



SOLUTION
READINESS

Microsoft® Exchange 2010 on VMware® Use Cases

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1. Background

"It's not the strongest or most intelligent of the species that survive; it is the one most adaptable to change" – Charles Darwin

E-mail is one of the most critical applications in an organization's IT infrastructure. Organizations increasingly rely on messaging tools for individual and organizational effectiveness. As a result, messaging administrators face a constant challenge as they continually seek to manage the conflicting demands of availability, agility, and cost.

Microsoft® Exchange is the most widely used e-mail system in the world. Its operational and performance characteristics are well understood, and best practices for design, deployment, and operations are readily accessible. Exchange continues to evolve through enhanced features and functionality, and through previous limitations addressed with each successive new version.

With its release of Exchange Server 2010, Microsoft has added many features that improve messaging performance, reliability, and scalability. These provide a major step forward. However, Exchange Server 2010 is still subject to many of the shortcomings inherent in most applications running directly on physical hardware, such as hardware platform dependence, under-utilization of server computing resources, lack of flexibility to respond to changing workloads, and heavy costs associated with maintaining disaster recovery, test, and development environments. The architectural improvements in Exchange Server 2010 cannot fully address these limitations.

The ideal platform for Exchange would adapt easily to changing workloads, provide flexibility to accommodate changing demands on an organization's IT infrastructure, remain reliable and resilient despite system outages, and improve both staff and infrastructure hardware effectiveness. A new operational platform based on VMware vSphere™ can accomplish these goals.

2. Microsoft Support Considerations

Customers looking to take advantage of VMware virtualization technology in their Exchange environment can now benefit from recent improvements in Microsoft licensing and support policies. In particular, there are two important changes to be aware of:

- **Support for Exchange 2010 running on VMware Infrastructure/vSphere:** VMware ESX™ 3.5 Update 2 was the first hypervisor to be listed under the Microsoft Server Virtualization Validation Program (SVVP). This certification assures our customers who run ESX 3.5 Update 2 or later (including vSphere), Windows Server 2008, and Exchange Server 2007 SP1/Exchange 2010 access to cooperative technical support from Microsoft and VMware. Additionally, if escalation is required, VMware can now escalate mutual issues rapidly and work directly with Microsoft engineers to expedite resolution. With this support program in place customers can now take advantage of the many benefits that come with virtualization of Exchange on vSphere. For more information on the Microsoft Server Virtualization Validation Program visit: <http://windowsservercatalog.com/svvp.aspx?svvppage=svvp.htm>
- **Relaxed policies for application license mobility:** Microsoft has updated its licensing policy for 41 server applications, including Exchange, to more effectively accommodate their use in a virtual environment. The application licenses are still tied to a physical server; however, Microsoft has now removed the clause that had restricted reassignment of an application license between servers to once every 90-days. The new amendment allows customers to more freely reassign application licenses to from one server to another, effectively removing the need for excessive application licenses to remain compliant while performing virtual machine migration (VMware VMotion™) and high availability in a virtual environment (VMware HA). Additional information can be found at: http://download.microsoft.com/download/3/d/4/3d42bdc2-6725-4b29-b75a-a5b04179958b/Application_Server_License_Mobility_VL_Brief.doc

3. Exchange Performance Considerations

Those familiar with earlier versions of Exchange know that it can be a challenging workload to manage. Proper design of the server, network and storage architecture is critical for proper performance. In particular, careful sizing and configuration of the storage subsystem is essential to address the heavy demands on disk I/O that Exchange can generate. Even with the most powerful server hardware available, proper performance of Exchange is often highly dependent on the performance characteristics of the storage design.

The performance characteristics of Exchange 2003 directly relate to the inherent limitations of the Windows 32-bit architecture. Specifically, addressable memory on a 32-bit platform is limited to approximately 4GB and only 900MB is available for Exchange 2003 database cache. Since reading application data stored in memory is many orders of magnitude faster than reading it from disk storage, applications are typically designed to run in memory to the greatest practical extent. Large Exchange 2003 implementations can easily overrun the addressable memory limit, resulting in increased access to disk and degraded performance if the storage subsystem has not been properly designed.

The type of disk I/O generated by Exchange 2003 can influence performance as well. Exchange 2003 was designed to generate highly randomized I/O traffic in very small (4KB) chunks. If the disk subsystem is not designed to support this particular type of workload, performance can degrade rapidly. Typically, proper storage design for Exchange 2003 deployments focuses on the number of disk spindles required to support the number of I/O operations per second (IOPS) generated by each user. Unfortunately, particularly with modern high-capacity disks, this I/O demand results in more spindles being required than would otherwise be needed based purely on capacity requirements.

Exchange 2007 underwent a number of architectural improvements. Most notably, Exchange 2007 runs exclusively on 64-bit hardware and requires a supported 64-bit Windows Server operating system. This change in architecture allows effectively unlimited memory for Database Buffer Cache, resulting in dramatically reduced disk I/O workloads.

In Exchange 2010, Microsoft reduced disk I/O by a further 50% over Exchange 2007. I/O specific changes from Exchange 2007 to Exchange 2010 have increased page sizes from 8KB to 32KB, resulting in larger but fewer writes. In addition, many client connection tasks have been offloaded onto the Exchange 2010 Client Access Server role. The result is that an Exchange 2010 mailbox server is fast, lightweight, and performs well in a vSphere virtual machine!

4. Exchange Performance and vSphere

Testing performed by VMware and its partners has demonstrated the viability of running Exchange 2003, 2007, and 2010 with either VMware Infrastructure 3 or VMware vSphere. Customers who have deployed Exchange 2003, 2007, and 2010 in production environments and are benefiting from the operational advantages of a virtualized Exchange infrastructure have confirmed this. Some have virtualized their entire Exchange environment and carefully designed their infrastructure to accommodate the architectural challenges previously noted. Others have preferred to split their Exchange implementation, limiting virtualization to front-end server roles such as CAS and Hub Transport Servers, and infrastructure services such as domain controllers and global catalog servers.

