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# iSCSI: Superior Storage for Virtualization

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*IT management is increasingly focused on better utilization of infrastructure, containment of “server sprawl,” and improving responsiveness to business needs. Virtualization and iSCSI are two technological advances that, in themselves, can help create a more cost-effective and flexible IT environment—but together, they’re even better. Dell is well positioned to help organizations exploit this “storage symbiosis.”*

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## Business Drivers of Virtualization

These days, IT departments are being asked to do more with less—and do it faster. CIOs and IT managers need to reduce costs and increase their flexibility to respond rapidly to changing business needs. At the same time, they need to keep data safe and available, for tactical and strategic use, and also to meet ever-tightening regulatory requirements.

Virtualization—essentially, the creation of “virtual machines” or “guest operating systems” that can run independently on the same physical hardware unit—can help meet these challenges. In a virtualized environment, multiple applications can run on the same server, each on its own guest OS, without the risk of unforeseen interactions between the applications. IT departments can consolidate servers and storage, improving utilization and reducing operating costs. The guest operating systems, along with their applications, can readily be moved between physical resources, enabling IT to respond quickly to outages, changing demand caused by Web 2.0 application traffic, new business models, and corporate initiatives. Virtualization is a boon for improving server utilization and enabling business continuity & disaster recovery planning. With shared storage at the back end, if one server goes down, the guest operating systems will transfer to another physical server seamlessly and automatically without any disruption noticeable to the user.

## How Virtualization Works: ESX

VMware ESX virtualization software partitions a physical server into multiple virtual machines. This robust layer of secure virtual machines sits between the physical server and the operating system. Each virtual machine is independent and represents a complete system—with processors, memory, networking, storage and BIOS—so that operating systems and applications run in a virtualized environment without any modification.

## The Problem with Fibre Channel

Fibre Channel (FC), the traditional technology for Storage Area Networks (SANs), offers the high performance necessary for certain high-throughput, low-latency enterprise applications; for instance, large-scale decision support. However, FC SANs require both specialized knowledge and specialized equipment—and managing FC at the ESX layer can complicate storage management. An example: Virtualization is used to create cost-effective solution-development environments. But transferring tested solutions, and their associated storage resources, from a virtual environment to a dedicated physical machine over Fibre Channel requires extensive migration planning and reconfiguration.

## The iSCSI Solution

Fortunately, Fibre Channel is no longer the only technology available to build a good-performing enterprise SANs: Enter iSCSI, a robust and proven IP- and Ethernet-based SAN technology that helps lower the barriers to adoption of shared/consolidated storage for virtualization through reduced cost and complexity.

The Internet Small Computer Systems Interface, or iSCSI, is a protocol that allows SCSI commands to be sent over a TCP/IP network. iSCSI is getting a lot of attention these days because it lets organizations create SANs at a much lower price point than traditional Fibre Channel SANs, by using standard IP network equipment such as Ethernet switches and standard network interface cards (NICs).

iSCSI is a simple and cost-effective way for organizations to deploy SANs, because IT organizations do not need special training to work with iSCSI infrastructure. It's the same IP network equipment that IT organizations use for standard corporate networking. While not every IT organization has a Fibre Channel expert, virtually every IT professional will be familiar with implementing and managing IP/Ethernet

networks. There is a very large installed base of organizations with the equipment, technical knowledge and skill sets to easily deploy iSCSI solutions.

For high-performance, mission-critical servers, the cost of Fibre Channel is often justified, because Fibre Channel provides higher bandwidth (4 Gbps vs. 1 Gbps) and lower latency than IP networks.

However, many environments are over-served by 4Gbps Fibre Channel links. This is particularly true for hosts running applications characterized by random traffic, such as database applications and Exchange; and it means that a great many organizations can enjoy the benefits of iSCSI in their IT environments—including the reduced complexity of storage consolidation through virtualization.

## How iSCSI Alleviates the Complexity of Storage for Virtualized Servers

Fibre Channel is controlled at levels that roughly map to the lowest levels of the OSI model—the physical and datalink layers. To make FC work in a virtualized environment, one first assigns storage resources to the WWN associated with the physical ESX server and then must utilize ESX to further provision those storage resources to the Guest OSES above. To facilitate VM mobility, fabric zoning and masking must be opened up, such that each and every ESX server has access to that storage. To the Guest OSES above, the provisioned storage looks as if it is directly connected—the guest has no direct relationship to the storage or the array on which the storage resides.

