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Enterprise Backup and Recovery for ESX Server

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Server Virtualization Basics

Server Virtualization (SV) continues to gain popularity. Virtual machine technology, which has matured to the point where many companies are using it in an enterprise production environment, allows a network administrator to run multiple Virtual Machines (VMs) on one physical host server. This allows you to keep logical servers separate from each other, having each server in a separate virtual workspace. VMware, which has the most market share of any virtual machine product on the market today, offers ESX Server, an enterprise virtual machine product that can be used to:

1. Consolidate and run multiple servers on one physical/host server.
2. Effectively use server resources.
3. Quickly create a test/lab environment.
4. Create a Disaster Recovery (DR) site.
5. Replicate Data from Virtual machines to a DR Site over a WAN.
6. Significantly reduce server hardware costs.

ESX Server, which is specifically designed to run in an enterprise environment, uses a specially developed secure microkernel to provide a generic virtual machine hardware environment for guest operating systems. The microkernel is designed specifically to provide “near native” access to host server hardware, and includes scalability and management features specifically designed to run virtual machines.

Candidates for Server Virtualization

SV works best for companies that require a number of dedicated machines running different applications such as File and Print, Exchange, SQL Server, SharePoint, IIS, Oracle, Peoplesoft, SAP, Citrix, Terminal Server, Apache, BEA WebLogic, and other applications, but that don't have the budget or space to run each of these applications on separate physical hardware. SV is very attractive for companies that are replacing older computers. Instead of purchasing new servers to replace old servers, consider using SV to consolidate these servers on a few enterprise-class servers. Ideally, each of the servers has low utilization without a lot of users accessing any given server. However, for VMs that require more resources you can configure ESX Server to guarantee specific service levels for high-priority virtual machines.

If you have a server that is low on memory, has high disk utilization, has a large number of users, or is heavily

utilized, SV is probably not the right solution—at least in a production environment. Consolidating this type of server will just make a bad situation worse. If you have thousands of users to support and the server is already heavily taxed, keep it dedicated. But even if you're in this situation, SV still has a legitimate place in your lab environment, and more likely than not you probably have at least a couple of servers with low utilization that would be ideal candidates for SV and consolidation.

For production environments, I suggest limiting the number of VMs from 3 to 10 per host machine, although ESX Server supports up to 80 VMs on one host. Of course, this general rule will vary depending on the aggregate requirements for processor, memory, disk space, and disk performance for all VMs running on a physical server. Increasing the number of VMs per host allows you to cut down on your physical hardware requirements; however, if the host machine experiences a hardware failure, you will lose all the VMs running on that machine. In a production environment, it's still a good idea to spread your VMs across a couple of physical servers, so a hardware outage may decrease network functionality, but it will not take down the entire network.

Virtual Machine Hardware Requirements

When planning the hardware requirements for your virtual machine environment, you must size your host server properly to ensure that you have adequate memory, disk, and processing power for all of your virtual machines. Of course, the type of applications and the number of users connected to each virtual machine will significantly influence the hardware specifications for your host server. Vizioncore's esxCharter is a great tool for monitoring the health of virtual machines. If you're considering consolidating your production servers, you may want to consolidate these servers in a lab environment, simulate a network load, and use esxCharter to monitor the health of the test virtual machines. In general, you'll experience the following constraints with your ESX Server hardware:

1. **Server Model, Vendor, and Guest OS.** ESX Server supports a number of hardware platforms and guest operating systems. Make sure that the server you select is compatible with ESX Server, and that all guest operating systems are supported by ESX Server. You can download a systems compatibility guide for ESX Server from http://www.vmware.com/pdf/esx_systems_guide.pdf.