Exchange 2010 is proving to be much easier to deploy and operate than its predecessors. The dynamics of deploying Exchange 2010 are shifting dramatically in ways that align well with the benefits offered by the vSphere platform. This shift is a result of advancements in several key areas:

- Architectural improvements of Exchange 2010 on a 64-bit platform have drastically increased memory utilization and reduced disk I/O load; addressing many of the shortcomings found in Exchange 2003 and 2007. With full support for 64-bit Windows virtual machines, these same benefits are realized when Exchange 2010 is deployed on a vSphere platform.
- Advances in server hardware such as dual and quad-core processors, higher memory density, and advances in storage technology are far outpacing the performance requirements of today's applications, including Exchange. Virtualization becomes an effective way to leverage the full resources of these systems. Recent performance studies have shown unprecedented performance and scalability of up to 16,000 users on a single 64-bit physical server.
- The advances in Exchange 2010 and server hardware technology have been met with similar advances in vSphere. Virtual machines can now support up to 255GB RAM and 8 vCPU and are capable of running even the largest Exchange mailbox servers. Network improvements such as Jumbo Frames and TCP Segment offload have lowered overall CPU usage. These and other enhancements make vSphere capable of meeting performance requirements for even the most demanding Exchange workloads.

Testing of Exchange 2010 in virtual operation was completed with Microsoft's Jetstress and LoadGen tools, the standards for Exchange performance analysis. These tests show that performance for a virtualized Exchange server is comparable to a non-virtualized server running on the same hardware.

With concerns over relative performance eliminated, many Exchange administrators are finding that the flexibility, enhanced availability, and lower costs associated with virtualization are very attractive in supporting an Exchange infrastructure. This document discusses examples of a variety of benefits that are only available with the vSphere platform.

5. Benefits of Virtualizing Exchange

Many VMware customers running Exchange 2003, 2007, and 2010 are already taking advantage of the benefits offered by virtualization to improve their organization's messaging capabilities and effectiveness. Microsoft Exchange Server 2010 includes a number of enhancements in areas such as availability, architecture, remote access, operational efficiency, and improved end-user experience. For organizations not already using vSphere, the upgrade cycle from previous versions of Exchange to Exchange 2010 presents an ideal opportunity to begin leveraging the power and flexibility of virtual machine technology.

In this section, we examine some of the primary technical benefits that can be achieved by deploying Exchange 2010 on a vSphere. These benefits are presented along with examples based on real VMware customer experiences, but described using a composite, fictitious organization named XYZCorp.com. The examples follow XYZCorp.com, a rapidly growing online retailer with 2,000 employees. XYZCorp currently uses a GroupWise e-mail solution, but is considering a migration to Exchange Server 2007.

5.1 Server Consolidation

5.1.1 Utilize All Your Server Processor Cores

Large multi-core servers are becoming the norm and most applications cannot take advantage of all the processor cores in a physical server (the recommended maximum for Exchange is 12 cores for a single role server). Although vSphere virtual machines can scale to 8 vCPU if needed for the workload, smaller virtual machines offer flexibility in placement and can help increase consolidation ratios and improve performance.

Today's new 64-bit servers now come with increasing numbers of multi-core CPU's, increased memory limits, and physical RAM. For many organizations, particularly those not using virtualization, it is unlikely the Exchange environment will use the full computing power of these systems. However, in many cases, the cost of filling all available processor slots when purchasing a new 64-bit server may not result in a substantial cost increase—with vSphere, this extra CPU power is put to good use.

For example, smaller Exchange 2010 deployments may be able to benefit from server consolidation while still preserving server role isolation. Larger environments can run very large Exchange virtual machines with up to 255GB of RAM, and benefit from increased flexibility vSphere provides. In any case, running multiple virtual machines on these 64-bit systems is an excellent way to maximize the value derived from this new, more powerful hardware.

vSphere can also virtualize 32-bit and 64-bit Windows servers such as Domain Controllers, Global Catalog servers, DNS servers, DHCP servers and other infrastructure servers. These can be run as virtual machines on the same 64-bit systems to further leverage hardware investment and reduce costs for deployment, maintenance, support, power, cooling, and floor space.

Example: XYZCorp has been fortunate to experience substantial growth. The IT department plans to purchase two new 64-bit servers for the Exchange 2010 environment. The servers each have two quad-core CPUs and 32GB of physical RAM. As a small company, even with recent growth, there is no way the Exchange environment will normally use the full physical resources of these powerful servers. To fully utilize the hardware, they run the Exchange mailbox virtual machines on the new 64-bit servers in addition to several other non-Exchange virtual machine workloads from other parts of the organization. They are now able to maintain CPU and RAM utilization at 65%, maximizing their value to the organization and providing a rapid ROI on this hardware investment.

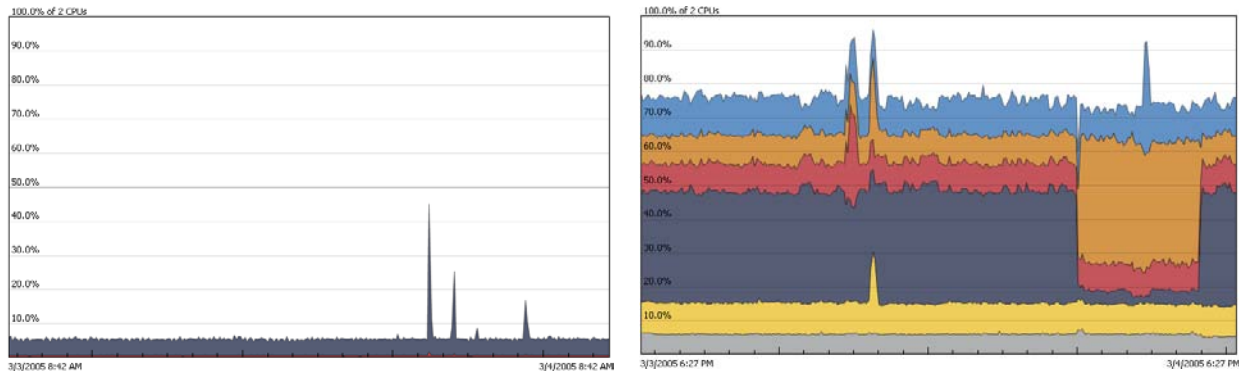


Figure 1. CPU utilization on Exchange ESX Hosts Before and After Consolidation

5.1.2 Maintain Role Isolation without Additional Hardware Expense

Isolation of Exchange server roles can aid in troubleshooting, but in smaller environments, this may not be an option due to limited hardware budgets. With vSphere, you can logically separate server roles however you like, without worrying that each server role will require its own dedicated hardware.

