Virtualizing Business-Critical Applications

Technology Concepts and Business Considerations

Abstract

More than 75 percent of Fortune 500 companies have adopted server virtualization in their data centers, and the numbers are increasing for organizations of all sizes. However, it is estimated that those firms that have adopted virtualization have migrated only about 20 percent of their servers from physical deployments. This white paper addresses the concerns and challenges of companies that hesitate to virtualize business-critical applications and suggests a path for realizing even greater benefit from virtualization.

January 2010
Executive summary

Organizations of all sizes have experienced the financial and operational benefits of a virtualization explosion that has taken place over the last several years. Most of these firms have seen the advantages of virtualizing their lower-tier applications, such as file servers, Web servers, and network services and infrastructure servers. However, despite the unqualified success these firms have had virtualizing lower-tier applications, they have been hesitant about taking their virtualization efforts to the next level—to virtualizing business-critical, tier-one applications.

Reasons for not virtualizing tier-one applications vary. In most cases, firms have been hesitant to move forward on tier-one application virtualization due to concerns over application performance, changes in management procedures and practices, risks related to downtime and business continuity, and uncertainty on how to proceed. In some cases, there is a lack of understanding of the profound advances made in virtualization technology in the last several years. Regardless of the motivation for delaying tier-one application virtualization, it should be clear that the benefits these firms have realized from their current virtualization investments can be augmented by future virtualization of tier-one applications.

Introduction

This white paper focuses on the issues and solutions involved with virtualizing tier-one applications. It begins with a discussion of what sets tier-one applications apart from other line-of-business and infrastructure applications and the unique requirements of tier-one applications. The paper then discusses some of the concerns that firms have with moving their business-critical applications to a virtual environment. The remainder of the paper provides information about and examples of VMware and EMC products, technologies, and service solutions that can facilitate virtualization of tier-one applications.

Audience

The audience for this paper is composed of IT managers who have already begun on a path to virtualizing the data center. They have realized many of the benefits of server virtualization for lower-tier applications but have not taken the step to virtualize tier-one applications. This paper will address:

- Business-critical application requirements
- Concerns and challenges in virtualizing tier-one applications
- The costs—in terms of management, serviceability, and availability—of not virtualizing
- Examples of firms that have successfully virtualized their business-critical applications
- Information on EMC Proven™ Solutions and EMC Consulting services, which can be leveraged to architect, design, implement, and manage the solution, and to train in-house IT staff on deployment and best practices

Virtualization is now widely adopted

Virtualization has revolutionized the way organizations run server applications in the data center. More than 75 percent of Fortune 500 companies have adopted server virtualization in their data centers and, for organizations of all sizes, the numbers are increasing. These companies are reaping benefits in lower capital expenditures, decreased operational costs, reduced administrative overhead, greater uptime, higher availability, and superior disaster recovery.

A recent VMware customer survey of 1,036 customers found that more than 50 percent of respondents had virtualized Microsoft SQL Server and Microsoft SharePoint, with half of the respondents virtualizing IBM WebSphere. The survey also found that 36 percent of respondents have virtualized Microsoft Exchange. Among Oracle users, 34 percent have virtualized Oracle databases and 41 percent Oracle middleware.
A recent Gartner poll found that 73 percent of customers claimed to use x86 virtualization for mission-critical applications in production. This survey, combined with VMware’s customer experience, provides strong evidence that the virtualization of business-critical applications has gone mainstream.

However, despite these findings, it is estimated that firms that have adopted virtualization have migrated only about 10-20 percent of their servers from a physical to a virtual environment. These servers generally host lower-tier applications that play important, but not business-critical, roles in the organization. These lower-tier applications will not bring the business to a halt if they are offline for a short time.

In contrast, tier-one applications are business critical; they are the lifeblood of an organization. Downtime of these applications costs money and may damage the brand. In the past, companies have been hesitant to move these applications to a new environment, citing a number of concerns, most notably:

- Performance degradation
- Changes in management of VMs, networking, and application service level agreements (SLAs)
- Risk related to availability, downtime, and business continuity
- Uncertainty about how to proceed

Only as these issues are addressed can key decision-makers find the confidence they need to move to the next step in their journey—first to a fully virtualized data center and then onward to the private cloud. Fortunately, the tremendous strides made by modern hypervisors and virtualization management software are addressing these concerns.

