Expanding Linux System Configurations for Enterprise Deployment

An IDC White Paper
Sponsored by VERITAS and IBM

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EXECUTIVE SUMMARY

Linux has made tremendous progress in growing its market presence since first becoming available in 1993 and making a humble entry into mainstream use in 1999 and 2000. Linux is now available aboard virtually every major hardware platform, including 32-bit and 64-bit processors, as well as a wide variety of low-end embedded processor lines.

Although its open source origins guaranteed a vastly different development history, the deployment and adoption of Linux have, in many respects, paralleled that of Windows nearly a decade ago and Unix a decade before that. Initially embraced and deployed by technical users who supported themselves or smaller departments, Linux subsequently found a niche as a supercomputer alternative in high-performance computing environments and in the more mundane but equally important role of providing basic infrastructure services such as file, print, Web, and network support.

Today, Linux is poised to take the next step in its evolutionary growth by supporting general application workloads, as Unix servers do today. However, this step requires that Linux systems — which would include not just Linux, the operating system, but also the supporting hardware infrastructure, supporting middleware, application packages, management tools, and services — offer a level of availability, scalability, and reliability on a par with that of other high-end system configurations.

The high quality of service required by enterprise-level users is not unique to Linux but rather is the baseline expectation for any system configuration that would be deployed in an enterprise application role. This means that for Linux to be considered for deployment to fulfill enterprise requirements, it must offer the same level of manageability and flexibility that Unix (and mainframe) environments have offered for years.

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Not surprisingly, the same core infrastructure technologies that helped Unix to expand its market share in enterprise deployments are now available for Linux. These capabilities include virtual access software, virtual processing software, shared file systems, storage virtualization and sharing technology, scalable hardware architectures, and state-of-the-art database technology. As a result, customers now have more choices and attractive new options for system deployment.

Moreover, the evolution of industry-standard server technology, pioneered by companies such as IBM with its X-Architecture strategy, has created a cost-effective hardware foundation for enterprise Linux services to be built upon. IBM's x440 eServer is a key example of one of the systems helping make the transition from expensive closed Unix environments to less expensive, open, and industry-standard solutions.

This white paper analyzes the evolution of Linux from an operating system at the margin to one increasingly being deployed as the platform for business-critical applications. It looks at the contributions that VERITAS Software and IBM are bringing to the Linux market, helping take Linux to the next level. The configurations evaluated here include elements from VERITAS, IBM, and Red Hat. These solutions typically are built on IBM xSeries systems, using software from VERITAS, IBM, and Red Hat to build out an Intel-based solution that provides an alternative that offers levels of service not traditionally associated with servers based on Intel Architectures.

We also examine an important, business-critical solution currently up and running at eBay, the world's leading online auction company, that is based on VERITAS storage software and IBM eServer systems.

Looking ahead, IDC forecasts call for Linux server operating environments (SOEs) to be one of two platforms to experience growth through 2006, with that growth coming in part at the expense of Unix SOE new license shipments. As part of this transition, we see Linux poised for some degree of success in acting as a Unix replacement or as a supplemental server within a Unix-friendly environment. As a result, it is likely that Linux will compete for new deployments being made at shops traditionally favoring a Unix solution.

LINUX ADOPTION TRENDS IN THE ENTERPRISE

Linux was not always the force to be reckoned with that it is today. When commercial products first entered the market in the early 1990s, many competitors dismissed Linux as a fad that would be unlikely to mature into an enterprise-grade solution. Yet against the odds, Linux continued to evolve and improve. From 1999 to 2001, annual Linux SOE new license revenue shipments grew by 23% while installed base totals grew by 63%.

This growth has been accompanied by a dramatic increase in the level of industry support offered by vendors of hardware products in many categories, software product vendors, and providers of various types of professional services. Not surprisingly, the growth of Linux has varied based on workload area. In some respects, early Linux usage has similarities to early usage of Windows and Unix. Linux has been embraced and deployed by technical users who support themselves or smaller departments and those who may be outside the corporate IT umbrella.

The release of the 2.4.x kernel in early 2001 answered the common critique of limited scalability. Today, Linux offers good off-the-shelf scalability in up to 8-way configurations, although usage continues to be most common with uniprocessor, 2-way, and 4-way configurations.