2. **Server Memory.** The current version of ESX Server supports 64GB of host memory. As you increase the number of VMs running on the host server, memory will probably be the first limitation you will run up against in a virtual machine environment. When selecting your host server hardware verify that the server you're considering has the appropriate memory capacity for the number of virtual machines you plan to run. If the server will run only file and print services, I like to start with at least 1GB of memory. If the server will run additional applications such as Exchange or SQL Server, I typically configure the server with at least 1.5GB of memory. Linux servers typically require at least 500MB of memory. As a general rule, it's always easier to add more memory to a VM than it is to take it away from a running VM. Because the total memory capacity of your server is fixed, be conservative about the number of virtual machines you can fit onto one machine; memory is typically the main bottleneck in 4- to 8-way hosts.
3. **SANs and Server Disk Throughput.** Assuming that your virtual machines have adequate memory, server disk throughput most likely will be the second bottleneck. Server applications such as Exchange are especially disk intensive. An ideal situation is to have your virtual machines connected to a Fibre Channel Storage Area Network (SAN) for the best disk performance and configuration flexibility. Most Fibre-Channel SANs have a connection charge per port on the Fibre-Channel switch, so consolidating servers on one physical machine can yield a significant cost savings. ESX Server has built-in support for SAN multipathing to take advantage of dual-attached Fibre-Channel connections from the host server to a SAN. ESX Server supports most SANs, but verify that your SAN is compatible by reviewing the document at http://www.vmware.com/pdf/esx_SAN_guide.pdf.
4. **Server CPU.** On most servers, the processor is really underutilized, unless you're running an enterprise application that is very CPU intensive. ESX Server is licensed based on the number of CPUs (2, 4, 8, or 16) in the host server. Most network administrators find that a 4-processor server is optimally sized for their VMs. Typically, you'll hit memory and disk bottlenecks before you can fully utilize the processing capability of more than 4 processors.
5. **Network Interface Card (NIC) teaming and ports.** ESX Server supports native NIC teaming for the virtual machines. If you plan to use VMotion (used to load

balance and transfer running VMs to different host servers), ideally you should have a minimum of four gigabit network ports installed in the host server: a dual port bond for the virtual machines, one for the VMware Service Console, and one for VMotion. If your virtual machines will generate a significant amount of network traffic, consider increasing the number of ports to handle the additional network load.

Multi-port NICs can reduce the number of PCI slots required in the server when space is limited.

Backup Strategies of Virtual machines

Backing up virtual machines has some unique challenges and advantages compared to backing up physical servers. As you know, each virtual machine's configuration and data are stored as encapsulated files on the host server. One approach to backup is to purchase remote agents for each virtual machine and use a backup program to back up the server data to tape or other backup device. If you're running other server applications such as Exchange, SQL Server, SharePoint, Domino, Oracle, SAP, or another server application that requires a backup agent to properly protect the server, this adds to the cost of the backup software and usually complicates the restore process.

Fortunately, virtual machine-specific backup solutions such as Vizioncore's esxRanger Professional are specifically designed to back up VMware's ESX Server. Without esxRanger, it's difficult to capture the image of a running virtual machine because the VMware Virtual Disk (VMDK) file is locked while the virtual machine is running. You could shut down the virtual machine and then back up the Virtual machine's VMDK files, but this is usually not practical in a production environment. esxRanger uses the following process to capture the VMDK file:

1. **Unlock VMDK.** esxRanger uses the VMware Application Programming Interface (API) that adds a .REDO log that allows the VMDK to be unlocked for read only purposes. The .REDO log tracks any changes to the VMDK while it's backed up by esxRanger.
2. **Compress VMDK.** esxRanger copies and compresses the VMDK file, which can significantly reduce the size of the VMDK file based on the contents of the VMDK file.
3. **Commit REDO log.** The .REDO log is committed to the VMDK file, and the VMDK file returns to its "normal" state.
4. **Add additional backup Information.** esxRanger saves the compressed backup file to a backup destination

and adds an information file that contains all of the information needed about the backup image including who performed the backup, what time the backup occurred, the size of files in the backup archive, where the backup came from (ESX Server and the VMWare ESX Server File System - VMFS) and retains the permissions of the files in the archive. This is an important feature of the backup process, because it allows the backup file to be independent of any specific esxRanger backup server. All of the information that is necessary to restore the VMDK file is contained within the backup file itself. A backup to a SAN or tape device is very common.