**Business-critical applications drive the enterprise**

Business-critical applications drive the enterprise. By definition, a business-critical application must be available in order for the firm’s employees to do their work, for partners to work with the firm, and for customers to purchase products and services. If a business-critical application goes offline for even a few minutes, the firm loses money, brand equity, and the confidence of customers and partners.

While every company has its own set of business-critical applications, most companies have deployed one or more of the following:

- E-mail applications, such as Microsoft Exchange
- Customer relationship management (CRM) applications, such as SAP
- Database applications, such as Microsoft SQL Server and Oracle

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1 “Linux and Windows Server Virtualization is Picking Up Steam,” ID Number G00161702
• Collaboration applications, such as Microsoft SharePoint
  Tier-one applications often participate in a multitier server environment, making management more complex because availability and performance issues can involve one or more servers. In order to meet performance, availability, and change management requirements in a physical server environment, businesses have created complex infrastructures and processes:
• Complex and expensive hardware and software clustering and load-balancing methodologies help ensure high availability.
• Scaled-up high-end servers are required to meet the performance requirements and handle peak workloads.
• Application-specific and third-party hardware and software solutions are needed to back up data, application services, and operating systems.
• Complex disaster recovery run books define processes and IT staff procedures.
• Disaster recovery and business continuity requirements mandate duplicate hardware at a recovery site.
• Development and test centers are separated so that developers can create new components of the tier-one solution and testers can address software or hardware issues.
This approach to managing tier-one applications increases:
• **Expense**—A great deal of capital expenditure is dedicated to purchasing servers for upward and outward scalability and to replicate primary sites at recovery sites.
• **Complexity**—Traditional solutions for high availability require complex hardware and software configurations from multiple vendors.
• **Risk**—The cost of disaster recovery and business continuity precludes many firms from putting plans in place while the pressure on uptime prevents many others from testing the plans they have.
Clearly, business-critical applications would benefit from the streamlined management and cost savings that virtualization provides, yet many companies are slow to move.

**Concerns over virtualizing business-critical applications**

Performance concerns are at the top of the list of reasons that IT organizations are slow to move tier-one applications to a virtualized environment. Business owners want to make sure that a shared hardware model will not introduce bottlenecks, will be able to sustain the needed throughput, and will not introduce limitations imposed by the hypervisor or virtualization management infrastructure.

Earlier hardware and software virtualization solutions did not adequately address these concerns. However, over the last several years, the processor technology, the hypervisor, and virtualization management software have made great strides in power and level of sophistication. These advances make it possible to virtualize tier-one applications. The new generation of solutions built on VMware vSphere™ solves the performance problem.

Organizations that maintain one set of management skills and solutions for a physical environment and another for a virtual environment limit IT efficiency. Therefore, most IT organizations would like to be able to virtualize all applications. But the risks involved in fixing what is not broken loom large. Application owners do not want to take the chance that their backup/restore and business continuity solutions will fail in the new environment. They need to know that high availability and disaster recovery requirements will be met. Technologies from VMware and EMC, such as VMotion™, VMware High Availability, VMware Fault Tolerance, VMware vCenter Site Recovery Manager, and EMC® Replication Manager, easily address these concerns.

We realize that, in order to feel confident in virtualizing business-critical applications, organizations need to know not only that current solutions can deliver on performance and reliability, but also that they are more cost-effective and that the firm can actually implement them based on proven practices and experience.
In the next sections, this paper shows how these solutions measure up and how new technologies drive the move to virtualization of more and more applications. It will cover:

- **Performance**
- **Consolidation**
- **High availability and business continuity**
- **Proven Solutions**

**Performance**

Much of the concern over virtualizing tier-one applications revolves around performance. Bottlenecks at any tier in a multitier solution can lead to poor application performance and can negatively impact employee productivity or lead to a poor customer experience. Concerns over performance of early-generation virtualization solutions were understandable. VMware ESX Server 2.0 was limited to one vCPU and 3.6 GB of memory per virtual machine, and less than 10,000 I/O per second with support for a net throughput of 380 Mb/s. These parameters clearly would not have met the needs of business-critical applications.

However, as depicted in Figure 2, things have changed radically on the virtualization front since ESX 2.0. VMware vSphere (ESX 4.0) now supports up to eight vCPUs per virtual machine, up to 255 GB of memory per virtual machine, and over 300,000 I/O per second and 30 Gb/s net throughput. In parallel, major advances in the newer generation of multicore Intel x86 Nehalem chipsets have significantly improved performance of the hypervisor. As a result, most tier-one applications that were not suitable for virtualization with earlier releases of ESX Server can now be virtualized with VMware vSphere with the same, if not greater, performance than current physical deployments.

