LAB VALIDATION REPORT

NetApp Ethernet Storage

Protocol Independent Convergence with FCoE

By Brian Garrett
With Bob Laliberte

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ESG Lab Reports

The goal of ESG Lab reports is to educate IT professionals about emerging technologies and products in the storage, data management and information security industries. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab report was sponsored by NetApp.

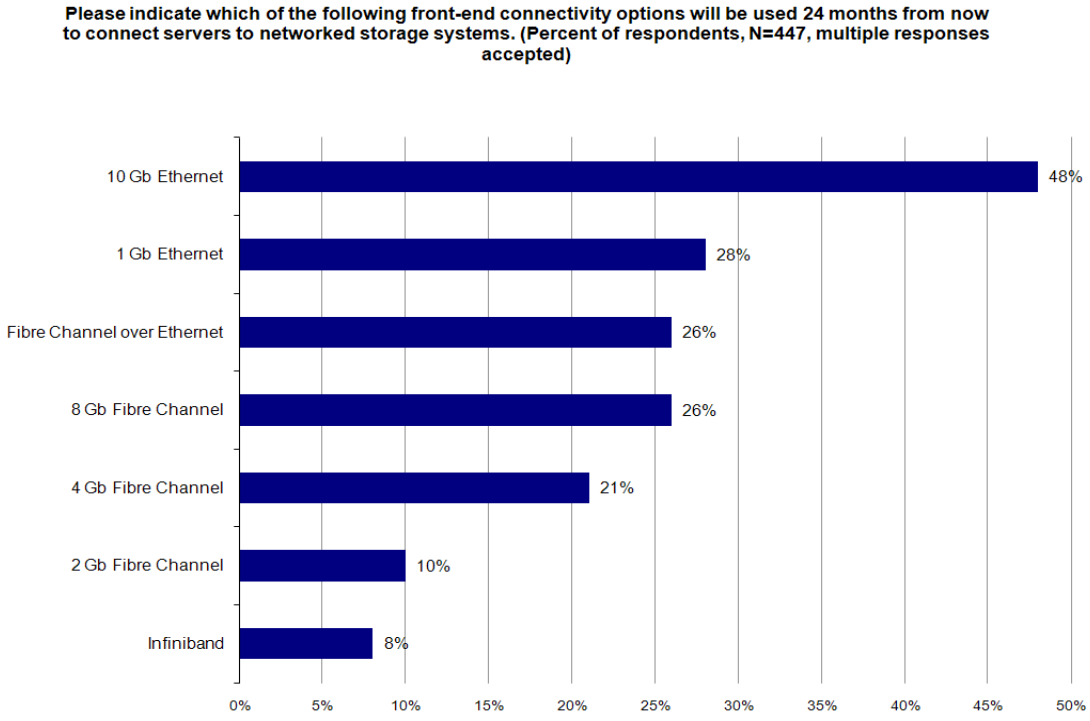
Introduction

Fibre Channel over Ethernet (FCoE) is an emerging standard that maps Fibre Channel storage traffic over an Enhanced 10 Gigabit Ethernet network. NetApp is the first storage vendor to support native end-to-end FCoE protocol in its storage systems. This report explores documents the value of independent data mobility from FC to FCoE, demonstrates protocol independent access and storage services from a single NetApp Data ONTAP 7G platform, and verifies that the protocol independence of NetApp FAS and V-Series systems makes it easy to migrate from FC to FCoE technology.

Background

Demand for networked storage is expected to surge in the next 24 months as organizations take advantage of the savings and enhanced availability offered by storage consolidation—especially when deployed in conjunction with server virtualization. According to a recent ESG survey, Ethernet tops the list of interface options that Enterprise-class organizations plan to deploy for networked storage connectivity over the next 24 months.[1] As shown in Figure 1, 48% plan on deploying 10 Gb Ethernet, 28% plan on deploying 1 Gb Ethernet, and 26% plan on deploying FCoE. The high interest in adopting FCoE over the next 24 months seems surprising at first blush, given the fact that the FCoE standard had not yet been finalized when this survey was taken. Yet when you reflect back on the meteoric rise and wide-spread adoption of Ethernet over the past two decades, it is not surprising that respondents look forward to deploying 10 Gigabit Ethernet as a converged and centralized network infrastructure for all of their client, server, and storage networking needs. Bob Metcalf, often referred to as the inventor of Ethernet, did a great job of summing up the widespread preference for Ethernet during a conversation with ESG Lab a few years ago when he said, "I don't know what comes after Ethernet, but it will be called Ethernet."

FIGURE 1. ETHERNET AND FCOE TOP THE LIST OF PLANNED NETWORKED STORAGE ADOPTION



[1] Source: ESG Research, *Enterprise Storage Survey*, December 2008

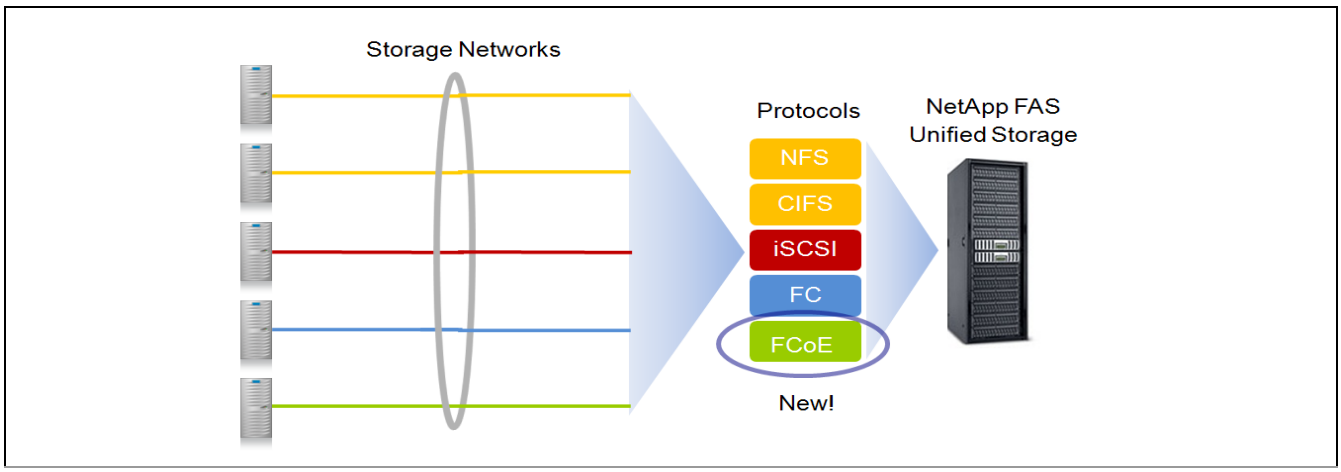
ESG research also indicates that organizations are looking for flexible storage solutions that can support multiple connectivity options. As a matter of fact, 43% of organizations report that they have deployed multi-protocol storage arrays (FC, iSCSI, NAS, etc.) in their environments and another 28% are planning to do so within the next 12 months. While still in its infancy as a protocol, interest in FCoE technology is gaining due to its ability to work with traditional FC infrastructure in conjunction with Enhanced Ethernet that supports multiple networking protocols over the same wire.

NetApp FAS and V-Series Storage Systems

NetApp FAS and V-Series storage systems[2], powered by Data ONTAP software, have been deployed as a unified storage platform for applications relying on networked storage by thousands of companies around the world. As shown in Figure 2, FAS systems and Data ONTAP software are used to create a unified platform for managing file- and block-based data accessed over a number of different networking protocols.

With its origins firmly rooted in the Ethernet networked storage market, NetApp began with the support of the NFS and CIFS protocols for accessing shared files over an Ethernet network. Fibre Channel support was added to support applications—including databases and e-mail—which access networked storage using a block, instead of a file-based protocol. NetApp took the storage market by storm, providing iSCSI support as a no charge upgrade for existing NetApp customers when the iSCSI specification was finalized in the summer of 2003. With the introduction of iSCSI running over commodity Ethernet adapters and switches, NetApp provided a cost effective alternative to FC for block-based applications. NetApp has adopted a similar strategy in recent years as the Enhanced Ethernet and FCoE standards began to take form. Working closely with industry-leading partners, NetApp was the first storage vendor to support native FCoE connectivity, currently providing FCoE protocol support as a no charge Data ONTAP upgrade for existing FC customers.

