



Server Virtualization in the Scalable Enterprise

Server virtualization—a core enabling technology for computing infrastructure now and into the future—can bring measurable benefits to corporations today, including simplified operations, better resource utilization and cost-effective scalability to meet business demands. As this important technology evolves, Dell will continue to drive standards development and deliver standards-based solutions that promote customer choice and control.

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EXECUTIVE SUMMARY

Virtualization is among the hottest topics in computing today. It is also a technology that is in the midst of a multi-year evolution from its origins as a discrete layer of middleware to becoming part of the base infrastructure of industry-standard servers and operating systems.

This paper looks beyond the short-term hype and possible confusion and explains the role of server virtualization within the broader context of enterprise computing. In addition, it will explore the important attributes that server virtualization brings to Dell's Scalable Enterprise strategy.

THE SCALABLE ENTERPRISE

Dell's enterprise strategy—the Scalable Enterprise—is focused on standardizing core elements of the computing infrastructure to reduce complexity and deliver superior value. Systemic standardization, and the resulting interoperability, enables organizations to build advanced, scaled-out solutions from standard hardware building blocks and best-of-breed software components.

Why is this important? Time has proven that mainstream, standardized technologies—whose development has been fueled by market volume and competitive pressures—deliver optimized, sustainable technology innovation with the highest level of value. A simple look at where the investments and innovations are taking place in the IT industry today reinforces in the power of standards, interoperability and integration.

The Scalable Enterprise:

- Is an open, multipurpose architecture
- Is standards-based
- Enables optimized use of resources
- Anticipates incremental growth
- Supports virtually limitless expansion



Dell is unique among the world's top IT providers in that its Scalable Enterprise strategy is built upon, and demands, industry standards. The Scalable Enterprise charts a phased, practical roadmap for building the IT infrastructure of the future based on standardized technologies. Thus, organizations may avoid closed architectures that make promises based on proprietary shortcuts that serve only to drive costs up while limiting flexibility and control. Dell, on the other hand, works with industry-leading partners to drive toward a no-compromises approach where users don't sacrifice openness to gain the value-added benefits of an advanced architecture.

The net result of Dell's Scalable Enterprise strategy is that companies can gain organizational benefits through simplified operations, improved utilization and the ability to cost-effectively scale their IT infrastructure to meet changing business demands.

WHAT IS VIRTUALIZATION?

Virtualization is a core enabling technology of the Scalable Enterprise. Simply put, virtualization decouples software from hardware and presents a logical view of physical hardware to software. In other words, a single server can act and behave as multiple, independent servers.

Virtualization is a basic tenet of computing. Forms of it show up in a variety of constructs meant to abstract the interface of a resource from its physical implementation. Examples include storage (RAID or logical volumes), networking (VLAN), and Web services APIs. Server virtualization applies the same concept to industry-standard servers.

Server virtualization is enabled primarily by a piece of software (often called the hypervisor) that sits between the server hardware and the operating system. This software provides a container that presents a logical hardware interface, to an operating system. This operating system (guest OS), along with any applications or other software running on it, thinks it is running on a physical server and is known as a virtual machine (VM).

This logical interface enables hardware resources to be partitioned and shared among multiple guest operating systems, allowing servers to be utilized more fully. Additionally, a VM—including the associated operating system, applications and data—is stored as a large file on the physical system. Administrators can easily transfer a VM from one physical system to another or save it on shared storage so that multiple systems may access it as business needs dictate.

VIRTUALIZATION'S ROLE IN IT INFRASTRUCTURE

Server virtualization helps deliver benefits in three primary ways:

- **Simplifying operations.** Server virtualization effectively hides hardware details from software, allowing the hardware to be truly interchangeable without affecting the software.

Virtualization can simplify operations by:

- Ensuring workload portability across multiple servers. This includes the ability to “re-host” software, including legacy OSs that are no longer supported, on new servers.
- Streamlining application development and platform certification by certifying to a common virtual interface rather than multiple implementations or generations of physical hardware.
- Encapsulating complex configurations into a file that is easily replicated and provisioned.

- **Improving utilization and uptime.** Server virtualization helps organizations gain optimal use of existing resources. A single physical server may now host many virtual workloads that previously would have required many physical servers. Additionally, because workloads can be relocated or replicated easily, administrators can move them when performing maintenance without affecting service levels, and quickly provision new servers on the fly, as needed.

Virtualization helps improve utilization and uptime by:

- Enabling safe resource sharing on industry-standard servers—if one virtual server fails, the others aren't affected.
- Leveraging the ability to migrate workloads dynamically from one physical server to another. Thus, workload SLAs can automatically match demand with capacity, and system maintenance may be performed without disrupting business services.
- Empowering disaster recovery operations by restoring lost services regardless of the target physical platforms providing the service.