For example, VMware engineers tested Oracle 11g Release 2 running on Red Hat Enterprise Linux 5.1 hosted on an eight-core CPU Intel Xeon-based server using a TPC-C workload. As depicted in Figure 3, the engineers found that the virtual solution scaled almost perfectly as they increased the number of CPUs from one to eight. Testing also revealed:

- Less than 15 percent overhead for an eight-vCPU virtual machine
- Performance of 8,900 total database transactions per second

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• 60,000 I/O operations per second

Figure 3. Comparing database performance on hardware and virtual installations

VMware use of the VMware Capacity Planner to analyze more than 700,000 servers in customer production environments revealed that the overwhelming majority of servers required less than 500 I/O per second. VMware then compared the disk I/O per second (IOPS) requirements of all the servers in the study to I/O requirements for SQL Server and the percentage of SQL servers that require a specific disk I/O value. As depicted in Figure 4, only a very small percentage of the total servers in the study required nearly 1,000 disk IOPS. Comparing this data to known SQL Server deployments, it is clear that only about 10 percent require disk IOPS of more than 100. VMware vSphere can scale to 300,000 IOPS, which clearly shows that vSphere can scale to the I/O requirements of almost any database deployment for even the most demanding business-critical applications.
VMware used the SAP Sales and Distribution (SD) benchmark to test the amount of overhead incurred when 300 to 815 users used a virtualized CRM application. As shown in Figure 5, VMware found that, on average, overhead was less than 10 percent.
**Consolidation**

While server consolidation and its resultant cost benefits are common reasons for virtualizing lower-tier applications, consolidation has not been a driving force for virtualizing business-critical applications. However, given the fact that many business-critical applications are multitier and, therefore, require multiple servers to create a complete solution, tier-one applications can also realize significant benefits from server consolidation.

### Figure 6. How many cores can an application scale on quad-socket x86 servers?

With advances in chip technology, multicore servers are delivering ever-increasing CPU performance. However, few applications can be expected to take advantage of large numbers of cores. Virtualization technology can help organizations leverage the power of multicore servers to support larger numbers of users.

For example, Figure 7 depicts a typical SAP implementation. As is common in many complex tier-one applications, this deployment involves more than 50 servers in training, development, QA/test, and production environments. We have found that in a typical physical environment with more than 50 servers, a 7-to-1 non-production to production consolidation ratio can be accomplished, with 10-to-1 consolidation ratios being common.
Microsoft Exchange is another example of a tier-one application that can benefit from consolidation. Exchange has matured to become a robust, multitier, business-critical application that includes an edge, transport hub, client access, and mailbox server roles. In order to maintain high availability, organizations have used network load balancing and standby servers for Exchange Server. Using VMware vSphere—with consolidation ratios of up to 5-to-1—organizations can achieve the same or a superior level of availability with far fewer physical servers, can consolidate Exchange Server roles, and can eliminate standby servers.

Figure 7. Server consolidation ratios seen in a typical SAP deployment

>50 Servers
7:1 non-production to production
10:1 consolidation is common
On the database side, while database administrators are seeking to consolidate databases in order to reduce total cost of ownership and reduce management overhead, they encounter several challenges that make consolidation difficult. Administrators typically use two methods of database consolidation:

- Multi-instancing
- Shared instance

Figure 8. Server consolidation ratios typically seen in Exchange Server deployments

Figure 9. The SQL consolidation methods: multi-instancing and shared instance
Each method involves significant performance and security challenges:

- Neither allows for operating system isolation.
- There is no load balancing across physical nodes for both methods.
- Resource isolation requires SQL Resource Governor.
- There is no database isolation for sharing instance consolidation.

These limitations make it difficult to create a highly available and secure environment for the consolidated solution. Virtualization, on the other hand, provides a solution.

Figure 10 depicts a virtualized environment that provides consolidation and performance improvement. This solution preserves both database and OS isolation because each database runs in its own virtual machine. The virtualized solution enables you to guarantee resources for each of the databases by creating virtual machine reservations, priorities, and maximums for hardware resources.