FIGURE 2. PROTOCOL INDEPENDENT NETWORKED STORAGE FROM NETAPP



The combination of a protocol independent platform and the advanced storage services provided by Data ONTAP software enables organizations to increase efficiencies, reduce storage costs, simplify management, and scale more effectively. Innovative storage services provided by Data ONTAP software include Snapshot for quick and easy data protection, FlexVol for space-optimized storage provisioning, RAID-DP for protection against double disk failure, SnapMirror for advanced disaster recovery, and data deduplication for automated capacity reduction.

This ESG Lab report documents the results of hands-on testing of FCoE-attached servers—and storage—on a protocol independent NetApp FAS system powered by Data ONTAP software.

[2] V-Series solutions connected to a multi-vendor mix of FC storage arrays, were tested previously by ESG Lab (http://www.enterprisestrategygroup.com/ ESGPublications/ReportDetail.asp?ReportID=1041)

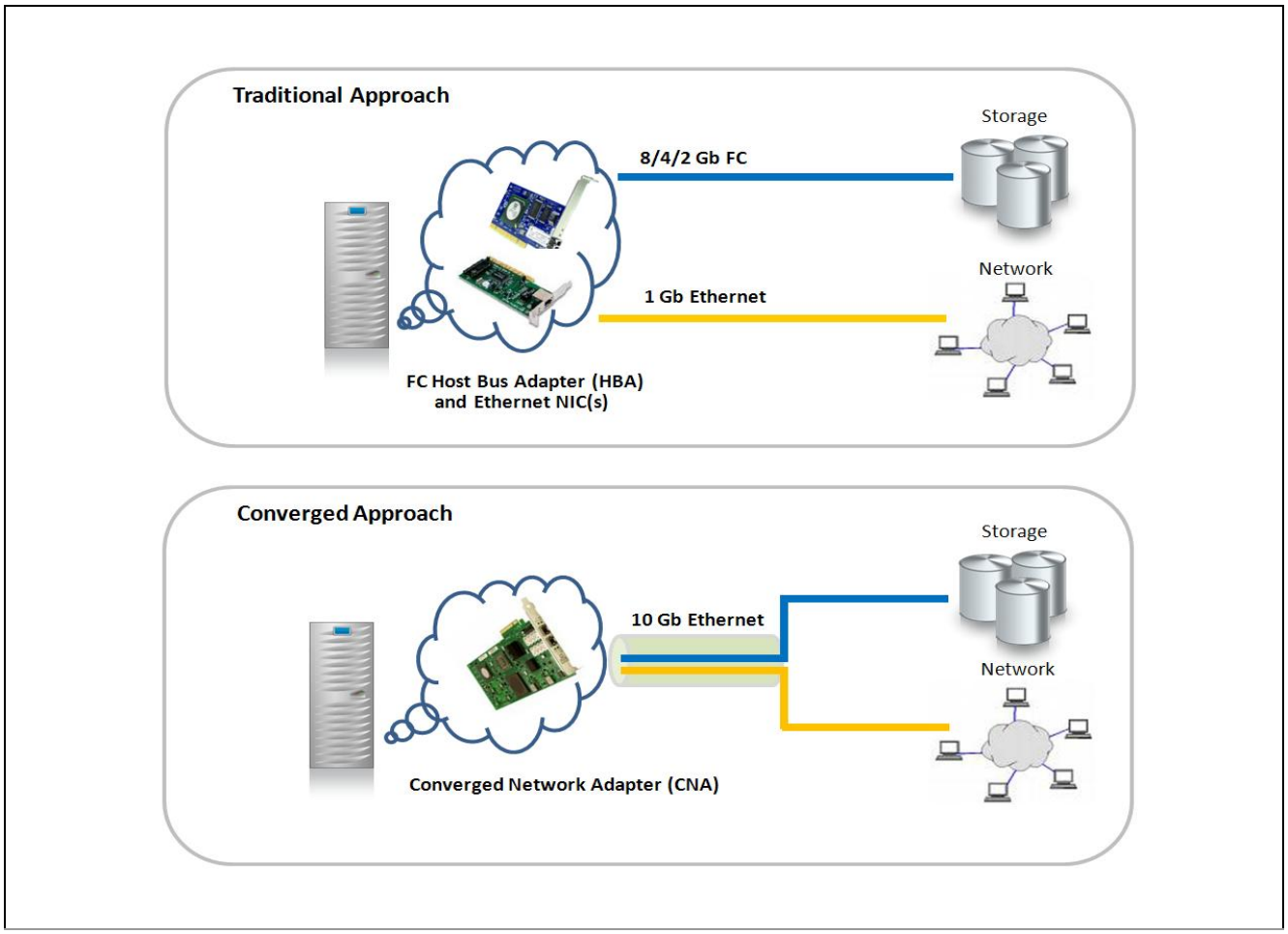
ESG Lab Validation

ESG Lab performed hands-on evaluation and testing of NetApp FCoE support at NetApp's facility in Research Triangle Park, North Carolina. ESG tested transparent network and storage connectivity for physical and virtual servers attached to a single NetApp FAS3140 storage system via the FCoE, CIFS, NFS, iSCSI, and FC protocols. Bridged and native FCoE topologies were tested as Data ONTAP provided valuable storage services including snapshots and thin provisioning.

Introducing FCoE

Fibre Channel over Ethernet (FCoE) was developed with a goal of converging storage and networking traffic onto a single platform leveraging familiar management tools, security models, and processes. FCoE has the potential to reduce data center complexity and environmental (power, cooling and space) costs as it reduces the number of cards, cables, and network devices in the data center. As shown in Figure 3, a Converged Network Adapter (CNA) installed in a server can be used to combine FC and IP onto a single Ethernet-based adapter as it eliminates the need for separate network interface cards (NICs) and FC host bus adapters (HBAs).

FIGURE 3. ENHANCED ETHERNET ENABLING NETWORK CONVERGENCE



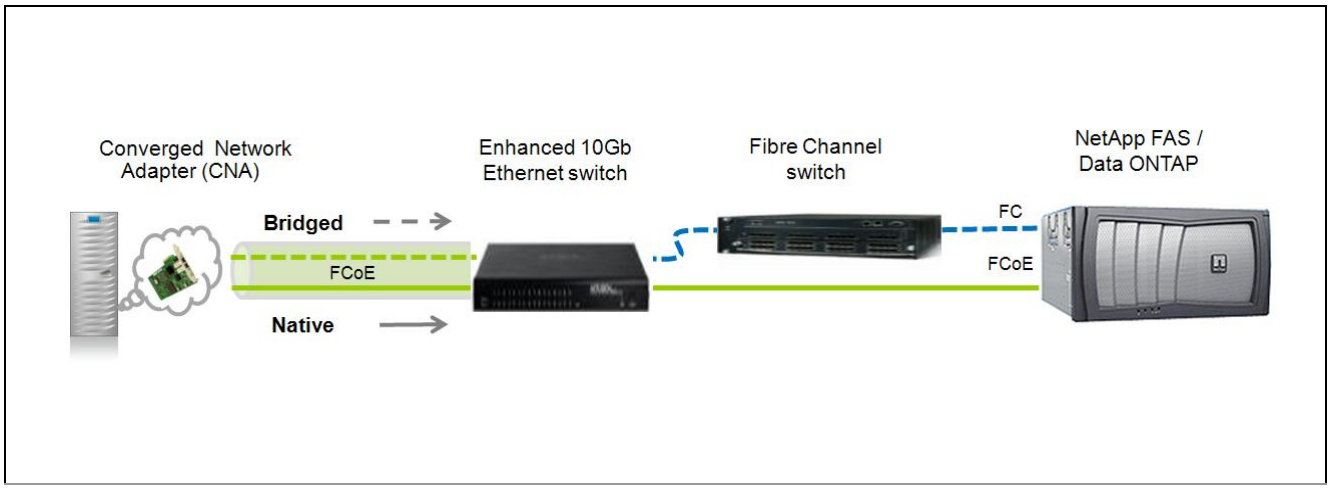
The Enhanced Ethernet standard (a.k.a., Data Center Bridging, Data Center Ethernet or Converged Enhanced Ethernet) was defined to enable the converged approach shown in Figure 3. One of the key features of

Enhanced Ethernet is its ability to differentiate between and prioritize different types of traffic sharing a common physical layer (a.k.a., Quality of Service or QoS). The Enhanced Ethernet standard also supports link-level flow control and end-to-end congestion management to meet the lossless performance requirements of mission critical applications currently relying on FC for networked storage connectivity.

