

Lab Validation Report

Emulex OneConnect FCoE UCNA

Universal Network Convergence Platform

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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 Emulex.

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Introduction

This report documents ESG Lab hands-on testing of Emulex OneConnect Fibre Channel over Ethernet (FCoE) Universal Converged Network Adapters (UCNAs) and explores how a converged infrastructure can enable users to realign traditional technology silos into adaptive pools that can be shared, optimized and managed as a service.

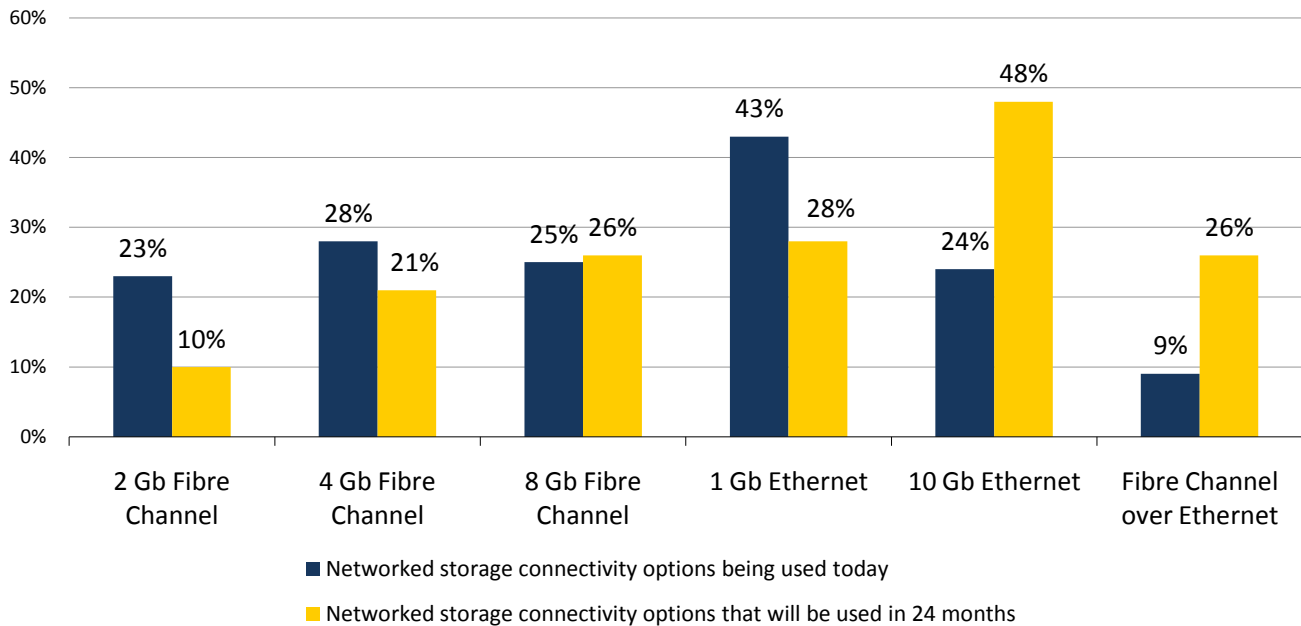
Background

Organizations are in the process of transforming their data centers into environments that are able to better handle rapidly changing business requirements and unanticipated business needs. In order to meet these objectives, they are eliminating their monolithic legacy data centers and infrastructures and replacing them with consolidated, highly virtualized, flexible environments. FCoE, an industry standard protocol (ANSI T11) that maps Fibre Channel storage traffic over an enhanced 10 Gigabit (10Gb) Ethernet network, is a key technology that will enable that transformation.

FCoE technology has experienced an accelerated development cycle, going from concept to alpha, to beta, and now to second-generation, production-ready technology in just a few short years. Even more important, it has been tested and “certified,” and is supported by most major vendors. This support will be a critical factor in FCoE adoption, as organizations can now take advantage of the technology, knowing their trusted vendor will support it. ESG research¹ indicates that 2010 and 2011 should be significant years for FCoE adoption, as shown in Figure 1. IT professionals surveyed by ESG indicated that 10GbE is poised for 24% growth, while FCoE usage looks to expand by 17%. Meanwhile, utilization of traditional Fibre Channel is flattening out.