Exchange 2010 has evolved into a modular architecture that includes distinct server roles:

- Mailbox
- Edge transport
- Hub transport
- Client Access
- Unified Messaging

In smaller deployments (generally, 500 users or less), it may be possible to run multiple server roles such as HUB or CAS on a single physical server to maximize utilization of the required 64-bit server hardware. The tradeoff of this approach is that risk is concentrated, increasing the chance that some issue on the server could result in an outage to multiple server roles. Larger environments may choose to run supporting server roles on separate physical machines. But this approach increases the amount of hardware required for the solution, and typically results in a lower utilization of physical servers and increased overall cost.

The design approach using vSphere to host an Exchange 2010 installation deploys each Exchange 2010 server role in its own virtual machine to provide maximum flexibility (see Figure 2). As hardware requires maintenance or workloads change, roles can be moved to other servers at any time using VMware VMotion, which allows migration of live, running virtual machines from one physical server to another, with no loss of service.

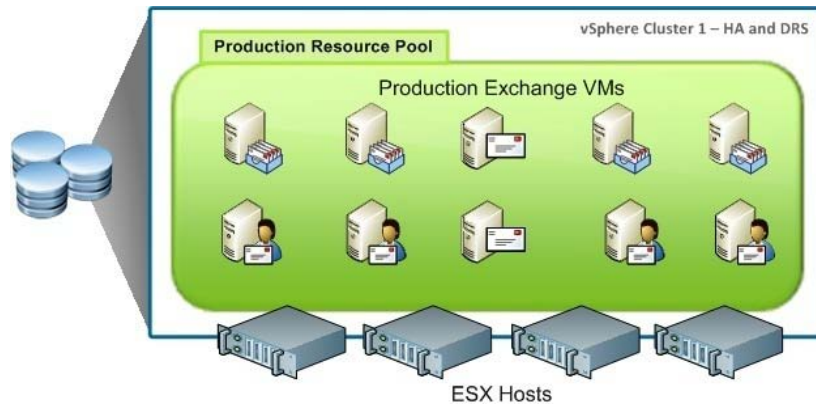


Figure 2. Exchange 2010 Server Roles in a Virtualized Environment

Example: XYZCorp.com is moving forward with their migration from GroupWise to Exchange 2010. Initially, they plan to move 50 pilot users from the IT department onto the new production Exchange 2010 environment. With such a small number of users in the pilot program, XYZCorp wants to run the initial Exchange environment on a single production ESX server. As their migration continues, XYZCorp plans to expand the environment to a larger number of ESX servers without re-installing or re-configuring Exchange servers and without requiring any downtime.

XYZCorp purchases a 64-bit server to run VMware vSphere. They deploy the required Active Directory components and each of the Exchange 2010 roles in separate virtual machines and initially run them all on the new ESX host. When they have finished their pilot program testing, XYZCorp has determined that their production environment will require two additional ESX hosts and they want to distribute the virtual machines across a pool of all three ESX hosts. When the two new ESX hosts are deployed, they can re-distribute the Exchange virtual machines online at any time using VMware VMotion. The virtual machine approach provides flexibility to meet the needs of various Exchange 2010 deployment strategies.

5.2 Operational Advantages

5.2.1 Design for Today's Workload Rather Than Guessing about Tomorrow

Using vSphere for an Exchange 2010 deployment avoids costly over-provisioning of Exchange server computing resources. Organizations can size their infrastructure based on current requirements and use excess capacity on their ESX hosts to run other virtual machine workloads. CPU and RAM resources can be monitored and fine-tuned at any time to meet changing performance requirements. The ability to adjust resources in this manner provides new levels of flexibility for Exchange virtual machines running on a vSphere platform that are not possible without virtualization.

In a physical server-based Exchange deployment, there is a tendency to overprovision server resources, since resources typically remain static until the next upgrade cycle of hardware provisioning. Projected increases in the number of Exchange end users through growth or acquisition can be difficult to estimate, but still must be factored into server provisioning and sizing decisions.

In an attempt to avoid problems associated with moving an Exchange server to a newer physical machine, many system implementers will choose to over-size physical server CPU and memory resources during the design of the system infrastructure to account for future growth. This can result in wasted computing capacity, as the resources of these servers are rarely fully utilized.

This problem can be avoided using vSphere. CPU and memory allocated to the virtual machine can be increased at any time with a simple reboot of the virtual machine. Moreover, the CPU and memory allocated to a virtual machine can be sized more realistically, based on current workloads, and adjusted at any time as the workload increases (see Figure 3).

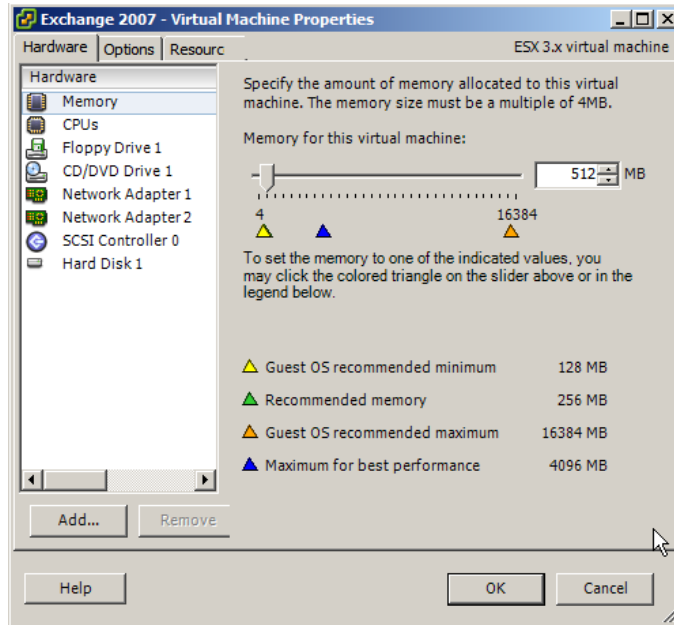


Figure 3. Adding Additional RAM to the Mailbox Virtual Machine

Example: XYZCorp.com has 2,000 mail users in their GroupWise environment that will be migrated to Exchange. XYZCorp estimates that based on current GroupWise usage, their users will likely fit into the “average” Exchange I/O profile, once migrated. They follow Microsoft best practices and size the 2000-user virtual machine with 2 vCPUs and 24GB RAM.

Several months into production they find that the new Exchange system is being used heavily and performance requirements are higher than they had originally estimated. Additionally, they have just acquired a new company and need to integrate 500 new users into the Exchange environment immediately.

