

# Choosing Network-Attached Storage for VMware: What You Should Know

Gartner RAS Core Research Note G00159391, Pushan Rinnen, 16 July 2008, R2943 06102009

VMware users have three choices when selecting a networked storage protocol: Fibre Channel (FC), Internet SCSI (iSCSI) and Network File System (NFS). While vendors tend to market their products based on their strengths and interests, users need to look at different variables to determine what is in their best interest.

## Key Findings

- Using NFS, the ESX server can support all virtual machine (VM) guest operating systems, including Microsoft Windows.
- The current interest in adopting NFS for VMware is mostly driven by ease of management and existing skill set. For some users, using NFS has resulted in significant savings in both storage infrastructure and IT operations.
- The ease of management delivered by NFS derives from the fact that network-attached storage (NAS) itself is a highly virtualized storage system because of the intelligence of its embedded file system.
- Using NFS does not require a dedicated FC storage team, but leverages the commonly available Windows networking staff, who can manage server and storage together.
- NFS, similar to software iSCSI initiator, will take more ESX CPU cycles than FC and iSCSI host bus adapters (HBAs). However, NFS has less file system overhead than VMFS, and a VMware performance study with ESX Server 3.5 in 2008 found that NFS has very similar performance to iSCSI.

## Recommendations

- To determine whether to adopt storage area network (SAN) or NAS for the VMware infrastructure, users need to look at their VM application needs, their existing storage infrastructure and internal skill set, and the overall cost including management cost.
- For those who have decided to adopt NFS for VMware, they should be aware that not all NAS products are created equal and need to carefully evaluate specific NAS products that can cater to their requirements.

## WHAT YOU NEED TO KNOW

VMware supports three fundamental storage interface protocols: FC, iSCSI and NFS. While FC and iSCSI are easily understood straightforward block storage access protocols, NFS is often mistaken as only a client access protocol. In fact, it's also an enterprise storage access protocol, which is the case with NFS support of Oracle database applications and NFS support of VMware ESX server. With NFS residing on both the ESX hypervisor and storage side, the application sees a local disk that is implemented by the ESX hypervisor as a file stored in the NAS system.

Gartner found that most adoption of NFS to support VMware infrastructure is driven by ease of management especially when dealing with a large number of VMs, as well as no requirement of a

dedicated FC SAN storage team. Some customers have used NFS to support production-mode VMs running Oracle, SAP and Web servers with back-end SQL store for the past two years.

## ANALYSIS

To leverage VMware's advanced features, such as VMotion, users are required to adopt networked storage to support nondisruptive VM migration and failover. The three dominant networked storage architectures are FC SANs, NAS and iSCSI SANs. Since FC SANs have a much-higher adoption rate than the other two alternatives in the midrange and enterprise markets, and noting that users tend to leverage their existing infrastructure, it's not surprising to see that the majority of the VMware users are currently using FC SANs today as their VMware storage infrastructure. The current dominance of FC SANs in a VMware environment is further influenced by the fact that early versions of VMware did not support iSCSI SANs or NFS. However, since the launch of VMware Infrastructure 3 in June 2006, which included support for iSCSI SANs and NFS, vendors have created marketing collateral attempting to educate users on the three interconnect choices. To date, most of the vendor collateral is focused on promoting iSCSI SANs and comparing iSCSI SANs with FC SANs. Unfortunately, not much information from vendors can be found about the implementation of NFS. Meanwhile, an increasing number of users are quietly adopting NFS to support VMware virtual servers as well as virtual desktops.

Why do most the major storage vendors remain quiet about using NFS? There are probably several reasons, including these:

- Some storage vendors don't have a strong NFS (NAS) product with rich storage management features.
- From the storage vendor side, unified NAS/SAN storage vendors such as NetApp try to stay neutral and let their customers pick and choose. Only pure NAS vendors, such as Isilon Systems and ONStor, advocate the use of NFS with VMware since their products don't support FC and iSCSI protocols.
- NFS would replace VMFS, a file system for VMs developed and promoted by VMware to work in conjunction with direct-attached storage and SANs. Therefore, VMware would naturally promote its VMFS product instead of its replacement.

Why are users interested in adopting NFS? Gartner research has found the following reasons:

- NFS supports all VMware guest OSs, including Windows. Some people have a misunderstanding that NFS supports only Unix/Linux clients and doesn't support Windows; but in fact, NFS is a server storage protocol as well, and ESX presents a file in an NFS volume as a virtual disk to all VM types, including Windows applications.
- ESX datastore contains only .vmdk files, which can be easily read and written to via NFS without a local file system on ESX. In addition, NFS is a thinner stack than VMFS, resulting in some space savings.

- NFS offers fast and easy configuration and ongoing storage provisioning, especially for a large VM environment. There is no need to carve and map individual logical unit numbers (LUNs) and format individual VMFS file systems. In essence, NAS is a highly virtualized storage system itself because of its embedded file system.
- NFS supports all VMware features except the newest Site Recovery Manager (SRM). However, SRM doesn't offer its own replication and still needs to leverage storage-based replication tools. Therefore, NFS users have been able to leverage other remote replication tools for disaster recovery without SRM.
- Using NFS, array-based snapshot restore can be more granular (at individual VM or file level) than using block LUNs. Although one can restore individual VMs with some storage vendors' LUNs, it is a more complicated procedure.
- Many NAS products have larger file system size than VMFS and can therefore manage larger data stores.
- When utilizing multiple 1Gb Ethernet network interface cards with network trunking, some users reported faster performance with NFS than 2Gb FC SANs.
- Other benefits quoted by users are NAS-vendor-specific. These benefits include thin provisioning to increase storage utilization, scalable space-efficient cloning for rapid VM implementation, deduplication for storage space savings, and VMware plug-ins for easier backup and restore.
- As some vendors offer NAS as part of their unified NAS/SAN storage, some users use both NFS and SAN protocols for their VM infrastructure to consolidate storage.

In a world where nothing is created perfectly, users should also be aware of the limitations of NFS, including these:

- NFS, similar to software iSCSI initiator, will take more ESX CPU cycles than FC and iSCSI HBAs. However, NFS has less file system overhead than VMFS, and a VMware performance study with ESX Server 3.5 in 2008 found that NFS has very similar performance to iSCSI.
- NFS does not support SAN boot of the ESX hypervisor. NFS users have been using local disk drives to work around this issue. However, an NFS data store supports the boot disk of individual VMs.
- VMware tends to first offer the latest feature for the SAN crowd, which represents its largest customer base today, and then follow up later with NFS support for the same feature. For example, VMware Consolidated Backup was not available for NFS before Virtual Infrastructure 3.5, and the latest SRM is not available with NFS.
- NFS doesn't support Microsoft Cluster Services (MSCS). Only FC storage supports MSCS.



In terms of NAS vendor selection, users should evaluate the NAS vendor's overall partnership with VMware and its customer adoption rate, as well as its specific solutions for the VMware environment.

#### **Tactical Guidelines**

Examine the VM application workload input/output patterns and performance characteristics to see if they would require 4Gb FC SAN bandwidth and raw disk mapping. If not, NFS could be a viable choice.

Examine your internal storage infrastructure and storage skill set within IT operations. Usually, leveraging the existing storage infrastructure means the least disruption and training. Therefore, if you already have staff who are well-versed in using NFS to manage storage, it would be a natural extension to use NFS to support VMware.

Some vendors offer unified NAS/SAN storage, which does not necessarily have equal functions on both the NAS and SAN sides. Evaluate the product strengths on either side to decide which side can best meet your requirements.