



Technical Case Study: Using a Network Appliance SAN with VMware to Facilitate Storage and Server Consolidation

Network Appliance | May 2005 | TR-3401

TECHNICAL CASE STUDY

Network Appliance, a pioneer and industry leader in data storage technology, helps organizations understand and meet complex technical challenges with advanced storage solutions and global data management strategies.

Introduction

Many companies are experiencing a rapid proliferation of commodity Intel® servers. These systems are typically equipped with a small amount of internal or direct-attached disk storage. As server numbers grow into the hundreds, the management complexity for both servers and storage increases exponentially, putting a strain on limited administrator resources and IT budgets.

Server and storage consolidation using VMware ESX software and Network Appliance™ storage systems significantly reduces these problems. VMware allows multiple operating system instances to run on a single physical machine and does not require major changes to existing application software.

Previous VMware implementations have demonstrated that it is possible to reduce the number of deployed Intel-based servers by 50% or more while achieving

- 60% to 80% utilization rates (up from typical rates of <15%)
- Application provisioning time measured in seconds not days
- Response times for change requests measured in minutes
- Zero-downtime hardware maintenance

The benefits of VMware are uniquely complemented by Network Appliance storage solutions. Using NetApp technology, storage can be consolidated onto one or a few storage systems accessed across Fibre Channel SANs or regular IP networks. This dramatically simplifies storage provisioning, increases asset utilization, and allows a company to take advantage of NetApp data protection and disaster recovery functionality. This paper describes the real-world experiences of a customer that reduced its server count 50% and implemented a tapeless storage infrastructure using VMware and NetApp solutions.

Background

In 2001, the company first implemented NetApp storage to support its Oracle® databases. The original F700 series system was upgraded to a F800 series system and then more recently to a FAS960. Today, the FAS960 hosts Oracle via CIFS while providing Fibre Channel SAN storage used by VMware and Microsoft® Exchange servers.

Like many organizations, the company's Intel-based server environment has grown exponentially over the years to support additional business requirements and applications. At the time, it relied on over 100 servers. After internal benchmark studies against similar companies in the same industry showed that the number of servers was significantly above average for the number of users supported, the company launched an initiative to lower operating costs by reducing servers.

In 2004 the company selected VMware as an enabling technology to replace physical servers with virtual hardware instances running on powerful multiprocessor systems.

VMware requires either direct-attached or SAN-based disk storage. The company chose a Fibre Channel SAN to allow storage to be consolidated onto the existing NetApp storage systems. While building a new Fibre Channel infrastructure can be expensive, the VMware server consolidation project server count was cut dramatically and overall expenditures were significantly reduced. Costs were also offset by the advantages of consolidated storage and the advanced data management capabilities offered by the NetApp platform.

Customer Challenges

- Server proliferation results in rising complexity and costs
- Low asset utilization

VMware and Network Appliance Value Proposition

- Simple server/storage virtualization
- Reduced operating costs
- Increased business flexibility
- Advanced data protection and disaster recovery

Deployment Results

- Servers reduced >50%
- Server management cut 20%
- Tapeless backup for rapid recovery
- Bare metal recovery in 30 minutes
- Disaster recovery for all critical business applications
- Dramatically increased IT flexibility

Infrastructure

The company's SAN infrastructure utilizes two NetApp FAS960 storage systems: one in its main data center and another in a secondary data center. Both FAS960 systems are configured to support SAN-attached VMware servers. An Exchange server in the main data center also utilizes NetApp SAN storage with NetApp SnapManager® for Exchange software. Gigabit Ethernet is deployed throughout each data center. Redundant DS3 circuits link the primary data center to the secondary data center.

Both FAS960 systems have FCP Target cards installed, while all VMware servers are configured with QLogic 2342 adapters. Exchange 2003 hosts have Emulex initiator cards installed. Servers and storage systems are connected to a Brocade model 3800 fabric switch using factory default settings and no zoning.

Three four-processor Xeon servers have been configured with VMware ESX software. These ESX servers are configured to access LUNs on the NetApp system in the primary data center. An additional four-processor machine is connected to the SAN in the secondary data center and configured in standby mode. VMware SAN volumes and other NetApp volumes are mirrored to the FAS960 in the secondary data center using NetApp SnapMirror® software. In the event of a disaster affecting the primary data center, critical applications running under VMware can be quickly restarted in the secondary location.

LUNs are provisioned in their own qtrees. In accordance with NetApp best practices, each virtualized server is allocated a qtree in a SAN_vmware volume on the NetApp storage system. In addition, each VMware LUN is formatted as a VMFS-2 volume. This allows the VMware Virtual Center to be used to migrate a virtual machine from one VMware ESX host to another while the server is live. This facilitates maintenance or other administrative needs while minimizing application disruptions.