**Figure 10. Using P2V to more efficiently and securely consolidate SQL Server**

In addition, VMware can use VMotion and Distributed Resource Scheduling to move virtual machines from one virtual server to another automatically so that databases always have the hardware resources they need to meet SLAs. In addition, consolidating databases on virtual machines eliminates some software licensing fees.

**Improved management**

An enterprise-grade virtual infrastructure hosting tier-one applications requires robust management tools. Ideally, the management tools enable visibility into multiple levels of the virtual deployment. They should provide information and configuration options at the virtual server, virtual server cluster, virtual machine, storage, and application levels so that all aspects of the deployment are visible to administrators in various divisions within IT.
Virtualization abstracts applications from the hardware, making applications and machines difficult to track. Tools are needed that understand this design and represent the architecture clearly so that they can be easily managed.

Network, server, and application teams are brought closer together because of virtualization. Teams need to adapt and need tools that help each other communicate and see into each other’s domains. Plug-ins, such as EMC plug-ins to vCenter, should be available to provide transparent access to both the software and hardware infrastructure.

It is important to address security concerns with software such as VMware VMsafe™ and security plug-ins such as RSA for logging, authentication, and data loss prevention.

VMware and EMC work together to provide a single “pane-of-glass” solution for managing the virtual infrastructure, storage arrays, and replication environment. For example, EMC management plug-ins, such as EMC Navisphere® and EMC Ionix™, work with the VMware vCenter console. In addition, the network team can take advantage of virtual switches, such as the Cisco 1000v, which can be managed like any other Cisco switch on the physical network.

**High availability and business continuity**

High availability

High availability is vital to any tier-one application. Even a few moments of downtime can move a company from a positive to a negative fiscal position. IT groups have spent a lot of time and effort to create a highly available environment for tier-one applications in non-virtualized environments, but these efforts are often expensive, fragile, and unreliable. Virtualization can both enhance and simplify the high-availability infrastructure for your tier-one applications.

Important VMware features that simplify and make high availability more reliable include:

- VMware High Availability
- VMware VMotion
- VMware Distributed Resource Scheduling
- VMware Fault Tolerance

**VMware High Availability**

VMware High Availability (HA) provides easy-to-use, cost-effective high availability for applications running in virtual machines. In the event of physical server failure, affected virtual machines are automatically restarted on other production servers with spare capacity. In the case of operating system failure, VMware HA restarts the affected virtual machine on the same physical server. The combination of VMware HA and the other availability features of the VMware vSphere platform enables organizations to select and easily deliver the level of availability required for all of their important applications.

VMware HA allows IT organizations to:

- Minimize unplanned downtime and IT service disruption while eliminating the need for dedicated standby hardware and installation of additional software.
- Provide affordable uniform high availability across the entire virtualized IT environment without the cost and complexity of failover solutions tied to either operating systems or specific applications.

VMware HA allows companies to provide high availability to any application running in a virtual machine. With VMware HA, IT organizations can:

- Protect applications with no other failover option
  Provide cost-effective high availability for any application running in a virtual machine. High-availability solutions are often relatively complex and expensive, and as a result are typically reserved for mission-critical applications. VMware HA provides a cost-effective high-availability solution that
makes high availability possible for applications that were formerly left unprotected, and can also be
used to provide enterprise-class high availability for business-critical applications.

- Establish consistent “first line of defense” for an entire IT environment
  Unlike other high-availability solutions that are tied to specific operating systems or application and
  are often complex to use, VMware HA provides an easy-to-manage high-availability solution that can
  be deployed easily and uniformly across heterogeneous environments.

- Reduce costs and complexity
  Avoid the cost and complexity of failover solutions tied to either operating systems or specific
  applications by using VMware HA to provide protection with any hardware, operating system, or
  application running in a virtual infrastructure with minimum cost and management overhead.

VMware HA ensures that your tier-one applications are always online and ready to meet your uptime
requirements.

**VMware vMotion**

VMware vMotion allows you to move mission-critical workloads between members of an ESX array
without downtime. vMotion makes it possible to service hardware and software without missing a beat so
that business-critical applications can be configured, managed, maintained, and updated without risk of the
application going offline and hurting the firm’s bottom line.

VMware vMotion allows you to:

- Perform hardware maintenance without scheduled downtime
- Proactively migrate virtual machines away from failing or underperforming servers
- Automatically optimize and allocate entire pools of resources for optimal hardware utilization and
  alignment with business priorities

Live migration of a virtual machine from one physical server to another with VMware vMotion is enabled
by three underlying technologies:

- First, the entire state of a virtual machine is encapsulated by a set of files stored on shared storage such
  as Fibre Channel or iSCSI storage area network (SAN) or network-attached storage (NAS). VMware
  vStorage VMFS allows multiple installations of VMware ESX to access the same virtual machine files
  concurrently.

