the vendors are represented and active on the various industry committees (e.g., Linux International). HP and IBM are differentiated by their leadership. They are on the boards of most organizations and contribute significant technology. Where relevant, they have committed to providing Linux-compatible services or APIs (application programming interfaces) or have Linux running natively on their legacy system environments. They differ, however, in their strategies; and in the level of solution enablement, support, and integration they offer.

Since Linux is part of the open source community, the supplier offerings must be very much alike in terms of operating system content. Packaging, ease of deployment, support, open source community involvement, application and solution focus, and execution are key factors of success for these systems suppliers beyond product differentiation.

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. Some, such as IBM and HP, offer an extensive software portfolio that they make 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 has very effectively brought its efficiencies of operation and the strength of its direct model to the Linux market.

DELL HIGHLIGHTS

Dell is quick to focus on customer requirements. Thus, when Dell embraced Linux, it was clear that customer demand was there. Dell's entire product line is based on Intel processor based. Offering Windows and Linux across its product line gives Dell an effective way to compete with both their direct Intel Windows competitors and also the UNIX community. Linux is Dell's UNIX. In keeping with its pragmatic approach, Dell is focused on what is available now. However, Dell has publicly stated it will launch an Itanium 2-based server in 2003.. As the bulk of the Linux market is IA32, this is no real inhibitor. Dell is not doing anything to promote Windows to Linux migration, though they are not discouraging it either. Typical with its model, Dell will facilitate whatever direction customers choose.

Dell has developed a pragmatic approach to Linux. Pragmatic in that Dell is responding to real customer demand. It is also opportunistic in that Dell has put itself in a position to actively respond to Linux demand without having to actually create it. Dell's focused strategy, responding to both SMB and enterprise customer interest, addresses the substantial Linux value proposition of IA32 cost advantages over more expensive RISC UNIX systems. Dell positions Linux as the low cost alternative to "proprietary" UNIX. This melds well with Dell's market position as the low price leader. Linux enables Dell to compete directly with Sun, HP, and IBM in a UNIX environment.

In 2002 Dell's attention shifted to the enterprise. Dell was initially focused on the high-volume Linux client and server markets, but is now targeting enterprise applications using Linux as an alternative platform to UNIX for database, High Performance Computing Cluster (HPCC), and application rack servers. Dell's strategy for the enterprise 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 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 with industry standard clusters (providing more computing power at a reduced price point).

A primary focus for Dell is UNIX to Linux migration. Dell continues to offer 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 High Performance Computing Cluster (HPCC) business to attack selected market segments previously locked into UNIX. These segments are bioinformatics and energy. Dell has built specialized services in server consolidation, distributed applications, and high performance computing (HPCC) to support this Linux thrust. Dell has created a UNIX migration analysis tool illustrating TCO and ROI benefits to justify and promote the UNIX to Linux migration effort. This tool also supports the other key parts of Dell's strategy.

Red Hat remains the Linux distribution that Dell uses to certify its hardware. Dell recommends 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 United Linux or SuSE (however, Dell provides hardware & some engineering support to SuSE, SCO, and therefore, UL, for these Linux Distributions to certify Dell systems themselves), though Dell will preload SuSE and other distributions as part of a custom service offering. 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 service for Linux and all the software installed on its servers. It will provide level 1 and 2 support and will manage more extensive support and 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 makes it well positioned be the high volume, commodity Linux server leader. Dell is less prepared to take a leadership enterprise Linux role. While Dell is being very visible with its Oracle relationship (highlighted at Dell's recent analyst meeting) as the primary mechanism for Dell to enter the higher value enterprise market, some enterprise customers may require additional capability and support to entrust their mainline production systems to a commodity provider. In 2003, Dell plans to drive Linux into the enterprise by focusing on customers' life cycle management, improved technical support, and more services to meet their customers' immediate needs with Linux. The challenge for Dell is to communicate that it has the relationships with the ISV community and the services capability to do that, as well as offering 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. In this strategy, HP positions Linux as the leading system targeting Internet infrastructure, financial services, and Telco solutions for enterprises of all sizes. HP is an early leader in blade servers, offering highly scalable blades and carrier-grade Linux systems as well as offering a range of Linux-based server appliances. HP is also active in the emerging Linux-based enterprise application servers, database servers, and ERP with 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.. A key message of HP's global services and support is that HP provides the same level of support for Linux as it does for Windows or HP-UX. HP behavior is consistent with its strategy in this regard.

A very important element of HP's strategy is the Itanium platform. HP has committed itself to an industry standard hardware strategy built on IA32 and IA64. According to industry sources, HP has market share leadership in both IA32 and IA64 Linux shipments and is the most focused supplier for 64-bit Linux on Itanium with a full line offering. Itanium is the future high-end hardware environment for all of HP's operating environments. To this end, HP has been aggressive in ensuring binary compatibility for applications between HP-UX and Linux. HP has 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 API's) 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.

The acquisition and integration of Compaq's Linux business and strategy into HP's has created synergy for the Linux effort. The strengths of the two companies offered significant complementary value. The new HP Linux strategy not only delivers value-added focused solutions, but also reveals an aggressive push into emerging Linux segments such as application serving, ERP, and database. The ProLiant brand complements the HP solutions focus and gives HP

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

IBM's Linux strategy is broad to the extreme. IBM is totally committed as 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 is very active and effective in promoting Linux and open source 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 something like it) is critical to make it possible to compete in the volume space above the hardware.

IBM recognizes that Linux is an opportunity to move the basis of competition away from commodity hardware and operating environments into higher value software and services where it has an advantage. This is not to say that IBM won't continue to invest in delivering leading edge hardware products or enhance their legacy of operating environments or systems architectures. Rather it is an observation of how much IBM has become a software and services company, focusing on the kinds of customer demand and customer issues that go with the territory. IBM still offers 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, what is striking about IBM's embracing of Linux is how the company has chosen to substantially focus its Linux strategy above the operating environment; allowing (and even helping) 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 IA32 Intel server line and its zSeries mainframe systems. These have the bulk of Linux installations and arguably the most customer interest and value. To reiterate, the primary drivers of customer Linux interest are cost, flexibility and diversity of supply. That means IA32. 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. They are focused on TCO for their overall installation and maximizing returns from their

zSeries installations. IBM has recently announced Linux pSeries offerings and Linux partition support for its iSeries. IBM is positioning these Power-based systems as the 64-bit Linux environments. While pSeries Linux adoption is slow, IBM has made recent announcements targeting Linux on pSeries to improve its positioning and attractiveness. IBM's iSeries has numerous references. There is substantial demand for IBM's xSeries and zSeries servers. That may reflect Linux's current primary position as an edge network and enterprise infrastructure server. With the availability of the Linux kernel 2.6 and the additional enterprise features and scalability (up to 16-way) that it brings Linux's enterprise capability will change 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 ala UNIX. There is perhaps a lesson learned here. IBM (and HP and Dell) has built relationships with the standard Linux distributions - Red Hat, SuSE, and others - to provide the Linux operating environment. IBM is avoiding distributing its own distribution or even an enhanced one of the standards, instead providing relevant enhancements into the open source process.

Linux is important to 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 ISV's. To appeal to these various constituencies, IBM has positioned all its middleware on Linux and is building "express" versions targeting the small and medium business market, not a traditional IBM stronghold. IBM makes much of the IBM 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.[3] This support makes it possible to create and deploy enterprise applications on Linux as the operating system matures. In addition, IBM has a very aggressive ISV campaign to attract the development community to Linux and 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. In addition, IBM offers programs such as "Speed-start your Linux app" to make it easy to port. To date, IBM claims that this program has achieved more than 4000 applications.

IBM is also being aggressive promoting Linux through its business partners. To do that, IBM has created the IBM Leadership Edge for Linux program. An interesting element of the program is a web based ROI tool for business partners that allow a Business Partner to input specific characteristics of its business environment and business model and evaluate the process for building a Linux practice. As an example, it helps ISVs evaluate the porting of their applications to Linux. Once a business partner makes the decision to invest in Linux, the

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

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 web sites, white papers, sales and technical education, and joint demand generation programs. The objective is to help business partners to successfully go to market with IBM and Linux.

IBM Services view Linux as a disruptive technology and disruptive technologies create services demand. While IBM Services does not actively sell Linux, it does offer a complete line of support and services capability from business and strategy consulting to deployment to 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 an on-demand basis, enabling customers to tap into "virtual servers" on IBM eServer zSeries mainframes running Linux, paying only for the computing power and capacity they use. IBM has a large and trained services team available to address Linux services opportunities.

In summary, IBM has a strong Linux strategy and it is using Linux as a tool to drive their 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. IBM has added value to Linux through its major investment in its Linux Technology Center, applying IBM enterprise technology to Linux and support the community to create robustness and scale. IBM has 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 IA32 server environment with Windows and Linux is too large to ignore, Sun introduced the LX-50 with Linux in 2002, its first general purpose IA32 Linux server. With the LX-50, Sun embraced Linux for the low end and edge of network environments, targeting customers who were interested in Linux. Sun delivered the Sun Fire x86 Blade Server this year. This blade server 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 IA32 as a compatible end to end Solaris server environment for those customers who wanted the cost benefits of IA32. It is interesting that Sun is the only system supplier with multiple IA32 UNIX operating systems. Drivers for Sun's recognition that IA32 and Linux had to be part of their repertoire are the IA 32 entry server market opportunity, the need for a high volume platform for Java deployment, and customer demand, driving the 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 IA32 server market, enabling Sun to address a more holistic view of their customers' environment. Sun wants to be the Windows alternative and the UNIX champion. Sun is beginning to expand its Linux support into more general purpose solutions and is announcing that Linux is fully integrated into the mainstream of Sun offerings, including their support and services, their ISV programs, and the recently announced Project Orion. However, Solaris is still 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). Sun now supports the Red Hat Linux distribution and is a tier 1 premier partner with Red Hat. Sun ships and supports Red Hat EL. Sun also is providing Linux services on the Red Hat distribution and is a single point of contact for services. This is not an exclusive arrangement and there may be more distributions supported. Sun also plans to support Linux application source on Solaris. Finally, Sun is resurrecting the Solaris on IA32 strategy, providing Solaris customers (and Linux users) the ability to exploit a full UNIX environment on IA32 environments, giving cost focused customers an opportunity to stay with Solaris rather than migrate to Linux. Like IBM, Sun positions its proprietary RISC hardware as the strategic 64bit environment.

It is important to give Sun its due in supporting and contributing to Linux and open-source, in general. Sun has been an outspoken advocate of a more open systems environment, in general, and has been a driving force for Java, which is becoming the standard development environment for Linux systems. Finally, Sun is becoming aggressive in Linux clients with its Madhatter program, recognizing that there are business opportunities for client systems that do not require heavy personal productivity applications. Vertical and transactional applications have the potential to be a significant market and Linux has an opportunity to be a leading client platform.

Sun's Project Orion software strategy is an interesting development in how Sun 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. While this is still a concept at this writing (no packaging or pricing available), this may be an attractive solution to Sun's customers who have significant investments in Sun software and hardware and may be attractive to Linux users who want a pre-integrated, pre-tested, middleware and application stack to reduce complexity. 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. While the goals of reducing software complexity,

having predictable delivery, and reducing cost are laudable, there are no details available at this time. It will be interesting to see if Sun can address these better than Microsoft has with its licensing and pricing models.

Sun continues to position its Linux strategy as one that further advances 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 IA32, 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 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) are an interesting entry point into the IA32 world. Sun has recently announced new servers to demonstrate its interest and commitment to Linux. The Sun Fire V60 and V65 servers (1-way and 2-way Xeon) are higher end IA32 Linux servers and continue to flesh out Sun's line of Linux offerings. 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 IA32 systems as Linux matures, and HP will push with 64-bit Linux and the strength of their installed base.. Sun needs a competitive plan to bridge the space. The positioning of Solaris IA32 and Linux is a start. 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 IA32 and Linux on IA32 market that can't be denied. Sun has gotten the message.

As we stated in our last report, aggressive marketing and product delivery and better positioning with Solaris was required for Sun to have 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 give Sun something to talk about.

OPEN SOURCE MOMENTUM

Linux and the open source movement have created a significant change in the marketplace. According to industry estimates, Linux is the fastest growing operating environment in the industry. It has millions of users worldwide, is now second in market share in the *server operating system* market, and has 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 made it possible 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. Linux is moving up-market from its traditional server environments and entering the enterprise, both as an IA32 and mainframe server environment. It is becoming a significant force in the distributed and custom application space and is the target for migration of more traditional UNIX enterprise applications. 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 Linux 2.6 kernel, Linux will be largely able to compete for many of the more advanced enterprise datacenter application environments.