Figure 1. Data Center Connectivity over 24 months

Please indicate which of the following front-end connectivity options are being utilized today to connect servers to networked storage systems. Please also indicate which connectivity options will be used in 24 months.
(Percent of respondents, N=447)



The increased utilization and enhanced reliability of centrally managed Fibre Channel storage networks have fueled a massive wave of storage consolidation in recent years. Driven by a set of challenges associated with the cost and complexity of servers, a growing number of organizations are using server virtualization technology to

¹ Source: ESG Research, *Enterprise Storage Survey*, November 2008.

consolidate. As these trends continue, a new wave of I/O or network consolidation, supported by traditional Ethernet-based network traffic and Fibre Channel-based storage traffic, has begun to take form.

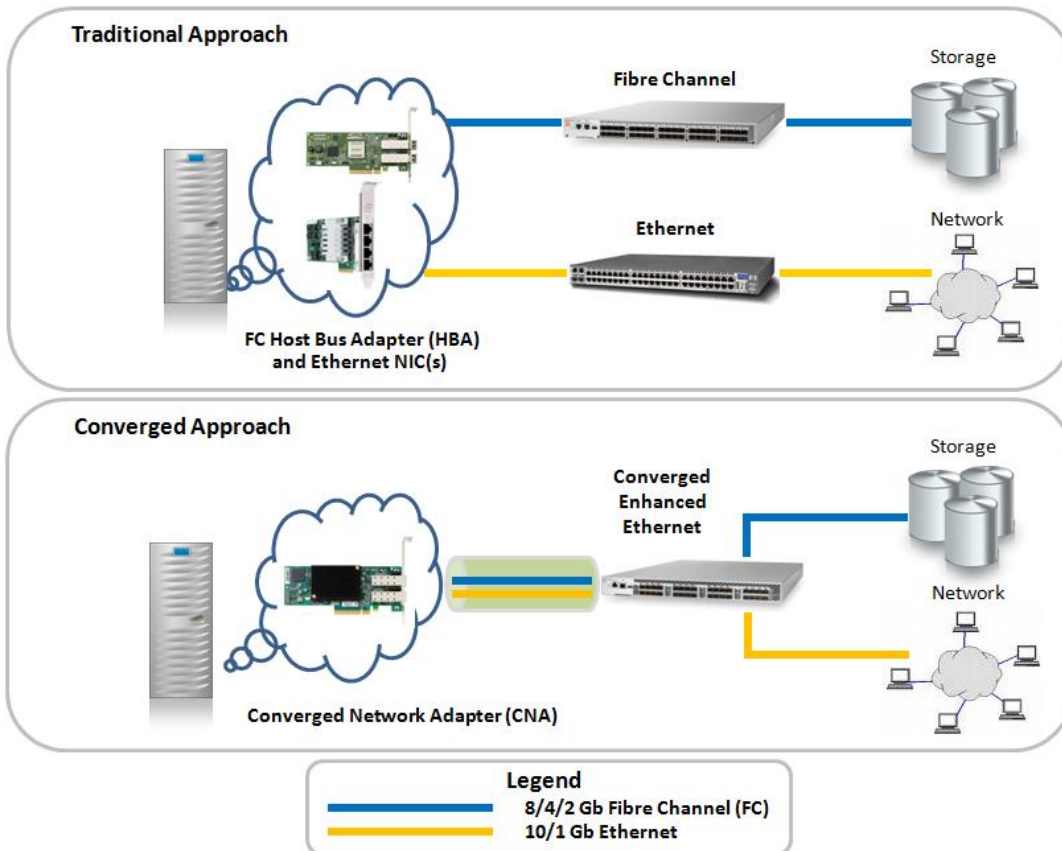
This is to be expected, as the intent of FCoE is not to create yet another separate data center protocol, but to merge Fibre Channel with 10GbE and gracefully migrate from existing Fibre Channel to Ethernet over time. With organizations looking to reduce operating expenses and accelerate business processes, a converged network enables rapid provisioning of new services and quick, seamless addition of throughput.

Fibre Channel over Ethernet

FCoE maps Fibre Channel storage traffic over an Ethernet network with the goal of converging storage and networking traffic onto a single platform, leveraging familiar management tools, security models and processes. Switches and server-based adapters supporting FCoE are being evaluated by a growing number of organizations interested in the potential benefits of FCoE technology.

The Data Center Bridging (DCB) standard (a.k.a., Data Center Ethernet or Converged Enhanced Ethernet) was defined to enable the converged approach shown in Figure 2. 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 DCB 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 Fibre Channel for networked storage connectivity.