Within IT departments, Linux has found a role in providing basic infrastructure services such as file, print, Web, and network support. IDC believes that Linux could today be classified as a mainstream choice for the functions that fall into one or more of the following categories:

- High-performance computing for research, engineering, academic, or digital content creation
- Modeling or scenario-based computing for financial services, manufacturing, and so forth
- Replicated, point-of-service applications in the banking, healthcare, retail, and travel industries
- Basic infrastructure workloads including print serving, file serving, and Web serving and other network infrastructure workloads such as providing DNS, DHCP, directory services, routing, and network backup services

Linux is also seen in pilot projects and technology evaluations in many other organizations. Linux is not, however, considered a mainstream choice for all functions in all industries. The availability of packaged software and robust, enterprise-class infrastructure management capabilities and the commercial support from the vendor community are still concerns in some industries and types of companies.

HOW ENTERPRISE READY IS LINUX?

Even before the release of the 2.4.x kernel, users were surprisingly confident in the capabilities of Linux. In a study conducted in 2001 prior to the launch of products including the 2.4.x kernel, IDC found that users rated Linux reliability on a par with commercial Unix distributions and operating systems quality just below that of commercial Unix versions. On the other hand, the same study, which compared user perceptions of AIX, Linux, NetWare, HP-UX, OS/390, OS/400, Solaris, Windows NT, and Windows 2000, ranked Linux applications availability at the bottom of the heap.

Despite an overall acceptance of Linux among IT professionals, there is a big difference between holding a favorable perception of a product and a willingness to stake one's career on it. Other IDC research has found that IT professionals are often not confident enough with a Linux infrastructure to act as an advocate for such a solution within their corporate environments. There are a number of reasons for this caution. Perhaps first among them is the relative immaturity of Linux solutions. As with other new solutions that enter the market, Linux initially did not enjoy the support of third-party vendors offering the supporting software and hardware infrastructure commonly deployed in a Unix environment.

This infrastructure support includes hardware/software technologies such as network attached storage (NAS), storage area network (SAN) connectivity, and related management tools. Infrastructure software technologies that were lacking from a Linux solution included distributed file systems, journaling file systems, storage volume management tools, system management tools, storage management tools, and commercial clustering technologies.

Interestingly, while many of these technologies were not initially available for Linux, existing enterprise-grade solutions were commonly available for Unix environments. For vendors of those technologies, moving those technologies to Linux often represented more of a business decision than a technology decision. After all, both Unix and Linux support the same POSIX operating system interfaces, have similar development and deployment tools, and are based upon similar architectural philosophies.

Developments during 2001 and 2002, including the release and commercial delivery of the 2.4.x kernel, the introduction of Red Hat Advanced Server — a high-end version of Linux designed for large-environment deployment — and vastly improved third-party independent software vendor (ISV) support, have set the stage for Linux to be taken seriously for business-critical applications in market segments in which it has traditionally not been a factor.

In an initiative similar to Red Hat's Advanced Server product, the UnitedLinux organization was formed earlier this year through a partnership of Connectiva, SuSE, The SCO Group, and TurboLinux. Like Red Hat's goal with Advanced Server, the UnitedLinux organization is also targeting the development of enterprise-grade capabilities. UnitedLinux environments are supported aboard IBM's xSeries hardware and already are (or will be) supported by VERITAS and other ISVs.

In parallel with the improvement and growth of the Linux kernel, distributions, and supporting ISV tools and applications, there has been a fundamental shift in the adoption and growth of Intel-based industry-standard server platforms in the last few years. No longer relegated to file and print, collaborative, and Internet-edge workloads, industry-standard server technology has been catapulted into the back end of the datacenter by advancements in the software stack as well as the reliability and scalability of the systems themselves. As a result, volume servers (defined by IDC to be servers with an average sales value below $25,000) have increased their share of overall server

spending from 26% in 1997 to 39% in 2001 and are expected to represent more than 43% of the spending on server hardware in 2003.

As a result of these advancements, given the right stack of supporting software and Intel-based industry-standard hardware, the Linux operating environment now can be configured to offer similar levels of performance, reliability, manageability, and adequate scalability when compared with existing RISC-based Unix solutions. Linux can now arguably be configured in such a way that it is qualified to support critical applications, application services, or network services for larger organizations today.