An important factor contributing to Linux enterprise growth has been the ease of migration from UNIX to Linux. Dell and IBM have been particularly focused on exploiting that attribute, focusing on using 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 and, even more likely, put additional pressure on UNIX systems. As one large enterprise customer said, *"Linux is the most economically viable option for the broadest range of applications."*

Linux has not been successful as a *desktop client operating system,* however, with only a 1-2% share, less than the Apple Mac. Growth as a desktop operating system continues to be constrained by a focus on the knowledge worker market and few compatible productivity applications required to reach that market. Microsoft dominates that market with its ownership of the Office suite. However, there is another opportunity for Linux in vertical markets and in transactional markets (e.g., call centers) where the user doesn't need the high levels of office features that Office delivers. There are several providers (Ximian, Lindows, Crossover Office, Sun StarOffice, and others) who deliver either ways to exploit Microsoft applications required for the traditional office user. Sun is using some of these features in its Madhatter project to build a client stack that targets this not-office user environment. A critical success factor is going to be to the ability to use and share Microsoft office documents. It that can be solved, there may be a viable Linux client market. The primary reasons for vendor investment in Linux desktop software today are the needs of developers and system managers and administrators. There may be a large Linux desktop opportunity worth exploring with open source.

Though Linux has only marginal traction in desktop systems, 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, and is moving into all uses. HP has lead this market with its 3D workstations and is now growing to other markets like Electronic Design Automation and Mechanical CAD.

Linux has gained 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 specific applications historically developed for a number of proprietary operating systems. The HP sponsored handhelds.org is a good example of the growing community around Linux on PDA market. Linux offers the benefits of standardization and customization without royalty fees to the copyright holder. Linux and open source has 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) are the platforms of

choice for environments that can be generalized and 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. It has reduced the potential for vendor lock in to proprietary offerings. Linux and open source are the first real opportunity for system suppliers and customers to overcome the hegemony of Microsoft in the high-volume IT solution market. This is not to say that Windows goes away. Rather, Linux and open source provide a reasonable alternative to the Windows operating environment, and especially the Windows application environment for the growing Internet, business-to-business (B2B) networking, and distributed and custom application markets. Finally, Linux puts pressure on the existing UNIX offerings in that it provides a common high-volume application environment that is attractive to ISVs.

VENDOR POSITIONING

Given the nature of Linux and open source, all open source solutions from the large, well-established firms are "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 effectively communicate their offerings. The following tables provide a summary of each system supplier's strategy and offerings.

TABLE 8: Supplier Summary – Marketing

Linux System Supplier	Dell	HP	IBM	Sun

Targeted Markets	• UNIX to Linux migration
	• Enterprise (Oracle, SAP)
	• Retail Point of Purchase
	• Government
	• Financial/Banking
	• High performance computing clusters (HPCC / Scientific, Oil/Gas, Imaging)
	• Volume Linux market
	  • Edge servers
	  • Enterprise infrastructure - file/print, e-mail,…
		• 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
			• Enterprise & SMB
			• Server Consolidation
			• Edge of Network
			• Internet Infrastructure
			• Service Providers
			• Telco
			• Finance
			• Government
			• Retail
			• Technical/ Scientific
			• Electronic Design
			• Mechanical Design and Simulation
			• Application Development
				• Edge of Network
				• Appliances
				• Internet Infrastructure
				• Application Development
				• Service Providers
				• Commercial enterprise
				• Technical / scientific
				• EDA
				• Life sciences
				• Aerospace / mechanical
				• Telco
				• Finance
				• Government

Channels	• Direct Sales • Web-Direct	• Direct Sales • Web-Direct • Indirect Channel/VAR	• Direct Sales • Web-Direct • Indirect Channel/VAR	• Direct Sales • Web-Direct • Indirect Channel/VAR
Joint Marketing with Linux Distributors	Yes – Red Hat only	Yes	Yes	Yes – Red Hat only

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

Linux System Supplier	Dell	HP	IBM	Sun
Offerings – Server Platforms, Appliances, Clients, Personal Appliances	• Supports Red Hat on all PowerEdge tower and rack servers and appliances • SuSE, SCO, TurboLinx & thus UL certify PE & Optiplex systems • Delivers Linux HPCC systems using open source approach • Supports Linux on Precision workstations • Support Custom Factory Installation for desktop clients • Preloads Linux at customer request.	• Supports Red Hat, Debian, SuSE, Caldera, and Turbolinux, on HP rack and tower IA-32 servers, plus Linux on HP blade, and carrier-grade servers • Supports Red Hat on Alpha server • 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	• Supports Red Hat, United Linux on xSeries Intel servers, carrier grade servers, and selected clients • Preloads Red Hat for fee on xSeries • SuSE on pSeries • VMWare supported on selected xSeries models • Supports Linux on workstations and selected desktop clients • Red Hat, United Linux pSeries, iSeries, and zSeries models • Appliances • Supports Linux on IPF servers • Future support for AMD Opteron	• 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

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

Linux System Supplier	Dell	HP	IBM	Sun
Modifying Proprietary UNIX to Support Linux	• N/A	• 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 Tru64 • Added GCC (GNU C Compiler) compatibility	• Added Linux APIs for source compatibility • Supports open source tools on AIX for cross platform development	• Providing Linux source compatibility in Solaris • Supports open source tools on Solaris • GCC compatibility in Sun One Studio • Linux API's libraries, commands in Solaris • Companion CD with pre-built apps to run on Solaris
Porting Linux to RISC	• N/A	• PA-RISC • Alpha is supported with Red Hat 7.2	• POWER • S/390, zSeries	• To SPARC for embedded market only
Shipping Middleware on Linux	• Available through Custom Factory Integration (CIF), Dell Software and Peripherals	• Web JetAdmin • OpenView • Insight Manager • Utility Data Center • TopsTools • Service Control Manager and PRM • Rapid Deployment • ServiceGuard for Linux – SG/LX • Internet Usage Manager • Opencall SS7 • Storage Management • Disaster Recovery Storage Software	• 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 (GPFS) • IBM Director	• 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)
Providing Development Tools on Linux	• Dell Oracle Deployment CD	• Yes • Programmer's Tool Kit • OpenCall SS7 SDK • IPF SDK	• Yes • IBM UNIX development tools • WebSphere Studio Application Developer • WebSphere Studio Site Developer	• Yes • Sun One Studio • LinCAT • ABI Check • JXTA

			• WebSphere SDK • Rational ClearCase • Rational ClearQuest	

TABLE 11: Supplier Summary – Support

Linux System Supplier	Dell	HP	IBM	Sun
Operating System Preload	• Factory preload for Red Hat, Custom Factory Installation (CFI) for other distributions , or user installed	• Factory preload option for IA-32 servers and IA64 • Preinstalled by the channel • Fully integrated and preload on HP 3D Linux workstations • Turnkey cluster configurations	• 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	• Cobalt operating system preloaded and customized for appliance function • Sun Linux on LX 50 • Red Hat
Application/ Middleware Preload	• appliances • Cache server • Load Balancing • Web servers • DellPlus services CFI9iAS, Websphere, through Dell Software and Peripherals	• Custom integration services available • Appliance specific • Active Answers solutions • Oracle 9iRAC • Sendmail • Cluster software with ClusterBlocks program	• Specific solutions – Domino • Appliance specific	• Appliance specific
Product Support	• 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, and benchmarking, etc. • Limited educational & training services available through Dell Professional Services & RH Partnership	• 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	• 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	• Worldwide, provided by Sun • Electronic and community support • Appliance-oriented support – warranty and "Spare-in-the-Air"
Platforms Supported	• Intel IA32 • we have IA64 support on 7150 & will also provide Itanium 2 this summer)	• Intel IA32 and IA64 • PA-RISC (limited) • RISC (Alpha) • StongArm	• Intel IA32 and IA 64 • RISC (Power) • S/390 (and zArchitecture)	• x86 • RISC (embedded)
Distribution Supported	• Red Hat	• Red Hat, Debian, SuSE, Caldera, Turbolinux United Linux based distributions • Commercial desktops also support Mandrake	• Red Hat, SuSE, Caldera, Conectiva, The SCO Group, Turbolinux	• Cobalt operating system • Sun Linux (future)
Linux Training	• Yes	• Yes – • Web-based	• Yes – • Web-based	• Yes – • Web-based

		• Classroom	• Classroom	• Self • Classroom

TABLE 12: Supplier Summary – Community Participation

Linux System Supplier	Dell	HP	IBM	Sun
Contribute Open Source Operating System Code to Linux	• Device drivers • IPF	• Device drivers, printing, all-in-one drivers, Debian, GNOME, tape drivers • IPF kernel maintainer • Gelato – technical computing • Trusted / Secure Linux • Performance tools • Systems Imager	• 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	• Device drivers, X Internationalization Framework, GNOME, NFS, ABI Check, scalable type technology
Contribute Open Source Application and Middleware	• Linux management software	• Apache • Single System Image – OpenSSI • Large scale modeling software • Java tools • Samba • Chai embedded application server • Intelligent mobile device software	• Apache • Eclipse • Samba • Tool Box for Java • Web Services • NFS	• StarOffice • JXTA • Mozilla • NetBeans • Apache • Gridware • WEBM services
Open Source Development Lab (OSDL) Member	• Yes	• Yes • On Board	• Yes • On Board	• No – evaluating
Community Investments/ Leadership/ Key Relationships	• Red Hat – initial investor • Linuxcare – initial investor • VMWare • CollabNet • IHVs • Free Standards Group • OSCAR	• 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)	• Red Hat – investor • UnitedLinux • DeveloperWorks • Free Standards Group • Linux International • Free Software Foundation • Globus • Service Availability Forum • VA Software -SourceForge	• Linux International • X.org • OpenOffice.org • CollabNet • Free Standards Group • BigADMIN • Linuxcare • Caldera • Lineo • Timesys

LINUX PLATFORM OFFERINGS

DELL

Linux is available across Dell's server product line - PowerEdge Servers, PowerEdge Blades, appliances, and Precision workstations. In addition, through various programs, Dell will make Linux available on any system product they build. Consistent with Dell's model, it has offered Linux preload for Red Hat Linux for these systems since it started supporting Linux over 3 years ago. Additionally, Dell's Custom Factory Integration (CFI) service is available for customers to have any software configuration preloaded at the factory, including applications, on any Dell system. This program is very flexible and enables customers to define unique configurations for geographic or other distribution and have Dell manage it. This includes any industry Linux distribution or customer provided Linux image along with configuration information. Dell describes this as being part of the Dell model where speed to customer focused requirements is their strategy. This clearly reduces customer set up time and management issues and improves time to production.

Dell continues to build its server management capability. Dell's management focus is on "at the box" system management where Dell, through its Open Manage offering, focuses on management at the hardware and into the operating system layers to bridge the interface between them. Dell relies on partners to provide higher levels of system management. Dell's server assistant helps install the OS, including Linux and ensure 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 and supports hardware setup, event threshold setup, and manages diagnostics for PowerEdge or servers running Linux. The console can be centralized also. In addition, Dell provides remote out of band management through the Dell Remote Administration Console (RAC). New Dell systems have Embedded Remote Access (ERA). ERA serves as a RAC, but doesn't require a slot. Dell recently made a major addition to its OpenManage tools with the introduction of the Dell OpenManage Remote Install software supported first on its PowerEdge 1655MC blade servers allowing remote server deployments including installation and configuration of servers using a pre-configured 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 Performance Computing Clusters 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 and 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 give Dell Grid solutions using its HPCC hardware. The Dell HPCC products are modular and can use Dell 1650, 2650 servers or Dell's blade servers. Dell uses open source solutions and the management that comes with it, such as OSCAR and augments it with closed source enhancements in its OpenManage software as needed for clusters. Dell is positioning clustering as a preferable way to scale. However, Dell's Linux cluster offerings can change the price/performance dynamic given the price premium customers have to pay for higher end systems. Dell is targeting 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 IA32 Linux migration opportunity with certified and preloaded Oracle9*i* database and Oracle9*i* Real Application Cluster (RAC) configurations on PowerEdge servers. Dell supports the Oracle9i Real Application Clusters (RAC) configurations of up to four PowerEdge servers, using up to four Intel Xeon MP processors per server with 32GB 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 9*i* RAC system, including deployment, support and professional services for design, tuning, etc. This is Dell's primary enterprise thrust and thus it gets substantial visibility with Dell investing technical staff to enterprise pilots and deployments.