Figure 2. *Converging with FCoE*



The FCoE standard picks up everything from the Fibre Channel standard—except the cabling and the physical interface—and places it on top of a DCB Ethernet network. It was approved within the T11 committee in June 2009. FCoE has the potential to reduce data center complexity by reducing the number of cards, cabling and network devices in the data center. Combining Fibre Channel, iSCSI and Ethernet onto a single card, a UCNA replaces the need for separate network interface cards (NICs) and Fibre Channel host bus adapters (HBAs) while

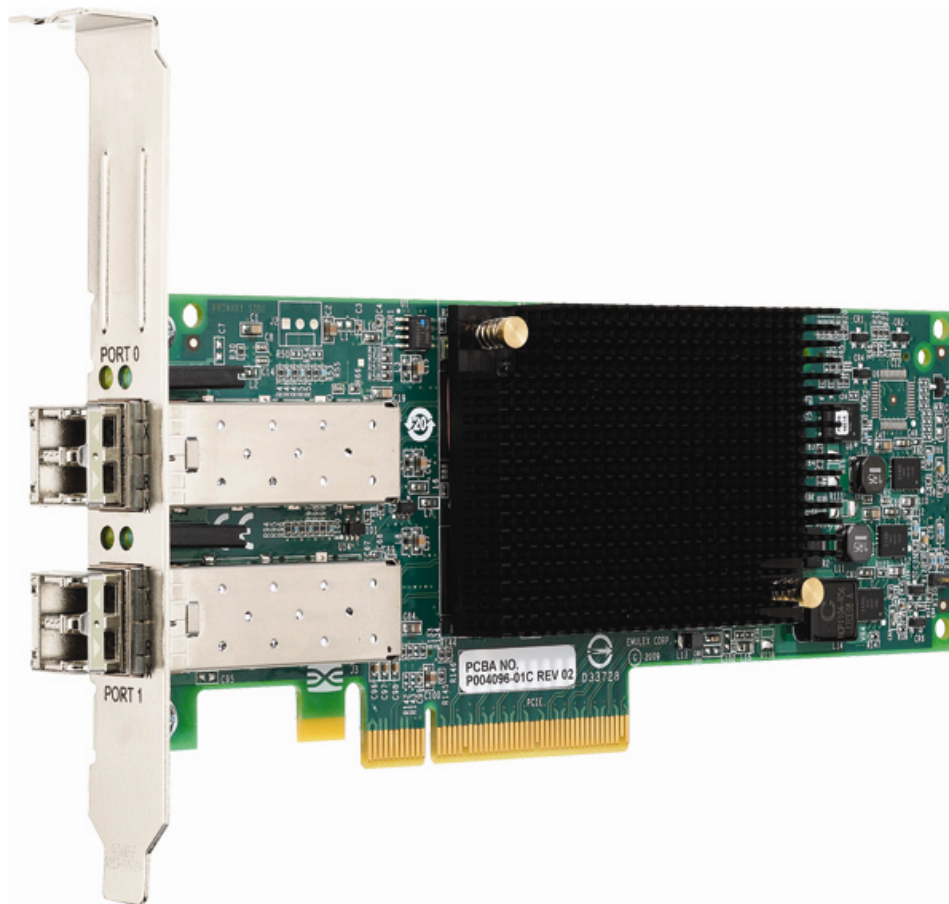
allowing organizations to replace separate edge or top-of-rack Ethernet and Fibre-Channel switches with DCB multiprotocol switches supporting Ethernet and Fibre Channel connectivity.

Consolidation and virtualization are the key data center initiatives for transitioning from existing, segregated, Local Area Network (LAN)/Storage Area Network (SAN) infrastructure to a more efficient, converged architecture. The ultimate goal of network convergence is to provide the foundation for a truly agile end-to-end infrastructure while achieving significant reductions in capital equipment and operational expenses.

Emulex OneConnect FCoE UCNA

The Emulex OneConnect FCoE UCNA, seen in Figure 3, provides LAN and SAN connectivity over 10GbE network using FCoE and DCB functionality. The OneConnect UCNA has a PCIe Gen 2 X8 connection for server-side communication and two ports of 10Gbps Ethernet connectivity for network and storage I/O.