The FCoE standard picks up everything from the FC standard—except for the cabling and the physical interface—and places it on top of an Enhanced Ethernet network. NetApp has been actively involved in the development and marketing of the FCoE standard, along with partners including Brocade, Cisco, Emulex, Intel and QLogic. The FCoE standard moved from development to review status within the T11 committee in October, 2008.

As shown in Figure 4, two methods are supported for connecting servers to an Enhanced Ethernet network using the FCoE protocol: bridged and native. The bridged method uses an FCoE network to connect servers and a legacy FC network to connect disk arrays. Storage arrays supporting a "native" connection to an FCoE network can be used to create an end-to-end 10 Gbps Enhanced Ethernet connection between servers and storage systems. NetApp began publically demonstrating bridged and native FCoE solutions in 2007 and was the first storage vendor to offer native FCoE support in 2008.

FIGURE 4. BRIDGED AND NATIVE NETAPP FCOE SUPPORT



Why This Matters

A growing number of IT managers are consolidating servers and storage to reduce power, cooling, and management costs. As a matter of fact, 66% of respondents to a recent global ESG survey indicate that a formal IT initiative or program is underway with a goal of reducing power and cooling in the data center.[3] With these challenges in mind, storage networking and server virtualization have enabled the first wave of consolidation and savings. FCoE was designed to fuel the next wave of consolidation as it lowers complexity, increases efficiency, improves utilization, and ultimately reduces power, space, and cooling requirements in the data center.

[3] Source: ESG Research Report, *Global Green IT and Business Initiatives*, August 2008.

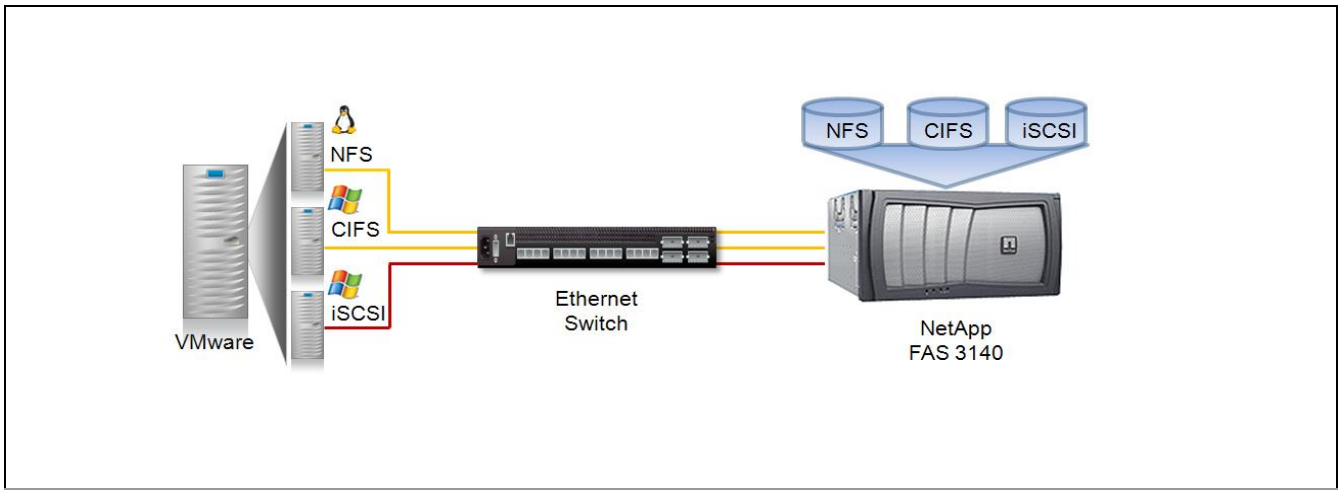
Ethernet Prowess

NetApp was a pioneer in the use of Ethernet for access to a shared pool of network attached storage. Using an appliance-based approach that provided shared access to files over an Ethernet network, the first protocols that NetApp supported were NFS and CIFS. End-users typically use CIFS and NFS for file-based data, including documents, spreadsheets, presentations, graphic images, and video. CIFS is the protocol used by Windows clients and NFS is used by Unix and Linux clients. NetApp leveraged years of Ethernet prowess with its early support of the iSCSI protocol. The iSCSI protocol is used for applications such as databases and e-mail that typically utilize a block-based protocol.[4] Continuing its heritage of Ethernet prowess, NetApp has recently introduced support for the emerging FCoE standard.

ESG Lab Testing

ESG Lab testing began with a demonstration of NetApp's legacy Ethernet capabilities using a single NetApp FAS 3140 storage system being accessed using the NFS, CIFS, and iSCSI protocols. As shown in Figure 5, a single physical server running VMware ESX was used to create three virtual machines. A virtual machine running Red Hat Linux accessed a shared file system using the NFS protocol. Virtual machines running the Windows 2003 operating system were used to access NetApp storage using the CIFS and iSCSI protocols.[5]

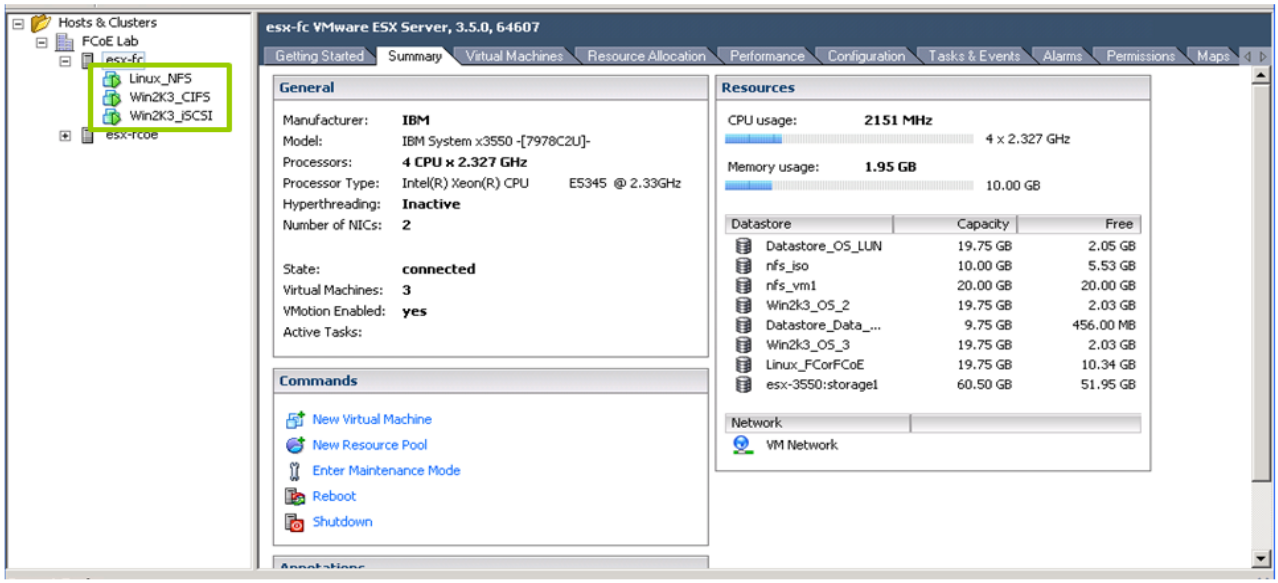
FIGURE 5. RECONFIRMING NETAPP ETHERNET PROWESS



[4] Source: ESG Lab Report, *NetApp iSCSI SAN Validation Study*, April 2004.
[5] A complete list of configuration details can be found in the Appendix.

The VMware Infrastructure screen shot shown in Figure 6 shows three virtual machines accessing the same NetApp FAS system over a commodity Gigabit Ethernet network using the NFS, CIFS, and iSCSI protocols, respectively.