- Second, the active memory and precise execution state of the virtual machine is rapidly transferred
  over a high-speed network, allowing the virtual machine to instantaneously switch from running on the
  source ESX host to the destination ESX host. vMotion keeps the transfer period imperceptible to users
  by keeping track of ongoing memory transactions in a bitmap. Once the entire memory and system
  state has been copied over to the target ESX host, vMotion suspends the source virtual machine,
  copies the bitmap to the target ESX host, and resumes the virtual machine on the target ESX host. This
  entire process takes less than two seconds on a Gigabit Ethernet network.

- Third, the underlying ESX host also virtualizes the networks being used by the virtual machine,
  ensuring that even after the migration, the virtual machine network identity and network connections
  are preserved. vMotion manages the virtual MAC address as part of the process. Once the destination
  machine is activated, vMotion pings the network router to ensure that it is aware of the new physical
  location of the virtual MAC address.

Since the migration of a virtual machine with vMotion preserves the precise execution state, the network
identity, and the active network connections, the result is zero downtime and no disruption to the user, thus
ensuring that your tier-one business-critical application remains online, even under conditions in which a
non-virtualized instance of the application might become unavailable.

**VMware Distributed Resource Scheduling**

VMware Distributed Resource Scheduler (DRS) dynamically balances computing capacity across a
collection of hardware resources aggregated into logical resource pools. It then continuously monitors
utilization across resource pools and intelligently allocates available resources among the virtual machines
based on predefined rules that reflect business needs and changing priorities. When a virtual machine
experiences an increased load, VMware DRS automatically allocates additional resources by redistributing virtual machines among the physical servers in the resource pool.

VMware DRS allows IT organizations to:

- Prioritize resources to the highest-value applications in order to align resources with business goals
- Optimize hardware utilization automatically and continuously to respond to changing conditions
- Provide dedicated resources to business units while still profiting from higher hardware utilization through resource pooling
- Conduct zero-downtime server maintenance

VMware DRS aggregates computing capacity across a collection of servers into logical resource pools and intelligently allocates available resources among the virtual machines based on predefined rules that reflect business needs and changing priorities. VMware DRS enables users to define the rules and policies that decide how virtual machines share resources and how these resources are prioritized among multiple virtual machines.

When a virtual machine experiences increased load, VMware DRS first evaluates its priority against the established resource allocation rules and policies, and if justified, allocates additional resources. Resources are allocated to the virtual machine by either migrating it to another server with more available resources or by making more “space” for it on the same server by migrating other virtual machines to different servers. The live migration of virtual machines to different physical servers is executed completely transparent to end users through VMware VMotion.

VMware DRS can be configured to operate in either automatic or manual mode. In automatic mode, VMware DRS determines the best possible distribution of virtual machines among different physical servers and automatically migrates virtual machines to the most appropriate physical servers. In manual mode, VMware DRS provides a recommendation for optimal placement of virtual machines, and leaves it to the system administrator to decide whether to make the change. Flexible hierarchical organization of resource pools allows administrators to match available IT resources to the needs of the business organization. Individual business units can receive dedicated IT resources while still benefiting from the efficiency of resource pooling. Robust access privileges make it possible to delegate routine infrastructure tasks for a business unit resource pool to a business unit system administrator.

VMware DRS helps ensure that tier-one applications not only keep running but keep running in the highest performance environment possible.

**VMware Fault Tolerance**

VMware Fault Tolerance (FT) leverages the well-known encapsulation properties of virtualization by building high availability directly into the x86 hypervisor in order to deliver hardware-style fault tolerance to virtual machines. It requires neither custom hardware nor custom software. Guest operating systems and applications do not require modifications or reconfiguration. In fact, they remain unaware of the protection transparently delivered by the ESX hypervisor at the x86 architecture level. FT relies on VMware vLockstep technology to establish and maintain an active secondary virtual machine that runs in virtual lockstep with the primary virtual machine. The secondary virtual machine resides on a different host and executes exactly the same sequence of virtual (guest) instructions as the primary virtual machine. The secondary observes the same inputs as the primary and is ready to take over at any time without any data loss or interruption of service should the primary fail.