Figure 3. The Emulex OneConnect FCoE UCNA



Emulex OneConnect FCoE UCNAs and Emulex Fibre Channel HBAs share a common Fibre Channel driver stack and both can be managed with the Emulex OneCommand Manager application; this is especially important to administrators with an installed base of Fibre Channel HBAs. Both also support N-Port ID Virtualization (NPIV), which provides virtualized addressing and zoning for enhanced security in server virtualization environments. Leveraging a proven heritage and a common tool set, Emulex OneConnect UCNAs are designed to enable consolidation, energy conservation and savings.

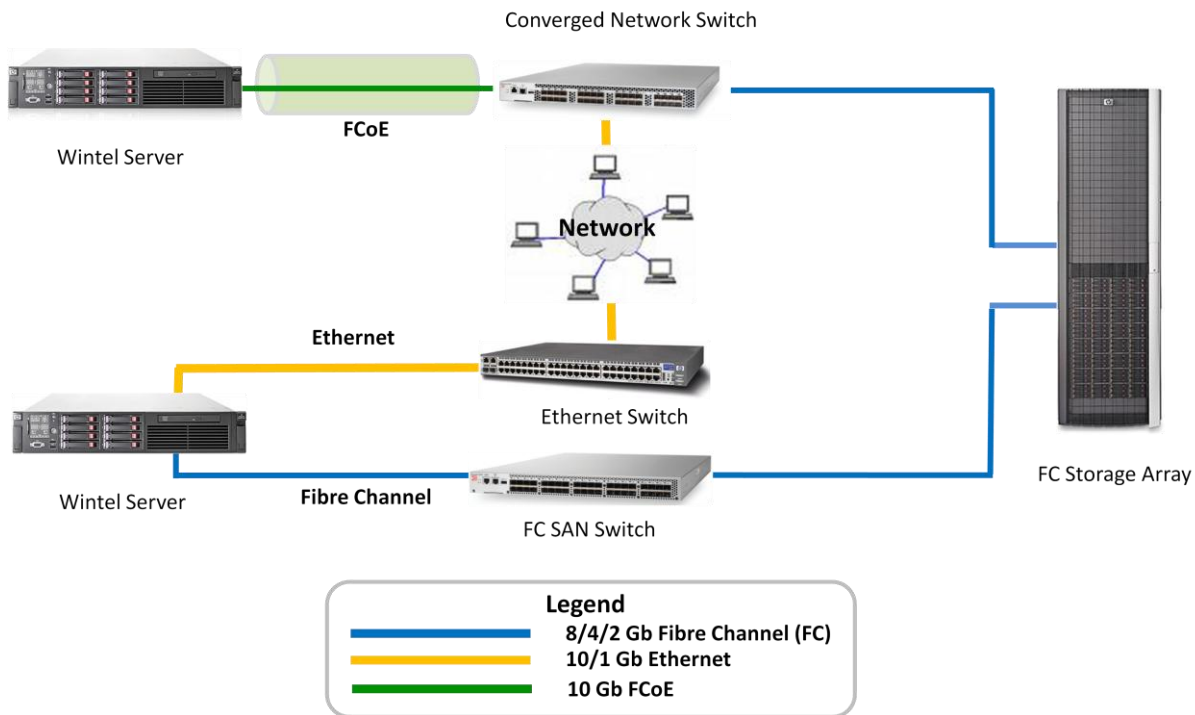
ESG Lab Validation

ESG Lab performed hands-on testing of the Emulex OneConnect FCoE UCNA at a lab facility in Marlborough, Massachusetts. ESG tested the OneConnect FCoE UCNA’s ability to provide transparent network and storage connectivity for industry-standard Wintel servers. ESG Lab also looked at the management capabilities of the OneCommand Manager application.

Getting Started

The ESG Lab test bed consisted of servers, network switches and storage as might be found in a typical data center.² Two physical servers were running Microsoft Windows Server 2008. One server was configured to represent existing Fibre Channel-attached servers in a traditional data center setup as seen in Figure 4, with an Emulex 8Gb HBA attached to a 24-port 8Gb Fibre Channel SAN switch, as well as a 1Gb Ethernet NIC attached to a 1Gb Ethernet switch. The second server was configured with a single Emulex OneConnect FCoE UCNA attached to a converged network switch for converged network and Fibre Channel storage connectivity. Both servers were presented storage from a Fibre Channel storage array.