FIGURE 6. VMWARE VIRTUAL MACHINES USING NETAPP ETHERNET ATTACHED STORAGE



Why This Matters

IT managers are drowning in a sea of data. ESG estimates that database data is growing at 25% per annum, with unstructured data increasing at two to three times that rate.[6] These double-digit rates are fueled by dependence on digital assets to conduct business and the need to support an increasingly mobile workforce. Collaboration, Web 2.0 applications, and use of messaging systems also contribute to information growth.

A shared, consolidated pool of storage is easier to manage and more cost effective than a number of disparate storage systems. Networked storage also improves the availability and serviceability of the growing number of application that rely on virtual server technology. Networked storage that uses the CIFS, NFS, and iSCSI protocols runs over cost-effective, industry standard Ethernet adapters and switches.

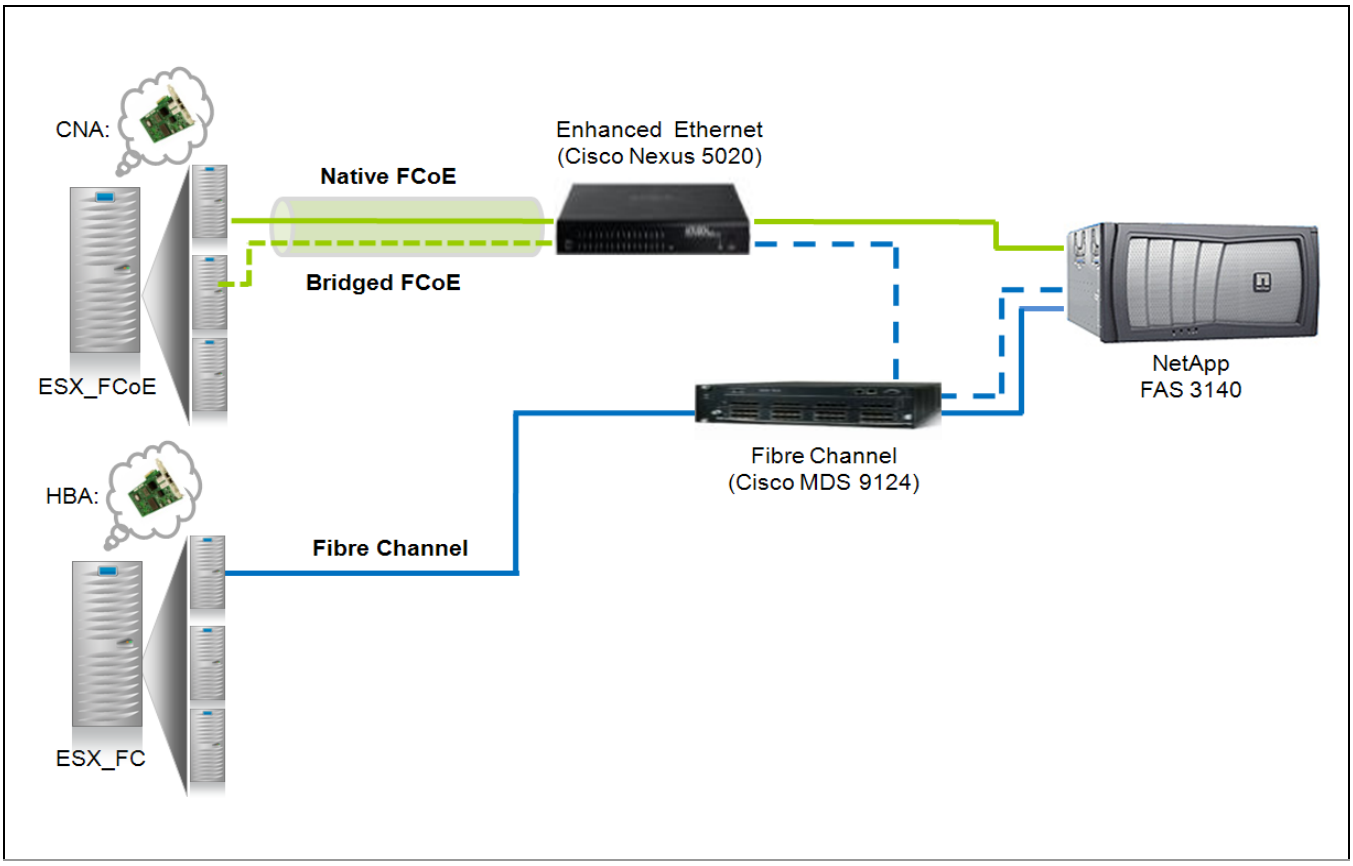
Tens of thousands of customers have taken advantage of NetApp's Ethernet legacy and prowess to save time and money with a unified pool of network attached storage. NetApp's unified architecture provides the flexibility to choose not only the right protocol, but also the right performance and price point to address changing business needs,

[6] Source: ESG Research Report, *Database Archiving Survey,* December 2007.

ESG Lab Testing

ESG Lab testing continued as the test bed was expanded to include virtual machines accessing the NetApp FAS3140 using the FC and FCoE protocols. As shown in Figure 7, a 10Gb QLogic CNA was installed in one of the ESX servers for native and bridged FCoE connectivity. A second server with a 4Gb QLogic HBA was used for native FC connectivity. A Cisco Nexus 5020 Enhanced Ethernet switch and a Cisco MDS 9124 FC switch were used to create the storage network. Last, but not least, the NetApp FAS3140 running Data ONTAP version 7.3 was used to create a unified pool of network attached storage.

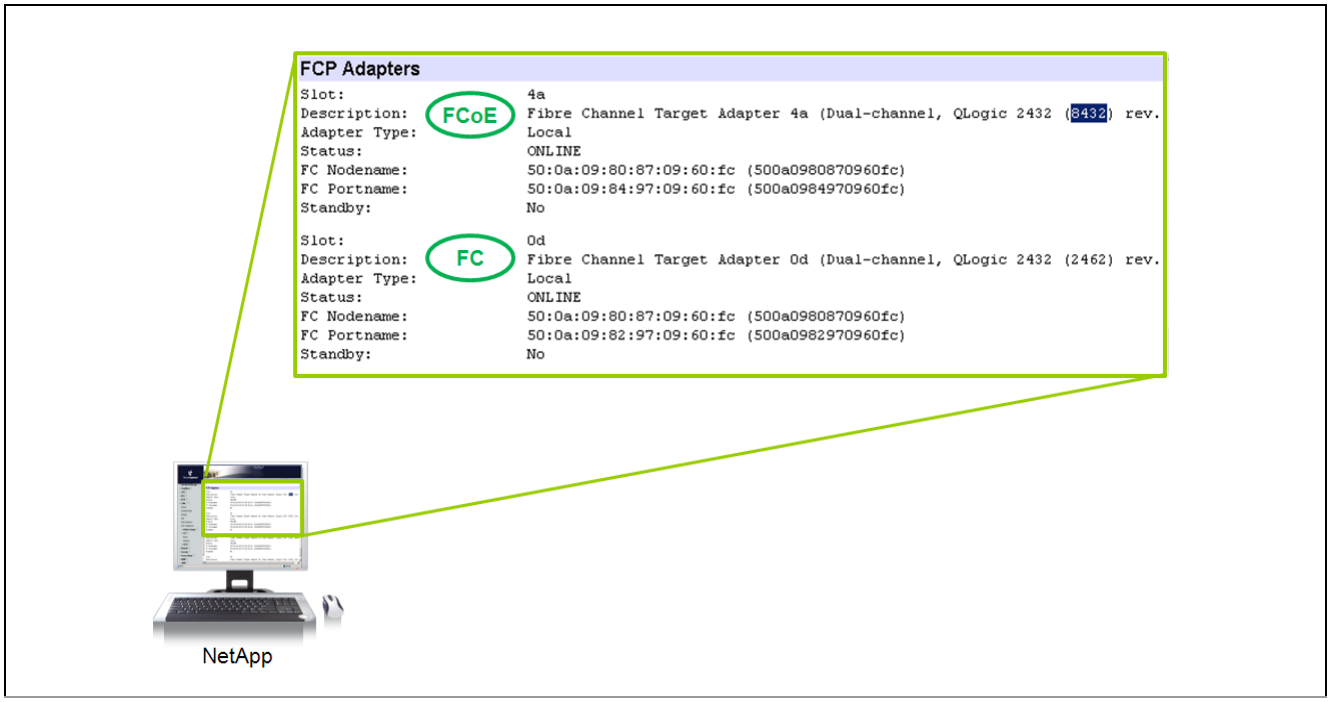
FIGURE 7. THE FCOE TEST BED



ESG Lab examined the configuration with a goal of comparing the configuration and management differences between FC and FCoE. From the storage system perspective, ESG found that managing an FCoE device with the NetApp console feels exactly the same as managing a FC device. As a matter of fact, ESG Lab was hard pressed to find any differences at all. The only evidence that FCoE was at work was found in the fine print of a query of the hardware configuration within the NetApp FAS system.