ENTERPRISE WORKLOADS THAT ARE SUITED FOR LINUX

Linux has historically been utilized for high-performance computing, infrastructure services, and replicated site applications. Early adopters were often technically savvy and more than likely to write some of their own application packages. Another related group of technically savvy users used applications developed by the community of which they were a part. Still other early adopters leveraged open source application software to build out their basic infrastructure layer on top of Linux.

Today, Linux is transitioning into more general-purpose deployments and finding its way into less technically proficient installations. One aspect of this transition includes replacing lower-end Unix system configurations. Another is the expectation that the operating system and associated tools have become mature and simple enough for administrative management and production applications.

One example that typifies this movement into supporting general applications on Linux but also highlights the type of user organization likely to do so is paint retailer Sherwin-Williams. This company's technically savvy IT department is converting in-store point-of-sale application servers currently running an older release of SCO Unix over to Red Hat Linux on IBM xSeries eServer hardware. Sherwin-Williams' corporate IT department supports a proprietary application at each retail location that calculates formulas for mixing custom paint colors. This same system doubles as a personal productivity platform for light office functionality.

Another development that IDC expects will accelerate the adoption of Linux is the availability of database software such as the Oracle9*i* RAC database management system software. The combination of Oracle9*i* RAC and Linux allows users to develop relatively inexpensive, highly available configurations of Linux for database workloads.

High-availability databases and business applications demand a new level of storage and data management capabilities. Such capabilities are now reaching the market in the form of more robust disk, network, and data management software for Linux.

IDC notes that outside these developments for Linux on IA-32 hardware, Linux has made inroads on virtually every major hardware platform in the industry. IBM, for example, currently supports Linux as a native operating system aboard every product in its server family, including the pSeries, iSeries, and zSeries systems.

GENERAL APPLICATIONS: THE NEXT CHALLENGE

The Sherwin-Williams Linux deployment described above illustrates what today is the most common scenario for Linux deployment as a general-purpose application server — running proprietary, in-house applications. IDC has long awaited the increase in deployment of Linux application servers that would include deployment of packaged application software.

IDC has repeatedly noted the significant lack of packaged software as an impediment to the use of Linux outside its historical role as an infrastructure server. Supporting application workloads is clearly the next hurdle that Linux must clear to become an enterprisewide SOE solution in corporate settings.

Application environments such as Lotus Domino, Pick, and M have been ported to Linux and have brought with them thousands of vertical market applications. IDC expects an increasing number of packaged software products to be launched on Linux over time.

Defining Enterprise Applications

While some users classify many workloads as being *enterprise applications*, this term is both vague and broad. IDC notes that all organizations are "enterprises," regardless of amount of revenue or number of employees. Vendors often use the term *enterprise* to create the perception that their product offers high levels of performance, scales to support large numbers of users and the largest possible database, or achieves some other very large metric without really indicating what their product will do.

To truly classify a given application as an "enterprise" application, companies should answer the following questions in the affirmative:

- Does the use of this product have a direct impact on each customer?
- Does the use of this product have a direct impact on each employee?
- Does the use of this product have a direct impact on each partner or supplier?
- If this product fails to function, will the organization go out of business or not be able to function?

If the answers to these questions are "no," then the product likely cannot be classified as one supporting enterprisewide operations. In particular, the last question, regarding the ability of the organization to function, is key. One way of judging the importance of an application is asking whether it is critical to the operations or success of an organization. eCommerce systems, for example, are the lifeblood of many

organizations, and their revenues would dry up in the event of system failure, causing monumental problems. On the other hand, a malfunctioning human resources benefits application might be only a temporary inconvenience, not a threat to the business itself.

Why Linux Is Increasingly Attractive

There are many reasons why Linux is an increasingly attractive choice for users. One is cost of acquisition: If hardware and software costs are critical decision factors, Linux solutions on Intel Architecture can offer attractive price points, particularly when compared with RISC/Unix system configurations.

On the other hand, if administration, operations, training, and other staffing costs are critical factors, Linux may or may not be mature enough for deployment. IDC notes that organizations having strong Unix expertise will be immediately comfortable with Linux and will likely find the cost of ongoing support to be similar to or less than that of a Unix platform. But organizations with deep experience in a Windows environment may not be as comfortable with the approaches used by Linux and may therefore face a steep learning curve.

Given the similarities of Linux and Unix operating environments and the increasingly compelling price/performance ratios offered by Intel-based servers, it is likely that the low end of the Unix market will be captured by Linux solutions.