Another enterprise focus for Dell is SAP deployments. Dell has certified its rack servers for SAP solutions on Linux. Dell has assigned dedicated technical and engineering resources as part of the SAP Linux Lab development team at SAP headquarters in Walldorf, Germany. Again, this is part of the Dell model of quick response to customer requirements. Dell is less interested in the technology of Linux, but very interested in its 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.

Dell's primary Linux distribution is Red Hat. Red Hat is the primary test vehicle for Dell Linux systems and Dell professional services resell Red Hat services. Dell preloads Red Hat Profession and Advanced Server versions as part of its normal OS preload process. Dell does however; understand that, depending on geography or customer interest, other Linux distributions need to be available. To address that, Dell is providing 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

Comment: DELETE reference to application solution centers

customized approaches including Dell Custom Integration. Consistent with the Dell model, these services tend to be narrowly focused on Dell customer relationship and support. They are not as broad or as deep as IBM's or HP's services offerings, but that is not their purpose.

HP

HP has taken a holistic view of Linux across its product line. Linux is supported across HP's 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's enables Linux on its entire product line of Intel architecture (IA-32 and IA-64) based products servers including its ProLiant and 2 blade server architectures, its ProLiant appliances, the Evo desktops, HP workstations, and even the iPAQ handheld. In addition, HP is delivering carrier-grade Linux servers designed specifically for the Telco market with NEBS compliance and AC/DC power supply options. HP has also been an early proponent of open sourcing drivers for its proprietary graphics cards and now fully supports the Linux drivers on its entire range of graphics cards. HP's 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 the 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 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 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. HP was one of the first suppliers to offer its own Linux drivers for its graphics cards and 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. HP has certified departmental (low entry cost), infrastructure (scalable FC clusters) and enterprise (highly scalable and reliable) clusters with 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. HP recently announced 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 WEBppliance 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.

As part of HP's 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 data center 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 financial information to financial services companies.

Building on its experience in high-performance technical computing, 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 2000 nodes), as well as major installations at commercial sites such as BP, Ford, and Toyota. The HP Linux ClusterBlocks products includes both Linux 32 (using Intel Xeon processors) and Linux 64 (using 64-bit Itanium2 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 & 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 SCO/Caldera, TurboLinux and Connectiva) for its server platforms. HP also offers Mandrake for its commercial desktops.

IBM

IBM supports Linux across its entire server product line - from entry xSeries servers to large IA32 clusters to the zSeries mainframe. This support crosses technologies - IA32, 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, z/VM virtualization technology, and support and service in one package, and Linux versions of one of its pSeries RISC systems - the p630 and p650 Express Configurations. In addition, IBM is modifying it proprietary operating environments to support Linux in either an LPAR or in adding Linux API's to AIX to provide source compatibility.

Most models within the eServer line support Linux. As does the rest of the industry, IBM targets the xSeries IA32 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. IBM is positioning its pSeries RISC servers as their high-end 64-bit Linux platforms and POWER4 systems versus the IA64 IPF systems for high-end application requirements. IBM expanded its IPF offerings with the introduction of the xSeries model x450, an Intel Architecture platform, positioned for workload consolidation and mid-range

application processing. For High Performance Computing (HPC), IBM announced its plans to offer a server product based on the AMD Opteron processor. The IBM iSeries is IBM's mid-market server entry. The IBM iSeries is IBM's mid-market server entry. 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 in certain packaged configurations. However, it does have a full set of services and support for Linux installation through its services organization and IBM Help Centers. IBM supports Caldera, Red Hat, SuSE and TurboLinux distributions.

Linux is an important technology for IBM software in that it gives IBM an opportunity to create an alternative to Microsoft's platform. IBM believes that the Linux market is broadening and that with the availability of the Linux 2.6 kernel, customers will be willing to make investments in higher scale servers, driving 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 that are 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 been very aggressive in attracting the ISV community to Linux. There are multiple programs in place to make it easy to port, provide no-charge versions of middleware to remove financial inhibitors to porting, and support of various kinds to help ISV's and corporate developers take their applications and subsystems to Linux. The list of ISV applications certified on IBM hardware running Linux is growing and IBM references over 3,000 applications for Linux. IBM's web site has a significant list of applications available for Linux and provides a software compatibility matrix for all of its own middleware showing what distributions and hardware platform are supported with each offering.

IBM has fully embraced Linux in its cluster products. IBM delivers the Cluster 1350, running on a standard Linux distribution. IBM's 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 that has substantial market experience. The 1350 cluster is a fully tested and preconfigured solution (up to 512 nodes) that has a full set of integration, setup, installation, and warranty services. Consistent with IBM's server model, the cluster has 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 has 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 can supports all industry Linux industry system providers and does not target only IBM systems and software for their business.

SUN

Sun currently has multiple offerings in the Linux market - the Cobalt appliance server line, the LX50 IA32 servers, and the recently announced Sun Fire V60x and Sun Fire V65x. Sun also offers the Sun Fire Blade Platform and Sun Technical Cluster Products. Sun has been shipping its Cobalt product for 4 years. The Sun LX50 was introduced earlier this year. 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, besides 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 participate in a Linux cluster running Sun's Grid Engine software. Sun also plans to offer an x86 Blade server running Linux later this year. The Sun Fire V60x and V65x servers will deliver a dual Intel Xeon processor based system with either Red Hat Linux or Solaris 9, x86. The V65 has more PCI expansion capability and up to 12GB of SDRAM. Also, the V65x has high availability features 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 has been contributing to the Linux community and offering Linux supporting software for some time. 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.

Sun plans to increase its role in this community and be more aggressive in contributing software and 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. Sun plans that Orion 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 that it does for Solaris offerings.

TABLE 13: IA-32 and IA-64 Server Compatibility Matrix

	Dell	HP	IBM	Sun
Processor Speed	2 GHz Xeon MP	2 GHz Xeon MP	2 GHz Xeon MP	3.06 GHz Intel X
No. of CPUs Supported	Up to 8 CPUs	Up to 8 CPUs	Up to 16 CPUs	Up to 2 CPU
Cluster	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster Offerings • Partnership with Cray for high-end and sophisticated HPC deployments **HA:** • Certified with SteelEye	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster Offerings • Partnership with MSC.Software for Beowulf-like Clusters **HA:** • HP ServiceGuard • Certified with SteelEye	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster Offerings • CSM management software • GPFS File System **HA:** • PolyServe Matrix HA • PolyServe Matrix Cluster File System	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster O • GridEngine softwa **HA:** • No
Memory*	Up to 32 GB	Up to 16 GB	Up to 40 GB	Up to 12 GB
Management Tools	**Installation:** • OpenManage Server Assistant • OpenManage Remote Install **System Management:** • OpenManage Server Administrator **Remote Management:** • Dell Remote Access Card	**Installation:** • SmartStart • Rapid Deployment Pack **System Management:** • Insight Manager agents • ServiceControl Manager **Remote Management:** • Remote Lights-Out Edition	**Installation:** • ServerGuide • Remote Deployment Manager **System Management:** • IBM Director **Remote Management:** • Remote Supervisor Adapter	**Installation:** **System Manageme** • Sun Cobalt Contr Station **Remote Manageme** • Baseboard Manag Controller

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 8-way SMP systems, with IBM offering up to 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 since Sun bundles the OS as part of its standard configuration. The table below 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.[4] Systems with the Itanium 2 processor follow a different discount structure than typical IA-32 servers.

TABLE 14: Examples of Linux System Pricing as of May 23, 2003

	Dell	HP	IBM	Sun
Appliance • 1U Web Hosting	$1,657 • PowerEdge Web 1650 • 1.26 GHz PIII, • 256 MB RAM, • 80 GB IDE	N/A	N/A	• $2,298 • Cobalt RaQ 550 • 1.26 GHz PIII, • 256 MB RAM, • 80 GB IDE
Entry Rack System • CPU • 512 MB • HD	$2,771 • PowerEdge 1750 • 3.0 GHz Intel Xeon • 36 GB SCSI • Dual GbE NICs	$3,238 • ProLiant DL360-G3 • 2.8 GHz Intel Xeon • 36 GB SCSI • Dual GbE NICs	$3,268 • xSeries 335 • 2.8 GHz Intel Xeon • 36 GB SCSI • Dual GbE NICs	$2,882 • Sun Fire V60x • 2.8 GHz Intel Xeon • 36 GB SCSI • Dual GbE NICs
Midrange System • 2x2.8 GHz Intel Xeon • 2 GB • 2x72 GB Mirrored SCSI disk • Dual GbE NICs	$4,989 • PowerEdge 2650	$7,006 • ProLiant DL380-G3	$5,724 • xSeries 345	$5,772 • Sun Fire V65x
High-End System • 4x2.0 GHz Xeon MP • 4 GB • 2x73 GB Mirrored SCSI disk • Hot-plug, RAID 1 • 2xGbE NICs	$26,835 • PowerEdge 6650	$33,616 • ProLiant DL580-G2	$31,173 • xSeries 360	N/A
Itanium 2 • 2x1.0 GHz Itanium 2 • 8 GB RAM	N/A	$81,886 • HP Server rx5670	$73,295 • xSeries 450	N/A

[4] For pricing on specific configurations, please see the D.H. Brown Associates, Inc. Intel Server Pricing and Configuration Monitor.

• **2x73 GB Mirrored SCSI disk** • **RAID, DVD** • **2xGbE NICs** • **3 yr 24x7x4 HW Warranty** • **Linux OS**				

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

DELL: TACTICS AND STRATEGIES

OVERVIEW

While Dell has its share of engineers and technologists, Dell primarily focuses on their customers' requirements rather than technologies. Dell delivers significant cost advantages to its customers and competes very effectively on price. Thus, when Dell embraced Linux, it was clear that customer demand was there. 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 their direct Intel Windows competitors and also the UNIX community. Linux is Dell's UNIX.

Dell is primarily an Intel systems hardware supplier whose emphasis is speed to focused customer requirements. Dell views itself as a customer satisfaction machine that exploits standards to deliver pragmatic customer solutions. Dell's approach to Linux is both pragmatic and opportunistic. 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 focused strategy, responding to both SMB and enterprise customer interest, addresses the substantial Linux value proposition of IA32 cost advantages over more expensive RISC UNIX systems. Dell positions Linux as the low cost alternative to "proprietary" UNIX. Dell is a practical advocate for Linux, applying the Dell model by reacting quickly to market changes and demand and 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 use that to target Sun and 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 with industry standard clusters.

Dell was initially focused on 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. The overarching focus for Dell is UNIX to Linux migration. While Dell retains edge of network servers as part of its focus, it is adding UNIX (mostly Sun Solaris) migration to Linux using Dell's ISV relationships (Oracle and SAP), and Linux clusters for the High Performance Computing Cluster (HPCC) opportunity to its repertoire. Further, Dell targets for migration enterprise custom solutions that began on RISC/UNIX. Dell has built specialized services in server consolidation, distributed applications, and high performance computing (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 supports the other key parts of its strategy.

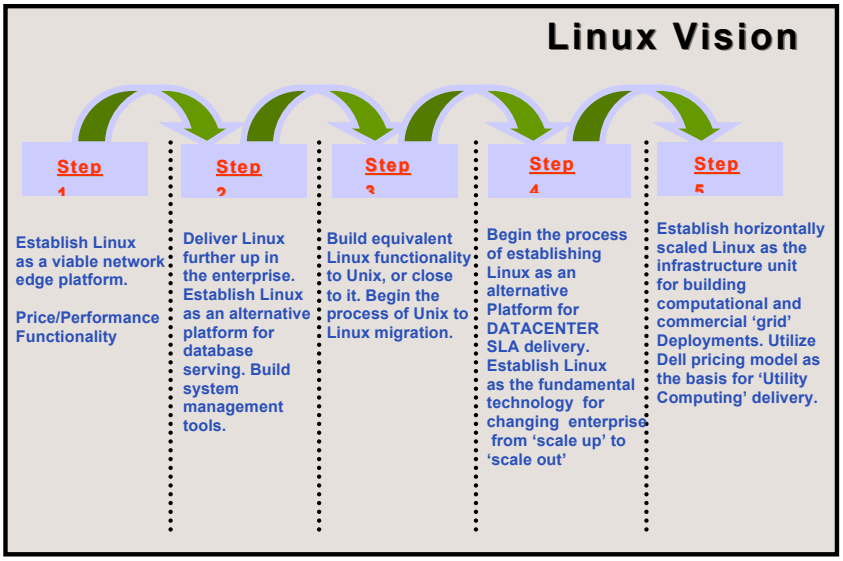
Red Hat remains the primary Linux distribution that Dell uses to certify its hardware. There is a strong partnership between the two companies that goes beyond hardware into professional services. Dell recommends Red Hat "professional" for appliances and edge of network servers and Advanced Server for enterprise applications. At this time, Dell Europe does not certify its clients or servers on United Linux or SuSE, but is actively working on certification. Dell has built ISV relationships with BEA, BMC, Oracle (9i, 11i), SAP (Linux certified), and Veritas. Dell is particularly focused on Oracle 9i rack servers to drive its participation in enterprise Linux engagements. Dell positions itself as the primary point of contact for service for Linux and all the software installed on its servers. It will provide level 1 support Dell provides L1, L2 & Advanced SW Support; it manages L3 escalations & owns the resolution when the customer has a support agreement through Dell; Adv SW support provides a full suite of complex installations & problem resolution) and will manage the interaction with Red Hat and the other software providers on the customer's behalf. We will report on how well this kind of front end management process works 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 7x24 support and Linux Consulting Services from Dell Professional Services. Dell Professional Services also resells Red Hat Professional Service as part of its Linux offerings.