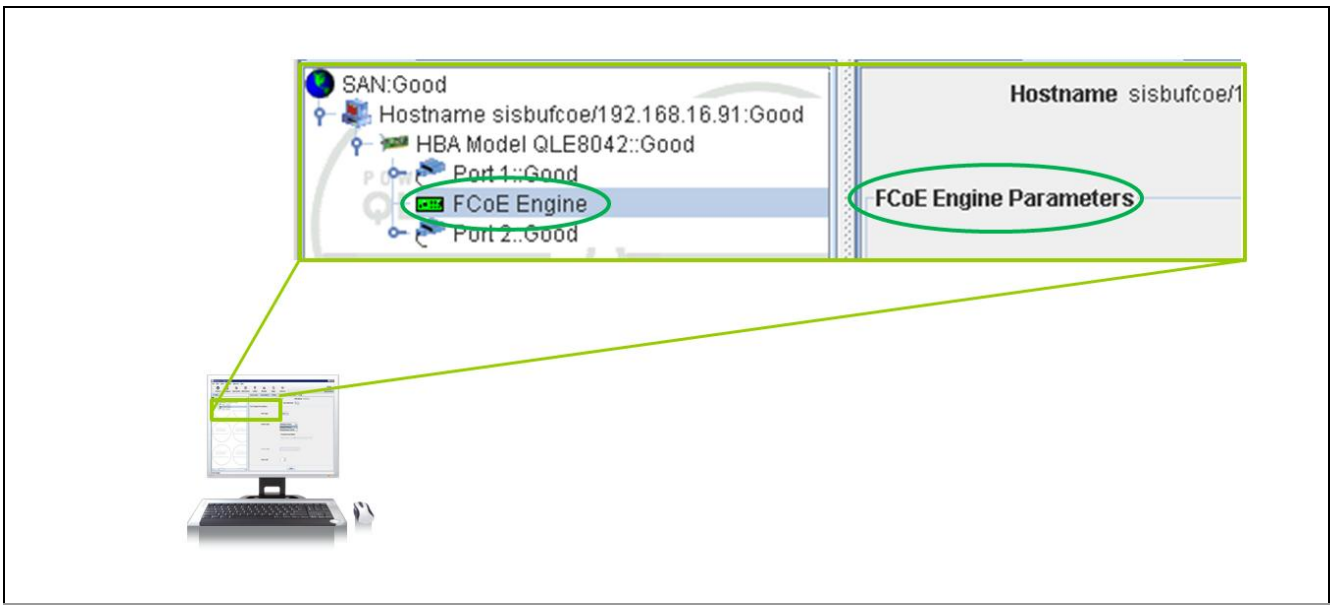
As shown in Figure 8, the target expansion adapter installed in the FAS system for native FCoE support has a different part number than the FC adapter. Other than this one very subtle difference, configuring and managing FCoE attached devices felt exactly the same as FC.

FIGURE 8. DETECTING FCOE ON A NETAPP CONSOLE



Switching to the other end of the wire, the QLogic SANsurfer utility was used to compare what it is like to manage a FC HBA vs. an FCoE CNA. Once again, we were hard pressed to find any differences beyond the interface used to update firmware and change default settings as shown in Figure 9.

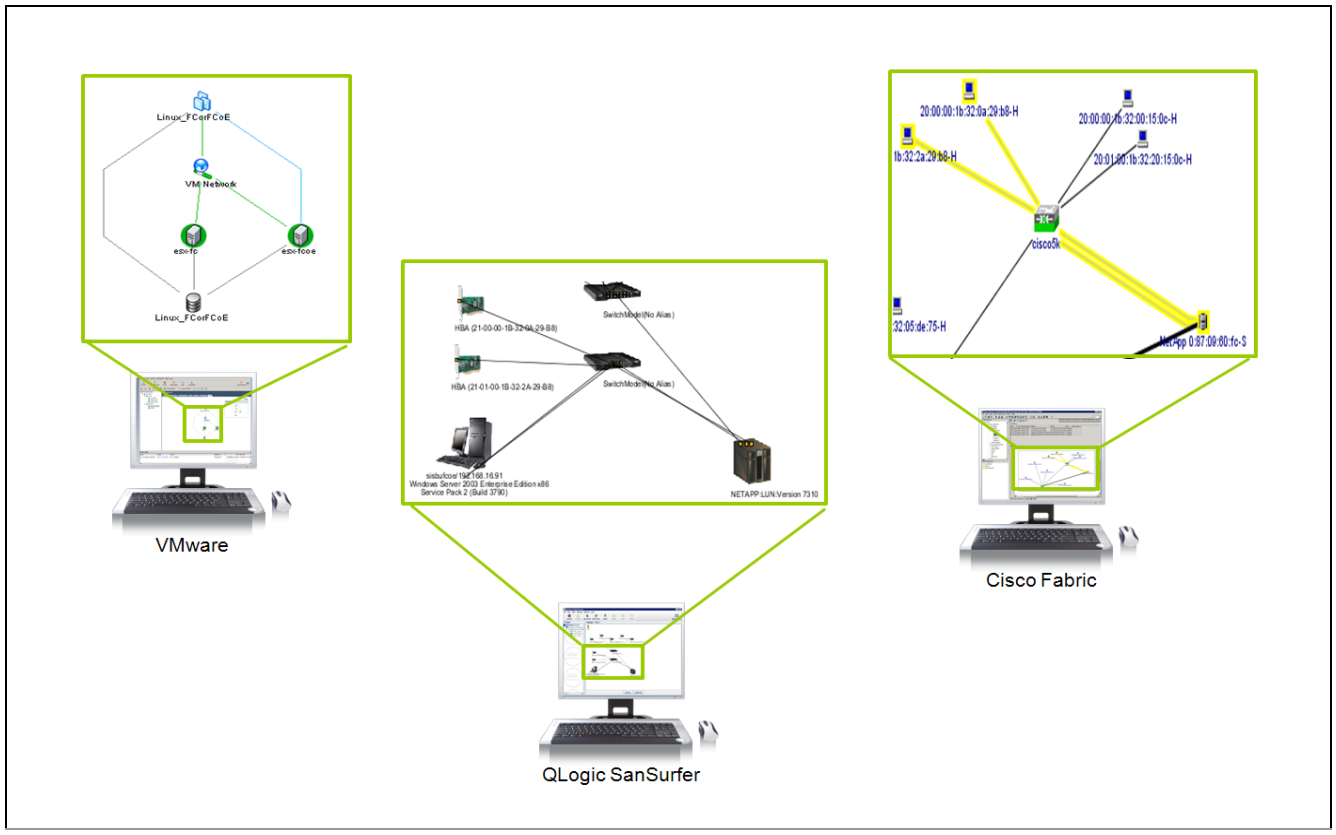
FIGURE 9. DETECTING FCOE ON A SANSURFER CONSOLE



Moving to the network, the configuration of the FC and Enhanced Ethernet switches was examined. The virtual interfaces which are used to define the protocol (Ethernet or FC) running through each port within the Enhanced Ethernet switch were examined. The configuration of the bridge between Enhanced Ethernet and FC ports for

the bridged FCoE connection was examined as well. Moving to the legacy FC switch, no difference was noted compared to a legacy FC SAN. Zoning looked and worked exactly the same. This was true all the way down to the way that the Enhanced Ethernet switch was represented on the Cisco FC Fabric Manager view as shown in Figure 10.

