Linux Strategies and Solutions

Linux Server Suppliers Contend for Leadership

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EXECUTIVE SUMMARY

Linux has become a mainstream operating environment for infrastructure solutions, "edge of network" applications, development platforms, and technical computing. Nearly all platform suppliers across the industry have embraced Linux and have been enhancing and tuning their strategies to meet their customer requirements. However, a few leading system suppliers view Linux as disruptive, developed by the iconoclastic open source process. The danger they see is that the proprietary nature of the server industry will disappear, opening wide new choices to customers. But the open source arena can also open new horizons. Some see Linux as an open enabler of and entrée to new markets such as pervasive computing devices. All of the vendors studied maintain hybrid strategies, offering choice to their customers. With the continued significant investment by all of these major vendors, Linux's evolution and maturity is proceeding at a rapid pace. Indeed, Linux offers the opportunity to drive commodity Intel-based technology server building blocks into the mainstream enterprise IT application space. For example, early adopters are already building significant SAP R/3 and Oracle deployments on Linux. This report reviews the strategies of five leading Linux system suppliers: Compaq, Dell, HP, IBM, and Sun Microsystems.

POSITIONING AND STRATEGIES

Reversing recent history, all of these leading suppliers hold aggressive positions on Linux. Each has built relationships with the leading Linux distribution suppliers or at least the Linux community in the case of Sun Cobalt. Since Linux has enjoyed much of its success in the Internet and networking community, all of the suppliers positioned their Linux offerings initially to address the Internet infrastructure segment, which has grown into the "edge of the network" segment. But Linux acceptance has moved far beyond a single market segment. In 2001, Linux made significant inroads into other market segments including distributed and enterprise custom applications. Several vendors, notably Compaq and IBM, are in hot pursuit of this area. Dell takes a slightly different slant. The champion of PC inventory management has offered both general-purpose servers as well as network edge appliances for some time. Recently Dell has begun to aggressively pursue UNIX-to-Linux migration, high-performance computing, and enterprise

Oracle and SAP R/3 opportunities. HP's focus remains targeted application segments. These solutions include both general purpose and appliance servers. Sun Cobalt offers innovative and tuned appliance solutions.

All of the vendors studied offer Intel-based servers that preload Linux as part of a standard offering, preload it as part of a service, or make Linux available on their Intel servers via their channel. Sun (SPARC/Solaris), IBM (pSeries/AIX), HP (PA-RISC/HP-UX), and Compaq (Alpha/Tru64) provide a UNIX install base and make their UNIXes source compatible with Linux. Beyond Intel-based systems, Compaq backs Linux on its Alpha platform primarily for technical computing. IBM supports Linux on its POWER-based pSeries and iSeries servers and has made a strong, highly visible push with Linux on the mainframe. Sun recently affirmed its support for Linux on SPARC for embedded applications and for significantly expanding its x86-based Cobalt line. All of the vendors are pursuing the server platform business growth that Linux offers. Some use Linux to bring new applications to existing install bases such as IBM's mainframe. Most see Linux as a way to balance power across the industry vis-à-vis Microsoft and keep the server and pervasive client tiers heterogeneous and open, offering customers a choice.

INTEGRATING LINUX INTO CURRENT PRODUCTS

The vendors have done considerable work to incorporate Linux into existing products. HP and IBM have ported most of their middleware products to Linux. Sun supports a significant part of its iPlanet software and Forte tools on Linux and plans to use Linux to support its entire application framework, Sun ONE.[1] All of the vendors offer significant technical support and support services. Also, IBM, HP, and Compaq provide a significant professional services business on Linux. Sun is adding Linux support to its Sun ONE services portfolio.

Alone among major vendors, Microsoft has viewed Linux xenophobically. Yet, despite the hype about Linux competing with Microsoft, Linux is more effectively consolidating and standardizing the UNIX industry. Linux offers a highly customizable software platform that offers a choice of enabling technology and service providers. By contrast, Windows 2000 and Microsoft .NET offers a tightly integrated, high-value software platform. There is competition, but these differences relegate Linux to rivalry with Microsoft primarily for lower value infrastructure solutions. In fact, none of the Linux offerings today compete with Microsoft Windows 2000 Server in terms of integration, ease-of-deployment and built-in capability. Linux lacks a built-in modern component-based runtime environment. The Linux platform suppliers would need to integrate much of a J2EE (Java 2 Enterprise Edition) platform into Linux to bring it to the level of capability of .NET Server. While there are numerous J2EE application servers and development environments available on Linux, only one vendor's

[1] At publication time, Sun announced that its iPlanet and Forte software brands would be folded into the Sun ONE brand. This software was already part of the Sun ONE application framework. For a complete description of Sun ONE see *e-Business Application Frameworks Enter a New Era of Capability and Competition,* D.H. Brown Associates, Inc., February 2002.

deployment offering comes close to competing with .NET Server in terms of price and potential packaging of a modern component-based runtime environment: the HP Application Server 8, which is free. However, HP's application server is a standalone offering and has not been marketed aggressively nor packaged with Linux to date. Sun says, "Linux is about competing with Microsoft, not UNIX." This comment is focused on the high-volume infrastructure and the embedded market. Its Sun ONE application framework, based on J2EE, will be a good start to move Sun's focus into newer Linux solution areas such as application serving. Sun ONE will also compete with .NET for higher value deployments on a high-volume platform, Linux.

COMPAQ HIGHLIGHTS

Compaq's strategy is to fully enable its product and services portfolio for Linux and capture market share in existing Linux strongholds such as web serving. Compaq also aims to be a leader driving new application deployment for Linux such as with SAP R/3, Oracle 9*i*, and Oracle 11i enterprise applications. Compaq's goal for its Linux-based business is to be the leading supplier of platforms, services, and solutions for Linux. In terms of Intel-based server hardware revenue, Compaq offers evidence that *it has achieved this part of the goal from industry sources*. Compaq's strategy may be summarized in these five areas:

- Server (ProLiant and Alpha) and StorageWorks
- Solutions and Middleware (Oracle, SAP, and Open Source Software)
- Open Source Partnerships (PowerCockpit, Covalent, SendMail, etc.)
- Global Services
- Access and Desktop Devices

Compaq has a multi-operating system strategy that includes Tru64 on Alpha, Windows and .NET on Intel platforms, and Linux on both Intel and Alpha. Tru64 is viewed as today's scalable offering for the high-performance Alpha environment. Linux is targeted for service provider solutions, web-enabled access to information, high-performance technical computing, software development, and appliances. These are the greatest growth areas for Linux. Compaq also notes that Linux is moving beyond the edge of the network and into mid-tier and business applications such as distributed databases, Java application servers and mail servers. Compaq's strategy includes working with commercial ISVs (independent software vendors) and partners to offer configured and supported solutions.

If the HP/Compaq merger occurs, Compaq's strategy adds strength to HP's, especially with its market share, clustering technology, and aggressive enterprise application focus. The combined company would present a strong challenge to IBM's Linux strategy and leadership. However, the potential of this challenge depends upon crisp execution and teamwork of the combined companies while minimizing distraction. Beyond its current enterprise focus, Compaq has the

opportunity to work with HP's middleware division to enable a high-volume base for J2EE applications and solidify a leadership position for higher value Linux solutions.

DELL HIGHLIGHTS

Dell's Linux strategy is two-fold: develop the products, partnerships, and services to support customer deployment of 1) UNIX-to-Linux migrations and 2) the Linux-based infrastructure.

Dell focuses on certifying Red Hat Linux and other open source software on its hardware for the high-volume infrastructure market, which includes its Precision workstations and PowerEdge servers, and custom availability on select models of its notebook and desktop systems. Dell's Linux product line also includes server appliances that offer a deploy-out-of-the-box customer experience for some well-defined infrastructure components. These infrastructure solution segments include file/print, directory, networking services, and web servers. This strategy centers on an all-Intel architecture and is based on Dell's well-known high-volume model. In Dell's open letter to customers about Linux, it states, "Dell believes that Linux enables an excellent migration platform for customers with applications previously restricted to proprietary UNIX platforms, such as workstation and Internet applications." For migration to Linux from UNIX and enterprise deployment, Dell supports the Oracle 9*i* database and RAC with plans to expand to 10i. It also tests and integrates its systems for high-performance computing clusters and develops Linux systems management programs and applications. The combination of Dell server hardware and Red Hat Linux has just achieved SAP certification. Further, Dell targets enterprise custom solutions that began on RISC/UNIX for migration. Dell PowerEdge servers are Oracle's development platform for the Oracle 9*i* database and future 10i on Linux. Dell offers Linux services, tailored for a customer's specific requirements, from per incident support to fully customized support packages providing 7x24 support and Linux Consulting Services.

Dell's strategy makes it the likely candidate to establish the leadership position for high-volume, commodity Linux servers. Its focus on aggressive pricing and customer experience from ordering through fulfillment and deployment satisfy these high-priority requirements for most purchasers of these systems. Dell will gain a presence with selected higher value solutions such as Oracle with its current focus. However, Dell does not offer a value proposition equal to Sun's Sun ONE or IBM's e-Business Software Strategy application frameworks for higher value solutions. Dell currently lacks a J2EE strategy and can gain additional opportunity by creating one and acquiring the skills and partnerships necessary to market and support these types of higher value solutions.

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. This framework provides HP's foundation for delivering end-to-end Linux-based solutions for targeted applications. Additionally HP adds value in six "pillars:"

- Managed Linux
- Secure Linux
- Pervasive Linux
- Fast-Ignition Linux
- Clustered Linux
- Standard Linux

In its tripartite operating systems strategy, HP positions Linux as the leading system targeting Telco and Internet infrastructure solutions for enterprises of all sizes. HP offers a range of Linux-based server appliances and is an early leader in blade and carrier grade Linux systems. HP's focus extends to application development. And, it is leveraging its historical strength in technical computing and delivering solutions for design and visualization, as well as clustered computing. HP offers differentiated solutions with key software in security, high availability, management, and telecommunications software. HP's services organization has built a portfolio of consulting and support services to complement its product and solution offerings. HP targets Windows 2000 and Microsoft .NET Server for the high-volume space and small-to-medium business application market and HP-UX as the high-value system for high-end/high-performance application services. In HP's view, Linux does not compete in these segments, but will expand into them over time. The strategy also targets the Itanium platform and includes a common Application Binary Interface (ABI) between HP-UX and Linux on Itanium to enable common applications to run in either operating environment.

HP is in a position to drive J2EE runtime environment ubiquity with its HP Application Server and Linux. However, HP needs to develop its strategy further, particularly with ISVs and other partnerships. The Compaq acquisition presents a great opportunity and install base to advance HP's strong Linux strategy and help HP gain market share with its middleware. As mentioned above, HP and Compaq need to focus on execution and get past the administrative issues and uncertainty of the current pre-merger environment.

IBM HIGHLIGHTS

Linux represents a disruptive technology and development process that IBM recognizes as an opportunity to provide customer choice, keep the server and Internet open and heterogeneous, while enabling IBM's software and services business to offer customized solutions. IBM recognizes the desirability of an alternative high-volume server and pervasive client platform to Microsoft .NET offerings. This is attractive from a customer's viewpoint, a developer and ISV viewpoint, as well as for its own software and services businesses.

IBM has developed a comprehensive Linux strategy including all elements from hardware and software through services and partner programs. IBM supports Linux across all eServer hardware platforms – xSeries (Intel-based), pSeries (RISC UNIX – AIX), iSeries (Integrated Applications – AS/400), and zSeries (Mainframe – S/390 and zArchitecture systems). Moreover, IBM makes much of the IBM software portfolio, including enterprise middleware, available on Linux with key contributions to open source such as the Eclipse development environment foundation. IBM's e-Business Software Strategy (its application framework) is largely supported and is one of the industry's leading enterprise application frameworks.[2] This support enables a wide variety of enterprise applications to be supported on Linux as the operating system matures. Linux has been fully integrated into IBM's Global Services offerings. In addition, IBM is investing in Linux for the embedded market, laptop and desktop clients, as well as server appliances. IBM continues significant investments in the Linux and open source communities through its Linux Technology Center.

In summary, IBM continues to:

- use Linux as an applications source for IBM hardware and software platforms;
- enable and enhance Linux on IBM platforms;
- port and enhance IBM middleware on Linux;
- apply IBM enterprise technology to Linux and support the community to create robustness and scale;
- enhance a services infrastructure around Linux and IBM offerings to add value; and
- create a value net around Linux and open source to rival other value nets such as those surrounding Windows and Solaris.

IBM's Linux strategy is very strong in most key areas studied. Indeed, IBM has been instrumental in enabling and driving the Linux market to its present success. IBM already understands the value of Linux and open source in setting standards and offering choice to customers, enabling its middleware and services business new growth opportunities. IBM's Eclipse and Apache strategies are prime

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

examples of how open source can be leveraged to attract developers and gain market share, though it is still early to judge Eclipse. Given the current J2EE market structure, D.H. Brown Associates, Inc. (DHBA) does not expect IBM to take the lead in leveraging Linux to drive runtime J2EE ubiquity. Its WebSphere product is a high-priced, high-value solution as well as a current market leader. However, IBM's position is exposed if ISVs begin to build and pre-require lower priced J2EE platforms, leaving IBM and BEA battling it out for custom IT developers. This is an area IBM needs to monitor carefully and where it may have to move quickly.

SUN HIGHLIGHTS

From Linux's earliest days in the public spotlight Sun has seen an opportunity to expand UNIX's market presence in general and against Microsoft in particular. Linux presents an opportunity to proliferate UNIX-like programming interfaces and applications enabling a greater pool of talent and applications for UNIX at large. Given this, Sun has been a supporter of and contributor to certain Linux and open source projects such as OpenOffice, an open-source Microsoft Office competitor, which it purchased, and GNOME, the object-oriented Windows-like user interface for Linux and now several UNIXes.

In 2000, Sun completed its acquisition of Cobalt Networks, a leading appliance server company that based its offerings on Linux and x86 processors. During 2001, Sun continued with Cobalt's appliance product line and integrated the company into Sun.

Realizing that the "edge of network" application segment of the server market was one of the fastest growing and that this growth was enabled on Linux, Sun announced a significant expansion of its Linux strategy to include a broader x86-based server line targeting general purpose Linux opportunities as well as supporting its application framework – Sun ONE – on Linux. Aggressive marketing and product delivery is needed to capture mind- and market share in the general purpose Linux server space. Further, Sun will need a crisp positioning strategy with Linux and Solaris. For example, Sun ONE offers much more than edge computing. It is primarily focused on enterprise application enablement and deployment – ISVs, custom IT development, integrators, and other partners.

Sun positioned its Linux strategy as one that further advances the cause of UNIX at large and against Microsoft and its .NET strategy. Sun is in the process of filling in the details of its Linux plan and strategy to build on its existing Linux business as well as to compete with Microsoft .NET. Sun will offer its own Linux distribution, Sun Linux, supported on its new x86 hardware line and as part of Sun ONE. Beyond this, DHBA believes that Sun can play a leadership role proliferating J2EE in conjunction with Linux. This can take many forms, one of which would be to open source a J2EE runtime. Or at least to open source the Java servlet and EJB containers. A separate form is to offer a high-volume, competitively priced package on Linux to compete with Microsoft Windows 2000

and .NET Server. Sun has not announced any intentions with respect to open source J2EE on Linux. However, it is porting the remainder of its Sun ONE software stack, including its J2EE application server, to its version of Linux, Sun Linux 1.0. Sun is expected to port and support key Sun ONE software to other Linux distributions, notably Red Hat.