Key Business Drivers for Linux

The key business drivers usually are derivatives of finding ways to lower costs and include the following:

- Increasing use of Intel Architecture or Intel-compatible architecture systems as a way to take advantage of high-volume platforms to reduce costs
- Centralizing functions previously hosted on many small systems onto a small number of much larger systems to lower costs of administration, operations, and support
- Purchasing packaged software wherever possible to reduce costs of development and support
- Addressing increasing concern with software licensing issues (Organizations are looking for ways to reduce software costs and asset management complexity and allow themselves greater levels of flexibility and vendor independence.)

Other business drivers usually are derivatives of finding ways to improve organizational revenue or profitability. Some drivers are:

- Creation of highly customized, highly adaptable systems that directly face customers
- Use of systems to better understand customer needs, wants, and purchasing behavior
- Ability to access system from any type of access point device, through any network, at any time

Total Cost of Ownership of Linux on Intel

IDC continuously conducts total cost of ownership (TCO) studies. We recently conducted TCO studies on Linux platforms compared with competitive environments. The conclusions of these studies, in general, were as follows:

- Acquisition costs are generally lower for a Linux-on-Intel solution compared to a RISC/Unix platform. Ongoing support costs can be similar or better for a Linux platform but are highly dependent upon the precise workload being deployed and the relative density of users supported (measured in total users per workload per server).
- A Linux-on-Intel solution generally has a lower acquisition cost than a Windows/Intel solution; however, ongoing support costs may or may not present a cost advantage. The ongoing costs of support will vary based on the type of workload deployed, the relative density of users supported, and the specific version of the Windows platform that is being used. Newer, more stable and scalable Windows platforms present a far better TCO story than older Windows SOEs.

TECHNOLOGIES REQUIRED FOR LINUX ENTERPRISE ADOPTION

The scenario that has been described here presents Linux as an attractive solution, with potential cost benefits, and in some cases, no significant downside. Yet the availability of application solutions continues to be an impediment to adoption, due in part to a chicken-and-egg issue among application solution ISVs.

ISVs correctly recognize that their large customers need more than a hardware platform, operating system, and application to build an enterprise-capable, supportable configuration. A complete system incorporates many system infrastructure software elements as well as management tools needed to round out an environment into a reliable, supportable, and manageable configuration. Yet many of the capabilities that enterprise users require either have not been available on Linux systems or do not possess the same level of maturity they do in Unix environments.

IDC believes that comparing Linux and Unix environments and identifying the enterprise-grade features and capabilities that exist in Unix but do not exist (or in some cases, have not until recently existed) for Linux can help explain why uptake on Linux for enterprise application deployment has been limited.

The following topic areas identify some of these critical issues. It is interesting to note that many of the technology areas to be discussed have long been critical elements of a Unix system deployment and have been instrumental in allowing Unix systems to compete for opportunities within large enterprise deployments and in datacenters. Meanwhile, solutions for Linux have been under development both by the open source developer community and by

commercial software vendors that are porting their products from Unix to Linux to expand their market opportunities. Such porting of commercial products tends to enrich the Linux environment by bringing with it the full complement of functionality developed to support Unix applications and environments.

Storage Software

Storage software manages and ensures the accessibility, availability, and performance of information stored on physical storage media. This category includes disk device and volume management, array management, data protection, and storage network management software but does not include operating systems or subsystems.

A classic Unix system deployment includes potentially very large storage subsystems. Because most enterprise Unix applications are built to leverage a commercial database, a large database structure often is housed aboard the storage subsystems. High levels of system reliability and application availability are fundamental requirements in these deployments.

Unix users typically use a number of software technologies to manage these large storage environments, including:

- **Backup and archive software.** Backup and archive software includes software to perform file and disk backup, restoration, and file archiving. It may also include hierarchical storage management (HSM) capabilities that allow the system to manage its own storage in accordance with best practices and policies set by an administrator. Software to assist in applying these policies to the other storage management disciplines and products that otherwise perform automatic file migration and demigration are also included.
- **Storage replication software.** Storage replication software includes software designed to create image copies of volumes or files via techniques such as clones, mirrors, and snapshots. Such copies may be used to perform online or "nearline" data recovery or to improve performance. This category also includes software that provides data disaster recovery capability, typically over long distances, as well as input/output (I/O) failover software. IDC does not include database replication software that operates at the database, table, or record level in this category.
- **Storage resource management software.** Storage resource management software provides for the management of storage as a resource and includes such functions as device discovery, topology mapping, monitoring, reporting, and configuration management as well as software that provides for SAN management, media management for tape and optical libraries, and volume and file management solutions.