Because the mailbox server has been deployed on vSphere, XYZCorp can easily make adjustments. During the next Exchange maintenance window, they shut down the mailbox virtual machine, add 2 additional vCPUs and 12GB additional RAM. Once powered on, the Exchange virtual machine now has a total of 4vCPU and 32GB of RAM. Performance has improved and the 500 new users have been integrated seamlessly.

5.2.2 Design for Specific Business Requirements

Deploying Exchange 2010 with vSphere provides additional options to meet specific business and technical requirements of an organization's messaging environment. For example, using virtual machines allows the user population to be split into multiple smaller Exchange mailbox virtual machines without requiring additional server hardware. Each mailbox virtual machine can then be configured with its own unique design requirements or characteristics without requiring additional server hardware or significant new design effort.

There are multiple benefits to this approach:

- Any outage on a single mailbox virtual machine will impact fewer users. This allows risk to be spread across multiple Exchange mailbox virtual machines without requiring additional hardware.
- Multiple virtual machines on a single server can increase performance and scalability to unprecedented levels. VMware Infrastructure has been successfully tested under LoadGen with up to 16,000 users on a single server.¹
- Organizations can support different backup, replication, or SLA requirements on each mailbox virtual machine.
- Multiple DR strategies can be maintained as each mailbox server virtual machine can be matched with its own DR solution.
- Compliance requirements for certain users can be addressed by placing these users into their own mailbox virtual machine.
- Exchange mailbox virtual machines can be deployed along with an Active Directory (AD) domain controller virtual machine on the same ESX server and on the same virtual switch. This design can isolate AD traffic within a single ESX server and keep it off the physical network (figure 4).

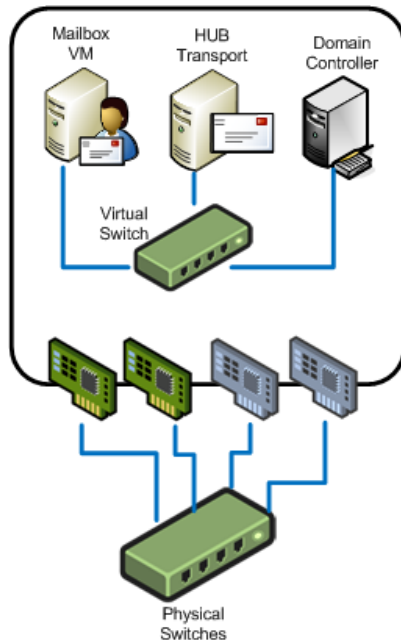


Figure 4: Localizing AD Traffic within a Virtual Switch

¹ http://www.vmware.com/company/news/releases/ibm_exchange_vmworld.html

Example: Over time, the XYZCorp Exchange environment has grown to 3,500 Exchange users deployed using three distinct mailbox virtual machines. One virtual machine contains the 2,000 users that were part of the original deployment. A second virtual machine supports 700 users that came in through an acquisition and belong to a separate AD forest for organizational reasons. This virtual machine is on its own virtual switch, with its own dedicated NIC on the ESX server and has its own IT staff, managing their own Exchange virtual machine independently. The third virtual machine contains mailboxes for all staff deemed critical in the event of a disaster. This virtual machine has its Exchange databases replicated to a DR site using array-based synchronous replication, and has a one-hour RPO/RTO in a disaster scenario.

By splitting the user population across multiple mailbox virtual machines, XYZCorp can meet different business and technical requirements without requiring additional server hardware. These mailbox virtual machines may all run on a single server or be moved across the virtual infrastructure as required.

5.2.3 Rapidly Provision Exchange Servers with Virtual Machine Templates

Virtual machine templates can speed deployment times by eliminating repetitive OS installation and patching tasks. New virtual machines can have their core configuration deployed in a matter of minutes, allowing rapid provisioning of applications into production and reduction of manual work required during their deployment. In addition, products like VMware vCenter Lab Manager and VMware PowerCLI can help accelerate and further automate the process of moving tested Exchange virtual machines into production.

Deploying a new Exchange server can take many hours by the time you configure the hardware and storage, install the operating system and patches, and install the associated applications and updates. This process must be repeated for each and every server instance, which can result in very long deployment times, especially for large, complex architectures.

Alternatively, a virtual machine template can be configured and stored once for each type of server in the environment, allowing Exchange administrators to keep a virtual library of all server images. This can save countless hours when deploying new systems, particularly for larger Exchange deployments that may have to deploy hundreds of new servers to support an organization's messaging workload.

To save time and reduce outages in software troubleshooting scenarios, it may be faster in some cases to deploy a new virtual machine from a template, configure Exchange, and then connect existing databases to the new virtual machine. Once the databases are connected to the new virtual machine, user mail service is restored and the old virtual machine is freed up for other tasks, such as performing advanced troubleshooting and diagnostics. Alternatively, the virtual machine can simply be decommissioned.

VMware vSphere PowerCLI is a powerful command line tool that lets you automate all aspects of vSphere management, including network, storage, VM, guest OS and more. PowerCLI is distributed as a Windows PowerShell snapin and includes more than 150 PowerShell cmdlets along with documentation and samples. For more information about PowerCLI, please see the following link:

<http://communities.vmware.com/community/vmtn/vsphere/automationtools/powercli>

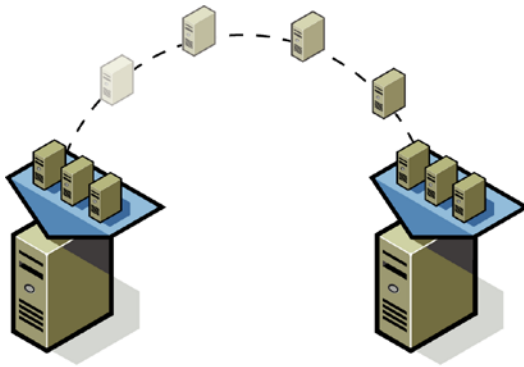


Figure 5. Virtual Machine Templates

Example: The XYZCorp migration plan to Exchange 2010 includes deployment of a number of new 64-bit Windows virtual machines. To streamline this task, XYZCorp builds a single virtual machine with all the appropriate patches, updates, antivirus, etc. and creates a master template of this virtual machine. Using the template, each subsequent virtual machine is deployed into the virtual environment in a matter of minutes. This saves XYZCorp's IT staff countless hours during initial deployment. The templates remain on-hand in the event that XYZCorp needs to quickly deploy a new Windows virtual machine for production, training, troubleshooting, or to meet changing service levels in the Exchange environment.