Sun needs to further refine and develop its Linux strategy and positioning with Solaris. In particular, what is Sun's strategy to compete with Dell for high-volume commodity Linux sales? Its current model is not competitive. However, DHBA gives Sun a lot of credit for the value of the Sun ONE application framework, which could give Sun a strong position for higher value Linux solutions. But, this will require delicate positioning with Solaris with perhaps a more aggressive Linux stance, especially for "mid-tier" solutions. DHBA believes Sun's Solaris-based business can retain differentiation and offer value for larger scale enterprise solutions for the foreseeable future, e.g., UNIX "mainframes," as well as offer value above and beyond Linux to midrange and lower-end customers for selected deployments.

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EVALUATING THE VENDOR STRATEGIES

The five vendors' strategies are evaluated for differentiation and/or leadership in several key areas. An "XX" in a column indicates that the vendor has significant differentiation or leadership in that criterion. An "X" in a column indicates an "honorable mention" for 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

	Compaq	Dell	HP	IBM	Sun
Broad Strategy	XX			XX	
Focused Strategy		XX	XX[3]		XX

This criterion describes how Linux fits within the overall product line, focus, and visibility in the Linux market. DHBA notes two different strategies, neither being better than the other:

- 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.

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

- 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.

All of the companies have a significant Linux strategy. Some, like Sun, announced recent expansions, while others, such as IBM, have had a strategy in place for a few years.

Within this framework IBM and Compaq have broad strategies and are aggressively pursuing new market segments with Linux such as ERP (enterprise resource planning), other business logic applications, and distributed enterprise applications.

HP's Linux commitment and strategy is significant as well. However, it focuses on a set of market segments where Linux is strongest and adds value in those areas: the "edge of network" applications, technical computing, application development, and visualization. HP gets credit for the clearest communication of its strategy to the industry and customers. It does this with three themes: 1) Linux target segments, 2) HP focus areas and value added, and 3) customer solution development and deployment scenarios.

Dell and Sun are focused on "edge of network" applications, primarily. However, Dell maintains a strong relationship with Oracle and will be expanding its list of target segments for Linux including high-performance computing in the near term. Sun will expand its strategy significantly to include general-purpose servers with new application segments beyond the edge of the network to be determined.

IBM had scored the greatest and most surprising Linux and open-source success story in 2001 with mainframe Linux. This achievement manifested itself particularly with infrastructure server consolidation projects mostly within existing mainframe customers, but IBM gained new customers as well. The experience generated a debate by competitors on the benefits of such a move. IBM's ongoing success verifies benefits at least for certain customers. This success has been so stunning and visible that it has overwhelmed IBM's marketing efforts in other areas of its Linux strategy, particularly its Intel-based Linux servers. This outcome positions IBM as a Linux mainframe company while competitors such as Compaq, Dell, and HP have established visible Intel-based Linux programs where most of the Linux market remains and will remain in the future.

PRODUCT LINE BREADTH

TABLE 2: Product Line Breadth Assessment

Compaq	Dell	HP	IBM	Sun
X		X	XX	

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. These products range from server appliances to datacenter consolidation servers for infrastructure workloads.

Compaq earns an honorable mention for its breadth across Alpha and Intel systems as well as its iPAQ and handheld initiatives.

HP rates an honorable mention as well for its push into server appliances, server blades, and carrier-grade Linux servers, as well as leading 3D workstation support. Further, HP is driving Linux into embedded with HP Chai and other products and initiatives.

Dell offers Linux across its server, storage, and client product lines, as well as dedicated network appliances. Sun will be expanding its x86-based server line for Linux as well.

SYSTEM PRICING

TABLE 3: System Pricing Assessment

Compaq	Dell	HP	IBM	Sun
	XX		X	

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

Dell takes the overall lead on system pricing and includes its Customer Factory Integration services, which offer customized preloads of Red Hat Linux. IBM has competitive system pricing and offers preload and other services for a fee above the system price.

VALUE ADDED

TABLE 4: Value-Added Categories and Assessment

	Compaq	Dell	HP	IBM	Sun
Customer Experience		XX			
Appliance			X		X
Hardware Differentiation			XX	XX	
Software Portfolio	X (cluster)		XX	XX	X
Migration Services		XX	X	XX	
Partnerships – Open Source Solutions Companies	XX				

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 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 Cobalt's appliances reveal a unique look and feel, a strong brand, and a customized Linux operating environment, the Cobalt operating system, which is tuned for specific appliance applications.

Key HP appliances earning it differentiation in this emerging market include the print server appliance; the smart meter appliance, part of HP's utility pricing usage plans; Apache-based blade web hosting solution; and software enhancements with its ASIK technology. The Application Specific Integration Kit (ASIK) builds upon a custom Linux distribution and provides a common set of services for OEM partners to add value and ease application deployment.

HP established a leadership strategy with significant differentiation in breadth and depth of support for it Intel-based systems including rack, tower, blade, appliance and 64-bit platforms. And HP supports its storage products aggressively as well as its printers including all-in-one devices for Linux.

IBM has developed significant hardware value added. This includes xSeries X-architecture reliability features spanning Light Path Diagnostics, Predictive Failure Analysis, and an Advanced System Management processor. All come configured with a network interface capability and CD-ROM. 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.

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 successful SP2 cluster software offering. 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.

Compaq differentiates itself through its breadth and depth of cluster offerings including Beowulf, SteelEye, and its own clustering technology.

HP is bringing most of its software portfolio over to Linux and has some interesting offerings for security, high availability, management, embedded, and Telco. Further, HP is in a strong position to significantly expand the J2EE platform's penetration since the HP Application Server is free. The HP Application Server is the only J2EE platform supported by a major vendor that is free. Combined with Linux, the HP Application Server offers a unique price/value point in the industry for J2EE application deployment.

Sun has announced its intent to support the Sun ONE application framework including its software portfolio and services on Linux, and it already supports a lot of Sun ONE software today including iPlanet Directory and Web Servers and Forte. Sun ONE software is and will be supported on both the forthcoming Sun Linux 1.0 distribution and others such as Red Hat. Sun ONE is among the industry's strongest application frameworks in several areas such as a total system approach, solution lifecycle support, and development methodologies.[4]

Dell is targeting all UNIX-based solutions that can be supported on Linux for migration. It 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 to Linux.

All of the vendors studied possess strong partnerships and community relationships. However, DHBA singles out Compaq due to its relationships with leading open source solution-based companies such as Covalent (Apache) and SendMail.

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

SERVICES AND SUPPORT

TABLE 5: Services and Support Assessment

Compaq	Dell	HP	IBM	Sun
		XX	XX	

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.

APPLICATIONS FOCUS

TABLE 6: Applications Evaluation

Compaq	Dell	HP	IBM	Sun
XX	X	X	XX	

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

IBM's strategy calls for expanding the application base on Linux and establishes IBM as a leader enabling that transition for ISVs. In 2002, IBM continues its investments in key targeted industry segments such as the Financial Services, Communications, Distribution, Industrial, and Public sectors. 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.

The Compaq focus hits key enterprise applications such as Oracle9*i* database-based custom solutions. Compaq is also driving Oracle 11i enterprise application sales to early adopters of Linux in the enterprise. Further, Compaq appears to be the leader in SAP R/3 Linux-based solutions with a significant number of large enterprises with hundreds of SAP Linux servers deployed. In addition, Compaq is targeting the migration of UNIX-based custom applications in the finance and banking, Telco, oil and gas, and pharmaceutical segments. Compaq appears the most aggressive in pursuing enterprise Linux application opportunities and relationships.

HP finishes a differentiated set of targeted solution offerings in many specialty segments where such open source benefits as customization are apparent. These solutions include Telco, Internet, and other networking applications. HP has built a significant partner program around its industry standard blade architecture. HP's

technical market focus includes partnerships in digital content creation, electronic design and automation, and scientific computing. Further, the free HP Application Server puts HP in the unique position of offering a modern, component-based (Java, EJB) free runtime software platform to ISVs based on Linux. HP has the opportunity to increase its marketing around this J2EE platform to gain share. HP is working with selected leading enterprise applications including Oracle and SAP R/3.

Dell's application focus is aimed at enterprise adoption of Linux. Dell believes that Linux will be a replacement for all UNIX and developed a staged application segment focus starting with Oracle database applications. For commercial customers, Dell has adopted the Oracle9*i* database platform, both single node and RAC clusters. Further, Dell is beginning the process of building a significant Linux-based ISV portfolio, recently adding SAP R/3 for example. Oracle will focus on Oracle 11i enterprise applications next. For technical computing, Dell's high-performance computing initiative is based around Linux. Additionally, Dell's strategic alliance with Cray provides enterprise-level solutions for key vertical target markets.

LINUX COMMUNITY LEADERSHIP

TABLE 7:
Linux Community Leadership Assessment

Compaq	Dell	HP	IBM	Sun
		XX	XX	X

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

IBM employs the largest contingent of open source programmers and projects as evidenced by the breadth of activity of its Linux Technology Center. 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 help proliferate those standards. IBM is also contributing mainframe enabler technology to the Linux kernel and source base.

HP has dramatically increased its focus on open source and has enlisted Bruce Perens, open source leader and co-founder of the Open Source Institute, for ongoing strategic advice. 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, secure Linux, 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.

Sun faces an opportunity to catapult its Linux and open source leadership by open sourcing J2EE. This would provide the open source platform with a modern component model development and runtime platform that could be integrated into Linux, offering a compelling story against Microsoft .NET's server component model and platform. Further, Sun could increase the attractiveness of its iPlanet application server software vis-à-vis BEA WebLogic and IBM WebSphere. But, Sun has not announced a plan for this.

Compaq and Dell reveal more focused community participation and contribution. Compaq's initiatives include handhelds, clustering, and the kernel. Dell focuses on IHVs (independent hardware vendors) and open-source device drivers.

CROSS-PLATFORM COMPETITIVE COMPARISONS

COMPETITIVE LANDSCAPE

All of the leading system suppliers – Compaq, Dell, HP, IBM, and Sun – have announced and now ship Linux offerings. They also embrace open source solutions (OSS). Their offerings range from embedded systems to client systems, through entry-level server appliances for the commercial market to high-end clusters targeting technical computing. These suppliers offer Linux through a variety of channels, and they preload and customize to meet their customers' demands. As a result of this widespread industry support, Linux has moved from being an industry curiosity and stealth movement several years ago to a mainstream business for major vendors.

These leading system suppliers have integrated Linux and open source into their offerings and their business models. This report examines their strategies for Linux and open source from the perspective of defining their Linux positioning; evaluating how they deliver; reviewing how they add value in support, software, and services; looking at what solutions they focus on and which enablers are supported; and assessing how they integrate their Linux and open source offerings into their existing product environments. The report considers their positioning and commitment to Linux and OSS, product line depth, system pricing, value added, support, applications focus, and Linux community leadership. (For a review of the methodology and a list of criteria, please see the Appendix.)

Linux's current success remains clearly in servers including server appliances. Hence, this forms the primary area of consideration. Nonetheless, the study identifies where these system suppliers invest in Linux clients and related areas.[5]

While the suppliers are well established with significant Linux and non-Linux offerings, all must integrate their Linux offerings into broader installed product bases. As Linux and open source are very quick moving environments, all of these system suppliers are working to respond with continuous updates. This report reflects their strategies and offerings through the first quarter of 2002.

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 Sun. Sun is building on the customized, standards-based Cobalt operating system and will offer the Sun Linux 1.0 distribution with its x86 servers. All of the vendors are represented on the various industry committees (e.g., Linux International). Where relevant, they have committed to providing Linux-compatible services or APIs (application

[5] This report surveys the key server suppliers and their Linux positioning, offerings, and support. For a detailed technical comparison of Linux distributions versus proprietary UNIX offerings, please see *2001 Linux Function Review,* D.H. Brown Associates, Inc., September 2001.

programming interfaces) or have Linux running natively on their legacy system environments.

They differ, however, in their commitment to Linux and open source; in their market success with Linux; in their level of investment in Linux and open source offerings; in their strategies; and in the level of solution enablement, support, and integration they offer.

Note that Linux is part of the open source community. At some level, the supplier offerings must be very much alike in terms of operating system content. Indeed, 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 is adding Linux support for its entire Sun ONE application framework as well. The entire business model of Sun's Cobalt division depends on Linux and open source. Dell brings its well-known efficiencies of operation and direct model to the Linux market. Compaq supports Linux across its Intel and Alpha server lines. The level of compatibility and integration into their existing system environments and the level of their contributions to the open source community may make a difference in terms of their time-to-market with advanced offerings, the fullness of integration for system management, skills and community contacts for technical support, and the ultimate customer benefit.

OPEN SOURCE MOMENTUM

Linux and the open source movement have created a significant change in the marketplace. According to industry estimates, Linux has over 20 million users worldwide, is now second in market share in the *server operating system* market and among the greater-than-30% of the web servers that reside outside the firewall. The Netcraft survey of Internet servers (www.netcraft.com/survey) supports this analysis. Linux remains the fastest growing server operating system and 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, especially for "edge of network" infrastructures. With continued improvements, Linux is becoming a force in the distributed and custom application space and is maturing to support more and more traditional UNIX enterprise 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 few high-quality productivity applications, virtually no mainstream office or home native applications, and market domination by

Microsoft in a mature market. These issues continue to be worked by various open source projects such as WINE (WINdows Emulator). The primary reasons for vendor investment in Linux desktop software relate to the needs of developers and system managers and administrators.

Linux has gained considerable strength in non-desktop clients such as kiosks, PDAs, embedded devices and others. These devices typically do not require Microsoft Office, other PC-based 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. Linux offers the benefits of standardization and customization without royalty fees to the copyright holder. This latter statement is important when one considers the price and profit margins of some of these devices. Most of the consumer electronic and other platform manufacturers understand that Microsoft and, to a lesser extent, Intel collected significant monopoly profit premiums from their positions. These manufacturers are not willing to let the same happen for these emerging, pervasive computing markets.