Dell's entire product line in enabled for Linux and 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 systems enabled are 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. Dell's strategy centers on the IA32 architecture for its Linux based systems. In keeping with its pragmatic approach, Dell is focused on what is available now and has no Linux on IA64 products Dell has provided support on the PE7150 since its launch in 2001; used RH 7.1 & 7.2 64b on IA64 platform;).. As the bulk of the Linux market is IA32, this is no real inhibitor. Dell has publicly announced plans to introduce an Itanium 2 – based server later in 2003.

Dell's strategy makes it well positioned be the high volume, commodity Linux server leader. It is a price leader for 1-way and 2-way commodity servers in a market where cost is critical. This is also a market where the customer is prepared to use existing well defined open source solutions, such as SAMBA, to build Linux solutions. Dell is beginning to target the enterprise Linux opportunity. While Dell is being very visible with its Oracle relationship (highlighted at Dell's recent analyst meeting) 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 just the hardware provided to a full development and production solution environment. The

challenge for Dell is to communicate that it has the relationships with the ISV community and the services capability to do that. Dell does not have to create a software infrastructure itself to be a viable provider and partner for enterprises. Dell must communicate that it understands the issues and 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 gives Dell proof to share with its enterprise customers.

By leveraging the Dell brand, the company is well positioned in its share of the worldwide Linux market. Dell's 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 who have large and diverse deployments. Dell views it self as a hardware supplier and does not have its own software stack. However, this is an advantage in that Dell can form deep relationships with leading ISVs such as Oracle, CA, BEA, BMC, Veritas, and others. Dell offers them a high volume industry standard market with no fear of competing with them. Dell is well positioned to profit from Linux. With a broader enterprise thrust and a larger solutions portfolio Dell can expand their Linux position substantially. The following figure describes Dell's vision to exploit Linux:



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.

Dell's primary Linux relationship remains with Red Hat. Given Red Hat's dominance in the US market on IA32 servers; Dell is certainly at no disadvantage in having developed 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 that its close partnership with Red Hat in the One Source Alliance gives Dell a time-to-market advantage in offering the latest versions of Red Hat Linux. Each of the suppliers we talked to claim a strong Red Hat relationship, so it is not clear if the strength of One Source does that. However, Dell uses Red Hat Linux in its manufacturing operations. That real time usage is likely of real value in helping Dell meet its commitment to deliver an integrated and assured OS and hardware combination.

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

- collaborative development of products between Dell and Red Hat and 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, and
- Working jointly on Oracle deployments.
- Supporting Dell partners and ISV's more effectively work with the open source community.

Dell is building partnerships with the software community (BEA, BMC, CA, Oracle, SAP, Veritas, and others) to build a strong Linux middleware and infrastructure portfolio. This is part of 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 HPCC solution that can address grid and high performance opportunities is many industries. Dell highlights bioinformatics and energy systems and has installed large clusters in universities, energy companies, and biotech. Among Dell's partners in this space are Fluent, Platform, and TurboWorx.

Finally, as a very large volume system supplier, Dell has significant relationships with the IHV community to provider drivers and other software to support their unique hardware components. Dell has worked with them to ship their software in an open source model. This is to Dell's benefit since it makes it easier to support their systems using Linux and it is 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

Dell is increasing its contributions to the open source community. Dell is a participant or board member on most of the open source community's organizations and it is a frequent promoter of Linux in the target markets that Dell is focusing. This is not completely altruistic. Dell gets a great deal of benefit from Linux and open source in that it has made it possible for Dell to attack the UNIX market with its low cost, high customer focus model The following is some of Dell's Linux community participation:

- 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 and is 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 is 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.
- Has placed its Linux platform management code and interfaces into 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 are interested in.
- Supports the Linux-Dell-Laptops group at Yahoo! – community-based support for running Linux on Dell Inspiron and Latitude notebook products.

Dell is a leading vendor driving Linux adoption and support by IHVs. Dell provides the volume and has the relationships with these companies through its Windows-based business and has extended that 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. Dell's website makes selecting, configuring, and ordering Intel-Linux servers 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 1000 nodes. In addition, Dell has built its appliances on a Linux base. Dell's 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" portfolio of solutions. 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 are very competitive.

Dell is also developing standards-based modular servers, 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 to simplify and help 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 targeting server consolidation, thin client computing, and high-performance clustering.

Dell has developed a line of Linux appliance servers. These servers are multi-functional and have 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 (CFI) 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 for purchasers of consumer systems.

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. It is 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 for 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 will have 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), Enterprise Resource Planning (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.
- Also – preconfigured "rack 'n stack" option – ie, ability to load OS, configure, cable & rack servers into Dell racks & ship directly to customer (US only) via Americas Merge Center; especially important for HPCC in Education &/or in large metropolitan areas with limited dock capabilities;

SUPPORT AND SERVICES

The Dell/Red Hat partnership provides support for Linux on Dell platforms. Dell now provides full end-end Linux support without a "warm transfer" to Red Hat. While Red Hat provides advanced level & back-end L3 support as a substantial part of the technical support, the face to the customer is Dell. 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 levels of support for Linux as it does for Windows and Netware. Linux support is integrated into their premier enterprise support gold and platinum agreements. These agreements include reactive and proactive support as well as entry-level planning services. The Dell web site describes the various levels of support and service at

http://www.dell.com/us/en/gen/services/service_PESStiers.htm . 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) Also Technical Account Management & Advanced Software Resolutions; plus direct access to Enterprise Expert Center technicians, higher-level, highly trained support; 3rd party seamless support integration for ISV).
- *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 Advance SW resolutions available in 1-30 incident packs; full support for RH 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 HPCC Design and Deployment
- Customer training and certification services
- Oracle 9i & 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 is on 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 Technology Consulting 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 joint, pre-sales consulting team working with Dell's Advanced Systems Group.

These solutions are based on:

- UNIX to Linux Migration
- Oracle (and SAP)

- High-Performance Computing Clusters
- 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 Walldorf, 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 is to deliver Linux as an alternative to UNIX, continue to drive the volume acceptance of Dell Linux offerings, and to continue to become a primary Linux provider into the enterprise. Dell wants to change the enterprise focus from scale up to scale out with industry standard clusters. To do all of these that, 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 focus on storage management from partners such 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

Company Description

Precision Response Corporation (PRC) provides outsourced customer relationship management services for large corporations and other organizations. As a world-wide provider with offices in the US, 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 4-9's 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 has all three in production 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 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 most effectively using its infrastructure and asset base. 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:

- Cost of UNIX RISC system maintenance is a significant expense
- Need 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 3 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, and server 3 has 20% capacity left. 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 their needs, limiting their responsiveness. *"By definition, we are an on-demand company as a service agency,"* said Bill Hicks, CIO, Precision Response.

WHY LINUX

The primary drivers of Linux at PRC are cost, flexibility, and asset utilization. The important cost elements are server acquisition costs vs UNIX and 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 gets 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 as either Linux or Windows servers, depending on the need. They no longer were constrained by the unique hardware dependencies of their UNIX environment. The result is that PRC has 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 and, as with many Linux users, PRC has people on staff who had already dabbled in Linux. As a result, they were able to accommodate the Linux transition with no increase in staffing by using the existing UNIX team. PRC put together a cohesive education and training strategy, employing local hands on experience and formal classroom education. The transition from UNIX to Linux was straightforward and is 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.

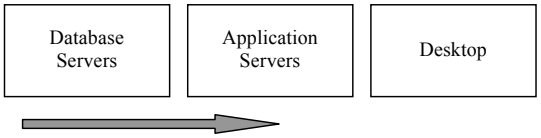
Database first

PRC's initial focus was putting Oracle on an Intel environment to get cost benefits.

The biggest return for PRC was to migrate their Oracle database servers from Solaris/SPARC to Linux Intel. By choosing Linux as their UNIX operating environment, they obtained the benefit of Intel system cost advantages, both initial purchase as well as maintenance. An enabler for PRC was Oracle's release of the Real Application Cluster (RAC) on Red Hat. 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 example described in the problem statement above. They could put the 4th CRM services customer's workload in the existing environment by using existing capacity. The result is that PRC gains value from clustering and also from being more responsive to their 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 their 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 that, so far, everything that has come up has been resolved quickly. PRC is working with a consortium of partners - Dell, Oracle, Intel, and EMC. All the 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 any new technology.

Measurable benefits
PRC experienced a 9-month ROI from their transition from UNIX to a more granular Intel environment. Also, they experienced improved flexibility - now able to respond more quickly to demand changes. The biggest measurable financial gains are reduced maintenance costs plus the avoidance of purchasing 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 transition to Linux. 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. Building and presenting a business case that demonstrated the financial as well as technical benefits ensured that PRC considered what they had to do, but also measured themselves against the investment. This ROI story made it easier to gain senior management support (both business execs and C-level execs) for the project and made it easier to manage. Calculating the projects ROI and demonstrating how that was going to be achieved added credibility with senior management. As part of that process, PRC built a plan and made sure that the commitments were in place to make project successful. PRC put their best people on the project and provided the necessary education. It is important for technical team to have 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 a manageable risk.

At the end of the day, UNIX to Linux was not that dramatic of a change for PRC. PRC noted that it was important to make peer groups and constituents understand the change being made and feel comfortable that it would not impact the quality of service .

WHY DELL
Specific values, skills, benefits Dell **brought**

In the past, PRC had a plethora of Intel servers from multiple manufacturers. Over the last 4 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 their customers. About 3 years ago, PRC made a positional decision that changed their 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 is the natural supplier of Intel IA32 servers for the PRC open source initiative. Once the decision was made to make the transition from UNIX to Linux, Dell was the natural supplier. PRC viewed Dell's role 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 was compatible with PRC's approach. Also, Dell had a commitment to the Microsoft relationship and environment. PRC felt that other suppliers' motivation was to use Linux on Intel to replace Microsoft Windows as a strategy. PRC believed that Dell had a more thoughtful approach to the business that more closely matched their objectives.

PRC believes that Dell had a high level of commitment to Linux and that was reflected in the various clustering options Dell offered. SUN was limited to a 2-way environment which didn't 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 get access to Dell's own IT people without the filter of sales people. As a result, PRC claims the following benefits:

1. Avoid pitfalls
2. Helped make people internally comfortable with the risk of the project
3. Got benefit of 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 is not planning to move from Windows to Linux - PRC believes that they can get some of these 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, they are looking ahead at their application servers. The following are areas of investigation:

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

PRC is using BEA WebLogic now and is testing it on Red Hat. They want to move from Solaris/SPARC to Linux and Windows, continuing their strategy of exploiting industry standard servers vs proprietary UNIX systems.

PRC currently has no plans for Linux on the desktop. The desktop operating environment is often driven by the software that PRC client specifies. As a result, PRC projects that Linux on the desktop is farther away than its Linux server investments. They don see an immediate business value for it.

SUMMARY AND OVERALL PERSPECTIVE

According to PRC, there is a substantial cost benefit from the Intel approach and there is a granularity benefit from clustering. These are tied together with Linux as an operating environment. Thus, they are getting cost and flexibility benefits along with an opportunity to be more responsive to their clients. PRC has 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.

The lessons learned are those of most successful projects - 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 was among the early Linux supporters. As Linux gained a higher profile, HP upgraded its Linux strategy with active marketing and support. It created a Linux Program Office and Linux and Open Source Lab. Since then, HP has substantially expanded its Linux and open source commitment.