5.2.4 Reduce Hardware and Operational Costs of Maintaining an Exchange Lab

Using VMware virtual machines for your Exchange lab can drastically reduce the amount of hardware required for functionality testing and eliminate the need for hardware that is identical to production. When the vSphere infrastructure is in place, provisioning of new test environments for Exchange can take minutes rather than hours or days to rack and cable physical servers. With VMware vCenter Lab Manager, the story gets even better, with self-service and storage utilization capabilities.

Using VMware virtualization provides a great foundation for Exchange 2010 evaluation and testing processes. vSphere allows organizations to build a logical architecture that exactly mimics their own production environment, but requires a fraction of the hardware. The flexibility that virtualization provides allows organizations to use a more realistic, less error prone testing process in developing and testing their infrastructure design. vSphere helps IT staff avoid the lengthy re-configuration tasks required in a physical server-based test lab. Post-rollout, a vSphere test lab provides an easy and affordable way to maintain a completely isolated test and development configuration that mirrors the production environment. This can yield valuable long-term benefits for continual testing, troubleshooting, training, and maintenance of Exchange 2010.

VMware virtualization is a great way to begin evaluating Exchange 2010 with minimal hardware commitment and maximum flexibility. With today's powerful multi-core 64-bit servers, it is possible to configure dozens of independent virtual machines on a single ESX host. Entire Exchange 2010 and Active Directory environments hosted on virtual machines can be staged on a relatively small number of physical servers to assess new Exchange 2010 features, test upgrades, and train users and IT staff.

Flexibility is a primary trait of virtual machines. Testing virtual machines on different hardware or storage platforms can be as simple as copying a few files; testing varying memory or processor configurations merely requires a reboot of the virtual machine, and testing patches and service packs can be controlled with VMware virtual machine snapshots and rollback capabilities.

After the evaluation process is complete and Exchange has been deployed to production, virtual machines also make it possible to maintain a complete affordable replica of the production Exchange environment running in parallel with the production systems. Maintaining a virtualized Exchange lab environment that mirrors a production deployment can be valuable for testing patches and new service packs before they are rolled out into production. Additionally, training new IT staff on Exchange 2010 operations or testing new configurations all can be done simply, without risking impact to the production environment.

Example: As XYZCorp begins to consider the business case for migrating to Exchange 2010, they decide to build a test environment that can be used by various groups within the organization to evaluate the Exchange 2010 messaging platform and determine benefits of the potential migration.

To create the test environment with minimal expense, XYZCorp installs vSphere on a single 64-bit host. With this single virtual platform, they are able to construct a complete test environment, consisting of more than 20 virtual machines, which are used to host the following:

- All the required Active Directory components deployed in their own virtual machines
- All the Exchange Server 2010 roles deployed in their own virtual machines
- Several Windows XP and Vista virtual machines to test the end-user experience
- Existing servers from their GroupWise environment that are converted to virtual machines using the free VMware Converter product

With this simple test platform, XYZCorp is able to build a test environment that exactly models their proposed production environment and allows them to adjust the environment as constraints are identified. They experiment with various virtual network topologies and components and adjust their configurations quickly and efficiently. They also simulate loads against various numbers of test users to understand the performance dynamics of their design in a fully isolated environment. With VMware Converter, they also are able to convert existing physical GroupWise servers into virtual machines, allowing XYZCorp to test various migration scenarios in an isolated test environment.

5.2.5 Enhance Testing and Troubleshooting Using Cloned Production Virtual Machines

Snapshots and clones provide powerful tools for testing and troubleshooting any virtual machine. In an Exchange environment, the complexity of the entire system makes this capability especially valuable. VMware-enabled troubleshooting can help to substantially shorten time to resolution of critical issues and reduce their overall impact on the production environment.

Virtual machine snapshots provide an extremely useful testing and troubleshooting tool. Live snapshots of VMware virtual machines can be used to instantly roll back to a previous known good configuration. Cloning a virtual machine allows Exchange Administrators to make an exact, independent copy of any virtual machine in their environment. The copy can then be installed in a test environment for offline testing and troubleshooting. Sharing the virtual machine with third-parties such as consultants, other partners and vendors eliminates the sometimes challenging step of creating a duplicate environment to reproduce problems.

Example: One of XYZCorp's Exchange virtual machines is experiencing an intermittent problem. It is difficult to troubleshoot this issue on the production system during normal business hours when users are on the system. XYZCorp staff makes a clone of the problem virtual machine and imports the cloned virtual machine into their Exchange 2010 test and development environment, which has remained synchronized with the production environment since the initial Exchange 2010 evaluation. Using a cloned virtual machine in an isolated test environment allows XYZCorp staff to immediately begin troubleshooting with an exact copy of the production machine, with no impact to end users.

As new service packs and hot fixes are released for both Exchange and Windows Server, XYZCorp can test the impact of these updates in their test and development environment. To accomplish this, they take a snapshot of the virtual machine before applying the update. If the update is successful, they can delete the snapshot and leave the update installed. If, for any reason, the update is unsuccessful, the virtual machine can be rolled back from the snapshot to its previous state. These tools allow XYZCorp to quickly and effectively stage and test patches in a controlled environment before deploying them onto production systems.

5.2.6 Higher Availability with Less Complexity

The vSphere platform can be leveraged to provide a wide-range of availability options. VMware HA provides protection from server hardware failure that is independent of the operating system or applications and works for every virtual machine running on vSphere. To aid in dynamic load balancing of Exchange virtual machines, VMware DRS can be used to balance workloads automatically. Base solutions built on VMware HA and DRS can be deployed with minimal configuration changes and provide a robust availability solution. These solutions can also be enhanced to provide higher levels of availability by combining them with more traditional clustering and replication options (described later in this section).

By leveraging the inherent benefits of a virtualization-based platform, an Exchange deployment using vSphere offers a variety of availability options. Each of these options provides different levels of both protection and cost, capable of meeting the unique high availability requirements of any Exchange environment. A number of tools available from VMware, Microsoft, and third-party software and hardware vendors can be used to facilitate both in-site and remote site availability and recovery. The vSphere platform leverages two powerful features as the basis for building high availability solutions:

5.2.6.1. Reduce Planned Downtime Due to Hardware or BIOS Updates with VMware VMotion

Virtual machines decouple the operating system and applications from the underlying hardware, allowing supporting infrastructure to grow and change rapidly. VMotion allows any virtual machine to be migrated across physical servers, even servers from different vendors with different hardware configurations. Planned downtime can be minimized and a more flexible infrastructure makes the Exchange environment more resilient. In an environment without virtualization, this level of flexibility does not exist.