Placement of esxRanger and location of the VMDK backup files

You have two options for installing esxRanger:

1. **Dedicated esxRanger Windows server.** In an enterprise environment, this is the ideal location. It simplifies the recovery process if you lose a host server. Because additional backup information is encapsulated in each VMDK backup, this allows the backup images to be independent of a specific esxRanger Backup server. Everything that is necessary to restore the backup image is contained within the backup image itself.
2. **Install esxRanger on a Windows VM.** This is the second best option for esxRanger, but if the host server crashes it complicates the restore process. You must install the ESX Server, setup the Windows VM and then reinstall esxRanger, before you can restore any VMs.

esxRanger can send the backup of the VMDK files to any Windows or Linux destination. Any storage location visible to esxRanger can be used. Typically, the VM backup files are stored on a SAN or locally attached storage. For the best protection of the VM image files, make sure they are ultimately stored on off-line/removable media like a tape. This ensures that the backups can be taken off-site and easily transferred to a DR site. Having the backups offline also protects the image files against corruption, in case the VMs or ESX Server are hit with a virus, root kit, or spyware.

esxRangerPro is VMotion Aware

VMotion is a separate module that works with ESX Server and allows the migration of a running virtual machine to a different ESX Server host. Since esxRangerPro is

VirtualCenter aware the backups will “follow” the virtual machine to a different host. VMotion is especially useful if you have two or more ESX Servers and have to perform hardware maintenance. You can temporarily move your virtual machines to a different server host, perform any maintenance tasks, and move them back to the original server host. With esxRanger, you don’t have to worry about reconfiguring your virtual machine backups, because the images will be backed up regardless of where they are running.

Advantages of Virtual machine Backups

Once you’ve backed up the VMDK images for your virtual machines you now have an image file of your running servers. There are many advantages of having your servers stored as image files.

Bare Metal Restore—If you’ve ever had to restore a server—especially a domain controller or application server like Exchange—you know how challenging, time consuming, and stressful the restore process can be. Even if you purchase a bare metal restore product, you have limitations, especially if you’re restoring to different server hardware because the CD you’ve created for the bare metal restore probably won’t work on different server hardware. ESX Server can be installed on many different hardware platforms from leading enterprise vendors. The installation process is quite simple and can be easily automated with the Linux Anaconda utility. Once the ESX Server is up, restoring the virtual machines simply requires restoring the VMDK on the ESX Server and starting up the virtual machine. Because ESX Server uses a generic x86 hardware platform that is consistent regardless of the host server hardware you don’t have to worry about server hardware differences when you restore the VMDK. The VMDK is a true image backup so all of your programs, data and sever configuration are restored in one step. You don’t have to worry about installing the OS, installing the backup software, cataloging the tape, and restoring the data, because everything is contained within the VMDK. You realize an even greater advantage if the server is a Domain Controller (DC) or runs a server application like Exchange or SQL Server because the restore process to a physical server is much more complicated compared to restoring these services to a virtual machine. This is a major advantage over a physical server because you can restore virtual machines much faster than any physical server.

Remote Disaster Recovery Sites—Virtual machine technology is ideally suited for fast recovery at a remote Disaster Recovery (DR) site. You can run a weekly full backup of each virtual machine and use a third-party agent to obtain daily incremental backups of your virtual machines that can be copied to the DR site. Assuming you already have ESX Server in place at the DR site, making the warm DR site hot is simply a matter of using esxRanger to load up your VMDK files onto the remote host server and then apply any incremental backup images. Because esxRanger compresses the VMDK files as part of the backup process, these smaller files will reduce the stress on WAN links to the remote DR site. You don't have to worry about ordering additional hardware, installing servers, or running any bare metal restores, because everything necessary to make the site hot is already there. If the virtual machines are mission critical you could run incremental (agent based) backups throughout the day and restore them on the DR site so your remote images are only a few hours behind the production site. This method is not desirable, though, because of the frequency and overhead involved. Using this technology, you could also quickly recover a file or folder in case it is deleted on a production server. Now you can simply bring up the DR virtual machine and copy the necessary file over to the production server. Depending on the file that needs to be recovered, you may be able to recover it without restoring it from tape.