Both virtual machines are managed as a single unit but run on different physical hosts (and even in different buildings, if you choose to configure your installation in this way). Because the solution is built directly into the virtualization stack, you can engage virtual machine protection with just a few clicks, minimizing deployment, configuration, licensing, and operating costs. Guest operating systems and applications remain unmodified.

**Backup**

VMware Infrastructure is the industry’s most widely deployed virtualization solution. Virtual machines deployed in the data center must be protected against failure. Extending data protection to virtual machines is thus an important function. In the virtualized environment provided by VMware Infrastructure, there are
many ways to improve the convenience and reliability of data protection, each with its particular advantages and challenges.

VMware Consolidated Backup takes the backup load off the ESX Server host, eliminates the backup window, removes backup traffic from the LAN, and eliminates the need to run backup agents inside virtual machines to perform file-level backups of virtual machine data. Consolidated Backup uses VMware tools to quiesce the file system inside the virtual machine, ensuring that when the snapshot is taken, all pending data changes have been written to disk so the snapshot contains consistent data. Consolidated Backup also facilitates running scripts before and after the backup, so you can freeze and quiesce applications, then unquiesce them after the snapshot is taken.

EMC Avamar® software is backup and recovery software with an important difference. Its global data deduplication technology eliminates the unnecessary transmission over the network and storage of redundant backup data. This deduplication slows the pace of data growth both in core data centers and at remote offices. Avamar is especially good in areas where traditional backup solutions struggle—virtual machines, remote offices, and large, LAN-attached file servers.

Avamar quickly and efficiently protects VMware Infrastructure environments by reducing the size of backup data within and across virtual machines using agents in the virtual machines on the VMware Consolidated Backup server, or in the ESX Server service console. For virtual machine backups, Avamar eliminates traditional backup bottlenecks caused by the large amount of data that must pass through the same set of shared resources—the physical server’s CPU, Ethernet adapter, memory, and disk storage. Avamar reduces the traditional backup load (up to 200 percent weekly) to as little as 2 percent weekly, dramatically reducing backup times and resource utilization. Avamar also brings benefits whether an organization uses VMware Consolidated Backup or does backups from the ESX Server service console, as outlined below. Unlike traditional backup solutions, Avamar can deduplicate the data stored in virtual disks (.vmdk files).

**Business continuity**

VMware Site Recovery Manager is a pioneering disaster recovery management and automation solution for VMware vSphere 4. Site Recovery Manager accelerates recovery by automating the recovery process and simplifies management of disaster recovery plans by making disaster recovery an integrated element of managing your VMware virtual infrastructure. Site Recovery Manager also ensures reliable recovery by eliminating complex manual recovery steps and enabling nondisruptive testing of recovery plans. Site Recovery Manager integrates tightly with VMware vSphere, VMware vCenter Server, and storage replication from leading storage vendors to make failover and recovery rapid, reliable, affordable, and manageable. It enables organizations to take the risk and worry out of disaster recovery and to expand protection to all of their important systems and applications.

Site Recovery Manager helps organizations with the key elements of building, managing, and executing disaster recovery plans. The solution plugs in to the VMware vCenter Server management interface, providing integrated management for virtual infrastructure and the disaster recovery plans for that infrastructure. Site Recovery Manager also integrates with storage replication software from leading storage vendors to simplify the use of storage replication software with VMware vSphere. Site Recovery Manager helps users with the key elements of building, managing and executing disaster recovery plans:

- **Setup recovery infrastructure:** Site Recovery Manager guides users through the process of connecting to the remote site and to the storage replication software in use. It also makes it easy to map production resources, including computing and network resources, to the corresponding resources at a recovery site.
- **Create recovery plans:** Site Recovery Manager provides an intuitive interface to help users create recovery plans for different failover scenarios and different parts of their infrastructure. Users can specify virtual machines to be suspended or shut down to free resources for recovery. They can also specify the order in which virtual machines are powered on, set user-defined scripts to execute automatically, and specify where to pause the recovery process, if necessary.
**Test recovery plans:** Site Recovery Manager automates the creation of a nondisruptive and isolated testing environment on the recovery site by leveraging storage arrays’ snapshot capabilities and connecting virtual machines to the user’s isolated testing network. Site Recovery Manager automates the execution of the actual recovery plan to be used in an actual failover and cleans up the testing environment once testing is complete. Test results are saved for viewing and export at any time.