Typical Unix installations also make use of homegrown or commercial storage utilities and various other software to manage storage, rather than system, functions. Examples include disk optimization and access accelerators, defragmentation and compression tools, and disaster recovery planning tools.

The growing popularity of Linux and its roots in the open source community have given rise to a wide variety of independently developed, standalone storage software products. Until recently, however, it has been difficult or impossible to assemble a coherent and integrated set of online storage management tools for Linux. This has acted to slow the rate of adoption of Linux as a large-scale business application platform.

Clustering and High-Availability Software

Clustering and high-availability software is part of a larger category of products called serverware. This technology is typically sold as independent system software that extends, coordinates, or "virtualizes" the resources provided by interconnected servers or nodes, regardless of their underlying processor architecture or operating system. It is often sold separately from the operating system upon which it runs.

The serverware market is segmented into the following four submarkets:

- **Clustering and availability software (CLAS).** CLAS virtualizes the system services of multiple systems so that they appear in some sense as a single computing resource. This market includes cluster managers and compute farm managers as well as load balancing software that stands between the user request and the processors or systems supporting applications or services. This software determines which processor or system has the most available capacity and routes the workload to that system.
- **Web server and Web acceleration software (WEBS).** WEBS allows systems or nodes to access files stored on a local server, or it can act as a relay station for information stored on other servers in the network. Web server software typically supports HTML- and/or XML-formatted documents and distributes them via HTTP.
- **Distributed file system (DFS) software.** DFS software allows remote systems to access files on a server. The applications on these remote systems, however, most often remain aware of the fact that they are using data from a remote system. Often, only one remote system is allowed to update shared files. Furthermore, these applications must use DFS functions to control multiuser access to prevent data corruption caused by several applications updating the same record at the same time. An effort is under way to develop a Linux Global File System (GFS), which synchronizes file access throughout the cluster, farm, or grid. GFS software can be seen as an extension or enhancement of basic distributed file system offerings.

- **Virtual user interface (VUI) software.** VUI software runs on servers and creates within the operating system a user interface that is virtualized for distribution to a nonnative environment. Terminal emulators, on the other hand, are not included in this category because they run on clients rather than on servers.

Broad Hardware Support

Finally, for Linux to be successful, it must support a broad array of computing, network, and storage hardware platforms, vastly expanding the deployment choices available to users. On the computing and general-purpose networking fronts, Linux has arguably far surpassed this requirement already. The operating system is available on Intel Architecture hardware platforms from IBM, Hewlett-Packard, Dell, Sun, and others and on RISC platforms made by HP (both Alpha and PA-RISC), IBM, SGI, and Sun Microsystems. Further, Linux is also available for hardware platforms including IBM's iSeries, pSeries, and zSeries and on numerous embedded devices. By contrast, the storage and storage networking support for Linux has progressed at a slower pace.

A LINUX IMPLEMENTATION INVOLVING VERITAS, IBM, AND RED HAT

This white paper next considers the viability of a Linux solution that uses Red Hat Advanced Server; IBM xSeries eServer hardware; and VERITAS' storage, clustering, and availability software. These three companies are working together closely to offer a robust platform that is capable of supporting business-critical workloads requiring the utmost in reliability, availability, scalability, and so forth.

VERITAS Storage Software

A solution based on either Linux or Unix will require some form of storage software. It is not unusual for a Linux or Unix installation to require, at a minimum, disk volume management (sometimes called disk virtualization) and backup and archive software, as well as, in many cases, more advanced storage resource management software. Larger configurations or those supporting business-critical applications will also use storage replication software either as part of a comprehensive data protection strategy or as a performance management tool. Finally, most configurations will utilize distributed file system software of some form.