Disaster Recovery Planning—Even if you don't have a "warm" DR site, consider integrating virtual machine technology into your DR plan. Even if you aren't running virtual machines in your production environment you can use imaging utilities which allow you to create a VMDK from a running physical server. Using this technology you can bring up virtual machines that are functionally identical to your physical production servers. During a major disaster, it may be difficult to obtain server hardware on a timely basis. Virtual machine technology not only allows you to reduce your hardware requirements, it speeds up the recovery process because you can perform a bare metal restore using esxRanger and VMDK files instead of setting up separate servers, installing tape back software and restoring from tape for each server. I suggest creating generic server images of all the guest operating systems you use. Even if you have to create a server image from scratch, you already have the guest OS "preinstalled" saving you precious recovery time in the event of a disaster.

Lab Environment—Often, it is cost prohibitive to physically duplicate every item in your production environment to test items in a lab, but you can closely simulate your production environment by using virtual machines instead. Imaging utilities allow you to easily duplicate your production environment by creating VMDK images of your production servers. esxRanger allows you to perform "point in time" backups of your virtual machines to ensure you get a good backup of your lab environment before running tests or perform a major reconfiguration of your test network. Using SV in a lab environment allows you to get up to speed with SV with relatively low exposure. It can also help you determine if SV is appropriate for your production environment. Virtual machine technology has the potential to save the company thousands of dollars compared to duplicating the hardware in your production environment, or can prevent potential downtime by having a lab to adequately test new applications, service packs, or other network reconfiguration tasks.

esxCharter from Vizioncore allows you to monitor the health of your Virtual machine Farm. It can help you make adjustments to VMs to optimize virtual machine performance. It's a great tool to help you profile your existing ESX environment to make informed decisions about future consolidation candidates. You can increase the number of virtual machines running on a host server until you find the number of virtual machines a host machine can handle without adversely affecting performance. It can also help you answer difficult hardware specification questions, by allowing you to determine the hardware specifications of the host server like: "If I add an additional 4GB of memory I can run two additional virtual machines on this machine without compromising performance." It can help you determine which hardware upgrades will give you the best performance per dollar by identifying bottlenecks in ESX Server performance.

Of course you will still want to use esxCharter to monitor your virtual machines in a production environment to verify that your servers are healthy and your users are happy with server performance. You can use esxCharter for trend analysis by monitoring and reporting on key server statistics over a period of time.

Branch Offices—Often, users in branch offices may require the same functionality as central office users, but usually there are significantly fewer users at the branch office. Maybe you're considering placing two or more servers at the branch office location, because they need the functionality identical to the home office, but you're

having difficulty justifying the expense of the servers with the limited number of users in the branch office. Another challenge that IT managers face is the lack of no or limited IT expertise at these branch office locations. For example, you'd like to run a file and print server, Exchange and SQL Server at the branch office location, but you don't want to install all of these applications on the same physical server because you'd like to keep each of these servers separate in their own environment just in case one of these servers gets hit with a virus, or a patch or other critical update takes the server down. Virtual machines can be an ideal solution, because you can run each server in its own virtual environment, but still realize the cost savings of placing one server at the remote location. Using esxRanger, you can easily perform a bare metal restore of any of the virtual machines, which has the potential to save you a trip out to the remote office if one of the servers goes down. Of course if you have a hardware failure of the physical server, all of your virtual machines will go down, but with branch offices this server failure typically affects fewer users than the central office.

The Hybrid Approach—Maybe you're not ready to convert all of your production servers to the virtual machine environment just yet. Even in a large network, you probably have a number of servers with low utilization that are good candidates for server consolidation. The next time these servers are due for an upgrade, consider consolidating these servers into virtual machines. This will allow you to

get up to speed with the virtual machine environment with relatively low exposure, save on hardware costs, and will simplify the restore process.

Summary

Virtual machine technology is now the biggest movement in server management and server consolidation. It can significantly reduce your hardware and administration costs, but it does require proper planning, monitoring and backup in an enterprise production environment. esxRanger will ensure that your VMs are probably backed up, and can be restored at a moments notice regardless of the number of ESX Servers, the VM's location, and the number of VMs. esxRanger's point in time backup makes it the ideal compliment to an ESX Server lab environment. Because esxRanger is specifically designed to work with ESX Server, it's easy-to-use interface for backup and restore reduces the backup administration workload. esxCharter helps you monitor your existing VM environment to watch for bottlenecks and identify other candidates for server consolidation. The vizoncore family of products helps you manage your VM infrastructure regardless of its size and complexity.

About the author

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