WHITE PAPER

VMware Infrastructure for SAP Enterprise Applications – Use Cases

vmware®

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Introduction

Virtualization allows you to run multiple applications and operating systems independently on a single server. Administrators can quickly move workloads from one virtual workspace to another - easily prioritizing business needs while maximizing server resources.

The combined strength of Dell, AMD, and VMware can deliver significant benefits for small, medium and large organizations across all industries and sectors in many ways:

- Increase operational flexibility and efficiency: Quick deployment of software applications and services and shorten time to productivity.
- Realize transformative cost savings: Low ownership (TCO) from virtualized IT infrastructures that can enable effective use of budget resources and help decrease operational costs
- Mitigate risk and enhance IT service levels: Zero-downtime maintenance capabilities and rapid recovery times for high availability and streamlined disaster recovery scenarios across the data center.
- Optimize IT environments: VMware® virtual infrastructures help optimize and manage the enterprise-from Dell™ PowerEdge™ servers to Dell OptiPlex™ desktops.

Flexibility in the allocation of computing capacity allows the consolidation of applications and servers. This eases IT management requirements and expenses and Dell's "pay-as-you-grow" Scalable Enterprise model can help you control computing costs.

SAP has more than 38,000 customers in 120 countries. This represents 100,600 SAP installations for more than 12 million users. The collaboration between VMware, AMD, and Dell provides unique value to our SAP customers. VMware, AMD and Dell have received requests from customers to understand how virtualization can play a role within SAP deployments. Collectively they have evaluated what a customer should expect from such a deployment. This document discusses the benefits of running SAP Enterprise Applications and Business Solutions on VMware Infrastructure. The paper covers use cases that range from server containment to disaster recovery, demonstrating tangible cost reduction, operational efficiency and time-saving benefits.

SAP Platform Overview

Businesses large and small have discovered that the SAP® Business Suite is one of the world's most comprehensive families of adaptive business applications, providing outstanding functionality built for comprehensive integration, industry-specific functionality, ultimate scalability, and easy collaboration over the Internet.

Individually, SAP Business Suite applications help customers manage their most critical business processes. Collectively, they form a tightly integrated suite that adds value to every facet of the customer's business, including their interactions with partners, suppliers and end customers.

The core product from SAP is called SAP ERP. In addition to ERP software, other key SAP product and solution offerings include:

- SAP NetWeaver® Business Intelligence Suite (SAP BI)
- Customer Relationship Management (SAP CRM)
- Supply Chain Management (SAP SCM)
- Supplier Relationship Management (SAP SRM)

- Human Resource Management Systems (SAP HRMS)
- Product Lifecycle Management (SAP PLM)
- Exchange Infrastructure (XI)
- Enterprise Portal (EP)
- SAP Knowledge Warehouse (KW)

The SAP Business Suite applications are based on the SAP NetWeaver platform, an application and integration platform. SAP NetWeaver enables rapid but controlled business process change. Through its enterprise services repository, the platform incorporates business functionality in the form of ready-to-use enterprise services and process components. It also provides an integrated platform of composition technologies for orchestrating business processes, composing applications, and deploying innovative solutions.

The SAP Business Suite can reduce total cost of ownership across an IT environment. Organizations that want to respond quickly to changing business requirements can greatly benefit from implementing SAP.

SAP enterprise applications can be deployed in two or three-tier architecture. In terms of software deployment, the three-tier client/server architecture consists of a presentation layer, an application layer, and a database layer. In terms of hardware deployment, these three layers can run separately on different computers or all together on the same computer, depending on the requirements and size of the SAP solution being deployed by each customer. The presentation and application server layers can be distributed over multiple computers. The three-tier architecture scales to support a large numbers of users. The two-tier architecture is usually sufficient for many smaller and midsize companies, as well as for sandbox, development, training and test systems.

Virtualization with Dell, AMD and VMware

AMD Opteron™ processor-based servers provide a robust foundation for maximizing the benefits of virtualization software, such as VMware® ESX Server. With simultaneous 32-bit and 64-bit computing capabilities, the AMD Opteron processor is well suited for the demands of server virtualization. The processor's Direct Connect Architecture features an integrated memory controller and HyperTransport™ technology, enabling more efficient memory and I/O access.