Configuring a NetApp Fibre Channel SAN with VMware

Once the appropriate software is installed, configuring VMware ESX to access NetApp storage via Fibre Channel protocol (FCP) is simple. VMware allows the administrator to map LUNs to the virtual SCSI disks used by each virtual machine instance. Provisioning LUNs on the NetApp storage systems requires the following steps:

1. Decide the size of the LUN, the LUN ID number, and where it will reside on the storage system (use linux as the Host OS type).
2. If not already present, create an initiator group for the host.
3. Run LUN setup on the NetApp storage system via the command line, or use the LUN Wizard tool in NetApp FilerView®.

Once the LUN is created, use the VMware administrative interface to map the LUN from the storage system to the specific virtual server.

In sizing the LUN for VMware, increase the size slightly to account for VMware administrative space. VMware uses this space to accommodate information about the instance, and to store the memory contents of the virtual server when it is suspended. The company created LUNs that were 2GB larger than the storage requirement to accommodate VMware.

After the company created its LUNs and virtual servers, the LUNs were mapped to individual virtual servers and the instances started. A migration tool from VMware called P2V was used to move data from existing physical servers to VMware virtual servers. After a period of testing and a brief outage for each, the physical servers were retired.

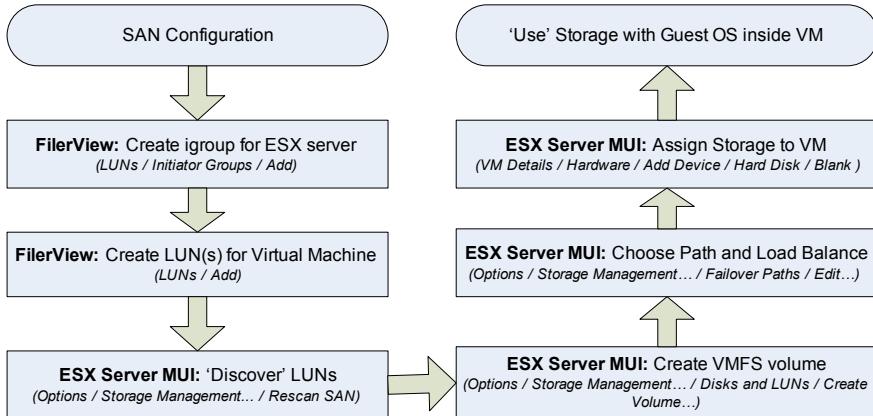


Figure 1) NetApp Fibre Channel SAN configuration with VMware software.

Backup and Disaster Recovery

In any data center, backup and recovery is critical. In this deployment NetApp Snapshot™ and SnapMirror technology help the company protect virtual server data and speed recovery in the event of a disaster.

The VMware Perl scripting API makes it simple to automate the capture of a consistent Snapshot copy of active data. Every night at 8pm the virtual machines (VMs) are suspended. Then the VMware instances and the Host OS buffers are flushed to disk, creating a consistent OS image on the NetApp LUNs. Once the instances are suspended, the Perl scripts direct the NetApp storage system to take a Snapshot copy of the VMware volume. Once the copy has been created, the VMs are resumed. This process is similar to using a database's hot backup mode—suspending I/O to the disks while the backup process creates a consistent copy of the database.

The entire process, from begin suspend to resume VM usually completes within 30 to 120 seconds on “normally” loaded servers in the lab. The Snapshot portion takes less than 5 seconds. At 9pm the Snapshot copy is mirrored to the secondary data center using NetApp SnapMirror software. As described above, the secondary site is running an identical NetApp storage system plus a single standby VMware ESX server.

In the event of a disaster or inadvertent loss of data at the main site requiring an extended outage, the remote site can use the SnapMirror copy of the data to restart critical virtual servers with minimal disruption to ongoing operations.

Once the situation is resolved, the SnapMirror technology allows a "reverse mirror" to be initiated. This is transparent to the applications, and when the mirror has been synchronized, a brief outage allows operations to resume at the main site.

