In order to understand the benefits of storage virtualization, it is important to understand how it works. In this e-guide, brought to you by SearchServerVirtualization.com, our experts explain how storage virtualization works and how it can provide benefits such as flexibility, reducing storage space and improving management.

How Storage Virtualization Works

Storage virtualization creates a layer of abstraction between the operating system and the physical disks used for data storage. The virtualized storage is then location-independent, which can enable more efficient storage use and better storage management.

For example, the storage virtualization software or device creates a logical space, and then manages metadata that establishes a map between the logical space and the physical disk space. The creation of logical space allows a virtualization platform to present storage volumes that can be created and changed with little regard for the underlying disks.

The most immediate benefit of storage virtualization is increased storage utilization, which can reduce wasted storage within the enterprise. For example, a logical unit number (LUN) provisioned on a storage area network (SAN) may allocate space that may not be used, or disks may be left unallocated -- lost and forgotten on storage arrays scattered across the data center. With virtualization, otherwise-unused storage can be cobbled together into viable LUNs and allocated to applications.

Data storage virtualization also supports migration and replication of LUNs between storage systems. This is particularly useful when one storage system must be taken offline for maintenance or replacement. By simply changing the mapping scheme, virtualization can move the location of data
without disrupting disk I/O, allowing for efficient and non-disruptive data movement within an enterprise.

Storage management can be greatly simplified. Rather than managing multiple (often heterogeneous) storage subsystems, a virtualized storage environment can be managed through a single mechanism. In addition, advanced storage management techniques such as thin provisioning and dynamic provisioning can readily be supported. Thin provisioning allows the creation of a LUN that is larger than the physical disk space allocated to it. For example, a 1 GB LUN can be created with perhaps 100 MB of storage space to start. As the associated application uses the disk space, more disk space can be allocated periodically (up to the assigned amount) without having to recreate the LUN.

Dynamic provisioning is similar, allowing the size of a LUN to be grown or shrunk as needed, ensuring the size of a LUN is always appropriate for each application. But traditional storage management (such as RAID group creation and maintenance) is still required.

Host-based storage virtualization such as Symantec’s Veritas Storage Foundation uses device drivers and additional software to virtualize the physical disks within a host system. Device-based storage virtualization such as Hitachi Data Systems’ Universal Storage Platform incorporates and manages virtualization within the storage array itself. Network-based storage virtualization uses a server (appliance) or smart switch like an EMC Invista within a Fibre Channel or iSCSI SAN to implement the abstraction between the network I/O and storage controllers.

The Benefits of Virtualizing Storage

The cornerstone of any virtualization deployment is the storage system, though every implementation involves a different approach. This tip discusses storage as a layer of abstraction in a virtual deployment and the benefits of virtualizing storage systems for server administrators, such as flexibility and application awareness. We'll also cover how FalconStor's
Network Storage Server (NSS) can ease data storage management in VMware environments.

**Just another layer of abstraction**

For smaller storage implementations begin with a server and a disk connected to each other. The infrastructure can be designed as a bunch of disks directly attached to a server through interface cards, Fibre Channel host bus adapters (HBAs) or on a network with storage protocols such as iSCSI. Each of these architectures has disk systems connected to a server and are managed manually, with the storage resources provisioned to that single server.

When organizations grow and move to larger architectures or high-performance storage systems, this model changes. When a storage area network (SAN) is introduced to a data center, one approach for storage provisioning is to have a storage server manage disk access. We'll cover a few examples of integrating this approach, but the principles described at the simplest level of server storage are critical to making the transition to virtualized storage.

Just as server-based virtualization is a layer of abstraction for a guest virtual machine (VM), virtualized storage is a layer of abstraction for the physical disks involved. For virtual environments, it means that the normal practice of obtaining disk information may work, but it may not deliver precise disk information. Figure A shows how this looks architecturally to a virtualization server administrator.

**Advantages and disadvantages of virtualized storage**

For server administrators, storage systems have traditionally been quite disjointed. The architecture addresses several problems in typically jumbled systems. By having a storage virtualization controller in place, many obstacles can be removed; namely a system managing access to disks lives separately from a system providing storage to the hosts connected to the storage network.
Another benefit is a storage system’s ability to move around logical unit numbers (LUNs) assigned to a server. This background task is executed in a way that is transparent to the virtual host system connected to the storage. Unfortunately, this administrative convenience comes at a cost: the lack of a direct path to the disks. Specific technologies such as VMware’s Storage VMotion allows virtualization administrators to move VMs from one storage system to another with no downtime.

To an extent, this provides the same functionality provided on the back end of a storage system. The storage system is aware of the entire LUN and can move the contents to another disk system, but Storage VMotion can move specific VMs to specific LUNs. The same result can be achieved with either process, only through different mechanisms and levels of administrative overhead. As the direct path to a disk is masked by the storage virtualization system, some details of storage become harder to interpret. One example is accessing disk serial numbers, which I explain in an article on using an IBM System Storage SAN Volume Controller.

**Virtualizing storage with FalconStor Network Storage Server (NSS)**

Virtualized storage systems can offer flexibility and be virtualization-specific. One example is the FalconStor Network Storage Server (NSS). While the storage systems are presented virtually to hosts, there are additional features, such as thin provisioning of LUNs and application awareness. In addition, FalconStor has a less complex offering that provides storage virtualization to smaller environments via a virtual appliance, specifically a VMware VM, which acts as the iSCSI target on an iSCSI network. This functionality for small virtual environments does have limitations, though: namely, NSS cannot migrate a virtual appliance because the iSCSI target would no longer exist in its required location.

NSS can also exist as a physical system. Unlike other storage systems, NSS can be built on customer-purchased server hardware. Known as NSS Enterprise, this option allows administrators to save money compared with storage systems on purpose-built hardware.
Perhaps the best feature of NSS is that it has application awareness, which addresses some limitations that come with the added layer of abstraction that virtualized storage brings. Specifically, FalconStor NSS offers an application-aware agent known as Application Snapshot Director for use with VMs and host systems to protect volume data. Application Snapshot Director keeps data transactions intact by interacting directly with VMware ESX. The key benefit is that this approach of managing storage with transactions allows for rapid recovery and no-impact backup. Further, Application Snapshot Director can integrate with VMware’s Site Recovery Manager to fit a disaster recovery model. Figure B shows how Application Snapshot Director interacts with a VMware implementation.

Thanks to its transactional architecture, NSS offers mirroring, time-based viewing of volume snapshots and replication functionalities. As mentioned previously, the thin-provisioning feature for LUNs with NSS is a plus for storage. On a storage system, thin provisioning functions like it would with VM disk files in Microsoft Hyper-V or VMware Server. The LUN is presented at its full size, but the storage system is aware of what the storage client uses on the volume. When this occurs, what is consumed on a “virtual” LUN is consumed on the disk, which is illustrated in Figure C.

Conclusion
Virtualized storage is pretty cool. The features we’ve touched on are only a sample of the functionality available from virtualized storage platforms. Planning storage systems for virtual environments is a challenge, especially for organizations that have separate server and storage teams. Also, if other systems can access a SAN, the case for a virtualization-optimized storage system becomes a tougher sell because broader interoperability becomes a requirement. But virtualization administrators that manage their own storage will discover that virtualized storage eases the burdens of storage management.
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