VERITAS is noted for its ability to deliver storage management, data protection, and high-availability software on open systems platforms. Customers have routinely deployed its software aboard the largest Unix system configurations since the company began expanding into large enterprise deployments in the early 1990s. In January 2001, the company began shipping its backup product for Linux, and more recently, it announced that Linux would be treated as a tier 1 operating system, supported by nearly all of its storage software products. VERITAS' current products for the Linux market include:

- **VERITAS NetBackup DataCenter.** This product includes cross-platform policy-based backup to provide data protection for environments including Linux, Unix, Windows, and NetWare. It supports integrated backup and restore for Oracle databases and includes automatic device discovery and configuration, tape library management, priority and calendar scheduling, firewall enhanced authorization, and a number of other features that make it well suited for enterprise-level data protection. The product was first shipped for the Linux market in January 2001.
- **VERITAS Foundation Suite.** Foundation Suite is a collection of storage access and management tools. It includes the VERITAS Volume Manager, a tool that provides online volume management through storage virtualization. This allows the configuration, sharing, and management of storage without regard for the physical limitations of the disks or disk arrays in use. Volume Manager enhances real-time data protection through the use of mirroring and RAID technology and supports volume replication and point-in-time snapshots to support backup, decision support, and reporting processes. The VERITAS Foundation Suite also includes the VERITAS File System, a distributed, extent-based journaling file system that provides for rapid file system recovery in the event of an unexpected storage or server failure. The components of the VERITAS Foundation Suite support a wide range of enterprise-class storage and storage network products from leading vendors and are integrated with other VERITAS storage software products. In combination, they allow online management of large-scale storage environments without interrupting application or data access.
- **VERITAS Cluster Server.** This product provides clustering services for Unix, Windows, and Linux. It supports large clusters of up to 32 server nodes (depending on operating system) and can be configured for load balancing, replicated data clusters, and policy-based wide area disaster recovery. It can be used independently or in conjunction with other VERITAS software products to enhance application and system availability and disaster recovery. VERITAS Cluster Server includes support for all major third-party storage providers and a wide range of operating systems. The future direction of Cluster Server is to go beyond today's 32-node ceiling.

IBM X-Architecture Hardware Platform

Server workloads and applications are increasingly exposed to variable demand from organizations outside a company's firewall, including partners, suppliers, and customers. As a result, infrastructure solutions that support enterprise applications are being asked to be easily scalable (to meet this variable demand) and to provide high levels of availability (to meet customers' and partners' business challenges) while keeping capital costs low.

IBM's X-Architecture is designed to fulfill these market demands. The core goal of this architecture strategy within Big Blue is to bring mainframe-class availability, scalability, management, service, and

support to the Standard Intel Architecture Server (SIAS) market. IBM has been delivering technology to the SIAS space for the last four years with enhancements such as Active PCI C2T Interconnect cabling, Chipkill memory protection, Predictive Failure Analysis, Light Path Diagnostics, Director Software Rejuvenation, and others.

IBM's X-Architecture took another evolutionary jump forward in the first quarter of 2002 with the x440 server. The x440 allows customers to scale seamlessly from a 2-way SMP system up to a powerful 16-way server by adding additional 4-way processing nodes. Additionally, "scalability ports" allow I/O to scale just as seamlessly. The innovative XpandOnDemand design creates a truly "pay as you grow" architecture to meet the dynamic demands being placed on enterprise applications.

IDC believes that as applications and workloads increasingly become internetwork enabled, the modular architecture that the x440 has introduced to the market will become the standard for building datacenter hardware infrastructure. A modular building block approach to processing power, I/O, and storage provides the tools for IS managers to acquire and scale their datacenter services without excessive hardware capital expense. IDC's quarterly server research data reflects the market's demand for this approach. IBM's x440 server has allowed the company to increase its share of the 4-way+ SIAS market from 8% in 2Q00 to 20% by 2Q02. Even potentially more telling is that in 2Q02, IBM servers in this category grew 43% over the second quarter of the previous year while sales of the top 2 competitors declined by more than 25% in the same period.

In addition to confronting challenges concerning scaling resources to meet new or variable IT demand, IBM's x440 provides improved IT service availability through X-Architecture advancements in subsystem and component fault tolerance and, as part of IBM's Autonomic Computing strategy, improved reliability and tools for self-healing and self-optimization of server resources.