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	Compaq	Dell	HP	IBM	Sun
Targeted Markets	• Enterprise • Edge of Network • Internet Infrastructure • Service Providers • Technical/Scientific	• Selected Enterprise • Edge of Network • Internet Infrastructure • Service Providers • Technical/ Scientific • Telco • Technical/ Scientific • Digital Content Creation • Electronic Design • Mechanical Design and Simulation • Application Development	• Edge of Network • Internet infrastructure • Service Providers • Telco • Technical/ Scientific • Digital Content Creation • Electronic Design • Mechanical Design and Simulation • Application Development • Selected Enterprise	• Enterprise • Server Consolidation • Edge of Network • Internet Infrastructure • Service Providers • Technical/ Scientific • Application Development	• Edge of Network • Appliances • Internet Infrastructure • Application Development • Service Providers
Channels	• Direct Sales • Web-Direct • Indirect Channel/ VAR	• 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	Yes – Red Hat	Yes	Yes	Yes – Embedded

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

Linux System Supplier	Compaq	Dell	HP	IBM	Sun
Offerings – Server Platforms, Appliances, Clients, Personal Appliances	• Supports Red Hat, SuSE, Turbolinux, and Caldera on ProLiant and appliance servers • Supports Red Hat on Alpha server • Supports Linux on workstations and selected desktop clients • Supports iPAQ • Supports Linux on IPF (Intel Processor Family)	• Supports Red Hat 7.x on all PowerEdge tower and rack servers and PowerEdge appliances • Supports Linux on Precision workstations • Support Custom Factory Installation for desktop clients	• 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 • VMWare supported on selected IA-32 servers • Supports Linux on all HP business PCs, workstations, and 3D workstations • Has a Linux port on PA-RISC hardware • Appliances • Linux on IPF workstations and servers	• Supports Red Hat, SuSE, Caldera, and Turbolinux on xSeries Intel servers and selected clients • Preloads Red Hat for fee on xSeries • SuSE on pSeries • VMWare supported on selected xSeries models • Red Hat and Turbolinux on one pSeries model • Red Hat, SuSE, and Turbolinux on iSeries • SuSE and Turbolinux support on zSeries; Red Hat announced • Appliances • Supports Linux on IPF	• Builds custom, appliance focused distribution from standard Linux source • Plans for Sun Linux 1.0 to be developed for x86 general purpose servers • Embedded

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

Linux System Supplier	Compaq	Dell	HP	IBM	Sun
Modifying Proprietary UNIX to Support Linux	• No • 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	• 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	• 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 Forte
Porting Linux to RISC	• Alpha	• N/A	• PA-RISC	• POWER, S/390, zSeries	• To SPARC for embedded market
Shipping Middleware on Linux	• Available through services	• Available through Custom Factory Integration, Dellware	• HP Secure Operating System • Web JetAdmin • OpenView • TopsTools • Service Control Manager and PRM • Rapid Deployment • MC/ServiceGuard • Internet Usage Manager • Opencall SS7 • Netaction Suite (Application and Message Server; Process Manager Interactive; Web Services) • Storage Management • Disaster Recovery Storage Software • OpenMail support (now licensed through Samsung)	• DB/2 • Lotus • Tivoli • WebSphere • Most of IBM's e-Business Software stack	• 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	• Yes • Embedded application tools	• No	• Yes • Chai platform for embedded applications • IPF SDK	• Yes • IBM UNIX development tools • WebSphere Studio • Visual Age for Java	• Yes • Forte • LinCAT • ABI Check • JXTA

TABLE 11: Supplier Summary – Support

Linux System Supplier	Compaq	Dell	HP	IBM	Sun
Operating System Preload	• Preload Red Hat 7.x and Caldera • Preload as a service for ProLiant Intel servers or user installed	• Factory preload for Red Hat 7.x with CFI or user installed	• Factory preload for IA-32 servers • Preinstalled by the channel • Fully integrated and preload on HP VISUALIZE 3D Linux workstations	• Red Hat preloaded by IBM for a fee on xSeries • User Installed • Preinstalled by channel • Other distributions downloaded or installed in channel (p, i, and xSeries) or on CD (zSeries)	• Cobalt operating system preloaded and customized for appliance function • Sun Linux (future)
Application/ Middleware Preload	• Active Answers solutions	• PowerEdge Web Server appliance • DellPlus services	• Custom integration services available • Appliance bundles	• Specific solutions – Domino • X135 web hosting appliance	• Appliance specific
Product Support	• Worldwide, provided by Compaq, partnering with the distributions • Professional services for consulting, install, Internet security, availability assessment, and training services	• Worldwide, provided by Dell and Red Hat for all Dell platforms • Electronic support • Customer mailing lists • Professional services for design validation, installing, tuning, configuration, technical consulting, and benchmarking, etc.	• Worldwide, provided by HP (and partners in back end) for multiple vendor platforms and multiple distributions • Customer education • Electronic support • Phone-in assistance • Installation and integration services • Proactive services • High-availability services • Professional services in design, security, migration, and 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	• Worldwide, provided by Sun • Electronic and community support • Appliance-oriented support – warranty and "Spare-in-the-Air"
Platforms Supported	• Intel • RISC (Alpha) • StrongArm (handheld)	• Intel	• Intel • RISC (limited)	• Intel • RISC (Power) • S/390 (and zArchitecture)	• x86 • RISC (embedded)
Distribution Supported	• Red Hat, SuSE, Caldera, Turbolinux	• Red Hat	• Red Hat, Debian, SuSE, Caldera, Turbolinux • Commercial desktops also support Mandrake	• Red Hat, SuSE, Caldera, Turbolinux	• Cobalt operating system • Sun Linux (future)
Linux Training	• Yes	• Yes	• Yes – • Web-based • Classroom	• Yes – • Web-based • Classroom	• Yes – • Web-based • Self • Classroom

TABLE 12: Supplier Summary – Community Participation

Linux System Supplier	Compaq	Dell	HP	IBM	Sun
Contribute Open Source Operating System Code to Linux	• Device drivers, GNOME • Linux port for handhelds (iPAQ) • SMP, NUMA, scaling support, and benchmarking contributions • Compiler technology	• Device drivers • IPF	• Device drivers, printing, all-in-one drivers, Debian, GNOME, tape drivers • Trusted / Secure Linux • IPF kernel maintainer • Gelato – technical computing • SCSI driver work • 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	• Device drivers, X Internationalization Framework, GNOME, NFS, ABI Check, scalable type technology
Contribute Open Source Application and Middleware	• IProbe • Em86 • Jumpstart for Alpha	• Linux management software	• Apache • Large scale modeling software • Squid • Samba • Chai embedded application server • Intelligent mobile device software	• Apache • Eclipse • Samba • Tool Box for Java • Web Services	• StarOffice • JXTA • Mozilla • Netbeans • Apache • Gridware • WEBM services
Open Source Development Lab (OSDL) Member	• No – evaluating	• Yes	• Yes	• Yes	• No – evaluating
Community Investments/ Leadership/ Key Relationships	• Red Hat – investor • Turbolinux – investor • Free Standards Group • Handhelds.org • SendMail • Covalent • SteelEye • SuSE (NUMA, Alpha)	• Red Hat – investor • Linuxcare – investor • VMWare • CollabNet • IHVs • Free Standards Group	• CollabNet investor • Red Hat – through pension fund • Lutris – investor • SteelEye – investor • Aduva investor • Free Standards Group • Linux International	• Red Hat – investor • DeveloperWorks • Free Standards Group • Linux International	• Linux International • X.org • OpenOffice.org • CollabNet • Free Standards Group • BigADMIN • Linuxcare • Caldera • Lineo • Timesys

LINUX PLATFORM OFFERINGS

COMPAQ

Compaq has gradually expanded its hardware support for Linux from its early roots on the Alpha RISC platform to its ProLiant Intel-based servers, selected Evo desktops, notebooks and workstations, ProLiant caching appliance servers, and even on the iPAQ handheld device. Compaq is offering customers a preload option on its ProLiant DL320, ProLiant DL360, ProLiant ML330 and ProLiant ML350 servers. Instead of preloading an operating system, Compaq ships its servers ready to run Linux or any other operating system customers may choose. The exception is the ProLiant caching appliance and the CheckPoint Solution Paq that comes with the operating system preloaded.

Compaq recently announced its first blade offering (ProLiant BL10e) with support for the Red Hat Linux distribution with SuSE support coming imminently. With a strong set of features, the blade servers are an ideal platform for Linux deployment in high-density, rack-optimized environments, and particularly front-end type applications. The list of supported storage controllers, both Fibre Channel (FC) and SCSI, Gigabit Ethernet adapters, and graphics adapters has also continually grown. On the system management front, Compaq offers management agents that run on ProLiant servers operating Linux and supports remote management with its Remote Insight Lights-Out board.

Compaq has extended its breadth of clustering solutions to include Beowulf for ProLiant servers. With partnership agreements with Scyld, Turbogenomics and Scientific Computing Associates, Compaq offers preconfigured, tested, and performance-optimized high-performance Linux clustering solutions as well as a turnkey Beowulf solution from Compaq Custom Systems Group. Compaq continues to broaden its high-availability Linux cluster solutions with the SteelEye alliance, recently announcing a DL380-G2 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, and SendMail Integrated Mail Suite (IMS) for e-mail messaging. Compaq has also worked with Hyperion to certify its Essbase online analytical processing (OLAP) tool on ProLiant DL380, DL580, and DL760 servers and supports VMWare software for Linux server consolidation.

For small and medium businesses, Compaq 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.

Compaq supports the Red Hat, and SuSE Linux distributions on its Intel-based servers, and offers some regional support depending on the geographies. Linux support for Compaq's Alpha-based systems (DS and ES series) continues with Red Hat and SuSE. Compaq is currently beta testing Linux on the high-end GS series, but has not announced any definitive plans for certification.

DELL

Dell has been offering a factory installation option for Red Hat Linux on its entire range of PowerEdge general-purpose servers, PowerEdge appliance servers, and Precision workstations for over two years. Dell is expected to announce Linux support for its "Blade" product line at the time of its introduction. Additional client products are supported through its Custom Factory Integration service. The support for storage controllers, Ethernet adapters and graphics cards has also been quite strong. Dell also provides the ability to factory install via Custom Factory Integration, (CFI) a customer-provided Linux image along with configuration information, thereby considerably reducing the burden customers feel in tackling the set up of these systems themselves and increasing time to production incrementally. The recently announced OpenManage Server Administrator allows management[6] of PowerEdge servers running Linux either directly at the server or remotely through a browser interface. Remote management for the PowerEdge servers is provided through the Remote Access Card along with OpenManage IT Assistant (requires a Windows-based console).

Realizing the growing importance of Linux in the HPC (high-performance computing) market, Dell recently announced its own set of integrated HPC products, 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. Cray will also provide service and support for the installations. This move by Dell is expected to change the price/performance dynamics in this segment.

Dell has also taken some key initiatives in bringing Linux into the database market with certified and preloaded Oracle9*i* database and Oracle9*i* Real Application Cluster (RAC) configurations on PowerEdge servers. The database configuration includes a single node PowerEdge 6400 server with the Oracle and Red Hat Linux software and Silver level support. The Oracle9*i* RAC consists of two to four PowerEdge 6450 nodes, a server clustering starter kit, the Dell/EMC FC4700 SAN (Storage Area Network) solution, and the associated network and FC switches. In both the offerings, customers have the flexibility to configure the system to their choice, with certain limitations. Among other offerings, Dell has certified its selected rack servers to implement SAP solutions on Linux. Dell underscores its commitment to SAP solutions on Linux in the enterprise, for

[6] Support for disk array information reporting , firmware, and BIOS updates is not available in version 1.

example, with dedicated technical and engineering resources as part of the SAP Linux Lab development team at SAP headquarters in Walldorf, Germany.

Dell has standardized its Linux offerings on the Red Hat Linux distribution for the standard factory installation option. It will install a custom configured Linux distribution through its CFI process. Dell provides its own services for Linux including Linux business consulting through its Dell Technology Consulting group. Their services include customized engagements, application solution centers to validate and tune solutions, as well as design validation and customized approaches including Dell Custom Integration.

HP

HP's Linux operating system support spans its entire product line of Intel architecture (IA-32 and IA-64) based servers including its Blade (bc1100) servers, appliances, desktops, and workstations. HP now offers the option to preinstall Linux on its new IA-32 servers. HP workstations running Linux have been on the market for over two years. Also, users can now configure HP systems to meet their requirements and gain more flexibility than previously available. It is the first amongst leading OEMs to offer carrier-grade Linux servers (ccx300) designed specifically for the Telco market with NEBS compliance and AC/DC power supply options. HP also maintains an ambitious blade offering built around the Compact PCI standard with a new NEBS compliance chassis, which chose Linux as the first deployment operating system. It has been one of the first OEMs to offer its own Linux drivers for its graphics cards and now fully supports the Linux drivers on its entire range of graphics cards, one of the most expansive sets of graphics cards supporting Linux in the industry. The Linux support on HP's PA-RISC architecture is still in preliminary stages. Given its processor strategy, HP reveals 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.

Supporting its system strategy, HP has ported a broad portfolio of software tools to the Linux environment, from CPU resource management (Process Resource Manager) to overall system management. HP provides agents that run on Linux servers feeding information to its TopTools, ServiceControl Manager, and OpenView for a comprehensive management framework. This includes HP's full storage management suite for its XP and VA disk arrays. It has also developed a secure open systems software stack for Linux built upon Red Hat Linux to create a secure Linux kernel.

HP has ported its MC/ServiceGuard high-availability software to run on Linux. With this software, HP offers high availability Linux clustering solutions. For high-performance compute clusters, HP has partnered with MSC.Software to offer turnkey solutions based on HP hardware for that market. MSC.Software has created its own Linux distribution – MSC.Linux – optimized to run HPC applications (computational fluid dynamics, crash simulation, etc.)

In another Linux-related development, HP has brought over its Opencall SS7 software, specific to the telecommunications market. An SDK is available now with deployment capabilities to be supported at the end of 2002. Also supported is HP's Internet Usage Manager.

The HP utility datacenter with the utility controller software provides a turnkey offering for datacenter customers wishing to deploy multiple racks of servers running Linux (or other operating systems), storage, and networking gear. Along with the Blade announcement, HP offered three new Linux-based blade solutions preconfigured, optimized, and tested for web hosting (Apache software), web caching (Inktomi Traffic Server), and media streaming (RealNetworks RealServer) applications. HP also offers 20 other server appliance configurations in the "traditional" one- and two-CPU server appliances including web hosting, caching, print server, document router, traffic manager, load balancing, and more.

HP is the only leading player supporting five major Linux distributions including Caldera, Debian, Red Hat, SuSE, and Turbolinux. The preload option is typically Red Hat Linux. HP also offers Mandrake for its commercial desktops.

IBM

Linux support from IBM encompasses its entire eServer product family comprising the Intel-based xSeries servers, the iSeries integrated servers, pSeries RISC servers, and the zSeries mainframes. Most models within the eServer line support Linux. Linux support has been available as well on the low-end pSeries (formerly known as RS/6000) servers for over a year, and was recently added to the new generation of pSeries servers including p610, p620, and p660. IBM has announced plans to support Linux on the POWER4 hardware, currently available as a technology preview on the p690. On the IBM iSeries, up to 31 Linux partitions are supported. Linux on the zSeries is supported in native mode, LPAR, and as z/VM guests giving flexibility to create hundreds of Linux images on a single system. IBM recently announced its first Linux-only mainframe, the IBM zSeries offering for Linux, which includes z800 server hardware, virtualization through z/VM, and maintenance for the hardware and software for three years. IBM does not offer a preload option on any of its servers except in certain packages. It does offer help on Linux installation, however, and support both through its services organization and IBM Help Centers.

IBM has ported its portfolio of software tools, including middleware, application development, and database to Linux. Key software solutions including DB2 Universal Database, WebSphere, MQSeries, Lotus Domino messaging and collaboration, and the Tivoli product suite are all supported on Linux. For the xSeries, the IBM Director allows installation and administration of multiple Linux images and runs natively on the server.