FIGURE 10. FAMILIAR TOPOLOGY VIEWS FROM THREE PERSPECTIVES



Last, but not least, the configuration was examined at the VMware virtual machine and application level. At the VMware and operating systems levels, there was no difference at all between FC and FCoE. As a matter of fact, ESG Lab was hard pressed to remember which volume was which when discovering and formatting a volume using the disk administrator utility within a Windows virtual machine. Both appeared as physical drives in exactly the same fashion. After quick NTFS format, each was accessed as a driver letter — much like a local C:\ drive. ESG Lab noted that familiar and field-proven FC drivers and multi-path software worked without change through bridged and native FCoE connections.

Why This Matters

The promise of new technology is alluring, but not if it disrupts the business. This basic tenet of the IT industry is especially true for existing applications which rely on a FC storage networks. Mission critical applications often rely on the field-proven stability and reliability of a FC SAN technology. FC storage networks are typically managed by high paid storage experts. The risks associated with retooling and retraining can be considerable.

ESG Lab has verified that other than learning a few new basic configuration operations on an Enhanced Ethernet switch, there is nothing new to learn with FCoE. Existing tools, processes and applications work exactly the same as FC; protecting the customer's investment and skill set.

Protocol Independent Data Mobility

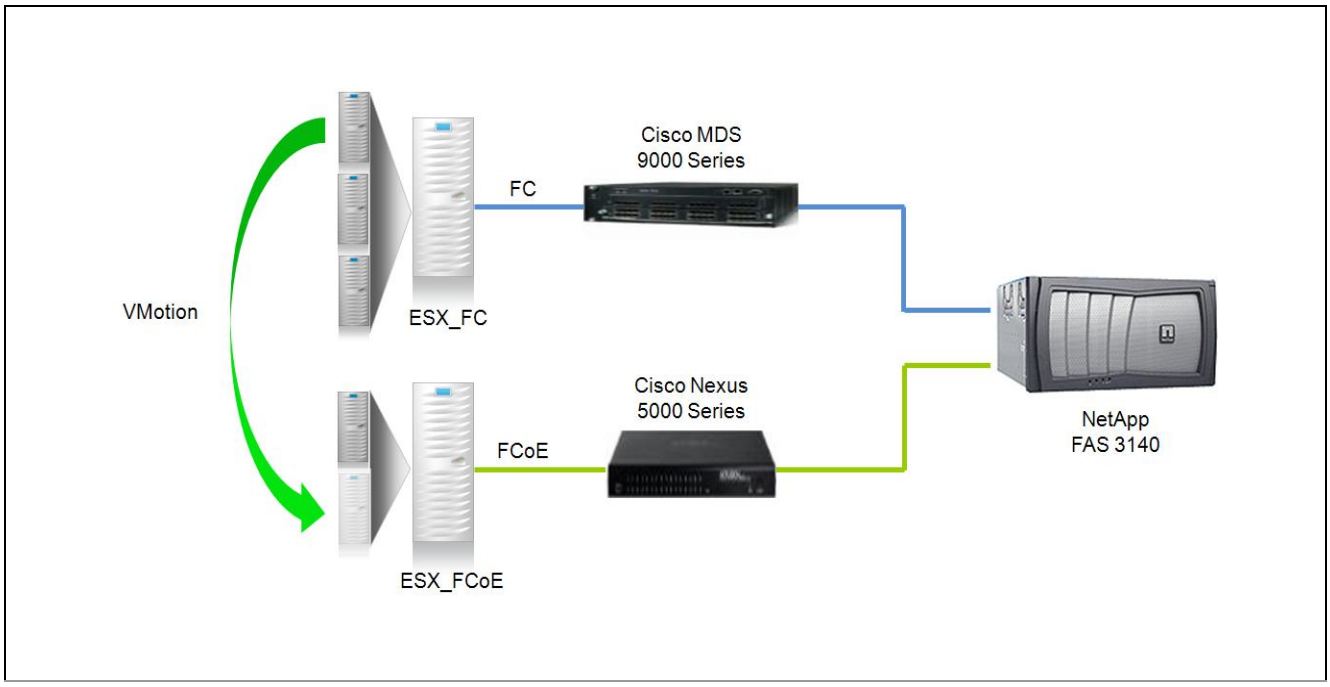
The FCoE specification was defined with ease of migration from existing FC networks in mind. Bridged FCoE support can be used to upgrade servers to a converged 10 Gb Ethernet fabric while existing investments in FC switches and storage systems are preserved. Native FCoE support, available today on all NetApp FAS systems and V series can be used to leverage existing investments in NetApp technology, tools and services.

The ease of upgrading to FCoE technology and the value of protocol independent data mobility is magnified for the growing number of organizations that have embraced server virtualization technology. Server virtualization benefits immensely from the use of networked storage. Compared to islands of direct attached hard drives, utilization is greatly increased when applications share a pool of networked storage. Applications deployed on virtual machines sharing a pool of storage are more mobile and available than those deployed on direct attached hard drives. Virtual machines attached to networked storage can be moved between physical servers for enhanced serviceability and flexibility. This last capability, provided by the VMotion utility for VMware ESX customers, can be used to move an existing virtual machine from FC to FCoE.

ESG Lab Testing

ESG Lab used VMware VMotion to move an active virtual server between physical servers configured with different connectivity protocols. A virtual machine was moved from an ESX server with a FC adapter (HBA) to a second ESX server with an FCoE adapter (CNA) as shown in Figure 11.

FIGURE 11. THE DATA MOBILITY TEST BED



A single NetApp volume was configured for host access through a FC and a native FCoE host connection. The volume was discovered on a Linux virtual machine and formatted as a file system. Background I/O activity was created before the migration using a copy command. VMotion was used to migrate the running virtual machine from FC to FCoE as shown in Figure 12.

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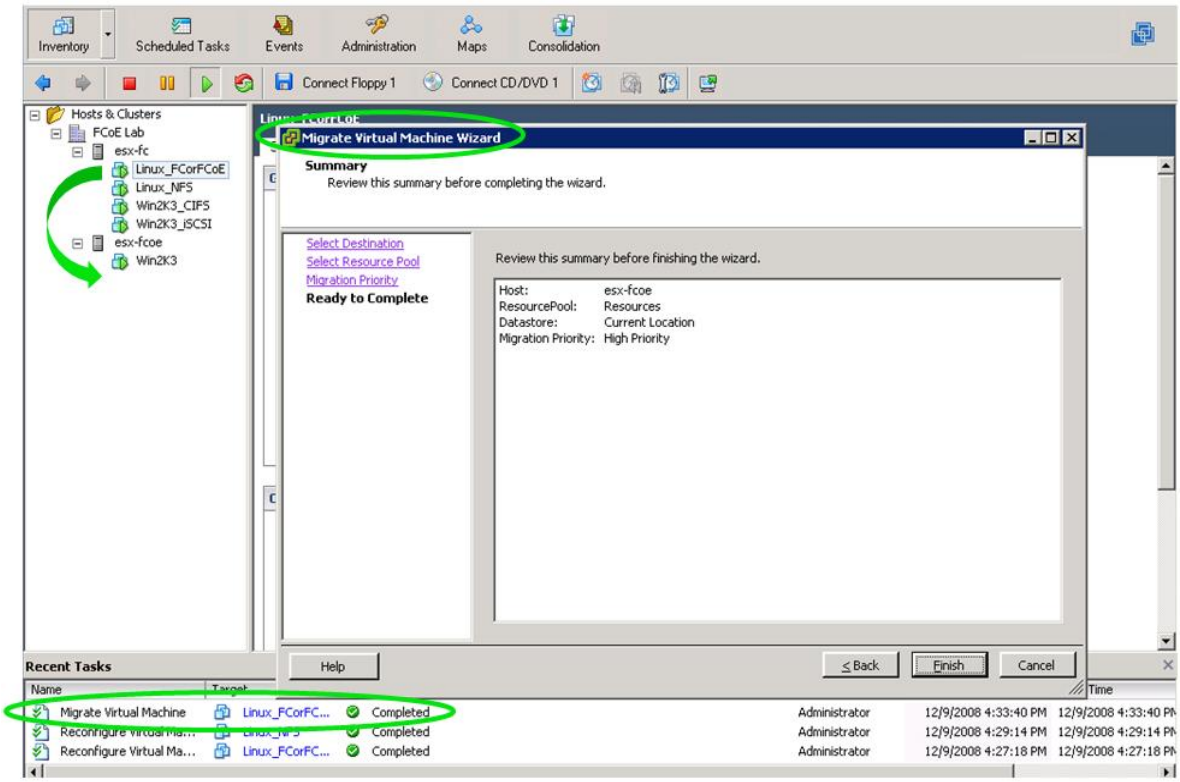
FIGURE 12. TESTING DATA MOBILITY



Within a matter of seconds, the virtual machine had migrated to the destination ESX server while the server was up and running. The copy command continued to run throughout the migration. No errors were reported by the operating system, the VMware hypervisor, the CNA utility, the switches and the NetApp FAS system. The experiment was repeated in reverse to migrate back to FC from FCoE.