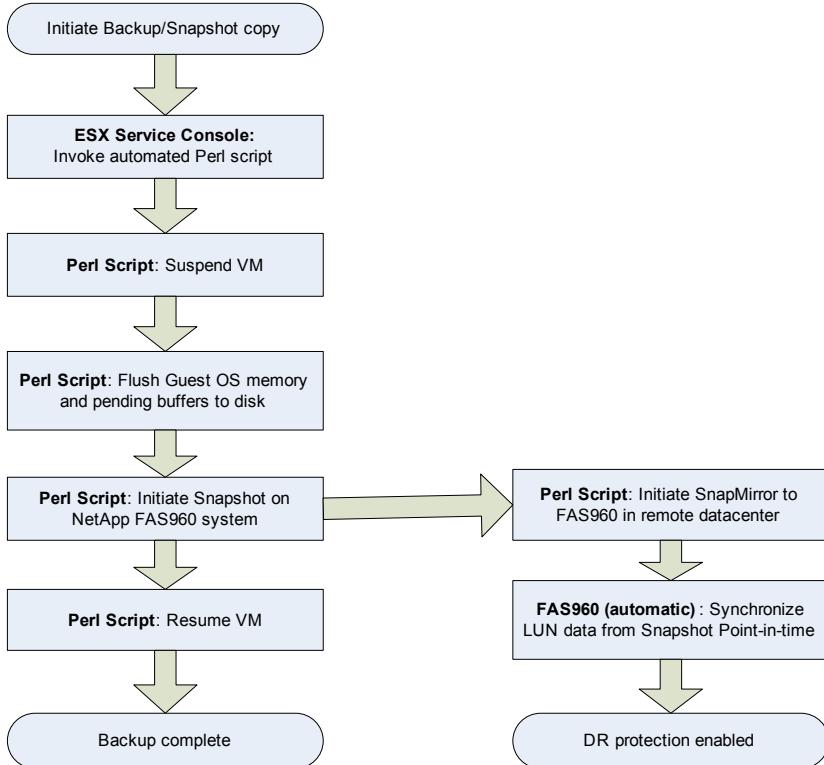


Figure 1) Process to automate the capture of a consistent Snapshot copy of active data.

In addition to allowing recovery in the event of a disaster, the Snapshot copies at the main site or from the mirror at the remote site provide consistent copies of the LUN images for backup purposes, allowing tape copies to be made for offsite archival without any additional virtual server downtime.

NetApp and VMware Impact

When the project began, the company relied on 105 servers across nine locations, supporting a wide variety of applications, including Oracle, Exchange, Web serving, Microsoft SMS, print, and file serving. By simplifying its IT infrastructure with VMware and NetApp storage, the company was able to reduce the number of deployed physical servers to fewer than 50—a reduction of more than 50%—without eliminating any services.

To further decrease complexity, the company reduced the number of locations where business servers were deployed by 66%, with the remaining three main sites interconnected with high-speed networking connections. This effort significantly simplified the company's IT infrastructure while making it easier to provide appropriate protection and disaster recovery capabilities for critical applications. As a result, the headcount directly responsible for server management functions fell 20% from 2.5 people to only two.

Consolidating server storage on NetApp storage systems has given the company much greater control over its data. In the past, backups were performed across the company's networks and had to be throttled to prevent network bottlenecks. With the high bandwidth between the three major sites, this is no longer an issue.

For individual file restores, the company has completely eliminated a previous service level agreement of 4 hours. The metric is no longer needed because restores occur in minutes.

In addition, the previous tape environment had a much higher risk of losing data, and bare metal recovery of a failed server could take from eight to 12 hours. Today, the company uses Acronis True Image software to back up virtual server images to a NetApp volume. The volume is also replicated to the secondary site for DR. In testing, bare metal recovery of critical servers can now be accomplished in 30 minutes.

Improved disaster recovery is another major advantage. NetApp Snapshot technology and SnapMirror software have replaced tape backups with a completely tapeless solution. In the past, the company provided disaster recovery for only a small part of its overall environment. With NetApp and SnapMirror, the company provides DR for all its critical applications and can rapidly add DR capability for any application that requires it.

The company has also found that resource usage is very efficient in its VMware environment. VMware efficiently shares processor and memory resources between instances of the same OS, so fewer processors and less memory has been needed than originally anticipated, while end users report that application performance has actually increased noticeably.

VMware allows the company to quickly implement new servers for proofs of concept or new projects. The company no longer has to budget immediately for new hardware and software; it can just configure a new virtual server. NetApp and SAN technology complement this capability. Today, the company makes changes to its storage environment four or five times a week with no disruption to users.

Conclusion

The combination of VMware software and NetApp storage solutions offers significant advantages for companies consolidating servers and storage to reduce costs and increase operational efficiency. VMware allows companies to reduce server counts by 50% or more without major application changes, while making it possible to adapt much more rapidly to support new projects and new applications.

NetApp solutions simplify a company's overall storage infrastructure, creating a storage system that adapts rapidly to changing needs while improving data protection and disaster recovery—often by reducing or eliminating the need for tape-based solutions.

Additional Resources

- “Using NetApp Snapshot Technology with VMware® ESX Server,” April 2005.
www.netapp.com/tech_library/ftp/3393.pdf