IBM also provides numerous precertified, integrated packages bundling the operating system and application into a cost-effective solution. The IBM Small

Business Suite for Linux assembles the best of IBM software with website design and integration tools, the IBM Start Now Solutions for Linux feature infrastructure, CRM and host integration solutions to exploit e-business opportunities. Beyond that IBM offers dozens of other solution packages tested and certified for the Linux platform on several of its hardware offerings.

The list of ISV applications certified on IBM hardware running Linux has been growing consistently. With extensive partnerships with software vendors and business partners, IBM currently references over 2,400 enterprise-level applications for Linux on the eServer platforms. IBM recently announced a partnership with VMWare to provide the latter's virtual machine software on the xSeries hardware.

Recently IBM made its first official entry into the high-performance Linux clustering market with the Cluster 1300 package. It is a fully tested and preconfigured solution built upon the xSeries hardware and Red Hat Linux distribution. IBM offers its own set of cluster management tools, the Cluster Systems Management (CSM) software for Linux based on the tried-and-proven IBM Parallel System Support Program (PSSP) for AIX. CSM provides comprehensive cluster installation, administration, and remote management capabilities through a single point of control. Other components available in this product include the Global Parallel File System (GPFS) for Linux, a shared disk file system that can be configured for availability, and IBM's FastT FC-based storage disk arrays.

IBM supports Caldera, Red Hat, SuSE, and Turbolinux distributions.

SUN

Sun gained entry into the Linux market through its Cobalt acquisition, incorporating four years of experience shipping Linux-based systems into the company. Currently, the only server products offered by Sun are from its Cobalt product line of appliance servers offering integrated solutions for web hosting, caching, and a personal/departmental appliance, all running the Linux operating system. However, Sun has been contributing to the Linux community and offering Linux supporting software for a few years now. 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 Forte for Java, and Java 2 Standard Edition. The Sun StorEdge T3 enterprise disk array is also supported on Linux with device drivers from Linuxcare. Beyond this, Sun offers the Sun Cobalt Control Station for remote management, system management, and service provisioning. There is also BlueLinQ for patch management; the server desktop for user, application, and server management; and Sun's packet management system with the *.pkg* installer format.

Sun recently announced that it fully intends to catch up to the rest of the players in its Linux offerings at least for the front-end type applications. These are currently served by thin form factor-based servers including blades. Among its plans, Sun will ship a full implementation of Linux on new x86-based general-purpose servers capable of running thousands of Linux applications natively. Other initiatives by Sun to boost its Linux offerings include agreement with Lineo to support its embedded Linux operating system on the UltraSPARC IIe processor currently supported on its Sun Blade 100 workstation, Netra T200, and Netra X1 servers.

SuSE, Debian, Mandrake, and Red Hat do offer development versions of Linux on UltraSPARC. SuSE and Debian offer production level distributions as well.

TABLE 13: IA-32 Server Compatibility Matrix

	Compaq	Dell	HP	IBM	Sun
Processor Speed	900 MHz Xeon	900 MHz Xeon	900 MHz Xeon	900 MHz Xeon	1 GHz Pentium III
No. of CPUs Supported	Up to 8 CPUs	Up to 8 CPUs	Up to 8 CPUs	Up to 8 CPUs	1 CPU only
Cluster	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster Offerings **HA:** • Partnership with SteelEye	**Building Blocks:** • Yes **HPC:** • Partnership with Cray for Beowulf Clusters • Partnership with Cray for high-end and sophisticated HPC deployments **HA:** • Certified with Steel Eye	**Building Blocks:** • Yes **HPC:** • Partnership with MSC.Software for Beowulf-like Clusters **HA:** • HP MC/ ServiceGuard • Also certifying with Polyserve	**Building Blocks:** • Yes **HPC:** • Beowulf Cluster Offerings • CSM management software **HA:** • No	**Building Blocks:** • No **HPC:** • No **HA:** • No
Memory*	Up to 16 GB	Up to 32 GB	Up to 16 GB	Up to 32 GB	Up to 1 GB
Management Tools	**Installation:** • SmartStart (manual only) **System Management:** • Insight Manager agents only **Remote Management:** • Remote Lights-Out Edition	**Installation:** • OpenManage Server Assistant **System Management:** • OpenManage Server Administrator **Remote Management:** • Remote Access Card	**Installation:** • Installation Navigator **System Management:** • TopTools agents • Service Control Manager **Remote Management:** • Remote Assistant	**Installation:** • ServerGuide • Remote Deployment Manager **System Management:** • IBM Director Agents **Remote Management:** • Remote Supervisor Adapter	**Installation:** **System Management:** **Remote Management:**

* Linux supports up to 64 GB memory on IA-64 hardware.

SYSTEM PRICING: COMPARISON OF ENTRY AND CONFIGURED PRICES

All the system suppliers offer a full range of Intel system server offerings, from entry to high-end 8-way SMP systems. The configurations below are priced independently of the operating system. The table below represents estimated street 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.[7]

TABLE 14: Examples of Linux System Pricing as of April 15, 2002

	Compaq	Dell	HP	IBM	Sun
Appliance • 1U Web Hosting	**$1,799** • TaskSmart W2200 • *933 MHz PIII,* • *128 MB RAM,* • *20 GB IDE*	**$1,986** • PowerEdge Web 1650 • *1.13 GHz PIII,* • *256 MB RAM,* • *18 GB SCSI*	**$1,789** • HP Server Appliances a1120 • *750 MHz PIII,* • *256 MB RAM,* • *9 GB SCSI*	• **$2,029** • xSeries 135 • *1,000 MHz PIII,* • *256 MB RAM,* • *18 GB IDE*	• **$2,999** • Cobalt RaQ XTR • *850 MHz PIII,* • *12 MB RAM,* • *30 GB IDE*
Entry Rack System • 1x1.26 GHz PIII • 512 MB • 36 GB disk	**$3,251** • ProLiant DL360	**$2,420** • PowerEdge1650	**$3,407** • HP Server lp1000r	**$2,523** • xSeries 330	N/A
Midrange System • 2x1.26 GHz PIII • 2 GB • 72 GB disk	**$8,453** • ProLiant DL380	**$5,716** • PowerEdge 2550	**$9,158** • HP Server lp2000r	**$6,399** • xSeries 342	N/A
High-End System • 4x700 MHz/2 MB Xeon • 4 GB • 72 GB disk • Hot-plug • RAID 1	**$22,069** • ProLiant DL580	**$18,420** • PowerEdge 6450	**$25,897** • HP Server lt6000r	**$20,498** • xSeries 350	N/A

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

COMPAQ: TACTICS AND STRATEGIES

OVERVIEW

Compaq's Linux-based business goal is to be the leading supplier of Linux platforms, services, and solutions. In terms of Intel-based server hardware revenue, Compaq's website offers evidence that it has achieved this part of the goal. Compaq's strategy consists of focus in these five areas:

- Server (ProLiant and Alpha) and StorageWorks
- Solutions and Middleware (Oracle, SAP, and Open Source Software)
- Open Source Partnerships (PowerCockpit, Covalent, SendMail, etc.)
- Global Services
- Access and Desktop Devices

Compaq runs with a multi-operating-system strategy that includes Tru64 on Alpha, Windows and .NET on Intel platforms, and Linux on both Intel and Alpha. Tru64 is viewed as today's scalable offering for the high-performance Alpha environment. Linux is targeted for service provider solutions, web-enabled access to information, high-performance technical computing, software development, and appliances. These are the areas where Linux has enjoyed the greatest growth. In addition, Compaq observes that Linux is moving beyond the edge of the network and into mid-tier and business applications such as distributed databases, Java application servers, and mail servers. Compaq's strategy covers working with commercial ISVs and partners to offer configured and supported solutions.

Typical of technology suppliers, Compaq views operating system usage as a customer specific decision: What is the customer (or channel) capable of? Do they know UNIX? Is open significant? It is important to remember that Linux is not necessarily appropriate for all environments, e.g., a multi-threading level is needed for databases. This opens an opportunity for the existing proprietary UNIX systems: Fix what is worth fixing. A part of Compaq's strategy is to provide integrated Tru64/Linux deployment with common tools, shared data, and common interfaces, yielding a sense of family between the operating environments. Basing this commonality on open source standards and involving the Linux community heightens the attraction of Compaq offerings.

In its strategy Compaq offers a complete and robust set of Linux offerings ranging from desktops and workstations, through ProLiant industry-standard (Intel) servers to Alpha servers and Alpha clusters. To accomplish this, Compaq has partnered with two of the leading Linux distributions – Red Hat and SuSE. Available throughout the product line is worldwide 24x7 Linux services and support. Compaq reached a significant decision in making Alpha visible to the Linux community and has gained success, particularly in the high-performance technical computing segment.

Compaq states its value proposition for Linux as the following:

- Retain leadership in Linux platforms, solutions, and services.
- Strong collaborations with the top Linux vendors and developers.
- Leadership in design and support of heterogeneous IT environments.
- Global 24x7 call center support.

Compaq has been a charter member of Linux International since 1995 and has had several programs in place to support Linux developers on both ProLiant and Alpha servers on most of the major distributions. It has also created certification programs for its resellers to be more aggressive with Linux. Compaq knows what accounts for its differentiation from the other system suppliers: Its focus on system management, the intrinsic design of its offerings, full service and support and the partnerships with leading ISVs like Oracle, SAP, and Veritas.

Compaq has successfully leveraged its leadership and Intel-based server brand image into a leadership position in the Linux market. Compaq's broad Linux strategy aggressively pursues new areas such as ERP with SAP on Linux. Beyond having strong channels and technical capabilities, Compaq also leverages its software product position, which does not include a software stack that competes with key ISVs such as Oracle and BEA systems. This gains a favorable position with sales forces and marketing efforts in those firms. Compaq focuses on ISVs and maintains relationships with leading open source companies such as Covalent and SendMail to further strengthen its marketing and support position.

INDUSTRY RELATIONSHIPS

Of particular note, Compaq has been an active participant in collaborations with the Linux and open source community and enjoys alliances with the major distributions – Red Hat and SuSE. Compaq also retains a relationship with Caldera for its Volution Management product and Turbolinux for its PowerCockpit product. Beyond these relationships, Compaq is linked with Linuxcare to support the CSA ISV application development and porting to Compaq platforms. It has also invested in Red Hat and SuSE.

Compaq has also taken the following steps:

- Partnered with the ISV community – Oracle, SAP, and others – to deliver commercial Linux offerings to its resellers.
  - Improve application availability on Compaq Linux platforms by providing the new Testdrive facility to the Linux community. Testdrive is an online service that provides free access to Compaq Linux systems for testing – functional, not performance – applications. Performance testing is available for Compaq Solutions Alliance members.
- Partnered with Linux ISVs and service providers – such as SendMail and Covalent – to establish channels and support for leading Linux open source infrastructure solutions on ProLiant servers.

- Generation Linux is a free program for Linux developers to help get applications optimized for Compaq Servers.
- Established a relationship with Mitel to market a small and medium-sized business server platform.
- Partnered with SuSE to develop Linux for Alpha servers including partitioning with Tru64 and NUMA support, which are under development.
- With its strategic partner, SteelEye Technology, Compaq offers the Linux clusters for ProLiant solution suite. Compaq and SteelEye now include IA-32 and IA-64 ProLiant servers and the newly announced DL380G2 Packaged Cluster as well as extends the StorageWorks content to include the MA8000 Enterprise Storage Subsystem.
- Compaq 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.
- The Testdrive site adds new versions as they become available, as well as new applications.
  - These systems include two- and four-way Alpha and ProLiant systems and eight-way ProLiant systems.
  - Compaq created the Compaq Solutions Alliance to support ISVs, VARs, or system integrators who want to benchmark or evaluate their applications on an Alpha server.
  - Compaq has an agreement with Linuxcare to provide free Linux technical support for CSA members.
- Additional examples of Compaq activity in the Linux and open source community include,
  - Compaq is a charter member of the GNOME foundation with the goal of advancing the availability of this easy-to-use, open source, desktop environment.
  - Compaq is a charter member of the Open Software Developers Network (OSDN), an industry-wide organization. This is Compaq's relationship with a large-scale open-source community service provider – SourceForge. Compaq sponsors the clustering open source foundry, and hosts its internally developed open source projects at SourceForge.
  - Compaq ported Linux to the iPAQ Pocket PC, and sponsors the HandHeld.org open source project to foster innovation on handheld devices.
  - Compaq assigned engineers to kernel development, benchmarking and optimization, and other areas to improve Linux and open source solutions.
  - Compaq released its single-system image clustering technology to open source as well as many other projects including the Solaris to Linux Threads porting libraries.

- Compaq made its compiler technology available to the open source community.
- Compaq is a charter member of the Free Standards Group and an active participant in the LSB (Linux Standard Base) specification.

OFFERINGS

Compaq approaches Linux offerings aggressively. It supports much of its product line on Linux. The following is a summary of Compaq's Linux offerings:

- For Intel systems, Compaq supports Linux across its ProLiant Intel server family, including up to eight-way SMP servers, selected Evo and iPaq personal computers and Professional and Evo Workstations.
- Compaq offers a server appliance that runs Linux. The TaskSmart C4000 is optimized for caching web content and live and on-demand distribution of streaming media. The TaskSmart C4000 (http://www.compaq.com/tasksmart/c4000/index.html) comes with the Linux operating system pre-installed and Inktomi Traffic Server and Media IXT on select models.
- For Alpha systems, Compaq supports Linux on Alpha servers and workstations. New features in Red Hat Linux 7.1 include the Linux 2.4 kernel, support of up to 64 GB of RAM, and files up to 16 TB. Other enhancements include improved security and XFree86 4.0.3.
- For Alpha systems, Compaq also supports running Linux binary applications under Tru64, and Tru64 binaries on Linux for true Linux to UNIX peer-to-peer application sharing.
- Compaq also provides storage support for Linux with its StorageWorks external controllers for both ProLiant and Alpha that includes support for entry-level SAN support for ProLiant and FC.
- Compaq services will preload and preconfigure Linux on any of the Compaq platforms. Compaq will preload Red Hat Linux on select ProLiant ML and ProLiant DL models.
- Compaq has added the ProLiant management features to the ProLiant Linux environment.
- A 64-bit Java 2 SDK and the Informix Dynamic Server on Alpha systems are available.
- Alpha Linux is a major offering in the high-performance technical computing environment that uses Beowulf clustering.
- Support for its ProLiant Intel-based server for technical computing Beowulf clusters that include support for Red Hat and SuSE are also on the market.
- Compaq provides services for custom systems, supporting customers in assembling complex, multi-node, multi-architecture (ProLiant and Alpha), and high-performance systems. This includes customized Beowulf cluster implementations.

CUSTOMER SUCCESS STORIES

Among those case studies with proven success with Compaq is Standard School District, which received a significant grant from the Federal E-rate program to update its aging network infrastructure. Recalling its past history with Compaq servers including a nearly four year, no downtime run, it chose Compaq as its server provider for the upgrade. The plan included connecting every classroom and office to provide e-mail, Internet access, and other services. Originally a Novell and Microsoft NT customer, one of the goals of the upgrade was to move to Linux. The IT manager especially liked that the school district received straight answers to technical questions without a marketing spin. The solution included nine Compaq ProLiant MLS30R servers running Red Hat Linux, Compaq SmartStart for deployment, and Compaq Global Services for systems support. The school district saved nearly $20,000 on software licensing fees as well.