Focused software partnerships are one of the keystones that highlight the significance of IBM's value-add investment to industry-standard server architecture. The company's partnerships with the open source community, VERITAS, and VMware are excellent examples of investments IBM has made to enhance its value proposition to the industry-standard server ecosystem. VMware, for example, with its virtual-partitioning software, allows IT administrators to "slice" the server resources into multiple partitions — and to manage those partitions via IBM's Intelligent Resource Director (IRD) resource-management software. VERITAS, and the company's Cluster Server software, which provides increased application availability through automatic failover, highlighted in this document, is another key partnership.

Linux Operating System

Red Hat has been a key player in commercializing the Linux operating environment. IDC data shows that Red Hat's share of the Linux operating environment new license and maintenance revenue as growing from 16% in 1999 to 38% in 2001. In terms of worldwide SOE new license revenue unit shipments, Red Hat captured 59% of the market in 1999, growing that share to 73.5% in 2001. IDC's operating environments research analysts believe that Red Hat is positioned to be one of the long-term survivors in the Linux market segment.

Red Hat offers both a general-purpose distribution of Linux (which carries the naming convention of Red Hat Linux 7.x, 8.x, etc.) and a second version that has been developed with large enterprise needs in mind. The Red Hat Linux Advanced Server product was introduced early in 2001 to respond to some of the more problematic aspects of Linux (as perceived by enterprise users) including the high frequency of upgrades, difficulty of managing regression testing, and the lack of a long-term support infrastructure for outdated releases.

Red Hat Linux Advanced Server is provided on a subscription basis with one year of support services and access to Red Hat Network Enterprise Service. Red Hat has promised extended release cycles, and the product comes with pretested (and in some cases, certified) compatibility with ISV products from major players such as BEA, Computer Associates, and VERITAS as well as hardware vendors including Dell, HP, and IBM. Red Hat optimized this product by tuning the kernel functions for better I/O performance and better resource utilization.

IDC notes that Red Hat is not the only Linux distribution provider to recognize that current release cycles are incompatible with enterprise deployment. A key tenet of the UnitedLinux partnership is the development of an enterprise-grade SOE, with longer release and support cycles, better regression testing, and consistency between branded distributions to create a larger overall installed base. The final point is intended to act as an accelerator for ISVs that may be porting application products to Linux.

Key Benefits of the VERITAS/IBM/Red Hat Partnership

By cooperating and providing access to code in the early stages of the development cycle, VERITAS, IBM, and Red Hat have worked to ensure that their products successfully interoperate. Any required patches are created and integrated into open source, and the products undergo extensive joint certification and testing before release.

The companies have also agreed to share their road maps in an effort to continually expand the device and application support, robustness, performance, and scalability of the combined Linux solution. The availability of many configurations provides users with a great deal of flexibility, scalability, and performance. Organizations can select a platform that closely fits their needs today and have a number of growth options as their requirements change over time.

Ease of Integration into Existing Infrastructures

Linux is based upon the same international and industry standards that Unix supports. This means that Linux configurations can easily interoperate with any other standards-based platform. This strength is one of the major reasons that Linux is being increasingly considered as an add-on or a replacement system in Unix environments.

VERITAS' storage software running on a Linux host is capable of supporting client systems running on a wide range of server operating environments. And like the Linux operating system, it interoperates with and supports international and industry standards, so it fits in well with existing installed systems and storage devices.

Broad Hardware Support

Linux supports every major microprocessor family and systems from nearly every major supplier. VERITAS' Foundation Suite, as well as its backup and clustering software, has been tested for compatibility with storage systems and storage networking devices from all major vendors. The joint testing and certification process established by VERITAS, IBM, and Red Hat should provide a rich matrix of supported processors, systems, storage networking, and storage system devices.

VERITAS/IBM/Red Hat Joint Support Program

In the event that a problem should arise, the three companies have established a cooperative support approach that provides a unified front for user interaction. Once the customer has made initial contact and established a trouble ticket, the case will be actively managed, and any transfers of support will be handled through "warm" handoffs until the problem is resolved. Although each party provides its own support and maintenance, the customer interface remains simple and consistent throughout the support process.

Key Challenges Facing VERITAS/IBM/Red Hat

VERITAS, IBM, and Red Hat have combined to deliver a serviceable Linux server platform capable of supporting critical applications, application services, and network services in small and large organizations alike. Many potential challenges remain, however, to rapid and widespread adoption:

- **Application availability.** Users continue to be concerned about the availability of business and collaborative applications on Linux. As development and support for the operating system continue and as more applications become available, this concern should diminish, and adoption can be expected to accelerate.
- **User confidence.** IDC surveys have found that the Linux operating environment enjoys a widespread favorable perception among IT professionals. Such favorable impressions are not the same as confidence in the solution, however, and any lack of confidence will slow the adoption of the platform. Continuing maturation of the operating system and increased third-party support will help boost confidence, but this will take time.