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

HP's software commitment is equally strong as demonstrated by the porting of its manageability, high-availability, storage, utility computing, quality-of-service, and, Telco software to Linux. 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. In addition, HP has seen clearly 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. HP's strategy covers working with commercial ISVs and partners to offer configured and supported solutions. HP's 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 is 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 offerings.

INDUSTRY RELATIONSHIPS

HP has pursued and built relationships with a wide array of open source community, ISV, hardware, and service communities to build an ecosystem surrounding its Linux solutions. Of particular note are the relationships and communities focused on specific solutions such as Sendmail, VMWare, and other partnerships. Further, HP 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**.** HP also retains a relationship with Caldera for its Volution Management product and. For its Evo PCs and e-PCs, HP also works very closely with Mandrake.

HP enjoys a 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. HP 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.

Linuxcare is also an ally of HP in several areas. Linuxcare provides back-line support for some Level 3 and 4 support calls and it 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 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 do 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 has 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. This is focused on ProLiant and Itanium 2.
  - The Oracle relationship includes the entire Oracle portfolio: Oracle9*i* database, RAC, Application Server (AS), and the Oracle11*i* 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. This 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 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. This combined with the previously announced Apache and Samba solution offerings make a suite of easy to order and install customer solutions for general Linux utilization. HP and SteelEye have also extended support for HP SecurePath for dual path high availability connection for the Modular Storage Array 1000, MA8000 Enterprise Storage Subsystem, as well as Enterpriser 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: HP 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 high-performance computing 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 IA32 ProLiant Brand. HP works very closely with the software providers to insure seamless utilization 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 for advancement of Itanium system by universities.
- Open Source Development Lab (OSDL): HP is on the Board of Directors and 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: This effort 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. This group of talented, dedicated developers and programmers works well with those who embrace the community contributing to current technical challenges as well as taking and building upon initial solutions. HP has extensive experience working in the open source community. The following are joint projects between HP and the Linux community:

- HP assigned engineers to kernel development, benchmarking and optimization, and other areas to improve Linux and open source solutions.
- HP has 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.
- HP is a charter member of the Free Standards Group (FSG) and an active participant in the LSB (Linux Standard Base) specification. HP chairs the Futures group for LSB.
- HP chairs the Open Printing Workgroup within FSG. Working with the open source community to advance the state of Linux printing.
- HP is implementing broad support for HP hardcopy devices employing open source technologies, and hosting the OSDN 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 is 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.
- HP is a major contributor to Apache 2.0 with 15 – 20 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 and being deployed by D.O.E. at several national laboratories with HP support.

- HP is a charter member of the Open Software Developers Network (OSDN), an industry-wide organization. This is HP's 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.
- HP supports the Open Source Software Institute that 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 a founding member of the Linux Tape Certification standard (linuxtapecert.org).

OFFERINGS

Linux is an integral component across HP's broad product portfolio, 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. All HP ProLiant industry standard servers are supported with Red Hat, SuSE, and United Linux based distributions. These ProLiant servers support the full range of Linux applications. HP supports Linux across its ProLiant servers including eight-way SMP servers. HP supports Linux on it's entry tc servers. HP 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 pre-configure 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 is similar to the services that Dell offers.

The following are significant Linux features of 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.
- HP has adopted Insight Manager for device management of HP ProLiant servers. It 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 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 Servicecontrol Manager 3.0 is a multi-system management solution 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 offers online ROM Flash component that gives system administrators the ability to upgrade systems firmware images whether locally or remotely across the network.
- The HP Array Configuration Utility (ACU-XE) is 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

HP blade servers are part of the ProLiant brand. They are all-inclusive computing systems that allow users to provision server or other compute resources on individual cards, or blades. Blades cover a wide range or applications. – servers, storage, network, and more. HP offers two blade design centers, the HP bl e-class and p-class. The e-class blades are targeted for static web hosting, utility applications and high performance technical computing clusters where integer performance can be applied on a massive scale specifically in bio informatics and life science applications. The p-class blades are higher performance and availability blade servers designed for enterprise applications. The p-class blades are either 2-way or 4-way servers. The 2-way p-class BL20P G2 has been used extensively in high performance technical computing projects. HP positions

them as part of a 3-tier network where the 4-way blade is a back-end server and the others are appropriate as front-end and mid-tier servers. The BL20P G2 is designed for high performance computing, providing up to 96 2.8GHz 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. HP demonstrated the first blade high availability solution at LinuxWorld – January using SteelEye's LifeKeeper for Linux Cluster Manager operating on two BL20P G2 Blades and one BL40P Blades all accessing 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. Telco requires high availability and reliability, and 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 is 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.

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 needs of high performance cluster customers. Since 1998, HP has played a key role in

developing Linux for Itanium. 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 experience with 64-bit Linux started with Alpha servers in 1995. HP certifies Red Hat on all one- to four-way AlphaServer systems and 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 from HP. 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. Red Hat 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 pre-load 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 directly from the web. HP also supports some laptops for Linux including the high end HP N800W laptop.

STORAGE

Linux storage solutions are also a focus for the new HP. 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 includes 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, HP brings its expertise in high availability to the Linux environment. HP has ported its MC/ServiceGuard high-availability software to run 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 MC/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 is a high-availability application and data cluster solution supported on HP ProLiant servers and StorageWorks storage systems. It is a partnership product and 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, SuSE, and Caldera eServer. In addition to the base Cluster Manager, HP certifies the full range of SteelEye Application Recovery Kits (ARKs). These 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 PostgresSQL 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 also adds 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 offer 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 has been working with the major developers of Linux cluster management software. These include ISVs and resellers such as MSC.Linux, Scyld, and 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 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 60 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, manages customer solutions running on Linux and through its partners program, 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 has agents that monitor the health and performance of Linux systems. HP OpenView Network Node Manager discovers Linux devices; HP OpenView Internet Services monitors Linux-based services. HP 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. This provides an interim stepping stone for a complete Linux deployment platform.

ServiceGuard for Linux SG/LX has been improved with enhancements including the ability to support eight nodes and disaster recovery support up to 100 km of separation, journal file system support (ext3fs and Reiser), Linux GUI and templates for Samba, Apache, and Sendmail.

Other HP software products include,

- HP Compartment Guard for Linux, which is currently available only in Japan, 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.
- HP Rapid Deployment for Linux is part of the ProLiant Essentials Initaitive.. It is based on Altirus and today supports Linux Image Management and deployment from a Windows console today. The full Linux version will be available later in 2003, allowing customers a choice from a mixed Windows and or Linux environment 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 HP services team has created a services framework that intends to deliver end to end Linux solutions, including technology, support, partnerships, applications, and services. HP services have specific support in the following Linux relevant technologies - Beowulf, IT consolidation, ERP, web services, high availability and disaster recovery - and have developed strategic relationships and support agreements with the key ISV's. HP services particularly target the Financial Services and Telco industries. HP claims to have 5000 trained Linux professionals. A major focus of the HP Linux services portfolio is making Linux an equal part of HP's multi-platform environments.

HP provides enterprise-level 24x7 global support for Linux, open source applications included with distributions, and HP Linux applications on HP, Dell, and IBM systems. HP supports Red Hat, SuSE, and other United Linux-based

Linux distributions. 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 wit Red Hat that enables HP to be a single-point fulfillment and service of the complete Red Hat Enterprise Linux product line on HP industry-standard hardware. This is similar to IBM's agreement with Red Hat. This includes Red Hat Enterprise Linux AS, Enterprise Linux ES and Enterprise Linux WS. This agreement fulfills HP's goal of being able to bring the same level of service and support to Linux that it does to 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. HP also provides a full range of integration, installation, and project management services. HP outsourcing services to include Linux for running and managing customer operations and IT infrastructures. HP's IT infrastructure consulting also includes 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 including telecommunications application and communication integration services.
- Financial services specific consulting through a center of expertise 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.
- Caldera Specialized Server Solution.

PORTING AND MIGRATION SERVICES

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

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. Covers 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 at: www.hp.com/go/developers.
- Periodic Linux training is offered through the HP Invent Online webinars. Info at: www.hp.com/go/inventonline.

OUTSOURCING

- Infrastructure management services for Linux providing an alternative to staffing and managing a customer's own infrastructure in-house.

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 information services with phone and electronic software-call submittal addressing defects and how-to questions. HP engineers have access to HP's diagnostic centers for the replication of software issues for problem solving. An upgrade to 24x7 is available. Coverage includes the open source applications included with the distribution.
- Hardware support with flexible hardware response times and coverage periods to meet customers' multi-platform hardware support needs.

EDUCATION AND TRAINING

HP offers a portfolio of educational services in different 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. Its strategy is built on industry standard platforms, partnerships, enterprise development environments and middleware, and professional services for the target Linux solutions. 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 has an integrated offering across multiple operating systems and can even provide levels of this across vendors.
- Pervasive Linux: Putting Linux to work in embedded intelligent appliances.
- Rapid deployment services and products. The service takes the OS and application image, preloads it on the hardware, and delivers a complete ready

to run server. An example of a product is the integrated Linux print servers that 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 MSC Linux, and load balancing appliances for web clusters. HP is also 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. HP has strong relationships with the Telco industry and has created Linux servers directly targeting that industry. Also, HP's Opencall SS7 on Linux allows live testing of telecom applications in real ss7 networks.

HP has evaluated all its software products for Linux. . In particular, HP has made ServiceGuard failover software available on Linux, as well as OpenView agents (for backup, network management and operations management), Insight Managerfor desktop and server device management, 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 includes Opencall SS7 Telco software, Internet Usage Manager, and WebJetAdmin.

APPLICATIONS FOCUS

HP is targeting specific industry segments to exploit Linux acceptance outside the edge server and Internet infrastructure environments. These segments typically are 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. These segments of interest to HP are:

- 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

As an example of HP's attention to Financial Services, HP has created a Linux center of competency for financial services. The objective is to make it easier for ISV's and integrators targeting Linux in that industry to meet and support interested customers, all to be implemented on HP equipment.

HP is focused on the following enterprise solutions:

- Mail and messaging – HP has formed a partnership with SendMail and offers its Mailstream Manager and Integration Mail Suite.
- Apache-based web server solutions building on a partnership with Covalent.
- Databases including Oracle9*i* 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 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 medium business high availability solutions and 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.

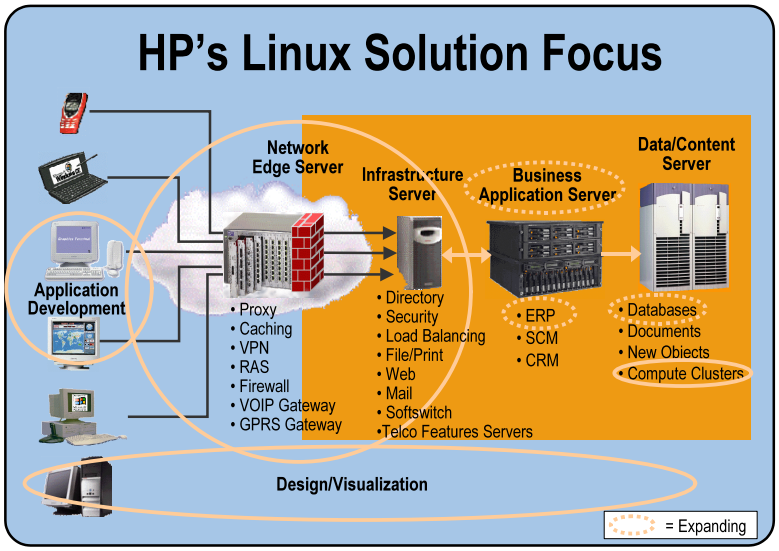
HP is exploiting the successful Active Answers concept that Compaq developed. Active Answers are pre-structured solutions encompassing a set of tools and solutions to support rapid deployment. These solutions are targeted to the channel or end users to plan, deploy, and operate enterprise solutions.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

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

Building and offering end-to-end business solutions based on Linux through its sales process is an HP focal point. 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 including porting, architecting, tuning, installation, project management, and repair. The following figure illustrates HP's end-to-end solution strategy.



HP has an active ISV enablement program for Linux solutions. Included in the program are 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 IA64 and development tools for HP-UX Linux deployment
- HP consulting to create LSB compliant code or platform independent code
- Preload for strategic ISV's (e.g., Oracle)

FUTURE ACTIVITY

Solutions and services for target Linux markets will continue to expand. This includes 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. Look for additional levels of Linux scalability and manageability here.