SuSE Linux announced the implementation of mySAP.com on "SuSE Linux Enterprise Server" at the SuSE Nuremberg headquarters. SuSE Linux AG utilizes four Compaq ProLiant series machines as the server platform for the central mySAP.com installation; two Compaq ProLiant DL580 systems for the SAP R/3 installation and the SAP DB installation; and two Compaq ProLiant ML530 systems as development and test servers. Besides the evaluation of the company's processes and the subsequent customizing of the SAP R/3 modules, the consolidation of comprehensive master data was a major milestone of SuSE's SAP project.

SUPPORT AND SERVICES

Compaq's support strategy calls for full support on behalf of the Red Hat and SuSE distributions and routes more advanced defect issues to the distributions. Compaq can offer from four hours response time to 24x7 support with someone on site at the customer location. Compaq provides call center services for Red Hat and SuSE on ProLiant servers. Non-distribution specific issues are routed to Compaq for handling. Compaq offers remedial telephone support for the Red Hat and SuSE distributions of Linux on both Compaq Alpha and Intel-based servers. Telephone software support, as well as assistance in getting code updates, is available 9x5 (8:00 a.m. – 5:00 p.m., local time), Monday – Friday, with an option to increase coverage to 24x7 worldwide. Compaq offers a granular-service model where service is available in ten-incident call packs through Compaq Authorized Service Resellers and directly from Compaq.

Hardware support is available 24x7 with a two-hour maximum response on a system or desktop running Linux. In addition, Compaq offers a complete line of services directly and in partnership with the distributions.

Beyond defect support, Compaq offers a number of security, availability, and startup support services for Linux:

- Hardware Installation and Start-Up – Hardware configuration, staging, installation, and startup support services.
- Hardware Maintenance Support Services – Onsite and off-site preventive and remedial hardware support services.
- Internet Security Healthcheck – An assessment of Internet and intranet security, including communications services, operating systems, applications, and routers.
- Availability Review – An analysis of downtime risks throughout the IT environment, including comparison of current state to availability goals.

Compaq also provides Linux training electronically or in the classroom through agreements with Learning Tree and others.

The Accreditation System Engineering (ASE) program is a certification and training program to ensure that there are identifiable systems engineers with appropriate skills to support Compaq Linux systems. ASE is Compaq's highest level designation. The candidates for this designation are Compaq resellers, consultants, integration specialists, and information management professionals. These are people responsible for sales, support, planning, and optimization of Compaq systems. Compaq has also extended its existing Windows program to Linux.

Services in the following areas are provided as well:

- Infrastructure
- Enterprise Applications
- Performance and Availability
- Outsourcing and Managed Services
- Industry Focused

Compaq maintains strong relationships with SendMail and Covalent to offer mail and web infrastructure solutions and services.

Migration services from any UNIX to Linux are an additional Compaq services offering.

VALUE ADDED

In addition to the professional services listed above, Compaq invests in Linux engineering. These include,

- Linux kernel developers,
- compiler and porting expertise for Linux,
- benchmarking and optimization experience, and
- solutions architectures (active answers).

One of Compaq's offerings is a Server Health driver providing a system-monitoring utility to deliver operational data to improve the availability and performance of ProLiant servers.

In a community-based action, Compaq has contributed its device drivers to the industry as well as other infrastructure software.

Value-added differentiation in Compaq platforms includes,

- A Multi-Function Small Enterprise Linux-Based Server comes with a subscription to ServiceLink, an integrated suite of system-management services delivered from the Mitel Networks NOC providing security and reliability. ServiceLink offers virus protection, IPSEC VPNs, guaranteed e-mail delivery, 24x7 monitoring, and DNS configuration.
- 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.
- The Compaq Management Agents (CMA) provide the instrumentation to enable fault, performance, and configuration management on Compaq ProLiant servers. Beyond providing server-level administration capability and predictive management, the CMA 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.

BEOWULF CLUSTERING

The Compaq Custom Systems and Solutions (CSS) group offers Linux building-block platforms, factory integrated, and preloaded with the Linux distribution of one's choice. These building blocks include a variety of Alpha and Intel platforms or a combination of the two. A choice of options, such as high-performance System Area Networking equipment like Myrinet (http://www.myri.com/), from Myricom, Inc., and external SCSI or FC RAID storage, creates a supercomputer Linux Beowulf cluster.

The Compaq Cluster Management Utility (CMU) is Compaq's management value-added to Beowulf. CMU offers a graphical user interface (GUI) for administration and supervision. In addition, the cloning utility helps to propagate system configurations to compute nodes.

HIGH AVAILABILITY

SteelEye's LifeKeeper for Linux Clusters is a high-availability application and data cluster solution supported on Compaq ProLiant servers and StorageWorks storage systems. It provides two to 16 node application and data fault-resilience. The ProLiant servers and storage combine with SteelEye Technology's LifeKeeper for Linux software and a choice of several leading Linux distributions. Compaq has fully tested and certified LifeKeeper for Linux on ProLiant for optimal performance on Red Hat, SuSE, and Caldera eServer. Compaq and SteelEye have developed a Single Point of Contact (SPOC) for one-stop service and support offerings from Compaq Global Services to minimize solution integration and operations issues. Compaq 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.

APPLICATIONS FOCUS

In light of Linux's move into the application and solutions space beyond Internet infrastructure, Compaq has chosen industry segments. These segments typically possess numerous custom, in-house UNIX-based applications and look to Linux to provide a lower cost and standard deployment platform. These segments are,

- Finance and Banking
- Telco
- Oil and Gas
- Pharmaceuticals

Further, Compaq is focused on these enterprise solutions:

- Mail and messaging – Compaq 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 Oracle11i.
- Business continuity and security covers several offerings including the CheckPoint Solution Paq.
- High availability for the "edge of network" applications through its partnership with SteelEye.
- Application servers including SAP and Hyperion.
- UNIX to Linux migration.

Compaq has created Active Answers, prestructured solutions encompassing a set of tools and solutions to support rapid deployment. These 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, and
- Internet infrastructure.

The Compaq Solutions Alliance and its free Testdrive service along with Compaq's porting centers target ISVs.

FUTURE ACTIVITY

With the HP/Compaq merger poised to move ahead, Compaq is working with HP to integrate their strategies, offerings, and teams. If the merger is well implemented, the new company will have a strong strategy (including differentiation and leadership in key areas), a solid team, and customer base to build on.

DELL: TACTICS AND STRATEGIES

OVERVIEW

Dell's overall strategy encompasses Linux. Dell's stated objective is to "help customers standardize and simplify enterprise deployments." This strategy centers on an all-Intel architecture and is based on Dell's well-known high-volume model. In its open letter to customers about Linux, Dell says that it, "believes that Linux enables an excellent migration platform for customers with applications previously restricted to proprietary UNIX platforms, such as workstation and Internet applications." Dell selected Linux and a standard Intel-based architecture as its primary offering into the UNIX environment. This represents Dell's first commitment in that space.

Dell's Linux strategy is two-fold: Capture a leading share of 1) UNIX-to-Linux migrations and 2) the Linux-based infrastructure. Dell focuses on certifying Linux and other open source software on its hardware for the high-volume infrastructure market that includes server appliances. These infrastructure solution segments span file/print, directory, networking services, and web servers. To capture migration to Linux from UNIX, Dell supports the Oracle9*i* database and RAC, as well as high-performance computing and Linux systems management programs and applications. Further, Dell targets for migration enterprise custom solutions that began on RISC/UNIX.

In addition, Dell employs Linux internally in its manufacturing operations and to manage the installation of customers' system images. This usage has the potential to yield Linux improvements based on Dell's high-volume experience. 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 customers.

By leveraging the Dell brand, the company is well positioned in its share of the worldwide Linux market. Dell's Linux shipments have increased by 100% on a year-over-year basis and now account for 12% of its server sales. Dell's focus on the customer purchase and deployment experience is top notch, especially its Customer Factory Integration process, which is unique in the industry. Like Compaq, Dell lacks a software stack and can form deep relationships with leading middleware ISVs such as Oracle and BEA Systems. With a tighter focus and raised visibility, Dell could make a strong run for the Intel-based Linux leadership crown.

INDUSTRY RELATIONSHIPS

Dell's stated goal is to "speed commercial acceptance and adoption of Linux and to provide one source for Linux solutions." In this vein, Dell has partnered with Red Hat in the One Source Alliance. In this arrangement, Red Hat and Dell agree

to use each other's products internally. Red Hat will use Dell as its primary development and certification platform and Dell will use Red Hat Linux in its manufacturing operations. According to Dell, this positioning provides a time-to-market advantage in offering the latest versions of Red Hat Linux.

In addition, Dell and Red Hat focus on the following:

- collaborative development of products,
- codevelopment and delivery of Red Hat-certified enterprise-ready global-service offerings and solutions,
- codevelopment of tools and test suites for open source,
- promoting the adoption of Linux,
- offering services and solutions,
- driving future technology innovations to support Internet infrastructure needs, and
- work jointly on Oracle deployments.

In the global market, Dell has formed other partnerships to support Linux. Dell has partnered with Asian market leader Turbolinux to provide a choice of Linux operating systems in the fast-growing markets of China and Hong Kong. (Dell monitors Red Flag Linux's adoption in China.) Dell has an informal relationship with SuSE for the European market as well.

Dell has also bolstered its Linux role by partnering with Linuxcare for certification and system support.[8] Linuxcare, Inc. provides support and certification for the Red Hat Linux operating system running on selected Precision WorkStations, OptiPlex business desktop PCs, Latitude notebooks, Dimension desktop PCs, and Inspiron notebooks. A subset of these Dell systems is also supported with other Linux distributions from Linuxcare. This agreement was recently renewed and Dell's client customers offered a choice between Dell support backed by Red Hat or Linuxcare. All of Dell's entire server line provides customers the choice of different support levels within Dell's Premier Enterprise Support Services.

In February 2002, Cray Inc. and Dell announced an agreement for Cray to market high-performance cluster solutions and services based on Linux using Dell PowerEdge servers worldwide. This agreement strengthens Dell's existing participation in the high-performance computing market by giving Dell access to skills, channels, and marketing support targeted to this segment.

[8] See http://dell.linuxcare.com/ for a complete list of support offerings and Dell systems supported.

DELL AND THE LINUX COMMUNITY

Dell has sharpened its focus on contributing to the open source community from which it draws Linux and other infrastructure software. In addition to supporting Linux on many of its systems, Dell:

- Is a 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.
- Is a 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.
- Is a member of the The Open Cluster Group, an informal consortium of commercial and research organizations involved with cluster computing.
- Has engineers actively participating 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 such as aacraid, megaraid, and acenic.
- 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.

Dell supports Linux development financially through Dell Ventures, its venture capital organization. Dell has invested in Linux companies such as Red Hat, Turbolinux, Linuxcare, and Collab.net. As with the other system suppliers, Dell recognizes that it needs to be active in this community of leading companies.

OFFERINGS

Linux is available on Dell servers, workstations, and selected client offerings. It is easy to order through the web with the same user interface other operating systems employ. Dell does separate the Linux offerings from Windows and Netware. Red Hat Linux 7.2 (and future versions, Advanced Server for example) is factory installed on Dell servers and desktops. Dell's website makes selecting, configuring, and ordering Intel-Linux servers quick and largely error resistant for rack-mounted and desk/floor models. Dell supports Linux on Intel systems up to eight-way SMP. In addition, Dell has built its PowerEdge web server line on a Linux base. Dell solutions are primarily hardware and operating systems. However, Dell offers Linux design, migration, hosting, high-availability, and solution-development services. Backing up all of these developments, Dell's systems are aggressively priced.

Dell is also developing standards-based modular servers, ideal for Linux-based applications. Dell recently launched a blade server offering, which includes a 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 appliances, known as PowerEdge Appliance Server Products. Using Red Hat Linux 7.2, these systems 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.

CUSTOMER SUCCESS STORIES

Compagnie Générale de Géophysique (CGG), a leading supplier of services and products to the worldwide oil and gas industry, is upgrading its Houston processing center with 384 Dell servers running the Red Hat Linux operating system. CGG chose Dell because it included the right mix of services (such as CFI) at a very attractive price.

Toyota chose Dell and its PowerEdge web server to provide a small footprint hardware solution that allows web caching to be customized for large file delivery. Dell and Toyota designed the customized solution, which was delivered through Dell's Custom Factory Integration process, a key value added for Toyota.

The Federal Aviation Air Traffic Control System Command Center in Herndon, Virginia – the FAA center that managers air traffic control throughout the United States – decided to manage its operational data with a network featuring Dell back-end servers and workstations and Oracle9*i* Real Application Clusters Certified Configuration for Dell, all running on Red Hat Linux.

Bang Networks offers real time web content delivery to businesses. Bang's infrastructure includes a new class of network routing devices that maintain global

knowledge of network operations and traffic flow, enabling it to optimize traffic on a real-time basis. These applications take advantage of Linux's customizability for tuning and performance. Further, Bang chose Dell for its aggressive pricing, the Dell/Red Hat One Source Alliance, and operational excellence.

SUPPORT AND SERVICES

The Dell/Red Hat partnership provides support for Linux on Dell platforms. 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. This is beyond the normal Dell support. Other areas of support include,

- timely operating system certification,
- Apache web server validation,
- OpenManage support,
- premier Dell customer support for Linux, and
- Linux Professional Services, delivered by Dell's own Dell Technical Consultancy (DTC) or via managed partnerships.

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).
- *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.

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

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:

- Oracle (and SAP)
- EMC
- High-Performance Computing
- Custom Applications
- UNIX to Linux Migration

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 plans to continue to advance Linux as an alternative to the combination of proprietary RISC/UNIX, from any of the RISC system vendors, while also promoting volume adoption for infrastructure deployment. As the market develops, Dell believes that Linux will follow the same adoption curve into the enterprise created by UNIX, but at a faster rate. To support this adoption, Dell will focus on building out facets of its UNIX-to-Linux migration program. Focus points for the program will be:

- high-availability configurations for business continuity,
- data mart and warehousing tools,
- security packages, and
- application consolidation programs for older UNIX applications.

HP: TACTICS AND STRATEGIES

OVERVIEW

HP was among the early Linux supporters, but its support was not visible until more recently. As Linux gained a higher profile, HP upgraded its Linux strategy with active marketing and support. It created a Linux Systems Operation and hired a recognized open source leader and strategist, Bruce Perens. Since then, HP has expanded its Linux and open source commitment dramatically.

HP has incorporated Linux as one of its three strategic operating systems for its Intel x86 and Itanium systems. With Windows and HP-UX, this trio provides complete solutions to customers and more closely builds partner-product relationships. This support includes HP's complete IA-32 and Itanium server family, all models of HP business PCs, and the 3D Linux graphics workstations.

HP's software commitment is equally strong. HP has ported its manageability, high availability, quality of service, Telco, and security software to Linux. In addition, HP made its printer drivers available on Linux to the open source community and continues to evaluate its middleware portfolio, looking for open source candidates where it makes business sense.