**Automate failover:** Once an administrator initiates a recovery plan from VMware vCenter Server, Site Recovery Manager automates execution of the steps in the recovery plan to ensure that recovery is executed exactly as designed. Administrators have full visibility into execution of the recovery plan through vCenter Server and can pause or stop execution at any time.

With VMware Site Recovery Manager and EMC storage arrays, you can rest assured that even in the direst of disaster recovery situations, your disaster recovery plan is defined, tested, and ready to deploy quickly and without fail.

**ISV support and Proven Solutions**

**ISV support**
Support is critical for tier-one applications. Even if the application has been tested and found to be highly reliable and high performing in a virtual environment, lack of vendor support for the virtualized application can be enough reason to stop the virtualization effort. Fortunately, the ISV ecosystem for VMware is expanding rapidly. SAP, IBM, Microsoft, Oracle, Adobe, and many more ISVs have formal support statements for virtualized applications.

All major ISVs realize that virtualization is the future of enterprise computing and are working toward improving support for virtualized applications. Over time you can expect even stronger support for virtualized tier-one applications, as those that do not have robust support for virtual environments will quickly become marginalized.
Proven Solutions

EMC has created more than 100 detailed Proven Solution Guides that help companies virtualize their tier-one applications. Table 1 lists a few examples of such solutions, along with quantitative benefits you can expect to achieve.

Table 1. Benefits achieved from EMC Proven Solutions

<table>
<thead>
<tr>
<th>EMC PROVEN SOLUTION</th>
<th>BENEFITS ACHIEVED</th>
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<tbody>
<tr>
<td>EMC Virtual Infrastructure for Microsoft Exchange 2007</td>
<td>Reduce costs by 40 percent with server virtualization and required storage by 35 percent with virtualized provisioning.</td>
</tr>
<tr>
<td>EMC Virtual Infrastructure for Microsoft Office SharePoint Server 2007</td>
<td>Reduce power and cooling costs by 75 percent.</td>
</tr>
<tr>
<td>EMC Virtual Infrastructure for Microsoft SQL Server 2008</td>
<td>Reduce physical server requirements by 50 percent.</td>
</tr>
<tr>
<td>EMC Integrated Infrastructure for VMware—Business Continuity</td>
<td>Reduce configuration time by 66 percent and deployment time by 50 percent with a standard virtual infrastructure solution.</td>
</tr>
<tr>
<td>EMC Archiving for Microsoft Exchange 2007</td>
<td>Reduce archiving volumes by up to 87 percent with a virtual archiving solution.</td>
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</tbody>
</table>

In addition, EMC offers the guidance of trained consultants with significant experience deploying business-critical applications in a virtual environment. These consultants can help you determine your strategy and create a plan for moving forward.

- **Applications**—**virtualize your tier-one applications.** Rationalize applications against business requirements. Develop a strategy for virtualizing and federating applications and leverage virtual application architecture and validated configurations.

- **Infrastructure**—**optimize your virtual infrastructure and service levels.** Develop a strategy and roadmap for computing, storage, and network needs; achieve service-level requirements for your private cloud; deploy tested solutions built on market-leading technologies; and protect the virtual environment with security configuration, backup, and disaster recovery.

- **Governance**—**manage the virtual program, processes and environment.** Engage business stakeholders throughout a private cloud initiative; establish program management to drive milestones and ROI; manage and automate the dynamic virtual infrastructure; and develop an operational model for the virtual data center.

When you are ready, EMC can help with deployment and train your staff to get the most out of the new environment.

By virtualizing tier-one applications you can:

- Drive down capital expenses by up to 50 percent
  - Reduce platform costs from high server utilization and deeper platform density
  - Limit new hardware (platform and component) purchases
  - Pare software licensing and maintenance costs. Scale back facilities-related expenditures (such as building, generators, cabling)
• Slash operational expenses by up to 40 percent
  ▪ The automation of day-to-day tasks means fewer management FTEs.
  ▪ Increased workloads per KW result in lower power and cooling costs.
• Reduce IT overhead by simplifying the IT environment
  ▪ Prefabricate all systems integration
  ▪ Standardize the software environment
  ▪ Fewer switches, NICs, servers, and arrays mean fewer points of management.
• Accelerate profit-enhancing IT service delivery to the business
  ▪ Reduce provisioning cycle times
  ▪ Continuous operation and availability mean the business is never down.