Due to the critical importance of Exchange within organizations and the care that must be taken when designing and deploying Exchange systems, Exchange deployments tend to be relatively static, meaning that the workload is more intimately tied to the hardware platform on which it runs. As a result, hardware upgrades to the messaging system infrastructure tend to directly correspond to the release and upgrade cycle of the Exchange application itself.

With the frequent changes that are sometimes required in the business world, the static nature of the Exchange system infrastructure can limit the ability to meet changing demands in the organization's messaging environment. For example, a massive influx of new e-mail users or the addition of new services for devices such as PDAs and Blackberry cell phones can require additional hardware and a great deal of system re-engineering to support.

In contrast to a static, physical server deployment, VMware decouples the OS and associated applications from underlying server hardware. With VMware VMotion, any virtual machine can be migrated "on the fly" between ESX servers with no interruption to service (see Figure 6). VMotion allows administrators to move Exchange workloads to more powerful hardware without outages or costly system re-engineering. This added agility allows the Exchange environment to change as the business environment changes. Planned downtime can also be minimized as Exchange virtual machines can be migrated to alternate hosts during scheduled hardware maintenance windows.

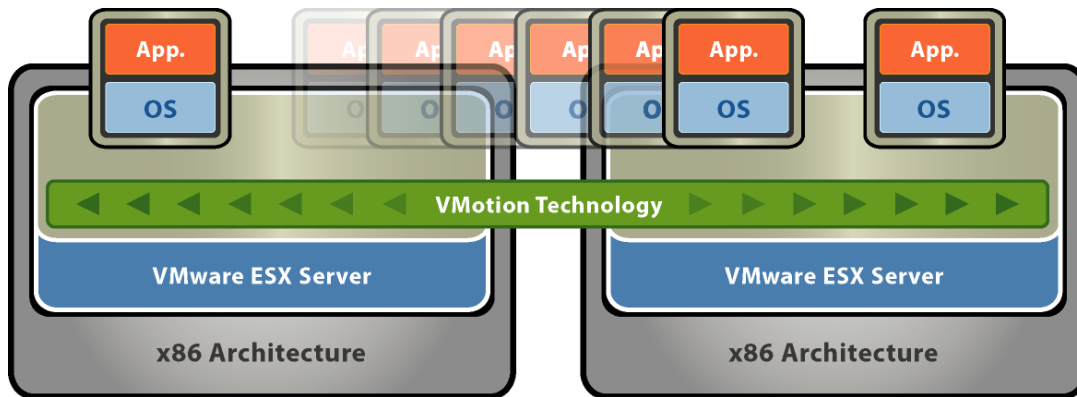


Figure 6. Migrating Virtual Machines Across ESX Hosts with VMotion

Example: As part of XYZCorp's ongoing maintenance processes, they regularly update the BIOS and other firmware on their host servers. To accomplish this without disruption, XYZCorp uses VMotion to move all virtual machines off of an affected ESX host. Heavily loaded mailbox servers can be moved online to a different ESX host with no loss of service. Virtual machines can even be moved onto hosts from different vendors with different hardware configurations. After all virtual machines are migrated off of a host, XYZCorp updates the BIOS and all firmware, reboots and then uses VMotion to move virtual machines back to the host. They repeat this process for their entire server infrastructure. This is just one example of how VMware VMotion can be used to provide new levels of flexibility and reduce downtime on critical Exchange servers.

5.2.6.2. Reduce Unplanned Downtime Due to Hardware Failure or Resource Constraints

The vSphere platform can be leveraged to provide a wide-range of availability options. VMware HA provides protection from server hardware failure that is independent of the operating system or applications and works for every virtual machine running on vSphere. To aid in dynamic load balancing of Exchange virtual machines, VMware DRS can be used to balance workloads automatically. Base solutions built on VMware HA and DRS can be deployed with minimal configuration changes and provide a robust availability solution. These solutions can also be enhanced to provide higher levels of availability by combining them with more traditional clustering and replication options.

VMware High-Availability (HA): Provides simple, low-cost protection for every virtual machine by guarding them against physical host failure. In the event of server hardware outage, VMware HA will automatically restart all virtual machines on another ESX host (see Figure 7), minimizing disruption to the Exchange environment. VMware HA is simple to set up and protects every virtual machine without requiring complex clustering software.

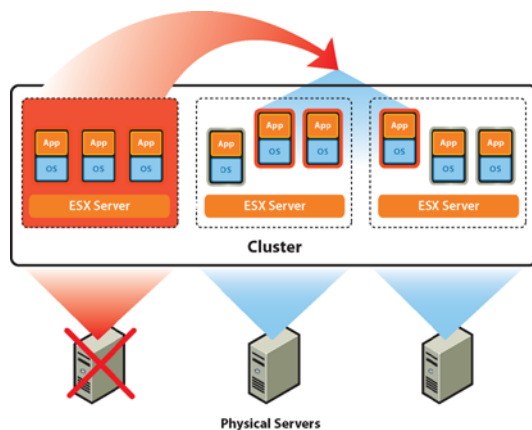


Figure 7. VMware HA managing an ESX Host Hardware Failure

VMware Dynamic Resource Scheduler (DRS): With VMware DRS, virtual machines are dynamically load balanced across an entire pool of server resources. DRS collects resource usage information for all hosts and virtual machines and generates recommendations for virtual machine placement. These recommendations can be applied manually or automatically. DRS can dynamically load balance all virtual machines in the environment by shifting workloads across the entire pool of ESX servers (see Figure 8). This ensures that critical Exchange virtual machines in the environment will always have the CPU and RAM resources they need to maintain optimal performance.