SAP systems benefit from this architecture, especially in I/O intensive deployments. AMD Virtualization™ (AMD-V™) allows 64-bit guest systems with VMware—infrastructure, which will help minimize overhead in virtualizing x86 platforms. Second Generation AMD Opteron™ processor products like the AMD Native Quad-Core processors expected to be launched in 2007 will contain significant enhancements to AMD-V such as Nested Paging acceleration, Tagged Translation Look-aside Buffers and faster World Switches for passing execution control between hypervisor and guest. AMD-V enhancements will be designed to result in better performance in many disk and memory intensive workloads.

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 can enable 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.

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.

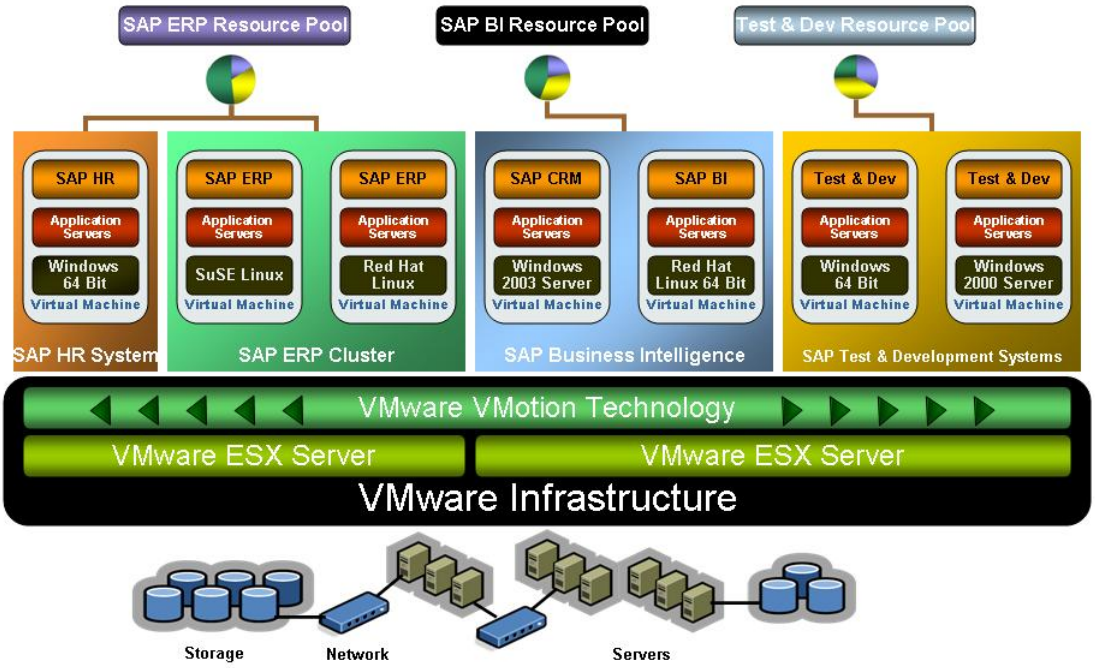
For more information visit www.dell.com/virtualization, www.dell.com/sap or contact sap_sizing@dell.com.

VMware® Infrastructure is one of the most widely deployed software suites for optimizing and managing industry standard IT environments through virtualization – from the desktop to the data center. An excellent production-ready virtualization software suite, VMware Infrastructure is proven to deliver results to more than 20,000 customers of all sizes, and for a wide variety of environments and applications. The suite is fully optimized, rigorously tested and certified for the widest range of hardware, operating systems and software applications. VMware Infrastructure provides built-in management, resource optimization, application availability and operational automation capabilities that can deliver transformative cost savings and help increase operational efficiency, flexibility and IT service levels.

Solution Architecture

A complete SAP implementation can consist of tens to a hundred servers with different SAP applications running on dedicated servers. Depending on the layer of the application stack and the processing demands at month-end, many SAP environments may have a low server utilization rate. Those with low utilization rates may be worthwhile targets for virtualization with VMware Infrastructure.

Figure 1 shows a graphic representation of the architecture for running SAP Enterprise Applications on VMware Infrastructure. It demonstrates the ability to run several applications on the same physical server by creating virtual machines containing the SAP application components and the operating system of choice. Using VMware Infrastructure makes it possible to deploy virtual machines running different operating systems on the same physical server. The graphic in Figure 1 represents a sample architecture. It is critical to evaluate the usage of each SAP solution at their collective peak loads to determine which solutions could be deployed on the same physical server. A sizing should be done to determine the CPU, memory and I/O requirements as well as the characterization of each solution in order to determine what can be run together.