It is clear that the combination of server consolidation and improved management for tier-one applications can reduce complexity, reduce capital expenditures, decrease operational expense, and lower IT overhead, making virtualization the most cost-effective solution for business-critical applications.

With Proven Solutions from EMC and guidance and training from EMC Consulting, you can be confident that your migration of tier-one applications to a virtual infrastructure will go smoothly.

Case study

Corporate Express

Corporate Express Australia—which offers office supplies, IT solutions, print services, and a range of other business services—has made 72 acquisitions since 1995 and has staff in more than 50 locations across Australia and New Zealand. Due to its rapid growth, the company needed to move to new corporate headquarters in Australia, and its existing data center had run out of capacity. The company did not want to move its data to a temporary data center before moving to its new corporate headquarters. Corporate Express solved the problem by virtualizing its server environment using VMware technology, enabling the company to reduce the number of physical servers in its data center.

Corporate Express worked with EMC Consulting to plan and implement a multi-phase strategy that included server virtualization, storage networking, improved consolidation, and tiering. The consultants introduced disk libraries with data deduplication to replace tape and improved the replication and disaster recovery environments.

In the process, the company reduced energy and space needs by as much as 80 percent. It decreased total server costs by 40 percent and improved utilization rates by up to 70 percent. And while streamlining the storage, the company also reduced required capacity by 52 percent through tiering, consolidation, and optimization.

Key results of the solution included:
• 70-80 percent reduction on data center space, power, and cooling
• 40 percent reduction of server TCO
• 70 percent improvement in server utilization
• 52 percent reduction in required storage capacity
• Tape backup solutions eliminated

In terms of changes in infrastructure, Corporate Express realized:
• A reduction in the number of servers from 200 to 16
• A reduction in the amount of disk space required from 50 TB DAS to 20 TB SAN
• A reduction in the number of network ports required from 600 to 64
• A reduction in the amount of backup space required from 2 TB to 200 GB
- A reduction in the number of server racks required from 20 to 2
- A reduction in the amount of power required from 100 KVA to 10 KVA

In addition to the server and backup consolidation projects, Corporate Express focused its attention on virtualizing its storage infrastructure. This project has enabled the organization to extract more efficiency from its network, and also created a tiered storage infrastructure within the business.

“Our storage demands were rapidly increasing and it was taking too long to deploy applications and services,” said Mark Jones, technology infrastructure manager. “We also did not classify our storage effectively so a non-critical application might be given priority over a more critical application. Working with EMC, we were able to address this challenge head-on and tier our storage requirements effectively.”

The company is now looking at continuing to drive new and innovative storage initiatives by implementing NAS gateways connected to the SAN as well as potentially upgrading its tier-one platform to gain improved capacity and performance levels.

**Conclusion**

You have seen the benefits that accrue from moving lower-tier applications from a physical to virtual environment. If your organization is like most, you are 20 percent there! The next step is to start thinking about migrating your business-critical applications to a virtual environment so that you can benefit from the same high availability, reliability, performance, backup, restoration, and disaster recovery advantages.

This white paper addressed most of the primary concerns that prevent organizations from moving business-critical applications to a virtualized environment. You have seen that advances in ESX software make it possible to run even the most demanding business-critical workloads. Advances in virtual infrastructure management software make it possible to manage all aspects of the solution, and make the solution available to multiple teams within the IT organization. We also saw the great strides that have been made in high availability, backup and restore, and business continuity, and how the combination of software and hardware make these activities faster and more reliable than ever.

In addition, EMC and VMware have extensive experience deploying business-critical applications in virtual environments and they can help you move down the path toward a private cloud. EMC consultants bring objective data gained from Proven Solutions and from their experience helping other customers virtualize tier-one applications. EMC consultants can help you design, plan, build, manage, and document the deployment, and then train your staff so that they can move forward to build their own virtualized solutions and management frameworks. These advantages focus on using storage services versus an application-specific solution.

Virtualization and all that it has to offer in the areas of performance, high availability, disaster recovery, backup and restore, automation, and cost-effectiveness for all applications are fully realized by the private cloud. But the private cloud is a journey, not a destination. The virtualization of applications, including tier-one applications, should be considered mainstream now—but there is no need to rush. Over time as you increase the number of virtualized applications, you will gain more experience, more expertise, and more evidence of the benefits of a private cloud. At that point virtualization will be the default, with physical deployments becoming the exception.