- **Scaling cost-effectively.** The management and utilization benefits brought by server virtualization facilitate cost-effective, “pay as you grow” scalability across a common, standards-based infrastructure.

Virtualization supports cost-effective scaling by:

- Separating the OS/application workload from the physical server and enabling dynamic scaling through resource sharing and rapid provisioning
- Leveraging and optimizing industry-standard hardware, which delivers sustained, incremental performance improvements at consistent, competitive prices.

DELL: DRIVING VIRTUALIZATION TOWARD STANDARDIZATION

Server virtualization is still in the early stages of a multi-year evolution that will culminate with the technology being integrated as a standard component of the base IT infrastructure. However, virtualization technologies can be deployed effectively today to deliver near-term benefits.

Dell is currently engaged in a number of activities to help ensure effective deployment of virtualization technologies today and tomorrow.

USAGE SENARIOS

Although server virtualization is still an evolving technology, it is a tool that can and should be incorporated into today's IT infrastructure to help increase effectiveness. Following is a description of existing usage cases that can be deployed effectively today.

Legacy OS support. Virtualization allows for continued support of guest operating systems and applications, and provides long-term stability and support in a static environment. By decoupling hardware from the host OS, each can evolve without disrupting the other environment.

Software development and test. Virtualization enables companies to create an environment for software development and testing without adding more physical servers. It provides a private environment in which to develop software and a pristine environment in which to deploy it for testing. Multiple virtual servers may be used to create a multi-server environment for distributed testing on a single physical server.

Additionally, IT departments can test patches and upgrades to copies of their exact environment without fear of corruption or end-user downtime. Virtual machines, since they are stored in a flat file,

can be set up in minutes and used multiple times. Certain software versions also have an “undo” option to roll back changes to a virtual machine.

Workload consolidation. Virtualization can accommodate many applications that do not coexist well in a conventional environment on a single platform, as the isolation between multiple guest OSs provides distinct execution environments that do not overlap. The resulting improved utilization helps increase return on assets.

Software distribution. Virtualization provides a reliable and portable distribution mechanism for software that is supported on multiple hardware platforms. Virtualization software combines the image of OS and application and creates a portable “wrapper”—allowing for application deployment on any server supporting the guest OS. The host/guest support helps to eliminate recertifica-

tion of applications on multiple platforms, provided the guest OS is supported by the host.

Load balancing. Virtualization creates a highly reliable mechanism for load balancing across a pool of cost-effective resources. Load balancing is achieved by allowing guests to be transported among multiple physical machines. This provides a robust and cost-effective environment and minimizes exposure to hardware failure.

Disaster recovery. Virtualization creates a highly reliable mechanism for reprovisioning and restoring execution environments delivered by virtual machines in the event of a disaster. The encapsulation of VMs provides distinct execution environments that can be renewed as needed. Several products are available that support this unique and cost-effective environment for disaster recovery.

Influence for Today

1. Dell Labs. A number of labs at Dell are working on practical implementation details around virtualization solutions. The Solutions Engineering lab works closely with Dell software partners to certify interoperability between Dell hardware and required drivers and virtualization solutions. The Scalable Enterprise Technology Center creates scalable enterprise reference architectures, including virtualization, to show customers how to build and maintain these solutions. The Technology Showcase gives in-depth technical briefings to customers who want to learn more about virtualization and how it should be implemented in their environment. Each of these labs' work helps customers more confidently and quickly adopt and implement virtualization solutions today.

2. Practical publications. Dell delivers a set of simple, pragmatic publications to help customers understand a variety of subjects associated with virtualization (see "Reading Material," below).

3. Platform management standards. One of the key objectives influencing virtualization is the management of the underlying platform building blocks. Dell is committed to providing platform management as defined by the Distributed Management Task Force (DMTF) and the Server Management Working Group (SMWG). Specifically, Dell has been a key contributor to the development of the System Management of Advanced Server Hardware (SMASH) and the recently ratified specification described below (for further details, visit www.dmtf.org/standards/smash).

The SMASH specification defines architectural semantics, industry-standard protocols and profiles to unify the management of the data center. These include the Command Line Protocol (CLP) specification, which enables simple and intuitive management of heterogeneous servers in the data center. Management occurs independently of machine state, operating system state, server system topology or access method, which facilitates local and remote management of server hardware in out-of-service and out-of-band management environments. Extensions supporting the management of virtual machines and their connection to physical resources are in progress. Further work on virtual machine/platform management and standardization is being conducted by the Virtualization, Partitioning and Clustering subgroup of the DMTF, which is charged with defining schema for the management of virtual machine resources and their dependencies (see www.dmtf.org for further information).