Benchmarks performed on an AMD Opteron processor-based Dell PowerEdge™ 6950 server shows that a large number of users can be supported on multiple virtual machines on the same physical server. Detailed information about the setup and tests are available from AMD in a technical specification sheet.

Server Containment

In traditional SAP deployments, there can be significant server sprawl primarily due to the need to provision separate systems for Development (DEV), Quality Assurance/Test (QAS) and Production (PRD) environments. Each SAP solution typically has its own system landscape, each containing at minimum a DEV, QAS and PRD environment. SAP Enterprise environments also can contain multiple layers in the application architecture including the database, application server and web server layers. Typically every layer of the environment would be hosted on dedicated physical systems that are not always fully utilized at all times.

VMware virtualization technology is able to contain server sprawl by running SAP application layers in virtual machines consolidated onto fewer, highly scalable and reliable enterprise-class servers which leads to increased server utilization.

Approximately 66% of all new SAP installations are deployed on Microsoft Windows. Often these implementations have application servers that have low CPU utilization rates. These are candidates for virtualization. Analysis should be performed to determine which layers in the stack are appropriate for consolidation. For example, Database servers may have higher loads at various periods and may need to remain as dedicated resources. (The Dell|SAP Competence Center can assist in providing guidance based upon your implementation).

Customer success stories include SAP hosting companies that deploy SAP on VMware Infrastructure and provide a 25-30% price advantage to their customers while providing the same service levels. Other customers have experienced infrastructure savings of $2 million over 3 years after consolidating and migrating from a proprietary environment to a Windows environment running on VMware infrastructure.

Key Benefits:

1. Dedicated and isolated SAP developer environments containing multiple tiers of the application for all developers and consolidated to run on a single physical system.
2. Multiple SAP enterprise applications on the same physical system can provide consolidation and helping to lower total cost of ownership (TCO).
3. Multiple OS and SAP versions on the same system reducing the need for dedicated hardware and can also provide for interoperability.
4. Multiple Test environments sharing the same physical system reducing the need for dedicated test systems. It should be noted that best practices state that the QAS/Test architecture should match closely to that of Production. Therefore, careful consideration should be given to the architecture deployed in each environment within a system landscape.

Customers using VMware Infrastructure have been able to consolidate multiple virtual machines per physical processor, thereby drastically increasing server utilization and containing server sprawl.

Rapid Provisioning

VMware virtualization solutions reduce the time to provision new SAP (development, test or production) application environments. Typically, for a new deployment, it is required to procure new hardware, install the operating system and then the applications. This process takes time and IT resources, in addition to the need for dedicated hardware. While using VMware Infrastructure, SAP customers can take advantage of Virtual Machine Libraries and Virtual Machine Templates to provision new pre-configured SAP application environments in minutes on virtualized infrastructure hardware. Customers can also use the VMware Lab Manager solution to automate the setup, capture, storage and sharing of multi-machine software configurations to streamline development and test environments. Development and test teams can access them on-demand through a self-service portal. With its shared library and shared pool of virtualized servers, VMware Lab Manager lets you efficiently move and share multi-machine configurations across software development and test teams and facilities.

VMware Infrastructure provides for rapid SAP application deployments with sophisticated automation capabilities, centralized control and responsibility for hardware resources while giving business units and application owners control over how resources are utilized.

Potential Key Benefits:

1. Rapid Provisioning of new SAP application layers from VM templates.
2. SAP development images can be passed directly to testers.
3. Testers can pass SAP virtual machine images back to development for problem replication and resolution.
4. Recreate distributed multi server SAP production environment in a single physical system for test purposes.
5. Reset Test Images (after test completion) from templates and virtual machine libraries cutting down on test setup and reset time.
6. Store different SAP applications and versions in virtual machine libraries that can be provisioned almost instantly

7. Rollback Development and test images using virtual machine snapshots during problem resolution.
8. Rapid provisioning of additional SAP application servers during peak loads.
9. Software life cycle automation of Development and Test environments using VMware Lab Manager.