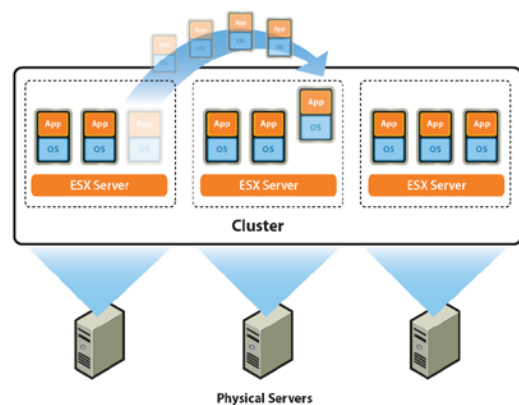


Figure 8. VMware DRS Dynamic Load Balancing

Solutions built using VMware HA and VMware DRS provide out-of-the-box high availability for the entire Exchange environment without requiring any Microsoft or other third-party clustering software. For Exchange environments deployed with vSphere, the VMware HA and DRS solution provides a new alternative that leverages the simplicity of standalone virtual machines while providing complete server hardware redundancy for every virtual machine, not just the clustered ones.

VMware HA is focused on hardware failure, not on operating system or software failure. If you need greater levels of protection and guarantees of availability for the Exchange mailbox server to handle those situations, VMware HA can be combined with traditional cluster solutions like MSCS. A few examples for extending the VMware HA/DRS solution follow:

- **Database Availability Groups (DAGs):** DAGs utilize a non-shared storage failover cluster solution, using built-in asynchronous log shipping technology to create and maintain one or more copies of each database on other mailbox servers in the DAG. Unlike previous forms of Microsoft Clustering, DAG failover happens at the database level rather than the server level. DAGs provide application-aware availability and the lack of a quorum disk makes this a VMotion-friendly solution.
- **DAG Delayed Log Replay:** Geared towards disaster recovery scenarios, this version of DAG delays the commitment of log files into the database copy based on an administrator defined lag time. Replay lag provides protection against logical database corruption by providing the ability to recover up to the last copied and inspected log file, or to a specific point-in-time (PIT) within the lag window by manipulating the log files and running eseutil.
- **Third Party Software-based Replication:** Several third-party replication solutions are available to enhance availability and recovery of a virtual Exchange environment. Some of these products emphasize availability, providing immediate failover of Exchange services, while others emphasize recovery in the event of a catastrophic failure. In most cases, these solutions can be used either within a single Exchange site or replicated over the WAN to a DR site.

Example: XYZCorp is seeking 99.99% total uptime (less than one hour of downtime annually) for their new Exchange 2010 environment. They have been evaluating several different high availability options that involve sophisticated cluster software which require additional 64-bit server hardware to function as the passive/secondary cluster node. The additional cost and complexity of these cluster solutions is more than XYZCorp wants for in their initial deployment.

XYZCorp decides to avoid cluster solutions entirely in their initial deployment and leverage instead a solution built on VMware HA and DRS. This solution provides complete protection from server hardware failure that extends beyond the Exchange mailbox server and protects every virtual machine. In the future, XYZCorp plans to enhance this solution by adding a Microsoft Database Availability Group (DAG) solution that will work in conjunction with VMware HA to provide enhanced availability.

In XYZCorp's testing, a physical server running the mailbox virtual machine and a domain controller virtual machine is powered down in a simulated failure. In response, VMware HA automatically restarts the impacted virtual machines on the surviving servers. Once the failed server is brought back online, VMware DRS automatically re-balances the workload across all three servers. This approach meets their needs for availability at a very low cost and is approved for use in the production system.

5.2.7 Implement Simple and Reliable Exchange Disaster Recovery

vSphere simplifies Exchange disaster recovery (DR) by reducing hardware compatibility constraints and, through consolidation, the number of servers required at the DR site. Combined with Exchange Database Portability, recovery from both hardware and software failure can be greatly improved, reducing the time to restore essential mail services to end users. Hardware independence allows the Exchange virtual machines to be restarted on any supported ESX server, and Exchange server replication is simplified, using virtual machine encapsulation.

An important benefit of virtualization is abstraction of the operating system and application from the underlying physical server hardware. This is extremely useful in disaster recovery scenarios, because it eliminates the traditional requirement of physical server-based disaster recovery to provide identical hardware at the DR site. Any virtual machine can be brought online on any supported ESX host without worrying about hardware or software compatibility. The ability to run multiple virtual machines on a single server also reduces the costs of a DR solution through consolidation of Exchange components and services on fewer physical servers than would normally be required. Thus, having all the necessary Exchange server roles and active directory components running in virtual machines at a DR site can be achieved with minimal hardware and can help speed recovery in a disaster situation.

Regardless of the make and model of the physical server hosting the virtual machines in production, virtual machines can be brought online on any VMware-supported ESX host at the DR site. Older servers freed up from other VMware vSphere consolidation projects are commonly repurposed to host a DR site, minimizing the overall lifecycle costs of hardware.

When used in conjunction with vSphere, the Exchange 2010 “database portability” feature creates additional options for disaster recovery. Standby virtual machines can be configured with the Exchange mailbox role and made available at both the production and DR sites. These virtual machines can be easily configured to connect to existing Exchange databases during a recovery.

Finally, virtual machine encapsulation means that an entire Exchange server can be contained in a small set of files (see Figure 9), which simplifies replication to DR sites. Moving an entire virtual machine can be accomplished with a simple file copy.