HP's commitment to the blade architecture is strong, so new blades and Linux solution support partners are likely. Also, we expect that HP Linux manageability

and utility computing software will 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. HP'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. The software that HP brings along with the focus on services to deliver solutions based on Linux offers a differentiated value proposition for mainstream customers looking for reduced cost with value-added Linux-based solutions and ISVs looking for a strong partner.

CUSTOMER SUCCESS STORY

HP and Amazon.com exploit Linux

COMPANY OVERVIEW

Company Description

Amazon.com, Inc. is an online retailer offering a broad range of items including books, music/video, electronics, apparel, office products and services, and home products and services via its international websites. The Amazon model is heavily customer-centric and Amazon customers can find virtually anything they may want to buy on the Amazon websites. As an international online retailer, Amazon is critically dependent on its systems to deliver a customer-centric experience and a cost managed delivery environment. Amazon.com's customer-centric business 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. Amazon.com has had dramatic growth in terms of both the size of its customer base and the variety of its services. The company's ability to accommodate growth and change while managing cost and remaining flexible is critical to its continued success and its hardware infrastructure is no exception.

Problem

Amazon.com is focusing on the same issues of cost, flexibility, and control benefits that other Linux users are focusing on. As an on-line retailer, Amazon is constantly managing its costs and focusing on improving its reliability and flexibility. The transition to Linux was driven by the need to manage cost while maintaining Amazon's market reliability. Also, Amazon.com customers use multiple features that don't necessarily map to specific single servers. As a result, Amazon doesn't want the customer's experience to be affected by idiosyncrasies of system outage, system growth, or reassignment of server assets to different services. Finally, Amazon.com needs a coherent infrastructure to help them keep their flexibility of customer services while meeting their 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

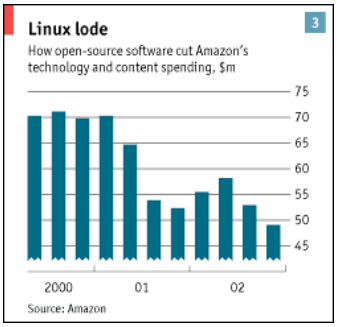
The greatest ongoing challenge for Amazon.com is the process of deploying and maintaining large numbers of servers delivering a wide range of services/functions. The size and scope of an environment as large as Amazon.com's, and with their substantial growth profile, requires that each server cannot vary much in the demand that each puts on the IT staff and infrastructure. To the maximum extent possible, all of them must look and work alike. As noted above, a key requirement for Amazon.com 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 says, *"…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 of which have been 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's virtually no learning curve--they don't have to be trained to use a proprietary or specialized platform. This benefit should become increasingly significant as Linux usage continues to spread.

As stated above, a key benefit of Linux for Amazon.com is the reduction in cost. As with most companies that have switched to industry standard and open source solutions, Amazon has experienced a substantial information technology spending reduction. The chart at the right 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's CIO commenting on the effect of Linux said *"The cost to serve a Web page is going down faster than the demand is rising"*. Amazon's experience provides the Linux community with supporting evidence that Linux can save money.



A second benefit of Linux is that it is 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's so inexpensive to implement each Linux server, Amazon has done it 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's no dependency on a single hardware supplier. Amazon.com is free to choose any vendor based on its products, pricing, and track record.

WHY HP

Amazon.com and Hewlett-PackardH have been working together since 1999, when HP helped Amazon.com make the transition to Linux servers (Red Hat) from SUN servers. When Amazon.com decided to make the move to Linux, it needed to quickly receive and deploy a significant number of new Pentium-based Linux systems. Amazon.com turned to HP to implement a Linux infrastructure. HP delivered the new systems within a short timeand had Amazon.com deployed and ready to run in a very condensed time frame. HP now fills nearly all Amazon.com's hardware needs, including desktop PCs and laptops, server hardware, and supercomputers. Increasingly, Linux is 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 have the flexibility to choose their suppliers to meet their specific criteria. That makes Amazon.com's allegiance to HP impressive. 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

A supporting driver of Amazon.com's choice of HP as a Linux supplier was their experience with HP as their partner in expanding the Amazon.com data warehousing system to meet accelerated growth. Amazon.com considered a wide range of options, but concluded that HP systems delivered the most substantial benefits and their experience with HP was one that had a record of responsive support. As a result Amazon.com selected HP Superdome systems for the data warehouse project. Amazon is very complementary of HP's efforts in making 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 and has also helped to solidify the company's partnership with HP. 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

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 recognized HP's commitment to Linux and especially the responsiveness of the HP team to helping them build the kind of infrastructure that would be responsive to the explosive growth Amazon.com was experiencing. That combination proved to make 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. In addition, IBM's endorsement of Linux gives it credibility with large enterprises. IBM recognizes Linux as an opportunity for customer choice, to keep the server market and the Internet open and heterogeneous, and 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 2-3 years. Having made 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 this new image with their on-Demand initiative. Linux is no longer a separate IBM message. Rather, Linux is now part of the on-Demand enablers - Linux, Grid computing, Autonomic computing, and other technologies. The IBM message for 2003 is on-Demand and a part of that is Linux. IBM is continuing the programs of the 2002 to promote Linux and enlist ISV's and business partners.

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

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

- 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 IGS 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.

IBM doesn't sell Linux directly, but partners with the Linux distributions to be the Linux source. IBM leverages Linux 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 model 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)
- High Performance Computing Clusters (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 has a comprehensive Linux strategy that includes 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. IBM has been active in the open source community and 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 as 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 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 IBM to focus on Linux as the development platform for all its server operating systems and. 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 scale for Linux on the eServer 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 has had an application drain in recent years that impeded its competitiveness. Linux creates an opportunity to exploit a growing application base on a platform

that IBM asserts has unique scalability, reliability, and availability attributes. In effect, Linux and the TCO a Linux server environment delivers, helps make these installed servers potentially more interesting to the customer. IBM's customer experience bears this out as 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 Linux'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 1-2 way SMP) systems. These same Linux systems delivered a very cost effective platform for these other workload. 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. These 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 is targeting server consolidation opportunities, and distributed applications, and is working 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 2003-4, with the availability of the Linux 2.6 kernel, IBM is focusing on bringing Linux to the transactional DB workloads, making it a competitor to Windows and the other UNIX environments.

While IBM has had success with Linux on the mainframe zSeries platform and at the high end of the xSeries IA32 platform, IBM is not the market volume leader in Linux, though is probably the market mindshare leader. Most of the Linux market remains in the IA32 server space and will continue to be there for the foreseeable future. To respond to this, 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 IA32 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. IBM is building on the 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 reports directly to 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. IBM wants to be an active supporter of Linux. It does not want to be the owner.

IBM has created industry focused Linux centers of competency to help customers in specific industries exploit Linux and open source in their enterprise and datacenter environments. The first center was a Financial Services Linux Center of Competency in NYC. These centers consist of hardware, software, and people. The objective 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. It is also a showcase for ISV applications and to help customers build prototypes. IBM has solicited ISV's to participate in these Linux centers of competency to either demonstrate complete Linux solutions or help customers build customer or industry specific solutions. The ISV's get access to hardware and other resources and visibility to enterprise customers. The value to the customers is that an industry specific ecosystem can be created. 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, Linux Hub Center of Seoul National University.

IBM has developed strong industry relationships with Linux distributors and other industry organizations. In addition to partnering with the four major Linux distributions, IBM is 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, IBM software is moving toward open source. Take, for example, its base WebSphere Studio development environment in Eclipse. IBM remains a leading member of the

Linux Standards Base and is a co-founder of Ll18NUX. 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. Eclipse is Java-based open source software that 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 include 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. We provide 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 offerings. 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 Software Development Network)
- 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 (Open Source Development Lab)
- FSG (Free Standards Group)
- LSB (Linux Standards Base)
- LI (Linux International)
- USENIX
- Kernel Developers' Summit

LINUX TECHNOLOGY CENTER

The IBM Linux Technology Center (LTC) is IBM's "face" to the open source community. It consists of 250 software engineers around the world whose mission is to "make Linux better". Its role is to accelerate the growth of Linux as an enterprise operating system and to work 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 that the improvements that the LTC develops be delivered 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 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 is now focusing on the 2.7-2.8 kernel. This level of technical participation measures the level of IBM's strategy that IBM will compete on middleware, servers and services and it is in IBM's interest to build a solid operating environment as a base.

The LTC is a key differentiator for IBM in that it enables IBM to build skills, increase visibility, and help 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 up IBM to internships from university students to become familiar with IBM and open source.

PARTNER RELATIONSHIPS

IBM supports the industry by providing access to discounted systems and other technical support. IBM has developed a comprehensive set of programs targeting ISV's 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 include 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 IA32 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/printetc.)
- High performance computing clusters
- Application specific environments - Oracle 9i RAC, SAP, horizontal and vertical applications.

IBM's xSeries servers range from rack-mounted configurations to large clusters. IBM 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 are 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 IA32 servers. IBM 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 have 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-OS capability.

IBM supports clusters of xSeries servers using Linux with the eServer Cluster 1350 targeted at intensive computing and web-intensive (e-mail, file-sharing, and web serving) environments, and scientific/technical workloads. These are user-configurable servers 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. IBM also optionally includes the IBM General Parallel File System 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 are the other suppliers, IBM is using SteelEye technology to deliver high availability Linux solutions.

IBM has refocused its solution packaging to be not only a software package, but a complete offering. As a result, the IBM is growing its Start Now Linux offerings and pre-testing them with the hardware. This is especially important for xSeries since it creates complete integrated Linux development environments and largely ready for production applications, all packaged with the necessary middleware, tools, and applications. IBM is build 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. This includes third-party hardware and software. IBM is also delivering Linux for its client platforms certifying selected ThinkPad commercial models, IBM Network Station, selected desktop systems, and all 2D IntelliStation workstation models. IBM also certifies its 3D IntelliStation models and delivers 3D adapter drivers on Linux.

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 these 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 server. Proactively alerts in advance to avoid unplanned outages

- Real Time Diagnostics - Industry-standards based; supports all CIM (Common Information Model) enabled OS's. 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 ability to customize 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 for many of the technologies employed to deliver high availability. The following are the providers and products used:

- Veritas
  - Veritas Foundation Suite - file system recovery though 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, returns the recovered system back into the cluster. ServerProven and ClusterProven certifications.

IBM and SteelEye have created high availability pre-defined 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 eServer BladeCenter in 2002. It is 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 1 or 2 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 are hot swapping, easy remote server deployment because of the system management tools, and especially the reduced cabling that makes the bade center more physically manageable. IBM plans POWER based blades later in 2003 that support Linux.

pSERIES

IBM supports Linux across most of its pSeries line, from 32- and 64-bit uni-processors to logical partitions in the POWER4-based p690. The pSeries targets large commercial applications, the scientific/technical market and the service provider market. United Linux (SuSE) has the broadest support for the pSeries servers. Red Hat will deliver pSeries support in the 2H 2003 with its new advanced server offering. The Linux support on the pSeries is native support, native Linux support in pSeries partitions, and mixed partitions of AIX and Linux. Partitioning is only supported on the Power4 systems. IBM 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 OS on the platform. These systems include 64-bit nation Linux on 2, 4, or 8-way systems. IBM plans to bring cluster support to the pSeries systems in 2003.

In addition to native Linux, IBM 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 integrated application platform. Linux enables clients to consolidate infrastructure workloads with Linux, to integrate and extend OS/400

applications with Linux applications on the same server, and to offer clients application flexibility by adding Linux environments to the existing OS/400, Java, Domino, WebSphere, DB2 UDB, and Windows application suite.

The three leading Linux distributions, Red Hat, SuSE, and Turbolinux, are available for iSeries. SuSE currently offers a 64-bit distribution for iSeries. Turbolinux is planning TLES 8 for iSeries and Red Hat has announced their intention to deliver Red Hat EL AS 3.0. These are both full 64-bit products. 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 can consolidate a number of servers and workloads depending 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. This gives customers 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. One of the advantages of logical partitioning is that processor, memory, and I/O resources can be moved independently between partitions.

iSeries shares resources between OS/400 and Linux partitions. Logical partitioning supports sharing 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 Storage Area Network facilities for the Linux partitions by automatically spreading the data across the iSeries disk drives offering RAID protection, and consolidating backup operations. Virtual storage resources can by dynamically added to Linux partitions. Each of the Linux partitions can also have direct I/O resources.

The iSeries is an integrated system. As a result, Linux gets many integrated system 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 is investing 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. IBM is also working with Solution Providers to deliver new business applications to iSeries customer ranging from email, to commerce, financials, and ERP

solutions. To enable additional business applications, IBM recently announced DB2 UDB and WebSphere for Linux on iSeries.