- **Taking Linux seriously for business.** Many organizations still see Linux in the context of its roots in the open source and technical computing communities rather than as an appropriate operating environment for business applications. As more and more companies offer proof of Linux viability in business-critical applications, however, sentiment will change.

CONCLUSION AND RECOMMENDATIONS

By combining their strengths, VERITAS, IBM, and Red Hat have created a Linux platform they hope will be accepted as a viable and cost-effective alternative to other open systems server offerings. It has a manageable release cycle, worldwide customer-oriented support, and a robust set of storage management and high-availability software tools. Customers should be mindful of the growing application availability for Linux and consider this new offering in their evaluation of new application or infrastructure server platforms.

CASE STUDY: EBAY REDUCES STORAGE COSTS AND IMPROVES PERFORMANCE WITH VERITAS VOLUME MANAGER AND IBM SERVERS

eBay has experienced exceptional growth since its founding in September 1995. eBay is the leading online marketplace for the sale of goods and services by a diverse community of individuals and businesses. Today, the eBay community has 61.7 million registered users worldwide. Profitable since its launch, eBay totaled $1.21 billion in net revenue for 2002. The company is one of the few Internet firms that have managed to thrive in the midst of an unprecedented economic downturn. eBay acts as a trading venue for sales of all types of goods in multiple geographies worldwide. Originally established as a consumer-to-consumer marketplace, eBay has added automobiles, real estate, vacations, business equipment, and other products aimed at both businesses and consumers. At any given time, approximately 12 million items are available worldwide each day.

As a result of rapid expansion in the number of customers and transactions, eBay sought to implement a server farm, consisting of many low-end Linux servers for servicing millions of SMTP transactions per day. The company evaluated the open source Linux LVM solution, but this is still largely unsupported code and has fewer features and less performance than some of the alternatives. Partly because the company was already using VERITAS across a key computing environment, it decided to implement VERITAS Volume Manager for storage management on Red Hat Linux. VERITAS Volume Manager is aimed at organizations that require uninterrupted and consistent access to mission-critical data. Volume Manager reduces planned and unplanned downtime and ensures high availability of data, optimized I/O performance, and freedom of choice in storage hardware investments. This choice made sense from an administration standpoint and also allowed the company to use standard Intel-based hardware. The VERITAS solution runs on

Red Hat Linux 7.2 running on IBM xSeries x330s (2x1.133GHz, 2GB memory) with IBM ServeRaid 4Lx RAID controllers, connected to split IBM EXP300 disk trays (six disks RAID 0+1 per machine, plus one spare). Each machine is running Sendmail 8.12.3.

One reason why eBay chose the VERITAS/IBM/Red Hat solution was that the company sought to maximize its investment in hardware. This made the choice of running Linux a good option because eBay found that Linux is easy to manage and easy to find support for (from both vendors and the public domain). eBay had prior experience with the Red Hat distribution, making it an easy fit into the company's support model. On the hardware side, eBay found the x330s to be very reliable, having good features for troubleshooting and error detection. IBM Enterprise X-Architecture (EXA) provides solid performance on the Intel platform with significantly reduced total costs of ownership for implementing mission-critical applications. The EXP300 trays support Ultra160 SCSI, are modular for field serving, and support hot-swapping of the disks. eBay already had an existing business relationship with IBM, which made implementation and support quite easy.

Volume Manager for Linux allows eBay to configure its RAID storage to give it a very efficient layout for SMTP transactions. Without the VERITAS solution, eBay believes that it would have been forced to use a less than ideal file system layout, potentially requiring more disks to do the same amount of work. VERITAS File System gives the company a reliable, journaling file system, which means quick recovery times should an interruption in service occur. This fast recovery allows eBay to get the machines back in service and mail flowing more quickly.

eBay has high praise for the VERITAS product and support, noting that support calls are always routed to knowledgeable technicians. All in all, the company is quite satisfied with having taken the VERITAS/IBM/Red Hat approach.

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03C3606SOFTWA3606
March 2003

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