READING MATERIAL

Dell provides a number of educational publications on virtualization and related technologies, including:

- Introducing VMware ESX Server, VirtualCenter, and VMotion on Dell PowerEdge Servers
- Deploying Dell OpenManage on VMware ESX Server
- Virtualization as an Enterprise Computing Infrastructure
- Using Virtual Machines to Simulate Complex IT Environments
- Evaluating Price/Performance of VMware ESX Server on Dell PowerEdge Servers
- Dell and VMware: Partnering to Deliver VMware Virtualization Software on Dell PowerEdge Servers
- Implications of Virtualization for Image Deployment
- VMware Virtualization Software on Dell Blade Servers
- Implementing Fault Tolerance Through VMware Scripting and Dell OpenManage
- Using Intel Multi-Port Server Adapters to Enable Virtual Infrastructure in the Data Center
- An Overview of Xen Virtualization
- Architectural Considerations for Creating High-Availability VMware VirtualCenter Infrastructures
- Enabling VMware ESX Server VLAN Network Configurations for the Dell PowerEdge 1855 Blade Server
- VMware ESX Server Performance on Dell PowerEdge 2850 and PowerEdge 6850 Servers

To access the complete list of publications, visit www.dell.com/powersolutions

This focus on the management of virtualization, and integration into general systems management tools, is very important for customers to consider. Not only does virtualization introduce new capabilities requiring new management interfaces, but some things remain the same, and the use and integration into standard tools and processes are key. For example, if you now have a single server doing what 10 servers used to do, you have 9 fewer servers to manage. But you still have 10 operating systems, 10 applications, and the virtualization layer. Integrated, standardized systems management options are the most obvious way to help address these issues.

Impact for Tomorrow

As we look to the future, Dell will focus on several key areas it deems essential to streamlining the evolution of virtualization.

1. Standard interfaces between the virtual machine resource manager and VM operational interfaces. Every managed element within a virtualized environment is associated with a resource manager. Typical functions consist of local operations within a VM, or the management of multiple VMs. As such, the interface must be standardized and appropriate for multiple types of virtual machines.

2. Virtual Machine Monitor (VMM) interoperability layer. The VMM is the interface that links each virtual machine to the underlying hardware resource. To date, successful virtualization schemes have either replaced or emulated instructions to enable virtualization. Recently, CPU and operating system suppliers have started adding support for virtualization that will eliminate this need. While it is unlikely that there will be a single common hypervisor implementation, it is important that a common interoperability mechanism be developed that minimizes differences.

3. Virtual hard disk interoperability. Today, there are at least two competing standards for the virtual hard disk format. One common standard must emerge for all virtualization schemes to support heterogeneous guest operating environments.

As these standards evolve, server virtualization, as a technology, will also impact:

- Software distribution: By creating a file-based distribution of server configurations, virtualization could dramatically simplify how servers are configured and provisioned.
- Dynamic, policy-driven resource allocation: Virtualization enables workload portability between servers. Because virtual servers can be migrated easily from one physical server to another without interrupting server operations, resources can be rebalanced dynamically to meet computing needs.

This drive toward standards will allow customers to avoid vendor lock-in, retain choice and control over their IT environment, have more ready access to resources to deploy and maintain a virtual environment, and ultimately drive better value as market forces compete for customers' virtualization dollars.

TOWARD A VIRTUAL TOMORROW

Server virtualization is a powerful technology that can significantly improve manageability and resource utilization. Although the technology is still maturing, current technologies deliver tangible benefits, particularly in the areas of:

- Supporting server consolidation
- Streamlining development and test environments
- Improving business continuity
- Increasing IT responsiveness

Over time, Dell believes that virtualization will become a standard feature of every industry-standard server system deployed. Organizations should begin actively evaluating and implementing current technologies to realize these benefits today, and to lay the foundation for broad-scale implementation, enabling the Scalable Enterprise, tomorrow.

Dell is taking an active role in bringing virtualization to the mainstream by working closely with industry leaders to enable current technologies and to help drive interface and management standards. Today, Dell delivers fully tested, proven virtualization infrastructure solutions along with services designed to streamline implementation and support. By maintaining a firm commitment to standards, Dell enables organizations to achieve a dynamic, scalable IT infra-

structure, while retaining choice and control.

- 1. The Scalable Enterprise is unique in that it is focused on standards.** It does not depend upon proprietary shortcuts to achieve a dynamic, automated IT infrastructure.
- 2. Virtualization is one of the essential technologies enabling the Scalable Enterprise.** To ensure customer value, Dell is driving the ecosystem toward a longer-term, standards-based approach.
- 3. Dell is a leader in industry-standard server virtualization today.** Dell offers compelling, well-tested solutions and focused services geared toward simplifying the use of virtualization. Then, Dell provides pragmatic guidance and best practices to help companies with their deployment efforts.

For more information on Dell's virtualization solutions, visit www.dell.com/virtualization ■



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