IBM has several programs to 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 is also including an additional processor in the package for no additional charge to run Linux.

ZSERIES

Linux is now available on the IBM mainframe. This is a significant solution for existing zSeries customers to exploit the Linux application base in a highly scalable and robust environment at 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 are in existing zSeries customers according to industry analysts.

Linux is 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 is most cost effective compared with multiple distributed servers in larger configurations and 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 is the following:

- Obtain new application source
- Demonstrate relevance in growth "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 running 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 Business Partner, LinuxCare, to deliver a system management tool, Levanta, that 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). The Integrated Facility for Linux is a processor that supports Linux workloads exclusively - running in native modes or as guests of z/VM. Since the Integrated Facility for Linux does not support traditional S/390 or zSeries software, processing power for Linux can be added without affecting the charge for traditional software. IFL engines cost a fraction of the price of a traditional engine that runs IBM proprietary software. The value proposition of the IFL is that it gives 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 strategy for Linux 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, integrating the two in a common operating environment. Further, IBM is now offering the IBM eServer zSeries offering for Linux, a packaged offering 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.

An important part of integrating Linux into the on-demand story is IBM Managed Hosting - Linux virtual services. This is targeted at customers with large server farms. IBM is delivering a server consolidation server to help these customers improve their TCO by consolidating distributed server workloads onto IBM zSeries servers running 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 to 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. IBM's

primary software Linux 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.[5] A new version of WebSphere Studio (built on the 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 the 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 ISV's and corporate developers to 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 33000 Developers and created over 4000 solutions. IBM is now adding Linux integration centers for customers to incent corporate developers to exploit Linux. The process the program follows is the following:

- Workshops for IT managers to understand Linux value proposition
- Provide downloadable and on-line development resources
- Provide ISV's with a complete support structure

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

IBM lists over 4600 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. As such, it creates new opportunities. To exploit these Linux opportunities, IGS has fully embraced Linux and made it a strategic offering in its services portfolio - from it Business Consulting Services to IBM's Strategic Outsourcing services. IBM's Global Services provides comprehensive worldwide Linux services that include

[5] Eclipse is covered in more detail in the "Industry Relationships" section above.

infrastructure consulting and planning, installation, configuration, and application enablement. IBM Global Services also provides support consulting and implementation services for Linux. IBM's IGS has over 2500 Linux specialists committed to providing these services.

- Clusters – IGS provides design, integration, and support for Linux high-performance clusters.
- Distributed Enterprise – IGS provides application design and rollout services for distributed retail enterprises.
- Workload Consolidation – targeted to reduce total cost of ownership (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 20 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.

One of IBM's most valuable training tools is the IBM Redbooks – tutorials and how-to guides written by experienced professionals that explain in detail how to install, tune, and operate systems. Anyone considering IBM systems with Linux should download or purchase the appropriate Redbooks. IBM has produced Redbooks on Linux for all the IBM server platforms and middleware. These documents do an outstanding job of leading the Linux planning, installation, and management team through 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 experienced writers.

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 supports other IBM operating environments. IBM supports several distributions of Linux with the same level of technical support it offers other IBM operating systems. IBM provides direct telephone and e-mail help center support for Linux on IA32 in 164 countries, 24x7, with the first 90 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 90 days from the first call to the Help Center.

IBM Global Services provides one-stop prime shift or full shift (24x7) enterprise-level support for its supported Linux distributions – UnitedLinux (Connectiva, SuSE, Sco Group, and Turbolinux) – with either toll-free phone or electronic access. Support embodies both defect and "how-to" support for all eServer platforms, including the eServer 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 – Support Line for the Linux Operating System offers 7x24 Enterprise Level remote support for the Linux operating system environment embracing problem resolution. This includes 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 "What operating system distributions are supported?"
- IBM provides how-to and defect support for the four major distributions of the Linux operating system.
- Standard Coverage – Basic prime shift support includes coverage during normal business hours, Monday through Friday, excluding national holidays. No restrictions are placed on who at the customer's facility 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, 7-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 software support at IBM.

- 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 the same level of value add to Linux that it has applied to its other system environments. This reflects IBM's need for an alternative to Windows and the 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 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 have 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 beyond software products as IBM's Start Now development patterns.
- 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. The result is that IBM has created a substantial volume or 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 (http://www.ibm.com/linux/) is an excellent resource for information regarding IBM, customers, partners, the community, and the industry.

The IBM 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. IBM 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

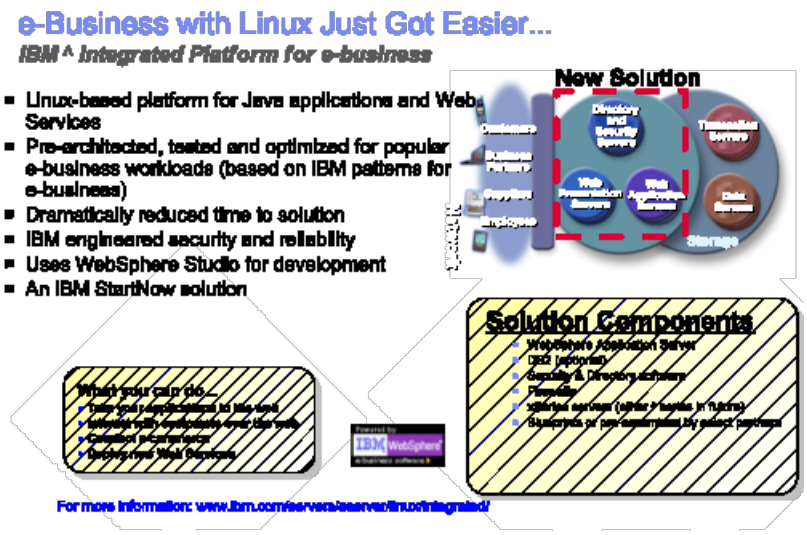
IBM's Linux application offerings have grown from edge servers and enterprise infrastructure applications (e.g., Firewall, Print/File, Web Server, e-mail, technical clusters) to more integrating applications (e.g., SW Development, Database server, Web Hosting, Branch Automation, eCommerce, ERP, small 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 the investments it is making or sponsoring to improve the Linux kernel and the ecosystem around it, IBM views Linux being able to reach the next step and 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, IBM is able to position this full range of applications and solutions across all their 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 IA32 xSeries servers. It delivers high availability solutions using SteelEye, Veritas, and Tivoli. These HA solutions 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 on Linux and also offers a high availability version of mySAP using SteelEye LifeKeeper. IBM is being very aggressive driving ISV and corporate developed applications for their server systems and middleware software. IBM has established low (or no) cost programs to help ISV's 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 their products on IBM's strategic middleware suites and entire eServer 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. It believes that it has a critical mass of these solutions to now target the solution-oriented mid-market with Linux.

For IBM servers that support Linux, Windows, and AIX, IBM is partnering with their ISV's 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 ISV's 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 Business Intelligence, Collaboration, Content Management, e-commerce, infrastructure and infrastructure management, Portal, and Wireless. The following shows the components and benefits of a StartNow solution.



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 versus 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 critical mass needed for IBM.

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 to drive Linux into the enterprise and the datacenter by working through the community to add high-end features to the kernel and soliciting the necessary tools and middleware to support corporate development of Linux applications. Among these are scalability, better IO 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-series servers. This will aid ISVs in leveraging their porting and development efforts to all of IBM's eServer series. IBM will 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. IBM will continue to actively promote Linux, primarily to the mid-market.

IBM will continue to drive packaged solutions on Linux, especially into the mid-market. The 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 IA32, Linux Based Power, and AIX based blades to all 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, & eOneGroup LINUX INSTALLATION

COMPANY OVERVIEW
Company Description
Tommy Hilfiger Corporation, through its subsidiaries, designs, sources and markets men's and women's sportswear, jeanswear and childrenswear 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 has 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 don't 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 don't have access to the other clothing product lines. The resellers need 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 required that any solution had to be integrated with the existing backend 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 web site that would improve their sales relationships with specialty retailers and reduce the cost and improve the flexibility of their manufacturing. Tommy did not do intensive analysis over long period. Rather, they were focused on getting a solution in place as quickly as possible, so they looked at what others in the industry were doing (e.g. Omaha Steaks - 2 million hits a day on Intel servers).

Tommy chose eOne Group, an IBM business partner to help them construct the solution. Linux is the platform of choice for eOne Group - they have 12-14 Linux customers (e.g., Omaha Steaks, YKK (USA), etc.). Tommy selected eOne Group's eOneCommerce product as the technology to drive the web site and integrate with the backend systems. While Linux was an underlying technology and Linux reliability and system cost were important considerations, Tommy was focused on the value that they were 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. They wanted to go to a Java solution because of the disparate systems they have and their view that Java is the Lingua Franka when you want the same code to run across all of them. An important factor for Tommy was their in-house UNIX expertise. They didn't think that Linux would be a major skills impact.

Tommy decided that the eOneCommerce and Linux approach yielded a low cost approach to driving the Tommy Hilfiger website. eOneCommerce is all Java, but is not EJB driven, so it doesn't require a lot 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. It was less expensive doing this on Linux than on the UNIX systems they have installed. Tommy started designing in November, coding in late January, testing in April, and production in May.

Tommy chose to implement the eOneCommerce portal solution from IBM Business Partner eOne Group. Rather than having to support functionality for separate departmental functions, eOneCommerce alone supports the following along with Web services: 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 of these servers run the eOneCommerce portal on Tomcat/Apache, the DB2 database and an HTTP server. The portals run on Linux Red Hat Linux. They are using 2 of the systems for production and the third for test, though the 3rd can be put into production immediately if needed. Performance to date has been satisfactory. Each user is authorized to different application capability. The website systems are closely integrated with all of Tommy's backend systems. Backend wholesale processing is done on an IBM iSeries server. They are running stored procedures directly off the Linux boxes. Almost everything done from the web site touches the iSeries system. For example, the iSeries checks authority in real time, checks browsing to see what items are in stock. When the user goes to an item, the system checks what sizes and colors are in stock, all in real time. The portal connects with back end systems through stored procedures, XML andJDBC connections. eOneConnector provides the system with the capability to replicate data with the DB2 database running on IBM iSeries, as well as Windows NT and HP/9000 servers.

As a result of the Linux installation, Tommy has integrated multiple servers into an integrated system with eOneCommerce playing a key role. Tommy uses Linux for B-B, the HP-UX system for their heavy graphics systems for designers, iSeries for wholesale systems, production orders, customer orders, inventory, etc., and the AIX system for

their retail division - company store and specialty stores. The web site will, in real time, go to a particular system depending on what information it wants to pull back - 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, there was 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 they have achieved the benefits identified in the business case presented to senior executives justifying the project. In particular, it must be notes that the system is delivering outstanding reliability - the system has been up for 2 years with few problems. The system is doing what Tommy expected at the cost point they planned on.

Tommy reports that 50% of the benefit of the system was better relationship and coverage of small specialty retailers and 50% was cost savings in putting technical specifications on-line. The employee portal was opportunistic. The manufacturing portal and access to employee stores will produce a 20 percent reduction in costs and design to product time. The employee store Web site allows employee purchases. It represents an 80 percent reduction in the cost of a physical employee store and improves employee satisfaction.

In its first month, the new Web site added 400 new customers and allows 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, they were able to get executive buy-in to the benefits of reaching the specialty retailers via the web and reducing costs and improved 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 they do things in a methodical, step by step way. For the Linux installation, Tommy used EONEGroup to lead the installation initially to 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 has complete ownership of the Linux environment, applying patches, Apache management, etc. With this kind of planned approach, Tommy believes that they reach their goal of a value producing production system more quickly and with less pain. This is the model that Tommy applies to their all their projects.

WHY IBM and eOne Group

Tommy selected IBM hardware because they have a good feeling for IBM hardware in general and they felt that they wouldn't have any problems running IBM hardware with Linux.

eOne Group comes from an ERP background, so their software is designed to integrate with backend systems, making it very attractive to Tommy Hilfiger and other companies who have significant historical investments in backend applications that they want to continue to exploit. Tommy has been very pleased with the eOne Group relationship. An example of what eOne Group brought to the engagement was the above mentioned ability to get the system up and running quickly and also serve as a mentor to the Tommy team for the eOneCommerce application, Linux, and 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 web-site's functionality. For example, today the QA people in Hong Kong write up inspection reports and fax them to the main office. Tommy plans to let them key inspection results directly into the web site and also let them look at their schedules to see where they are going to be going. 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 web site directly to the imaging system to let customers pull their own invoices, bills of lading, etc. Tommy is also planning to eliminate a T1 line to their bank because customers and suppliers can get on to the web site and can see the status of payments . Similarly, Tommy can charge back to vendors for problems. They plan to image their documents and make those available on the web site as well. They are using Linux because they now have the experience 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 their 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 Linux, eOne Group, and IBM.