Why This Matters

Early adopters of server virtualization report that the number one reason for their increase in networked storage is the mobility of virtual machines between physical servers.[7] Ease of mobility leads to the next most popular responses: enhanced disaster recovery, increased uptime, and simplified server and infrastructure upgrades. Each of these valuable benefits has been realized as the cost and complexity of server—and storage—infrastructure is been dramatically reduced.

ESG Lab has verified that the protocol independence of NetApp FAS systems makes it easy to migrate from FC to FCoE technology. Using VMware VMotion to migrate a running application from FC to FCoE was simple, fast and transparent.

[7] Source: *ESG Research Report, The Impact of Server Virtualization on Storage*, December, 2007

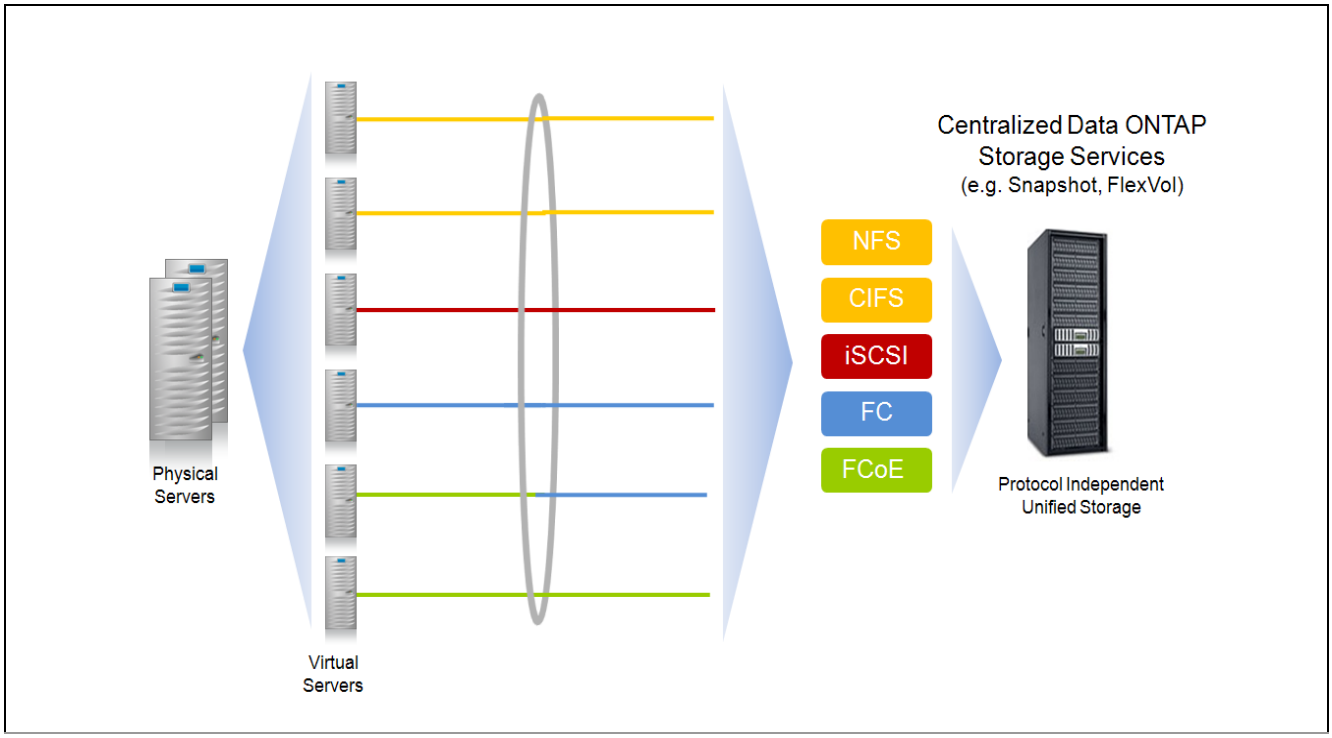
Protocol Independent Data ONTAP Storage Services

To simplify administration and protect existing investments, the tools and techniques used to manage existing NetApp storage are supported for volumes accessed through a bridged or native FCoE connection. Data ONTAP software is the engine that enables these protocol independent tools and techniques. Examples of protocol independent Data ONTAP services examined in previous ESG Lab Validation reports include snapshots, FlexVols, FlexClones, V-series virtualization for third-party storage systems,[8] and data deduplication.[9]

ESG Lab Testing

ESG Lab tested Snapshot and FlexVol services for FCoE-attached devices. The test bed at this stage of the validation is shown in Figure 13. Two physical servers running VMware ESX were configured with virtual machines running Linux and Windows operating systems. The virtual machines accessed a common pool of storage within a single NetApp FAS3140 using the NFS, CIFS, iSCSI, FC, and FCoE interfaces (bridged and native).

FIGURE 13. VALIDATING PROTOCOL INDEPENDENT DATA ONTAP STORAGE SERVICES



ESG lab tested NetApp Snapshot support on a native FCoE connected volume. Administrators use NetApp Snapshots for non-disruptive backups of production data, to makes copies of production data for application testing, and for fast recovery of corrupt or accidentally deleted files.

A native FCoE attached volume was accessed from a Linux virtual machine. Multiple folders were copied to the volume. The NetApp console was used to create a snapshot as a second file copy operation ran. The snapshot was created instantly. The copy operation continued without error and no performance impact was noticed.

[8] ESG Lab Report, *NetApp Data ONTAP 7G and V-Series Virtualization*, September 2005.
[9] ESG Lab Report, *NetApp Deduplication for FAS*, April 2008.

A file was deleted from the production FCoE attached volume. The snapshot was accessed from a virtual machine running the FC protocol on another physical server. The "accidentally" deleted file was accessed and recovered instantly using the snapshot image. The experiment was repeated on an iSCSI-attached volume.

Next, ESG Lab tested FlexVol support on an FCoE-attached volume. FlexVol is an extremely valuable Data ONTAP capability that is generally known in the industry as thin provisioning. Thin provisioning minimizes the cumbersome task of storage provisioning for block-based devices (FC, iSCSI, FCoE) as it improves capacity utilization. When a block-based device is provisioned using traditional methods, administrators allocate a fixed amount of capacity dedicated to an application regardless of whether that capacity is currently needed. Thin provisioning allocates virtual disk storage on an as-needed basis without having to dedicate physical disk in advance. In other words, thin provisioning delivers just-in-time storage capacity for block-based devices.

ESG Lab tested NetApp FlexVol support using a pair of 25 GB FCoE-attached LUNs. The LUNs were discovered using the Windows disk administrator utility and formatted as NTFS file systems. The Windows Explorer utility was used to verify that the Windows operating system had detected and formatted a total of 50 GB of capacity. A copy of the Program Files directory was started. The NetApp console was used to verify that each of the volumes was presented as having 25 GB of capacity, yet only 5 GB of actual capacity had been consumed.

Why This Matters

A recent ESG survey indicates that keeping pace with overall data growth, rising storage system costs, and the need to improve backup and recovery costs top the list of storage challenges facing IT managers.[10] NetApp has embraced a protocol independent approach for more than a decade with these age-old challenges in mind. Valuable snapshot, copy, and replication services can be used to eliminate backup windows and restore data instantly. A unified pool of storage supporting fast, flexible, and cost-effective provisioning maximizes storage efficiency as it reduces costs.

ESG Lab has confirmed that valuable Data ONTAP services are supported for FCoE attached devices with no change to existing management methods.

[10] Source: ESG Research, *Enterprise Storage Survey*, December 2008.