In its tripartite operating systems strategy, HP positions Linux as the leading system targeting e-commerce, infrastructure, and web serving for enterprises of all sizes. Linux-based server appliances for Internet applications and application development are key usage segments. Additionally, Linux is positioned for visual and technical computing solutions. HP targets Windows 2000 and Microsoft .NET Server for the high-volume space and small/medium business application market and HP-UX as the high-value system for high-end/high-performance application services. In HP's view, Linux may move into those segments over time, but it is not yet ready for this market. The strategy also targets the Itanium platform and includes a common Application Binary Interface (ABI) between HP-UX and Linux on Itanium to enable common applications to run in either operating environment.

A key strategy is to enable 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 permits HP to harness the growing Linux development community to create new applications that can run on the HP-UX install base. HP has delivered toolkits for Linux compatibility and porting including a Linux Porting Guide and Support Services, Open Source Developers Toolkit, and Linux Software Transition Kit that enable development on Linux and deployment across Linux and HP-UX. To accomplish this, HP will support Linux APIs on HP-UX. The overall objective is to allow a customer to start with Linux and grow into the higher value PA-RISC UNIX systems. HP's focus is the

Linux Standards Base (LSB) – the emerging standard interfaces for Linux (and UNIX) development.

The HP-UX enterprise experience is coming to bear on Linux with a focused strategy and added value on segments where Linux is already strong, such emerging areas like 3D. HP is putting these components together in a manner that IT professionals can understand – directly related to issues they are trying to solve. HP should gain further market share if it raises the visibility of its efforts, especially to its target audiences and then back to the industry at large. A real opportunity awaits HP: To offer a leadership Java runtime system that is affordable with Linux. (In fact, HP is only beginning to market the free HP Application Server to relevant ISV and channel audiences.)

INDUSTRY RELATIONSHIPS

HP has partnered with five of the leading Linux distributions – Red Hat, Debian, Caldera, SuSE, and Turbolinux – to satisfy customer demand and to reach the worldwide market**.** For business PCs, HP also supports Mandrake.

HP supports Linuxcare strongly, using it to certify all of its servers and desktop offerings on the various Linux distributions and to deliver drivers for these products. As stated above, Linuxcare is involved with the port to PA-RISC. HP also works with Linuxcare as the backline support provider for Level 3 and 4 support calls. Beyond this, HP and Red Hat certify HP's rack and tower IA-32 servers and have been bundling Red Hat Linux with HP's 3D graphics Linux workstations for over two years.

HP remains a leader for the Linux IPF port working with Intel and others to improve the Linux kernel scalability and to add support for future IPF processors. It is also moving toward making the IPF compiler open source.

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 in developing technology-intensive areas, such as life sciences and physical sciences. In another development, Gelato is launching an open source community initiative to foster focused computing solutions for researchers and associated IT staffs working on the Itanium Linux platform. Gelato will provide the research community with software downloads, including new solutions developed by Gelato member institutions and by other contributors from the greater open source community. Gelato also will supply information services – forums and technical data – to make the Itanium Linux platform more accessible to researchers and their support staffs. 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 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 have the same level of support. Note that HP made extra effort to do a thorough patent review to protect open source developers, their IP, and others who may use or contribute to them.

The following are joint projects between HP and the Linux community:

- Several core Debian team members are on the HP staff. Debian represents a non-commercial Linux preferred by some customers and developers. This effort includes a contract with Progeny to support Debian on HP products.
- 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.
- HP's University Program includes the Association of American Universities (AAU) HP-Linux Project, a collaboration between Hewlett-Packard and Aalborg University in Denmark. This venture maintains a website that has drivers and other support information for HP Linux offerings, investigates various aspects related to deploying Linux for typical office/desktop usage, and pursues research with a local Linux cluster built with HP PCs.
- HP Open Source Printing Initiative – Working with the open source community to advance the state of Linux printing. Implementing broad support for HP hardcopy devices employing open source technologies, which includes the LSB printing initiative and hosting the OSDN printer summit.
- 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 has built a collaborative development site at devnet.hp.com with help from VA Software.
- HP is a founding member of the GNOME foundation and has committed to making GNOME the default desktop for its UNIX workstations.
- HP is also a founding member of the KDE to ensure its customers have a choice of desktops.
- HP is a founding member of the Linux Tape Certification standard (linuxtapecert.org).
- Secure Operating System Software for Linux – HP has worked on process improvements and compartmentalization to further improve Linux security in this focused Linux base. The project comprises defining the communications policies for subsystem calls and flows, and HP has made these kernel enhancements available as open source.

The following relationships of note round out HP's value net associated with Linux:

- MSC Linux and HPC Clustering: HP is working very closely with MSC.Software's high-performance computing division as its global partner in offering complete turnkey Linux clusters designed for computationally intensive environments.
- Intel: Joint leadership of the Linux on IPF effort and the joint Telco solutions center.
- OSDL: HP is on the Board of Directors and supports the datacenter and Telco 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.
- Ximian: Includes a focus on the GNOME desktop and the Microsoft calendaring connector.
- Bruce Perens Book Line: Open source titles written by community and other authors.

OFFERINGS

SERVERS, DESKTOPS, AND STORAGE

The HP IA-32 server product line is a primary set of Linux offerings. All HP rack and tower IA-32 server family members are supported with Red Hat, Debian, Caldera, Turbolinux, and SuSE. In addition, there are installation support tools and an option to pre-install Linux on the IA-32 servers. This is a completely configured server designed to integrate automatically into a LAN (local area network) the first time it is turned on. The operating system is complete with the ability to operate as a simple stand-alone file/print/web/firewall server, or it can be used as a building block in a complicated solution stack. Custom integration is available from HP's Global Deployment Services using standard or customers' golden images and company-specific settings in order to provide a full integrated solution for servers, workstations, storage, and networking. In addition, HP business PCs can be ordered with Linux through the channel or directly from HP's website.

HP has taken a lead in broadening Linux's reach into the appliance market. Besides having the broadest appliance product line with caching, traffic management, VPN, document router, streaming media, and web hosting appliances, HP also has the 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 University of California, Berkeley, the Apache group (Jeremy Allison 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 the above, the HP server appliance offerings include four specific infrastructure solutions built on Linux: web cache, traffic management, VPN, and web hosting. These ready-to-run solutions leverage the customizability of Linux and open source providing optimized specific solutions.

The Linux Systems Operation group at HP created the ASIK technology to create a base platform providing file, networking, security, and management services across all appliances with a common user interface. HP has used the ASIK technology in its own caching and media streaming appliances as well as the HP smart meter appliance, part of the utility pricing program. OEM partners are currently using the ASIK technology along with best practices developed by HP in this area to create customized applications built upon this common set of frameworks. This allows faster application deployment without sacrificing the flexibility and strength of Linux.

HP blade servers 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 – servers, storage, network, and more. These blades are housed together with shared resources such as power supplies and cooling fans in the HP blade server bh7800 chassis, creating high-density systems with a modular architecture. HP uses the compact PCI standard for its blade servers and has attracted over 100 hardware and software partners with this open design. Blade servers provide high-density, lower cost infrastructure solutions, which blend well with the Linux operating environment. HP supports its blade server family with all five Linux distributions.

HP's cc2200 and cc2300 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, which Linux with other HP technologies such as HP MC/ServiceGuard provide.

HP fully supports all certified distributions of Linux on the Itanium-based HP server rx4610 and the HP workstation i2000. 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.

In addition to certifying its commercial business PCs with the Red Hat, Caldera, Mandrake, SuSE, and Turbolinux distributions (through Linuxcare), HP's high-end 3D Linux graphics workstations (targeting digital content creation) fully integrate Red Hat. Red Hat is preloaded by HP on the following models: HP x1100, x2000, 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: For HP Business PCs, customers can order most models with Linux (Mandrake) at a reduced price. In addition, customers can create and order custom-designed HP business PCs with Linux on the web.

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

Linux storage solutions have not escaped attention. The HP SureStore Disk Array supports an end-to-end, multi-terabyte solution for Linux on its XP and VA disk arrays. Employing high-speed, secure FC 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 of HP tape drive data-protection units are certified as Linux compatible. (HP was a founding member of linuxtapecert.org.)

Customers can now select IA-32 servers pre-installed with Linux. These can be up and running in under 15 minutes. The system is network aware and does not require a terminal or console. A Linux option with most commercial desktops is available from HP's website.

HIGH-PERFORMANCE COMPUTING

MSC.Software's high-performance computing division is HP's global partner offering Linux clusters designed for computationally intensive environments such as those needed to run CAE, life/material sciences, bioinformatics, oil/gas, digital cellular communications (DCC), and electronic design automation (EDA) applications. MSC works with HP's customers to understand their solution objectives. After that they design, build, deliver, and support a complete customized Linux cluster solution. MSC has created its own LSB 1.0 compliant distribution, MSC.Linux, which is a preferred Linux distribution designed specifically for HP technical and scientific distributed parallel-cluster solutions.

PRINTERS

HP is investing resources in open source efforts to improve support for devices within Linux, including HP printers. Support is available for over 40 Inkjet models. HP also supports its LaserJet series and many of the OfficeJet all-in-one products including scanning support.

As a recognized market leader, HP maintains a leadership printer strategy with significant differentiation in breadth and depth.

SOFTWARE

Numerous software products on Linux including HP's leading system management platform, OpenView, as well as components of its Netaction software suite are available. These offerings are combined with other HP and partner technologies to provide other value-added solutions and platforms.

OpenView – an end-to-end management solution – manages networks, systems, applications, and storage. The HP OpenView Operations agent monitors the health and performance of Linux systems. Its Network Node Manager discovers Linux devices; its Internet Services monitors Linux-based services. HP Omniback II provides support for data protection of Linux systems.

The Netaction 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. Recently HP announced a complete Opencall Linux developer platform. This 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.

The HP Application Server is the only J2EE platform supported by a major vendor available at no cost. Combined with Linux, the HP Application Server offers a unique price/value point in the industry for J2EE application deployment.

Other Netaction software products include,

- HP Secure Operating System Software for Linux helps businesses secure their Linux environments by offering intrusion prevention, real-time protection against attacks, and damage containment. HP is the only systems vendor to market this business-critical security solution for Linux.
- Process Resource Manager brings CPU resource management to Linux enabling system administrators to monitor, control, and optimize system resources.
- HP ServiceControl Manager for a single point of administration of Linux, HP-UX, and Windows. 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 were interested in creating Service Control Manager including Aduva, Bladelogic, TOLIS Group, Turbolinux's PowerCockpit, Symark, and Integrated Research software.

- HP Rapid Deployment for Linux allows customers to install, configure, and deploy their HP servers remotely and get them up and running quickly.
- TopTools for device management of HP PCs and servers.
- HP MC/ServiceGuard for mission-critical high availability.
- Web JetAdmin for printing installation and management.
- OpenView for end-to-end management including networks, systems, applications, and storage. Linux systems are managed through agent technology.
- HP Netaction Suite provides a comprehensive software foundation for the development, integration, and deployment of voice, web, and mobile services.
- The HP Application Server (HP AS), a Netaction product, is a free, standards-based Java Application Server built on a service-centric architecture. The HP AS is J2EE certified.
- HP Web Services Platform, a Netaction product delivers the foundation necessary for providing web services solutions to customers.
- Opencall SS7 SDK: Telecom software, a Netaction product, offers a spectrum of Linux and HP-UX software development and test tools. This creates a flexible development environment to help rapid and cost-effective development and deployment of new SS7 applications.
- HP Netaction Agile Business Infrastructure Solutions are prepackaged, integrated services for transitioning enterprises from existing patchwork infrastructure to a global infrastructure for the next generation of applications.
- OpenView Internet Usage Manager is a mediation and business intelligence solution that enables service providers to understand how customers use their infrastructure, and how to generate additional revenue based on that usage.
- HP's Chai Appliance Platform software, a Netaction product, combines customizable Java environments with web connectivity technologies and embedded Linux.
- OpenMail – now HP supported – sold and licensed by Samsung.
- HP Storage software including disaster recovery and high-availability features.

CUSTOMER SUCCESS STORIES

HP's customer success stories reflect its focused solution segment Linux strategy. These are solutions for web content delivery and high-end technical computing. HP emphasizes areas where Linux is a strong fit.

Speedera wanted to build a cost-effective, flexible, scalable content delivery network. It chose Linux because it would enable the company to quickly develop, deploy, and manage these new services. Speedera chose its Linux solution provider based on logistics and price. HP's TopTools Remote Control Cards for remote systems management and maintenance impressed Speedera, as well as the HP LP1000 servers, which perform best during stress and failure testing.

Boeing's Research and Development division is replacing expensive mainframe computing resources with Linux and HP compute clusters to run compute-intensive simulations for designing aircraft more cost effectively. Boeing was impressed with the cost and flexibility of Linux and Beowulf clustering software, which allow for growth and easier integration of new technology. So, it decided to buy a turnkey Beowulf cluster from MSC.Software, the software company that provides the key engineering software Boeing uses for simulating an airframe's structural integrity. (MSC.Software is HP's strategic global partner for complete turnkey clusters dedicated to computationally intensive environments like those needed to run engineering, life sciences, DCC, and EDA applications.) Customer support remains a critical differentiator for companies that want to keep their internal support headcount at a minimum; the HP MSC partnership met the need.

SERVICES AND SUPPORT

In its evolution from the open source community, 24x7 service and support moves Linux into a new arena. Support is a differentiator. HP provides 24x7 global support for Linux, major open source applications, applications included with distributions, and HP Linux applications on HP, Dell, Compaq, and IBM systems. The support ranges from electronic support, software phone-in assistance, to a proactive onsite presence with a dedicated support staff. In addition, HP provides high-availability support delivering proactive services to prevent downtime – offering rapid problem resolution. HP recently announced an extension of its outsourcing services to include Linux for running and managing customer operations and IT infrastructures. HP also extended its current IT infrastructure consulting to include the Linux platform, encompassing porting and migration services, security services, and open source consulting. Beyond this, its web-based and classroom curriculum has been supplemented to include training for Linux administrators in installation, configuration, troubleshooting, and security, as well as application management. Twenty four Linux classes are offered in more than 280 learning centers globally with two courses leading to LPI certification. This includes cross training for UNIX and Windows NT users.

A major focus of this service level is making Linux part of HP's multi-platform environments. HP services for Linux environments include,

CONSULTING

- Infrastructure and architecture analysis, assessment, design and implementation; infrastructure transition assistance; security infrastructure design and implementation.
- Porting and migration services spanning UNIX/Solaris/Windows to Linux transition analysis services and application porting and migration assistance.
- Telecom-specific consulting including telecommunications application and communication 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; multi-region, multi-system rollout assistance. Covers Linux, Windows, and UNIX-based platforms (HP and selected multi-vendor platforms).

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

- Critical Systems Support (CSS) is a high-availability support service aimed at reducing the frequency and duration of downtime through proactive and preventive services and specialized resources for recovery. CSS includes the industry-leading standard six-hour call-to-repair commitment for hardware.
- Personalized Systems Support (PSS) 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 software and information services, a two-hour response commitment, 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. Available on Red Hat, SuSE, Debian, Caldera, and Turbolinux; coverage includes the open source applications included with the distribution.
- Online Software Incidents provide comprehensive software assistance for Linux environments. HP Response Center engineers work with customers via e-mail to resolve problems with Linux and selected application products. The standard business hours cover Monday through Friday, with a 24-hour maximum response time.
- Hardware support with flexible hardware response times and coverage periods to meet customers' multi-platform hardware support needs.