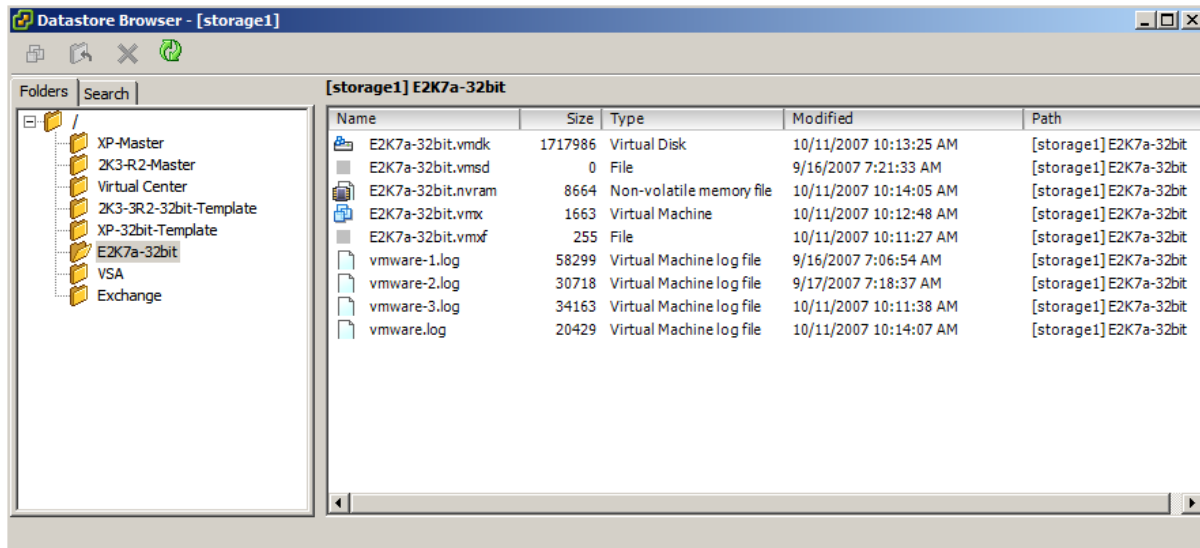


Figure 9. Exchange virtual machine encapsulated into a small set of files

Example: XYZCorp.com adopts more stringent disaster recovery requirements as part of their Exchange migration project. Their new objectives state that they will restore their messaging system to full functionality in less than 24 hours following a total loss to their primary datacenter. Designing the Exchange environment to meet this requirement is critical to the success of this project.

XYZCorp contracted with a third-party disaster recovery site approximately 300 miles from their home office. Two ESX hosts have been provisioned at the DR site as part of their recovery plan. To enable the fastest possible recovery, XYZCorp wants to make sure that all the required components are online and available at the DR site at all times. To accomplish this, all Active Directory servers have been deployed in virtual machines on the ESX hosts at the DR site and are online. Additional virtual machines have been provisioned as Exchange mailbox servers and configured for the Exchange organization. In the event of a failure, these virtual machines connect to the replicated Exchange databases using the database portability function in Exchange 2010. Additional virtual machines required to bring up an Exchange environment (HUB, CAS, etc.) are deployed in a similar fashion. Thus, a complete standby Exchange environment is online and ready whenever it is needed. A proof-of-concept test showed that the entire Exchange environment could be restored to live operation in a few hours.

Finally, because the ESX hosts at the DR site will only be heavily used by Exchange in the event of a disaster, XYZCorp also uses them to host a number test virtual machines used by their software developers. They use the resource pools feature provided by vSphere to make sure that the test virtual machines can only use a specified amount of the CPU and RAM resources available on the ESX servers, and will shut these virtual machines down in a disaster scenario. This design allows XYZCorp to take advantage of the computing resources of these servers when they are not being used for disaster recovery purposes.

XYZCorp continues to test their Exchange recovery ability on a quarterly basis and plans to test VMware vCenter Site Recovery Manager to further automate their ability to quickly and reliably restore Exchange mail service.

6. Deployment Alternatives

This document described several benefits of virtualizing Exchange 2010 on vSphere. There are a number of ways that virtualization can be used to take advantage of these benefits today to assist Exchange 2010 deployment. A few common deployment scenarios include the following:

- **Virtualizing Exchange in test and development environments only:** Virtualization provides a simple and cost-effective method for beginning the Exchange 2010 evaluation process in a staging or test lab environment using minimal server hardware. Testing on virtual machines is a great way to learn and bring users and IT staff up to speed on the new technology, and simulate migration scenarios in a controlled environment before rolling out new releases into production.
- **Virtualizing non-Mailbox Exchange 2010 server roles:** The server role concept benefits administrators by allowing for more modular deployments; however, this can result in underutilization of the non-mailbox server roles when they are deployed on physical machines. You can achieve cost-effective consolidation of the Client Access, Hub Transport, and Edge server roles as well as typically lightly-utilized infrastructure components such as AD Domain Controllers, Global Catalog Servers, DHCP, DNS, and WINS servers. Mailbox servers can remain on physical hardware, without virtualization, if desired.
- **Virtualizing Exchange 2010 Disaster Recovery servers:** In the physical world, disaster recovery essentially doubles your production hardware costs. Every production physical server requires an identical match of equipment provisioned at the disaster recovery site. Moreover, physical server-based recovery procedures can be complex and error-prone. Virtualizing your disaster recovery site can greatly decrease cost and complexity. First, you are not bound to the 1:1 ratio of hardware required at both production and DR sites, and you can run as many virtual machines on a physical host as performance allows. Secondly, you can use any hardware you want; your DR servers do not have to be identical. Finally, Exchange disaster recovery design and test can be completely automated using VMware vCenter Site Recovery Manager.
- **Full virtualization of all Exchange servers:** With Exchange 2010, performance in a virtual machine is very comparable to native performance and the mailbox server role is an ideal candidate to realize the benefits of virtualization. This deployment scenario virtualizes the entire Exchange environment to maximize the benefits of running on a vSphere platform.

The decision of which components to virtualize in a production environment depends on many factors, including your level of proficiency with Exchange 2010 and vSphere, and support agreements with Microsoft, VMware, and your hardware vendors. Regardless of the method that most suits your needs, you can begin to maximize value from IT assets with virtualization today.

7. Conclusions

The critical nature of messaging requires that any new platform chosen for hosting Exchange environments is as reliable and proven as the traditional physical server alternative. More than 100,000 customers worldwide use VMware products. More than 50% of VMware customers running Exchange have virtualized it for production use. The vSphere platform has the maturity, stability, performance and functionality required to host critical Exchange 2010 infrastructures.

To meet the needs of a continually shifting business landscape, today's messaging environments must also be highly available, flexible, and cost efficient. Using vSphere as the preferred platform for Exchange 2010 can help you to better align your messaging environment to your business goals.

Features such as VMware HA and DRS can decrease downtime associated with server hardware failure and allow for more rapid recovery of messaging services. Virtual machine snapshots and clones help with troubleshooting and resolving other deployment issues and can greatly enhance efficiency in the development cycle.

By decoupling the OS and associated applications from the underlying hardware, VMware VMotion greatly enhances the resilience and agility of your messaging system, allowing for on-the-fly hardware replacements and upgrades and the ability to quickly scale to changing workloads.

Finally, vSphere helps to maintain a cost-effective Exchange 2010 environment by maximizing utilization of computing power through conservative resource requirement sizing and taking advantage of other physical server consolidation opportunities. The robust feature set of vSphere can help to reduce management costs as well, eliminating many mundane and repetitive tasks and freeing up IT administrators for other challenges that are strategically important to the business.

8. More Information

Please visit <http://www.vmware.com> for more information or contact your local VMware sales representative.