ESG Lab Validation Highlights

- ☑ ESG Lab has verified that the protocol independence of NetApp FAS systems makes it easy to migrate from FC to FCoE technology.
- ☑ A mix of Linux and Windows virtual machines running over VMware ESX were used to verify NetApp's ability to provide a unified platform for applications requiring block- or file-based storage needs over a commodity 1Gb Ethernet network. The NFS, CIFS, and iSCSI protocols were exercised during this first phase of testing.
- ☑ The test bed was expanded from one to two physical servers: one equipped with a traditional FC HBA and the other with a CNA for FCoE host connectivity.
- ☑ An enhanced Ethernet switch and a legacy FC switch were configured for bridged and native FCoE host connectivity to the same volume within the NetApp FAS3140.
- ☑ The VMware test bed was configured to provide unified access to a common pool of storage within a single NetApp FAS3140 using the NFS, CIFS, iSCSI, FC, and FCoE interfaces (bridged and native).
- ☑ There was no difference in the configuration and management of FCoE and FC devices at the hypervisor (VMware) and operating system (Windows and Linux) levels.
- ☑ Managing FCoE devices at the adapter, switch, and NetApp storage system levels felt exactly the same as managing traditional FC devices.
- ☑ ESG Lab went out of the way to find the subtle traces indicating that FCoE was at work. Besides the output from a single low-level NetApp management console command, and a single pane for loading firmware and changing default settings at the host adapter level, ESG Lab was hard pressed to find any differences from a management perspective.
- ☑ VMotion was used to move a virtual machine actively exercising a FC volume to another VMware server accessing the same volume using FCoE. The VMotion demonstration illustrated the ease and transparency of upgrading from legacy FC to FCoE (and back, if needed).
- ☑ ESG Lab confirmed that valuable Data ONTAP services, including snapshot and FlexVol, are supported for FCoE-attached volumes. Configuring and managing Data ONTAP services for FCoE attached devices had the exact same look and feel as FC.

Issues to Consider

- ☑ The FCoE standard entered the T11 review phase in late 2008, but was not finalized when this report was published. Using a strategy similar to that which has worked in the past with iSCSI, NetApp was an early and active participant in the development of the FCoE standard with a goal of supporting this leading-edge technology as soon as it's available. With Brocade, Cisco, Emulex, Intel, NetApp, and QLogic amongst the active participants in the development and marketing of the FCoE solutions, ESG is confident that the standard will be approved.
- ☑ While the relatively high cost of Enhanced 10Gb Ethernet technology will slow the widespread adoption of FCoE within most organization in the near term, ESG is confident that prices will drop dramatically over the next couple of years. Just as we've seen for each of the evolutionary technology leaps that have occurred since Ethernet was invented, early adopters with experience in controlled test environments will be the first to reap the economic benefits of consolidating with FCoE.
- ☑ First-generation Enhanced Ethernet components, including the CNA adapters used during ESG Lab testing, have relatively high power and cooling requirements. Second-generation products, some of which were hitting the market as this report was published, are expected to consume significantly less power and be more cost-effective
- ☑ While the results documented in this report prove that a unified NetApp FAS system supports bridged and native FCoE host connectivity, ESG strongly recommends testing in a controlled environment before deploying FCoE in production. In particular, it should be noted that reliability and performance testing were outside the scope of this evaluation.

ESG Lab's View

Consolidation of data center infrastructure is a top priority for IT organizations of all sizes that are striving to reduce the IT infrastructure footprint and increase utilization rates. Vendors have responded by producing products that enable consolidation in the server, network, and storage domains. Most recently, server virtualization has been getting the majority of the attention as customers rapidly replace inefficient physical servers with virtual servers. This has allowed for massive consolidation and dramatically reduced the number of physical servers, helping to lower power and cooling costs as well.

The rapid adoption of server virtualization technology has also created the opportunity to drive greater consolidation in the storage domain. In order to take full advantage of the advanced features offered by server virtualization vendors—such as mobility and availability—a networked storage environment must be deployed in order to enable companies to remove inefficient storage from the servers and consolidate them into a larger array, increasing storage utilization rates.

The challenge many organizations will face is deciding which type of networked storage environment to deploy. The network storage environment chosen can vary depending on the size of the company, budget restraints, performance requirements, and existing infrastructure. Organizations must first choose between a file- or block-based protocol based on application requirements. The next step is the selection of the appropriate network protocol and transfer speed. For file-based systems, the choices are relatively simple - select either NFS or CIFS and 1 or 10 Gb Ethernet. Block-based network storage environments pose more challenges as users need to select from iSCSI, FC, and now FCoE. Transfer rates for iSCSI are 1 and 10Gb Ethernet; FC spans from 1 through 8Gb; and FCoE is based on enhanced 10Gb Ethernet. The reality is that many organizations will deploy many different network storage environments based on their specific needs.

When deploying many different network storage environments, it may be necessary to accommodate budget and performance requirements. But this doesn't mean you have to purchase multiple storage arrays to support them. NetApp has embraced a multiprotocol approach for more than a decade and was the first major storage vendor to offer iSCSI support. It's not surprising then that NetApp would be a pioneer in the FCoE space. Given the meteoric pace at which the FCoE protocol has progressed, going from concept to the final stages of ratification in less than two years, it is clear there is a lot of interest in the standard. The fact that vendors have developed and are shipping products in advance of official certification is also very reminiscent of iSCSI. NetApp was able to demonstrate native end-to-end iSCSI support prior to the standard being certified and went on to become a leading provider of iSCSI solutions. As ESG Lab testing demonstrates, NetApp is now in a similar position with FCoE and should be in a good position to capture a major portion of the native end-to-end FCoE market. Companies looking to test and validate end-to-end FCoE environments don't need to look any further than NetApp using existing FAS arrays with a simple upgrade.

FCoE will be a particularly interesting choice moving forward because it enables further consolidation in the data center by converging FC and Ethernet (IP) traffic. This means fewer adapter cards and cables, especially for those organizations running FC SANs. It also eliminates the need for redundant Ethernet (IP) *and* FC connections replacing them with a pair of converged 10Gb connections and cables. While that may not seem like a big advantage, if you multiply that by the thousands of servers typical in a large company, the savings can really add up.

As organizations strive to consolidate data center infrastructure in order to reduce costs and increase efficiencies, FCoE will play an increasingly important role in the data center. ESG lab was impressed with the seamless integration of FCoE into the NetApp family of multiprotocol FAS arrays. IT professionals that aren't yet familiar with NetApp would be wise to consider the benefits of a protocol independent approach that can take advantage of state of the art Enhanced Ethernet technology. NetApp customers with existing FC deployments would be wise to consider the consolidation and savings that can be achieved after scheduling a test drive with NetApp FCoE.

Appendix

TABLE 1. CONFIGURATION DETAILS

Storage	
NetApp FAS3140, Data ONTAP 7.3 Memory – 4 GB (8 GB Total) 4 Gb FC Connectivity (Built-in card) NetApp FCoE Target Expansion Adapter	Capacity – 26x 500 GB HDD (3.79 TB) – RAID-DP NetApp File View Console
Servers, Virtualization, Operating System, Applications	
IBM 3550 – 64-bit Intel Quad 2.37 MHz; Memory – 8 GB QLogic 8042 FCoE (F/W: 1.2) Dual Port CNA Sansurfer Version	ESX Server 3.5 (Update 2) Guest OS: Windows 2003 (SP-2) – 32-bit Linux Red Hat 5.2 – 64-bit
IBM 3550 – 64-bit Intel Quad 2.37 MHz; Memory – 10 GB QLogic 2432 (F/W:) 4 Gb FC Dual Port HBA Sansurfer Version 5.01	ESX Server 3.5 (Update 2) Guest OS: Windows 2003 (SP-2) – 32-bit Linux Red Hat 5.2 – 64-bit
Connectivity	
Cisco Nexus 5020 (10Gb) - F/W 4.0 (0) N1 (1a) 40x - 10 Gb ports (FCoE enabled)	1 – 6-port 10 Gb FCoE module 1 – 8 port; 4x -10 Gb FCoE; 4x 4Gb FC
Cisco MDS 9124 (4 GB) – F/W 4.1 (1a) 24x 4 Gb Ports	4 Gb ISL link between Nexus 5020 & MDS 9124

20 Asylum Street
Milford, MA 01757
Tel: 508-482-0188
Fax: 508-482-0218

www.enterprisestrategygroup.com