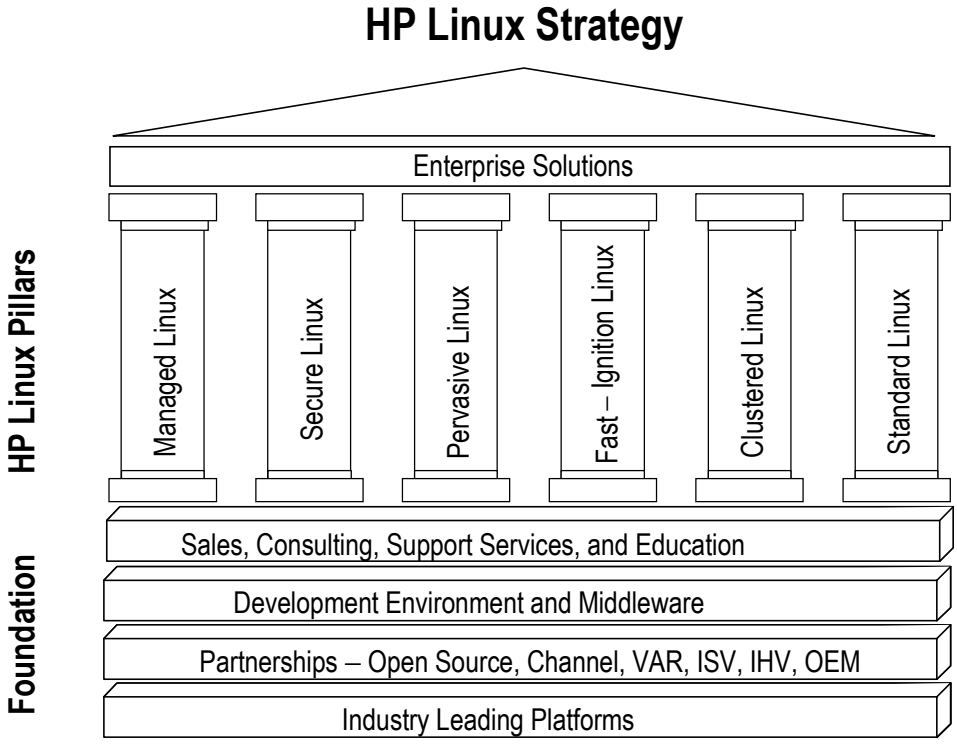
EDUCATION AND TRAINING

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;
- Managing Linux web servers;
- Managing Linux mail servers;
- Managing Linux file and printer servers; and
- Two courses leading to LPI certification.

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. Value is also derived from six "pillars:"



- Managed Linux: Provisioning, deploying, monitoring, and more. HP has an integrated offering across multiple operating systems.

- Secure Linux: Enhancing the Linux operating systems with triple layer security plus services.
- Pervasive Linux: Putting Linux to work in embedded intelligent appliances.
- Fast-Ignition Linux: Delivering Linux based appliances that are up and running in under 15 minutes.
- 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.
- Standard Linux: Supporting the Linux Standards Base for a common framework for developers and ISVs.

This framework provides HP's foundation for delivering end-to-end Linux based solutions.

HP is evaluating all software products for Linux and selecting open source software that the open source community will likely embrace with a focus on HP's business. The objective is to target the multi-operating-system environment, so that many applications and tools will also be available on Windows 2000 and .NET Server. In particular, HP has made MC/ServiceGuard failover software available on Linux, as well as Secure Operating System Software for Linux, Netaction application server software, OpenView agents (for backup, network management and operations management), TopTools agents for desktop and server device management, as well as storage management, software including disaster-recovery storage software. Other HP software supporting Linux includes Opencall SS7 Telco software, Internet Usage Manager, Chai development software for embedded applications, and WebJetAdmin. OpenMail e-mail software for Linux is now available through Samsung.

The full-service level is available for HP platforms, IBM, Dell, Compaq, and other vendors, extending to onsite support. Personalized Systems Support (PSS) and Critical Systems Support (CSS) for Linux and open source applications assign engineers to accounts for both proactive and reactive support. Proactive services sold as part of PSS and CSS and standalone include patch reviews, configuration, operational health checks, security reviews, and network assessments. This matches what HP offers for its UNIX and Windows platforms and provides a single point of contact for an HP customer.

HP offers a print-server appliance based on Linux and Samba called the Jet Direct 4000, which supports Windows and Linux as a client for printing purposes. HP also offers a document router based on Linux. HP plans many more appliances using Linux in both the server and client area. Many will be based on HP's Chai embedded software development tools, which provide compatibility with Java and offer up to ten times more compression as well as micro-browser functionality targeted for various client appliances.

Linux is now part of the HP service umbrella and receives the same level of professional services and consulting coverage as other platforms.

APPLICATIONS FOCUS

HP has five application segment foci oriented to Linux strengths today:

- Application Development
- Design and Visualization
- Network Edge Servers provide access and gateways for users and other networks. HP is offers solutions cover,
  - Proxy
  - Caching
  - VPN
  - Firewall
  - WAP
  - All-in-One
  - VOIP Gateway
  - GPRS Gateway
- Infrastructure Servers, which typically reside behind edge servers and provide network, basic infrastructure or departmental services such as:
  - Directory
  - Security
  - Load Balancing
  - File/Print
  - Web
  - Mail
  - NAS
  - Softswitch
  - Telco Features
- Compute Clusters for technical workloads including life sciences, research, and financial analysis.

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. More than 300 listed HP partners support Linux. HP has certified particular IA-32 servers with SAP on Linux for over a year. Also, certification is underway for HP IA-32 systems with Oracle9*i* RAC. And HP has a special partner program for its blade servers for both ISVs and IHVs.

Building and offering end-to-end business solutions based on Linux through its sales process remains an HP focal point. It offers total solutions by following a thread through application, deployment, management, middleware, Linux distribution, product, and chip set, as well as another thread through services including porting, architecting, tuning, installation, project management, and repair.

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 financial services, government, and retail.

Look for HP's Itanium-based workstations and servers based on Linux to grow significantly with the introduction of McKinley-based chips. HP has announced a new core processor chipset, the HP zx1, which will optimize the performance for HP Itanium workstations and servers. Also, HP's commitment to the blade architecture is strong, so new blades and Linux solution support partners are likely.

HP plans many more appliances using Linux in both the server and client area. Many will be based on HP's Chai embedded software-development tools, which provide compatibility with Java and offer up to ten times compression as well as micro-browser functionality targeted to various client appliances.

HP plans to offer the server appliance solutions (web cache, traffic management, VPN, and web hosting) with its blade systems as well. It has announced plans to expand the range of OpenView management products available on Linux.

With the HP/Compaq merger seemingly approved, the goal is to integrate their strategies, offerings, and teams. If the merger is well implemented, the new company will have a strong strategy (including differentiation and leadership in key areas), a solid team, and a customer base to build on.

IBM: TACTICS AND STRATEGIES

OVERVIEW

IBM recognizes Linux as an opportunity for customer choice, to keep the server and Internet open and heterogeneous, and to enable IBM's services business to offer customized solutions. A high-volume server and pervasive client platform that competes with Microsoft .NET is desirable from a customer as well as a developer and ISV viewpoint. It will also enhance IBM's software and services businesses.

IBM has a comprehensive Linux strategy includes all elements from hardware and software through services and partner programs. IBM supports Linux across all eServer hardware platforms – xSeries (Intel-based), pSeries (RISC UNIX – AIX), iSeries (Integrated Applications – AS/400), and zSeries (Mainframe – S/390 and zSeries). Moreover, IBM makes much of its software portfolio, including enterprise middleware, available on Linux with key contributions to open source such as 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.

In summary, IBM continues to:

- use Linux as an applications source for IBM hardware and software platforms,
- enable and enhance Linux on IBM platforms,
- port and enhance IBM middleware to Linux,
- apply IBM enterprise technology to Linux and support the community to create robustness and scale,
- enhance a services infrastructure around Linux and IBM offerings to add value, and
- create a value net around Linux and open source to rival other value nets such as those surrounding Microsoft .NET and Sun ONE.

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 find themselves enhanced with the flexibility and openness of a strong Linux affinity. 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 finally deliver a common application base across its server lines.

Embracing Linux as a common application development platform across all IBM environments facilitates ISV development for the installed base and for proprietaries. 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. .

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 its early strongholds – the enterprise Internet infrastructure, service provider, and technical/scientific segments. Much has happened since those early days. In 2001, IBM added these market solution segments:

- Workload Consolidation
- Linux Clusters for Commercial Solutions
- Distributed Enterprise

In 2002, IBM is adding further focus on two key areas:

- Infrastructure Solutions
- Application Solutions

From a systems point of view, Linux is positioned as IBM's mainstream UNIX-like offering, 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.

Embracing all major Linux distributions – Red Hat, SuSE, Caldera, and Turbolinux – lies at the heart of IBM's strategy. In addition to offering Intel server support, 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.

As measured by revenue across all product lines and service offerings, IBM is the largest Linux vendor. Its investment in Linux has paid off and has set IBM in a position to capture further growth and proliferation of its software. Linux was one of the major contributors to IBM gaining server market share in 2001 – a difficult year in which most competitors lost share. Beneath this general result lies spectacular IBM marketplace victories with Linux on the zSeries as well as an open source hit with Eclipse, its Java development open source initiative. However, this does not mean IBM is the leader in all segments.

The greatest and most surprising Linux and open source IBM success story in 2001 was mainframe Linux. This success manifested itself particularly with infrastructure server consolidation projects mostly within existing mainframe customers, but IBM gained new customers as well. This success generated considerable debate by competitors as to the benefits of such a move, but IBM's ongoing success testifies to benefits at least for certain customers. This success has been so stunning and visible that it has overwhelmed IBM's marketing efforts in other areas of its Linux strategy, particularly its Intel-based Linux servers. The net of this is a repositioning of IBM as a Linux mainframe company. Competitors such as Compaq, Dell, and HP have established visible and leading Intel-based Linux programs where most of the Linux market remains and will continue in the near future.

Given these developments, IBM is working to raise the visibility of its Linux on xSeries efforts significantly; these efforts are being positioned as its leadership platform to compete effectively with Compaq, Dell, and HP for the Linux-based Intel server business. Recently, IBM has accelerated its xSeries marketing efforts and is achieving a better balance in its market communications. IBM's recent efforts include,

- xSeries-based ServerProven program has produced 300 ISV partnerships and over 420 certified applications.
- New strategic partnerships were announced at LinuxWorld 2002 in New York: VMware, Bynari, Axiom Software Labs, Veritas, and Lecando.
- In 2002, IBM is re-emphasizing application development tools and infrastructure applications where Linux mainstream adoption is already underway. This initiative is centered on xSeries.
- 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 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:

- 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
- OSDN (Open Software Development Network)
- OSDL (Open Source Development Lab)
- FSG (Free Standards Group)
- LSB (Linux Standards Base)
- LI (Linux International)
- USENIX

LINUX TECHNOLOGY CENTER

The IBM Linux Technology Center (LTC) is IBM's "face" to the open source community. Its mission is to "enterprise-enable the Linux operating system through the development and contribution of utilities, tools, and code." The LTC's primary goal is to keep IBM a trusted, valued peer in the community and to "help make Linux better." The staff of the LTC consists of 250 developers. They are part of the open source community and are located worldwide. Major project areas include scalability, file systems, security, internationalization and performance.

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 its customers' problems. Further, it gives IBM a great image with potential talent and offers the opportunity for university students to experience internships to gain familiarity with IBM and open source.

OFFERINGS

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 also supported on the zSeries. SuSE is the foundation for many zSeries workload consolidation installations. Red Hat is planned for certification on the zSeries as well.

xSERIES

All models of xSeries Intel servers offer Linux. In addition to the four major Linux distributions, IBM supports VMware on selected configurations. xSeries

offers a preinstall option on Red Hat Linux for a fee. Red Hat Linux is also supported on IBM's Itanium-based xSeries servers. The other Linux distributions are certified on most xSeries systems and may be user or channel-installed. Note that this preload is not available from the IBM website for the largest rack-mounted eight-way SMP server. These servers range from rack-mounted configurations to large clusters. IBM offers xSeries servers ranging from 1U (1.75" high) to 8U rack-mounted Intel servers with one to eight processors and up to 42 servers in an industry-standard rack. The low-end servers are Intel Celeron; the high-end servers are eight-way SMP Xeon systems. X-architecture reliability features include Light Path Diagnostics, Predictive Failure Analysis, and an Advanced System Management processor. All are configured with a network interface capability and CD-ROM.

IBM supports clusters of xSeries servers using Linux with the eServer Cluster 1300 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.

The Small Business Suite for Linux contains Lotus Domino Application Server; WebSphere Application Server, Standard Edition; and DB2 UDB Server for Linux. This is a promotional offering for channel/OEMs and is targeted to small businesses with fewer than 100 users per server. The price is $499 (list) per server with client licenses sold separately for $90 each and represents a substantial savings over individual offerings. This is supported on Red Hat and Caldera Linux.

IBM offers the SuSE eMail Server II and Turbolinux's Enfuzion, which turns an existing Linux network into a supercomputer.

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, NetVista, selected desktop systems, and all 2D IntelliStation workstation models. IBM also certifies its 3D IntelliStation models and delivers 3D adapter drivers on 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 on. The pSeries targets the scientific/technical market and the service provider market. SuSE reveals the broadest support for the pSeries and RS/6000 lines with Red Hat and Turbolinux supporting one model only. IBM has not delivered its Linux cluster software on pSeries to compete with Compaq's Alpha, though standard open

source software and interconnects such as Ethernet and the Myrinet switch can be used for clustering.

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 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. Linux is supported across the iSeries product line from the entry iSeries Model 270 with one processor, the 820 with one to four processors, the 830 with two to eight processors, up to the 840 with 12-24 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, three 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 can 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 multiple OS/400 and Linux partitions. Through this virtual I/O support, iSeries provides Storage Area Network facilities for the Linux partitions. iSeries can also protect the disk via RAID and can add, move, or delete disk space assigned to each Linux partition. Each of the Linux partitions can also have direct I/O resources.

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 the iSeries offering for Linux to target the consolidation market for small and medium-sized business. For integration, IBM has introduced facilities that enable Linux applications to leverage OS/400 applications, databases, and files. This support includes ODBC, JDBC, Samba, and NFS services. To enable additional business applications, IBM recently embarked on a technology preview program for DB2 UDB and WebSphere for Linux on iSeries.

zSERIES

Linux is now available on the IBM mainframe. This is a significant solution for existing zSeries customers to take advantage of 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. 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, VM and VSE 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.

All zSeries processors currently in production are available with a hardware feature called an Integrated Facility for Linux. This is a processor that supports Linux workloads exclusively – running in native mode or as guests of z/VM.

Integrated Facility for Linux engines cost a fraction of the price of a traditional engine that runs IBM proprietary software. And it yields the attraction of giving customers a way to expand processing capacity for Linux to their enterprise without affecting the charges for traditional S/390 software from IBM and other vendors.