Tommy achieved all its objectives in the deployment of their website. They are now able to more effectively reach and support their specialty retailers; they have a faster, lower cost way of sharing critical manufacturing information with their factories; and they were 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, they achieved the business case objectives they promised to senior management and are now receiving requests to expand and extend the web sites capabilities. That, in itself, is a strong vote of confidence in the Tommy IT team.

SUN: TACTICS AND STRATEGIES

OVERVIEW

Sun perceives 2 trends in the IT server industry. At the high end, they see consolidation and the exploitation of 64 bit platforms. Sun believes that they are 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 IA32 servers and the use of Linux to capture that economic advantage. Sun sees a $30B entry server market in network and business services and high performance technical computing. They recognize that there is an increasing focus on low cost computing, low cost solutions, and TCO. All of these are drivers of the open source and Linux phenomenon.

Sun views Linux as another UNIX derivative that is largely compatible with Solaris. However, it recognizes that Linux has become 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. Sun recognizes that Java must have a volume platform to be successful and IA32 with Linux is the only viable option. This is similar to IBM's view that establishing a volume alternative to Windows 2003 and .NET is critical to having a viable software business. In addition, Sun has experienced substantial customer demand for x86 (IA32) offerings and for Linux. Sun appreciates that they must operate in a heterogeneous market. Doing it with a set of compatible Linux offerings is the least disruptive approach.

Sun has made a strategic decision to include Linux on IA32 platforms in the mainstream of its products. It is building consistent business models across Linux and Solaris in terms of how they deliver 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. Sun's strategy is to target Solaris for SPARC, Linux for IA32, and expand the functionality of its Solaris X86 operating environment for Solaris customers who wish to include IA32 servers in their environment. Sun's objective is to deliver Solaris X86 feature/performance parity with Solaris/SPARC. Sun's goal is to deliver a multiplatform 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 and other distributions to be named. Sun is also going to

support Linux applications (Source) on Solaris. Finally, Sun is resurrecting the Solaris on IA32 strategy, providing Solaris customers (and Linux users) the ability to exploit a full UNIX environment on IA32 environments, giving cost focused customers an opportunity to stay with Solaris rather than migrate to Linux. Sun positions its RISC hardware as the strategic 64 bit environment.

Sun's strategy is continuing to position Linux at the low end of solution offerings and attempting to establish Solaris on Intel as an alternative for higher value applications, while preserving the SPARC Solaris value proposition. Sun is attempting to perform the same kind of positioning that IBM and HP did up until two years ago. Both IBM and HP figured out that the task was impossible and thus they have a Linux everywhere strategy. It will be interesting to see the success that Sun experiences. It has an advantage in that there is an existing Solaris for IA32, soon to be as functional as Solaris on SPARC. Neither of the competitors made the investment to move their UNIX to IA32. Also, the others had a broad range of platforms that 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 want 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.

It is important to give Sun its due in supporting and contributing to Linux and open-source, in general. Sun has been an outspoken advocate of a more open systems environment, in general, and has been a driving force for Java which is becoming the standard development environment for Linux systems. Sun has been a supporter of and contributor 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 becoming aggressive in Linux clients, recognizing that there are large business opportunities for client systems that do not require heavy personal productivity applications. Vertical applications have the potential to be a significant market and Linux has an opportunity to be a significant part of that.

Sun's Project Orion software strategy is an interesting development in how Sun 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 includes 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 ISV's to offer competitive elements for those customers who either have existing investments in ISV software or choose ISV

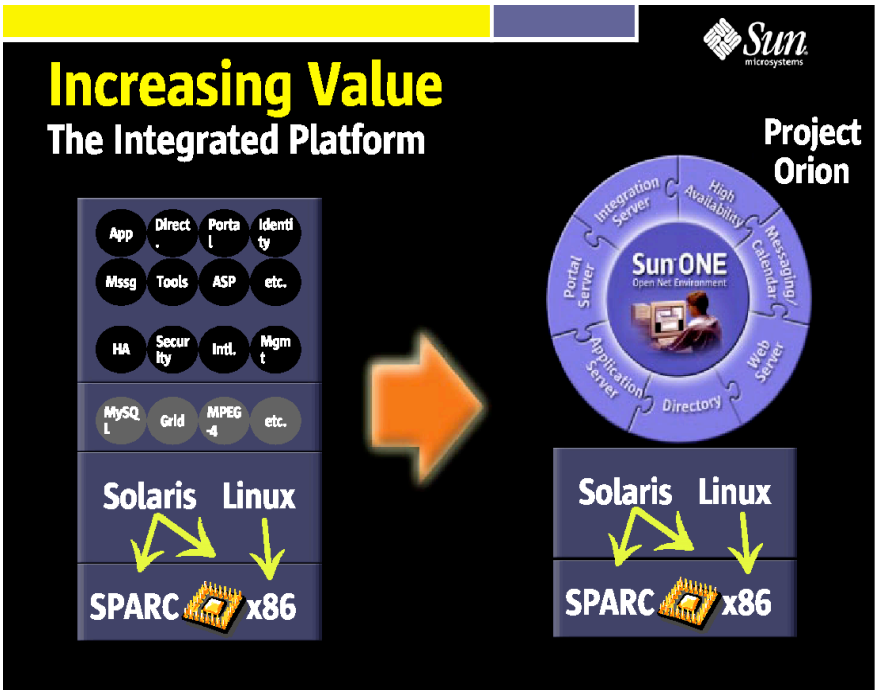
offerings over Sun's prepackaged components. While this is still a concept at this writing, this is likely an attractive solution to Sun's customers who have significant investments in Sun software and hardware.

Sun claims that this will enable them to deliver software on a predictable "software train" that customers can plan on and that will be less complex and more cost effective. This is a similar model to what IBM has been doing for mainframe environments. IBM's large system customers found this approach to be a requirement for their complex systems environments. While we expect the same to be true for Sun's large system customers who have significant Sun software investments, it is unclear how all of this sorts out since the ISV community has dominant positions on many middleware solutions. There is an open question of how interesting this is going to be to ISV's who now have a new competitor and another architecture and set of technologies to exploit. Similarly, there is little information at this time what the Linux stack will look like and how it will be integrated with the Red Hat and United Linux (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 one that further advances the cause of UNIX at large and against Microsoft and its .NET strategy. Project Orion, Sun One, the repositioning of Solaris on IA32, 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 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 is an interesting first foray in the IA32 world. Sun has since announced the V60x and V65x dual processor systems, a blade platform and cluster products that support the x86 environment. Dell will continue to attack at the low end and IBM will be ever present at the high end of IA32 systems. Sun is currently targeting Dell with low cost systems and solutions. This is consistent with Sun's view that Linux and x86 is a low end TCO driven market. The positioning of Solaris IA32 and Linux is a start at addressing that. 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 IA32 market that can't be denied, and it is beginning to move into higher value space. While Sun's positioning of Linux at the low end may address today's volume environments, they also need to articulate a more complete overall product strategy to address what may be an emerging higher end market.

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



INDUSTRY RELATIONSHIPS

Sun is a significant contributor of intellectual property to the Open Source development effort. Included in the organizations that Sun participates are the following:

- 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 is a highly popular open source Java development environment based on the Sun One Studio development environment (or visa-versa).
- the University of Michigan NFS version 4 Linux port.
- the Grid Engine Project

OFFERINGS

Sun currently has multiple offerings in the Linux market - the Cobalt appliance server line, the LX50 IA32 servers, the V60x and V65x servers, and the Sun Fire x86 Blade Server**.** Sun has been shipping its Cobalt product for 4 years. The LX50 and the blade server are 2002 offerings. The blade server offering is important because it is one more example of Sun's recognition that it is operating in a heterogeneous 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 has a vested interest in Java support on high volume platforms. After Windows, Linux is the highest volume server platform in the industry. Sun's Java products for Linux include:

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 a development tools and productivity wizards and templates, 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 is 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 designed for small businesses, departments, or individuals with a network. The Sun Cobalt Qube appliance is 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 is 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

The Sun LX50 is a 1 or 2 processor entry-level server. It 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 is targeted to 32 bit applications. It is supported by both Solaris x86 and Linux. The x86 blade can be part of Sun's heterogeneous blade platform with other blades running Solaris X86 or Solaris/SPARC.

SUN FIRE V60X AND V65X SERVERS

The Sun Fire V60x and Sun Fire V65x are 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 is the low end of the line with 2-PCI-X slots. The V65x is positioned as a 2-way performance server and targets the workgroup server, application server, and database server environments. It is also positioned as being more flexible with 6 PCI-X slots and up to 12GB of SDRAM. Both systems support dual 2.8GHz Xeon processors, a high speed bus, SCSI drives, and integrated 2x Gigabit Ethernet.

SOFTWARE

The new news for Sun in software is Project Orion, 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 is tightly integrated middleware stack on all platforms that 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 notion of a pre-integrated, pre-tested software stack constructed using open source and available on Solaris and Linux is an interesting idea. The thread that holds it together is Java, since that is the primary environment included in the stack. Project Orion could be a differentiator for Sun. At some level it competes with the various Linux advanced server offerings in that they also include (though not in an integrated way) many of these same components. It will be interesting to see it evolve this year.

For several years, Sun has been a contributor to the Linux community, 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 including Sun One Studio for Java, Java 2 Enterprise Edition, and Java 2 Standard Edition (currently beta).

The Blackdown Porting team took the lead porting J2SE to Linux and maintains Java on non-Intel Linux platforms. (For additional information on this effort, please see http://www.blackdown.com/java-linux/aboutus.html.)

Sun's Sun One Studio for Java software is a development environment enabling programmers to build Java applications. It is based on the open-source NetBeans Tools Platform (http://www.netbeans.org/). 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 (http://www.sun.com/software/forte/ffj/) product is offered at no charge and includes a complete and highly integrated set of tools – including 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 includes all the functionality in the Community Edition plus support for teams of developers building database-aware web applications. This edition includes integration with Tomcat (a Java Server Pages 1.1/Servlets 2.2 open source implementation [http://java.sun.com/products/jsp/tomcat/]), and it expands on the functionalities of the web browser and web server in the Community Edition.

Sun's Sun One Studio development environment is based on the open source NetBeans Tool Platform. NetBeans is,

- An open source IDE written in the Java programming language.
- A tools platform into that other tools and functionality can be seamlessly integrated by writing and incorporating modules.
- An application core which 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.

Chili!Soft is also supported on Linux. Chili!Soft is a web development and hosting solution, providing 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 from Sun is 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. 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 from 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 their 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 [http://www.sun.com/storage/highground/]) is a web-based management application providing IT managers with 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 storage area networks (SAN) 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.

SUPPORT AND SERVICES

Sun claims to offer equivalent support across its product line, including Linux. Sun Linux has 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 what other vendors deliver.

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 offers a reasonably complete set of training services targeting Linux. The bulk of these is targeted to the administrator and consists 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 class.

Sun also offers consulting services targeting Linux. While not as broad as IBM's, they are reasonable for the primary customers of Sun's low cost Linux x86 systems. The services include advanced architecture services, implementation and integration services, availability programs, etc.

VALUE ADDED

Sun adds value to Linux primarily through it 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 have built-in compatibility with Linux, so that any Solaris-based system can also run Linux applications. Sun's approach to Solaris Linux compatibility is the following:

- 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)

Sun's iForce partners program for Linux purports to have partners in each of 52 application or industry portfolios. However, a cursory check indicated 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 for Linux. To the extent that there are J2EE specific applications, they are Linux applications as well. Sun is very focused on driving Java volumes. Linux is a high volume platform. This is 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. This will assure that there is little likelihood of the kind of kernel fracture that occurred with UNIX. Sun plans to announce what distributions they plan to support later in 2003.

APPLICATIONS FOCUS

Sun's Linux offerings are targeted primarily as edge servers in 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 Also included are 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 including:

- Sun ONE Studio (formally 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 web site.

FUTURE ACTIVITY

Sun is integrating Linux into the mainstream of its business. It has built Linux edge of network servers, 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 standard ones is of benefit to both Sun and its customers.

Sun ONE will be fully supported on Linux. Sun ONE is Sun's application framework, an industry-leading software and services platform.[6] 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. The Sun ONE 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.

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

APPENDIX: 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 OSS projects.