Change Management

IT departments face two key challenges in change management – testing patches and upgrades for compatibility with standard corporate hardware, OS and application configurations. Traditionally, IT organizations need to procure hardware (mirroring production) and create test beds mirroring the OS and application configurations of the production environment. The typical SAP landscape has a constant DEV, QAS and PRD setup; although sometimes it is ideal to have additional testing environments. With VMware Infrastructure, customers can clone production or create a set of virtual machine libraries mirroring production which can then be used to provision the test environment. The latest patches and upgrades can then be tested against these virtual machines running SAP applications, while eliminating the need for dedicated hardware to perform these tests. These patches can then be rolled into production with minimal interruption to end users. In case of problems, the virtual machines can be instantly rolled back using snapshots.

Potential Key Benefits:

1. Fast change management with few system resource requirements.
2. Patches can be tested on multiple configurations (different versions of OS, SAP, Web etc) concurrently while hosted on the same physical system.
3. Instant rollback of SAP virtual machines using snapshots (during problem resolution).
4. Replicate production to test environment by cloning, performing changes and converting them into production VM, minimizing downtime.
5. Create a library of standard production configurations to perform change management testing and deployment.
6. Dynamically reassign SAP virtual machines to other systems while performing maintenance or changes on the current physical system with minimal disruption to end users.

Data Center Optimization: Distributed Resource Management

A VMware Infrastructure environment provides additional management capabilities that help optimize the infrastructure resources used by SAP and non-SAP applications. SAP provides distributed transaction processing, automated load balancing and replicated service framework that offer high levels of scalability and resource optimization for the application environment. VMware Infrastructure solutions support this by addressing resource management across the entire data center infrastructure and across multiple distributed SAP application servers. VMware Dynamic Resource Scheduler (DRS) dynamically allocates and balances computing capacity across a collection of hardware resources aggregated into logical resource pools. VMware DRS continuously monitors utilization across resource pools and intelligently allocates available resources among the virtual machines based on pre-defined rules that reflect business needs and changing priorities. When a SAP virtual machine experiences an increased load, VMware DRS automatically allocates additional resources by redistributing virtual machines across the

physical servers. VMware DRS optimizes IT environments to align resources with business goals while ensuring flexibility and efficient utilization of hardware resources.

Potential Key Benefits:

1. Dynamically reassign development, test and production SAP environments requiring additional capacity to the appropriate physical server with the optimal resource capacity. Consideration should be given to which systems are allowed to move dynamically. For example, a database server should be assigned according to resource requirements and architecture constraints.
2. Define resource pools, policies and priorities for different developer, test and production SAP environments to efficiently manage resource allocations.
3. Allocate processor and memory resources to virtual machines running on the same physical servers and prioritize access to those resources across virtual machines.
4. Optimize SAP application deployment across a virtualized enterprise data center by providing reserved resource pools with pre-defined minimum and maximum resource requirements.
5. Assured IT autonomy and service levels to applications and business organizations.
6. Automate physical server maintenance by dynamically relocating SAP virtual machines with minimal disruption to end users.
7. Optimize the service level of distributed applications by controlling the aggregate allocation of resources for the entire set of virtual machines running the distributed SAP and non-SAP application environments.

High Availability: Business Continuity and Disaster Recovery

VMware Virtualization works alongside SAP to deliver enhanced infrastructure and application high availability for critical business functions. Using VMware Infrastructure, customers can implement a unified disaster recovery (DR) platform that allows many production SAP virtual machine servers to be recovered in the event of failure without investing in an exact replica of the production hardware**.** VMware infrastructure capabilities such as VMware VMotion, VMware HA and VMware Consolidated Backup deliver enhanced levels of high availability to virtualized SAP environments**.** While SAP provides automated load balancing, distributed transaction processing and application failover to help ensure continuous service availability and transaction integrity, VMware VMotion™ enables the live migration of running SAP virtual machines from one physical server to another with minimal downtime. Live migration of virtual machines enables companies to perform hardware maintenance without scheduling full system downtime and disrupting business operations. VMware HA provides easy to use and cost effective high availability for SAP applications running in virtual machines. In the event of physical server failure, SAP virtual machines can be automatically restarted on other servers within the pool that have spare capacity. VMware HA minimizes downtime and IT service disruption while reducing the need for dedicated stand-by hardware. It provides high availability across the entire virtualized IT environment without the cost and complexity of failover solutions that are tied to either operating systems or specific applications. VMware Consolidated Backup provides an easy to use, centralized facility for LAN-free backup of virtual machines. VMware Consolidated Backup simplifies backup administration and reduces the load for ESX Servers.