IBM's strategy for Linux on S/390 targets Linux for workload consolidation for web serving, Internet infrastructure, file/print, 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 designed to enable customers to consolidate a larger number of UNIX or Windows servers onto a single or small number of zSeries servers.

IBM has dedicated one of its largest mainframes for use by developers bringing 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, 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 four software brands. Some IBM middleware support is planned for pSeries and iSeries with a focus on supporting Internet and other infrastructure 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.[9] A new version of WebSphere Studio accompanies the new product, which is also open source and 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 middleware, especially its Application Framework for e-Business[10] targeting IT developers, traditional ISVs, Net generation ISVs, service providers, and others who drive product development.

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

10 IBM's application framework is now called the IBM e-Business Software Strategy. See *e-Business Application Frameworks Enter New Era of Capability and Competition*, D.H. Brown Associates, Inc., February 2002.

CUSTOMER SUCCESS STORIES

Recent customer purchases using Linux on xSeries indicate that Linux is moving from an infrastructure-focused solution to an application platform. The Linux value proposition in this segment is price, ease of administration, and operational stability. Examples include Future Cellular with 1,500 kiosks managed by Linux on xSeries with DB2 and ACCPAC accounting software; DSD Dillinger Stahlbau GmbH runs SAP R/3 and Oracle for a human resource solution; and DEODEO runs a Japanese online mall using a clustered Turbolinux solution including a Java servlet-based application for data mining to help establish one-on-one customer relationships.

The mainframe with Linux is also being deployed for customer applications. And its ARTMAIL application, responsible for a number of operations, including the delivery of daily activity reports to Wall Street brokers and member firms on their respective buy/sell transactions. This client chose Linux on the zSeries because they have no tolerance for downtime.

SERVICES AND SUPPORT

IBM GLOBAL SERVICES AND TRAINING

IBM's Global Services (IGS) business has fully embraced Linux, now a strategic offering in its services portfolio. IBM intends to provide all of the enablement required to ensure that Linux has an industry value net and customer support structure second to none. IBM's Global Services provide comprehensive worldwide Linux services that include infrastructure consulting and planning, installation, configuration, and application enablement. IBM Global Services also provide support consulting and implementation services for Linux. With these service offerings, the Linux value net and support structure is well on its way:

- Clusters – IGS provides design, integration, and support for affordable Linux high-performance clusters.
- Distributed Enterprise – IGS provides customer-proven application design and rollout services for distributed retail enterprises.
- Workload Consolidation – Customers can reduce total cost of ownership (TCO) and server proliferation with IGS workload consolidation service.
- Strategy Customers can turn to IGS to develop a Linux plan to meet their business needs.

IBM also provides a full portfolio of courses via classroom (13) and web (13), available in 20 countries and in five languages, 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, 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. Finally, IBM sponsors the Linux Professional Institute to certify Linux professionals. In addition to education, IBM enables Linux in its 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. These centers are located worldwide and are up and running today.

TECHNICAL SUPPORT

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 xSeries 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 all four major Linux distributions – Red Hat, SuSE, Caldera, 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. 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 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 Strategy application framework has been implemented on Linux including such offerings beyond software products as IBM's Start Now development patterns.
- Small Business Pack for Linux – Contains Lotus Domino application server, WebSphere application server, DB2 Universal Database Workgroup edition, HTTP server, proxy support, and JDK (Java Developer's toolkit). This is a promotional offering for channel and OEM, targeting small businesses up to 100 users/server. It is attractively priced at $499 suggested retail. In fact, it offers a $3,500 value.
- 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 2002 middleware-based ISV worldwide program to drive high-visibility partnerships in finance, retail, accounting, and commerce.
- A significant 2002 demand generation campaign around Linux helps 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-1.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 launched its Linux strategy in March 1999 with a focus on providing Linux solutions against its strengths: Internet infrastructure, file/print, and technical computing. Eighteen months later, IBM decided to elevate Linux to become its strategic cross-platform operating system and invested to enable Linux to grow into an application solution platform. The results of these investments are beginning to become apparent in the customer deployments now unfolding as Linux has moved into distributed enterprise applications, branch office solutions, SCO-based small business applications, and a deployment platform for UNIX-based custom solutions. Further, the leading J2EE and database platforms support or are porting their offerings to Linux.

In 2002, IBM continues investments in key targeted industry segments – financial services, communications, distribution, industrial, and public sectors.

In addition, IBM is re-emphasizing application development tools and infrastructure applications where Linux mainstream adoption is already underway. In concert with contributions to the Eclipse project, IBM is working with key third-party application development tool vendors to ensure availability of its products on IBM's strategic middleware suites and entire eServer line. This will spur additional Linux adoption as developers gravitate to Linux to take advantage of a broad range of robust development tools. The addition of new third-party offerings in web serving, mail serving, file/print serving, security, clustering, firewall, and network and systems management will offer Linux customers the flexibility and reliability provided by complete infrastructure solutions.

Some of the ISVs in these segments – already using Linux with customer deployments based on IBM solutions – include SAP, Oracle, Sage, SendMail, Informix, Computer Associates, SGI, Resonate, BEA, Vignette, Chili!Soft, Citrix, Sanchez, SAS, Rogue Wave, Check Point, Inktomi, and Resonate. Additionally, IBM is building strategic partnerships, such as with Bynari and its Insight Server offerings and sales kit for e-mail and messaging solutions.

FUTURE ACTIVITY

There are several Linux investment needs where IBM remains focused. These include operating system enterprise capabilities and scalability, skill-base building, and mid-tier application solutions. IBM continues to invest in these technologies, while taking an active role in driving critical mass behind key technology standardization initiatives. IBM was one of the founding members of the OSDL Carrier-grade Working Group formed to develop a standard architecture and road map for using Linux in the telecommunications core-network. IBM also plans to

provide significant contributions in the Data Center Working Group that is just starting up. As one of the leading contributors to the Linux Standards Base definition version 1, IBM helped create an important standard that will facilitate application enablement, and is in the process of working with the community to plan the next version.

ServerProven is expanding to other series'. 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 innovative, Linux-based solutions in the market. IBM will also continue to roll out programs, which will help its Business Partners become proficient in delivering Linux solutions to small and medium-sized companies around the world.

Another future effort covers customer awareness activities to spread the word about the compelling opportunities enabled by Linux. It will continue to feature Linux as a premier development and deployment platform for web services, using its WebSphere product family.

SUN: TACTICS AND STRATEGIES

OVERVIEW

Sun views Linux as an opportunity to expand UNIX's market presence in general and to gain market share at Microsoft's expense in particular. Linux presents an opportunity to proliferate UNIX-like programming interfaces and applications enabling a larger pool of talent and applications for UNIX at large. Given this, Sun has been a supporter of and contributor to certain Linux and open source projects such as OpenOffice, an open-source Microsoft Office competitor, purchased by Sun; and GNOME, the object-oriented Windows-like user interface for Linux, now available on several UNIXes.

However, Linux introduces new competition to Sun's Solaris SPARC servers, particularly its higher volume, low-end devices designed for web serving and edge-of-network applications in general. More to the point, the Linux programming interfaces and programming environment are rapidly becoming the *de facto* standard for all UNIXes and represents UNIX's major high-volume install base on Intel-based systems. While Linux has made some progress on mainframes, and to little extent, on RISC platforms, Intel-based servers represent the lion's share of Linux business activity. To some degree, at a lower value point in the solution range, Linux is doing to traditional UNIX what UNIX has been doing to the mainframe: Pushing the higher value solution into ever higher end applications while growing its install base and solution range.

Against this backdrop, Sun acquired Cobalt Networks, a Linux-based server appliance company, in 2000. In 2001, Cobalt continued to build its Linux-based appliance business as Sun contemplated strategies to further integrate Cobalt into Sun. The "edge of network" application segment of the server market is one of the fastest growing and this growth is enabled on Linux. With this in mind, Sun announced a significant expansion of its Linux strategy to include a broader x86-based server line targeting general purpose Linux opportunities as well as supporting its industry-leading application framework – Sun ONE – on a custom version of Linux to be called Sun Linux 1.0. Sun Linux is expected to be Red Hat and LSB compatible, and, DHBA expects that all of Sun ONE will be supported only on Sun Linux. However, components of Sun ONE, like the iPlanet Web Server are already supported on other Linux distributions. Most of the Sun ONE software will be supported on other distributions as well.

Sun positioned its new Linux strategy to advance the cause of UNIX at large and against Microsoft and its .NET strategy in particular. Sun is in the process of filling in the details of its Linux plan and strategy to build on its existing Linux business as well as to compete with Microsoft .NET. Sun will offer its own Linux distribution, Sun Linux, presumably supported only on its hardware and as part of Sun ONE. Beyond this, DHBA believes that Sun can play a leadership role proliferating J2EE in conjunction with Linux. Such an undertaking can take many

forms, one of which would be to open source a J2EE runtime, or at least the Java servlet and EJB containers. Another is to offer a high-volume, attractively priced package on Linux to compete with Microsoft Windows 2000 or .NET Server. Sun has not announced any intentions with respect to open source J2EE on Linux. However, it is porting the remainder of its iPlanet software stack – including its J2EE application server – to its version of Linux, Sun Linux 1.0.

INDUSTRY RELATIONSHIPS

With the acquisition of Cobalt Networks, Sun picked up the Cobalt operating system – a standard Linux base customized for Cobalt appliances. This Linux platform is not a traditional distribution per se, though it retains compatibility with Red Hat Linux and the Linux Standards Base. Rather, its focus is on optimized, customized solutions best deployed on appliances such as web caches, firewalls, etc.

Sun Microsystems participates in and contributes to the open source community, furthering the proliferation of UNIX-based systems. These relationships and open source ventures comprise,

- 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 cofounding 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."
- 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 is a highly popular open source Java development environment based on the Forte development environment (or visa-versa).

- NFS: NFS 4.0 is an Internet Engineering Task Force (IETF) effort. Sun is a leader and funded the OSS port of NFS to Linux.
- Sun is a founding member of the TV-Linux Alliance.

OFFERINGS

Sun's Linux offerings are focused in several areas. Cobalt is its appliance server offering family, which is being expanded to include high volume entry servers based on Linux. Sun is also the leading player in contributing desktop client technologies including its support for GNOME and especially, StarOffice. Further, Sun has ported several of its Java-based technologies to Linux including a J2SE platform, iPlanet software and Forte. Finally Sun pursues other initiatives and offerings around Linux including Grid and Storage.

COBALT

Sun is a relatively new player in the Linux market, gaining entry through its Cobalt acquisition. Currently, the only hardware products offered by Sun derive from its Cobalt product line of appliance servers, offering integrated solutions for web hosting and caching. Also on the list is an SMB appliance that supplies all of the basic functions for an Internet presence in a box for the SMB space. (It is also used as a service delivery platform for SP and Telcos), all running the Linux operating system.

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.

SOFTWARE

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 Forte 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 Forte 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 Forte 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 Forte 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 Forte 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 iPlanet 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.

CUSTOMER SUCCESS STORIES

Comcast Business Communications needed to build the infrastructure to provide Internet/intranet and e-mail services to small businesses and schools. Comcast needed an all-in-one server appliance that could be deployed on customer premises to enable the network, and host network and e-mail services. It chose Linux due to its remote manageability and reliability over Windows. Comcast then chose the Sun Cobalt Qube 3 Server and employed Sun Professional Services to produce a customized, yet turnkey appliance solution for these small businesses and schools.

Dialtone Internet provides Linux- and Windows-based hosting and collocation services. It had been using Linux on white boxes, which did not provide their customers the control, reliability, and ease-of-use required. Dialtone's requirements included a complete server solution that could be administered by users who lacked programming skills. Dialtone chose Cobalt RaQ server appliances due to the ease of installation and management the value-added appliance provides. These server appliances could be brought online in one hour and developed a reputation as the best solution for "beginners." Further, the Sun Cobalt brand name helped Dialtone attract customers due to the Sun Cobalt brand recognition and following in the industry.

SUPPORT AND SERVICES

Sun Cobalt offers two hardware support options: Warranty Extensions and Spare-in-the-Air service. Warranty Extensions go beyond the standard warranty level of service for up to two years after the standard one-year product warranty. Spare-in-the-Air service provides next-day expedited shipment of a replacement unit in the event of a system failure.

Sun Cobalt user support centers around the online Knowledge Base – a tool allowing access to product information, troubleshooting, and tips for use, as well as access to the same data used by Sun Cobalt support engineers. The Support Forum and User Groups allow for interaction among the Sun Cobalt family of users. This community of users allows for online submission of questions for successful product use, tips, and system support. User groups promote additional e-mail-based developer, security, and product discussion. In addition to these no-charge online support offerings, Sun Cobalt offers pay-per-incident phone support. Further, Sun offers support through its enterprise support teams.

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. Sun has offered services for Linux to customers who wanted a single point of accountability for

the enterprise infrastructure since the inception of Linux at the enterprise level. To date Sun has provided this on an account accommodation basis, but now will expand those services to be mainline.

VALUE ADDED

Cobalt's Linux Operating System is a custom version derived from the Linux source base that is compatible with Red Hat Linux and the LSB. This customized version of Linux has tuned device drivers and is specially configured for appliance solutions. Sun tunes and optimizes the drivers and kernel for specific web-based performance. Kernel hardening also increases security of the appliance payload. Another key value-added feature is the tight integration of the operating system (drivers and kernel) to the hardware, increasing reliability and usability. A web-based tool, the server desktop enables application deployment and management, as well as user management – shielding the user from the complexity of the operating system. Sun Cobalt adds management services and packet management tools for increased reliability and usability.

Sun also adds value to Linux through its Java efforts – a particularly strong effort through NetBeans and Forte for Linux, which brings Java development to students and other individual programmers. These enhancements increase the exposure of Java to the "masses" and increase the extent of the Java community.

Another open source effort that adds significant value is StarOffice. Version 6 approaches many users' requirements for an office suite as well as increased compatibility with Microsoft Office.

APPLICATIONS FOCUS

Network "edge" applications such as web and access serving are Sun's Linux target. 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 high-value solutions.

Solaris is Sun's primary business logic and database server platform and industrial strength platform for high-value solutions.

FUTURE ACTIVITY

Sun is on the move. It recently announced its intention to catch up to the rest of the players in its Linux offerings at least for the "edge of network" applications, currently served by thin form factor-based servers including blades. To back up this goal, Sun will ship a full implementation of Linux on new x86-based general-purpose servers capable of running Linux applications natively. Other Sun

initiatives to boost its Linux offerings include an agreement with Lineo to support its embedded Linux operating system on the UltraSPARC IIe processor currently supported on its Blade 100 workstation, Netra T200, and Netra X1 servers. Sun will also support its storage systems and software on Linux.

Sun plans to expand the customization value provided by the Cobalt operating system to the Sun Linux 1.0 operating system. Further, Sun will evaluate Solaris differentiation and make it available on Sun Linux where it makes sense, for example, strengthening drivers and kernel modifications for reliability. Other areas of focus will include integrating Sun value-added from the Grid Engine, and management infrastructure.

Sun ONE will be fully supported on Linux. Sun ONE is Sun's application framework, an industry-leading software and services platform.[11] 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.

[11] 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.