Much like Fibre Channel, iSCSI has initiators (which function essentially as clients, requesting services) and targets (which function as storage arrays), but iSCSI supports software initiators, which reside at a higher, logical layer of the OSI model. The iSCSI software initiator is “agnostic” to all the lower layers. Therefore, a direct relationship can be formed between a software initiator in the Guest OS and application data storage resource. Provisioning of storage through ESX, for application data storage, is no longer necessary. In fact, there is no difference between managing iSCSI in a virtualized and a non-virtualized environment when utilizing iSCSI software initiators in the Guest OS.

## Dell’s Approach to Virtualization: “Storage Direct”

Dell approaches virtualization by leveraging our relationships with EMC and VMware to deliver world-class virtualization solutions. Dell offers native, or “purpose-built,” iSCSI SAN arrays that also support FC, enabling customers to create a tiered storage environment, optimized for performance requirements.

Dell’s iSCSI storage systems make it easy for customers to consolidate storage through virtualization—and iSCSI also facilitates VM mobility, and data migration and management. It’s “Storage Direct”—and the Dell advantage.

## iSCSI: Ideal for VM Mobility

One of the key benefits of virtualization is the ability to move virtual machines (guest OSES) quickly and easily in response to changing needs. VM mobility enables dynamic allocation of resources to meet demand. But VM mobility with Fibre Channel requires extensive user involvement and ESX arbitration. It also raises a data integrity concern, because to move the VMs, Fibre Channel zoning and LUN masking must be opened up—creating a new risk of misconfiguration due to human error. FC zoning and LUN masking essentially shield a server-to-storage connection from every node on the network except the particular server and storage system that are connected. Open zoning and masking, necessary for VM mobility, lets every node “see” and have access to storage elements.

Each iSCSI initiator and target has a unique name in one of two formats: iSCSI Qualified Name (IQN), which is based on a registered domain name, or EUI, a 64-bit unique identifier assigned by the IEEE. When combining iSCSI with virtualization, each virtual machine already has a unique IQN, and a direct relationship to storage that is distinct from the physical server-to-storage relationship. Therefore, tighter control of access is preserved.

## iSCSI for Superior Data Management and Migration

Storage networking solutions include various data management and migration tools, such as Snapshots, backup applications, and others. Virtualizing in a Fibre Channel network renders some of this functionality inaccessible without a great deal of complex interaction, and forces functionality tradeoffs.

With iSCSI, on the other hand, all the functionality available in non-virtualized environments remains available.

- iSCSI permits direct backups to tape or disk from the guest OSES (virtual machines), whereas in FC networks, backups have to be managed and arbitrated in ESX, taking staff time and expertise
- Similarly, storage management software and agents, such as VSS providers and EMC's Navisphere CLI software, can be used directly in virtual machines with direct access to storage, with 100 percent functionality. With FC, the functionality of storage management software is limited, because ESX arbitrates access to storage and controls the relationship with the external storage array.
- With iSCSI, images and applications developed on guest OSES can be migrated to a non-virtualized server seamlessly. Migrating virtual to physical via FC requires significant reconfiguration by skilled staff with specialized knowledge, and comes with the risk that staff errors will cause the migrated apps not to work correctly. The same holds true for Physical-to-Virtual and Virtual-to-Virtual migrations.

## Dell iSCSI Storage Products and Virtualization: True Flexibility

Dell's iSCSI product portfolio was designed to help customers optimize their storage environment in ways that make sense for their unique business, with purpose-built, multiprotocol SAN arrays.

The "purpose-built" systems are optimized for block storage. These systems are ideal for customers who want to start consolidating storage, and for larger organizations who have a FC SAN for their highest performance hosts and who now want to create a second tier of consolidation for their servers with lower performance requirements and virtualization servers.

Dell/EMC CX3-10c, CX3-20c, and CX3-40c systems are purpose-built block storage devices supporting both Fibre Channel and iSCSI connectivity, and scale from 64 servers/30TB to 128 servers/117TB. The combination of FC and iSCSI connectivity offer tiered, optimized storage consolidation. For example, File/Print, software testing and development, and a database application can run on Guest OSES on one physical server with ESX software. This server could connect to the array via iSCSI for a superior virtualization deployment experience. Meanwhile, Fibre Channel connectivity could be used for enterprise database and decision support, applications which require the lowest latency and highest throughput.

## Conclusion

iSCSI technology, in its own right a price/performance and ease-of-management breakthrough for SANs, also provides superior manageability to Fibre Channel for virtualized environments. Specifically, iSCSI lets users in virtualized environments utilize all the functionality available to non-virtualized systems. Dell iSCSI solutions give customers the "Storage Direct" advantage—the ability to seamlessly integrate virtualization into an overall, optimized storage environment.