Potential Key Benefits:

1. Development and Test Images can be saved for backup, audit or other requirements using snapshots and consolidated backup.
2. Layers of Images can be saved for regression testing (ie, keep exact version of OS, SAP, patches, state etc.) using snapshots and backup.
3. Snapshots enable point in time restores and rollbacks during test and development problem resolution.
4. Automatic restart of failed SAP application virtual machines using VMware HA.
5. Ensure capacity availability to support SAP virtual machine failovers.
6. Full and incremental file backup of virtual machines using VMware consolidated backup
7. Full image backup of SAP virtual machines for disaster recovery
8. Migration of SAP application virtual machines from failing server hardware using Live Migration without disruption to end users.
9. Restore from snapshots and backups during system failures or disaster recovery
10. Failover over SAN during disaster recovery by using SAN replication and restarting SAP virtual machines in DR sites.

Hardware Lifecycle Management

As the SAP enterprise solution evolves to solve more complex business problems, newer versions of SAP software and newer capabilities can be introduced. Often this requires more resources resulting in upgrades to existing infrastructure or additional hardware purchases. VMware infrastructure delivers the ability to provide capacity on demand for SAP functionality with minimal service interruption. Once the reassignment is completed, the older hardware can be re-purposed for test and development environments or other SAP and non-SAP workloads thereby reducing the cost and time to migrate and upgrade SAP environments and maximizing the utilization of existing capacity.

Legacy SAP Systems

Regulatory compliance (Sarbanes-Oxley - SOX) requirements and other IT policies might require older SAP environments and data to remain active beyond the hardware and software upgrade cycles. The need for dedicated hardware to host the older environments beyond their maintenance or warranty cycle may lead to additional costs. Virtualization with VMware allows consolidation of the SAP application environments on fewer, new generation physical servers and creates cost and support benefits.

Summary

Deploying SAP applications on VMware Infrastructure will drive tangible benefits through the complete software deployment lifecycle - from Development through Production and Maintenance. By expediting and simplifying the application development and testing processes, customers can experience fast time to production while maintaining high quality throughout these processes.

Rapid provisioning and change management in production environments can increase IT flexibility allowing timely response to sudden and changing business needs. Data Center optimization enables efficient resource pooling and maximized utilization of system resources. Implementing business continuity solutions for SAP applications on VMware Infrastructure can deliver enhanced high availability while minimizing the need for duplicate hardware.

VMWare, Dell and AMD are working closely to develop and test future AMD-V features driving x86-based Virtualization to exceptional performance with multi-core capabilities and fast memory access giving SAP customers the ability to maximize the return on their IT investments.

Together, VMware, Dell and AMD have the capabilities to help reduce the cost and time to deployment for SAP solutions. Using VMware Infrastructure and associated technologies, these companies can provide excellent operational efficiency and deliver low TCO and outstanding ROI for customers deploying SAP Enterprise applications.

SAP, Inc.

SAP AG is the largest European software enterprise, with headquarters in Walldorf, Germany. SAP was founded in 1972 and is the third largest software company in the world. It ranks after Microsoft and IBM Software in terms of market capitalization. SAP is also the largest business application and Enterprise Resource Planning (ERP) software provider in terms of revenue.

SAP has more than 38,000 customers in 120 countries. This represents 100,600 SAP installations for more than 12 million users.

VMware, Inc.

VMware modernized and brought virtualization to the x86 platform in 1998 and has saved its customers hundreds of millions of dollars by offering solutions for server consolidation and containment, business continuity, test and development automation as well as enterprise desktop management.

More than 4 million users and 20,000 corporate customers of all types and sizes use VMware software, including 99 of the Fortune 100 companies.

Advanced Micro Devices, Inc.

Advanced Micro Devices (NYSE: AMD) is a leading global provider of innovative processing solutions in the computing, graphics and consumer electronics markets. AMD is dedicated to driving open innovation, choice and industry growth by delivering superior customer-centric solutions that empower consumers and businesses worldwide**.**

Dell, Inc.

Dell Inc. (NASDAQ: DELL) listens to customers and delivers innovative technology and services they trust and value. Uniquely enabled by its direct business model, Dell sells more systems globally than any other computer company, placing it No. 25 on the Fortune 500. For more information, visit www.dell.com. To get Dell news direct, visit www.dell.com/RSS.

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