Figure 4. The ESG Lab Test Bed



ESG Lab Testing

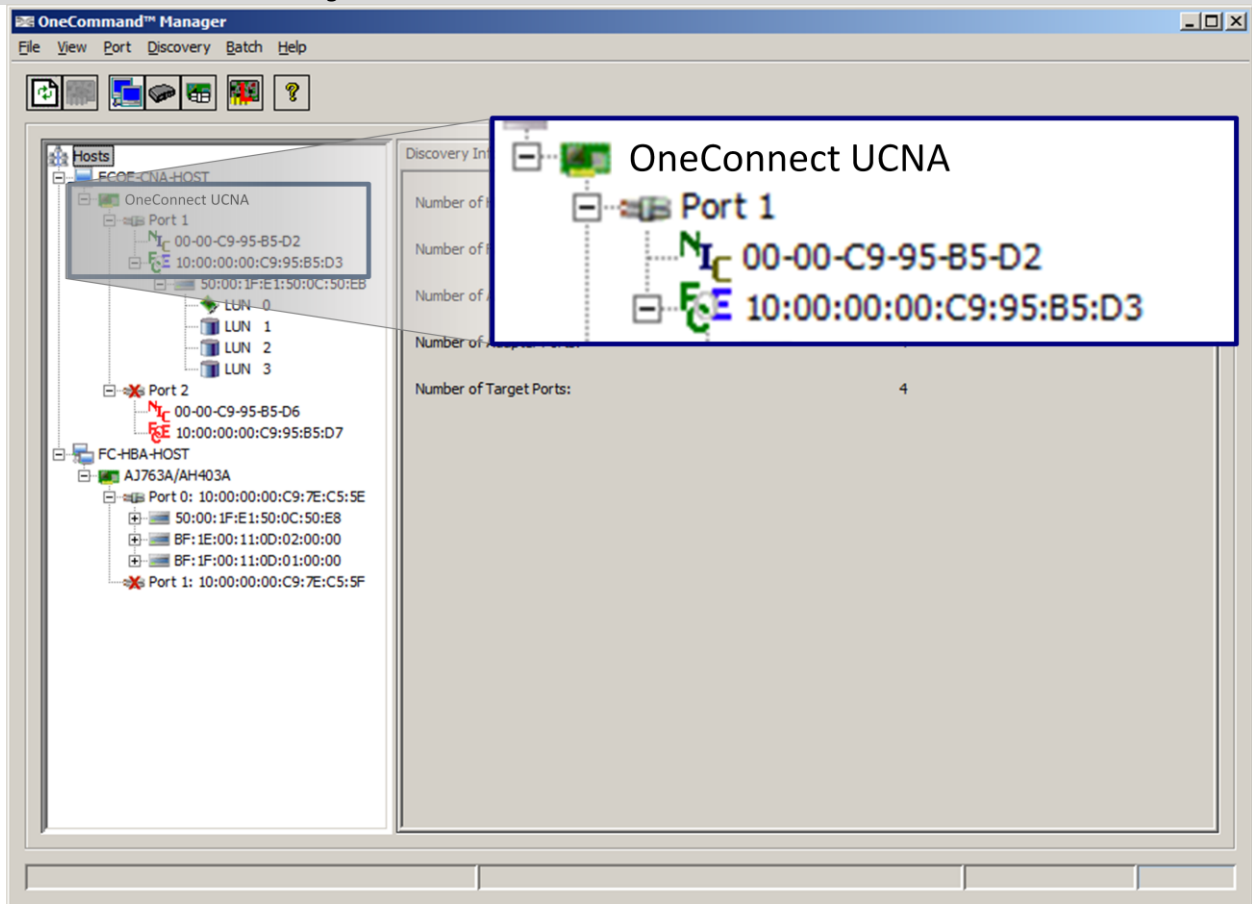
ESG Lab first examined the procedures required to incorporate the Emulex OneConnect FCoE-enabled UCNA into an existing Fibre Channel environment, including the configuration of both the OneConnect FCoE UCNA and the converged network switch.

First, ESG Lab downloaded the UCNA driver package and then the OneCommand Manager application, installing them both on the server where the OneConnect FCoE UCNA was physically installed. The drivers and software are easy to find on Emulex’s Web site or through one of its OEM partners’ Web sites. The entire process, from the first mouse -click on the Web site through downloading and installing both the drivers and the OneCommand Manager—including rebooting after installing the drivers and software—took nine minutes. Once

² Complete configuration details can be found in the Appendix.

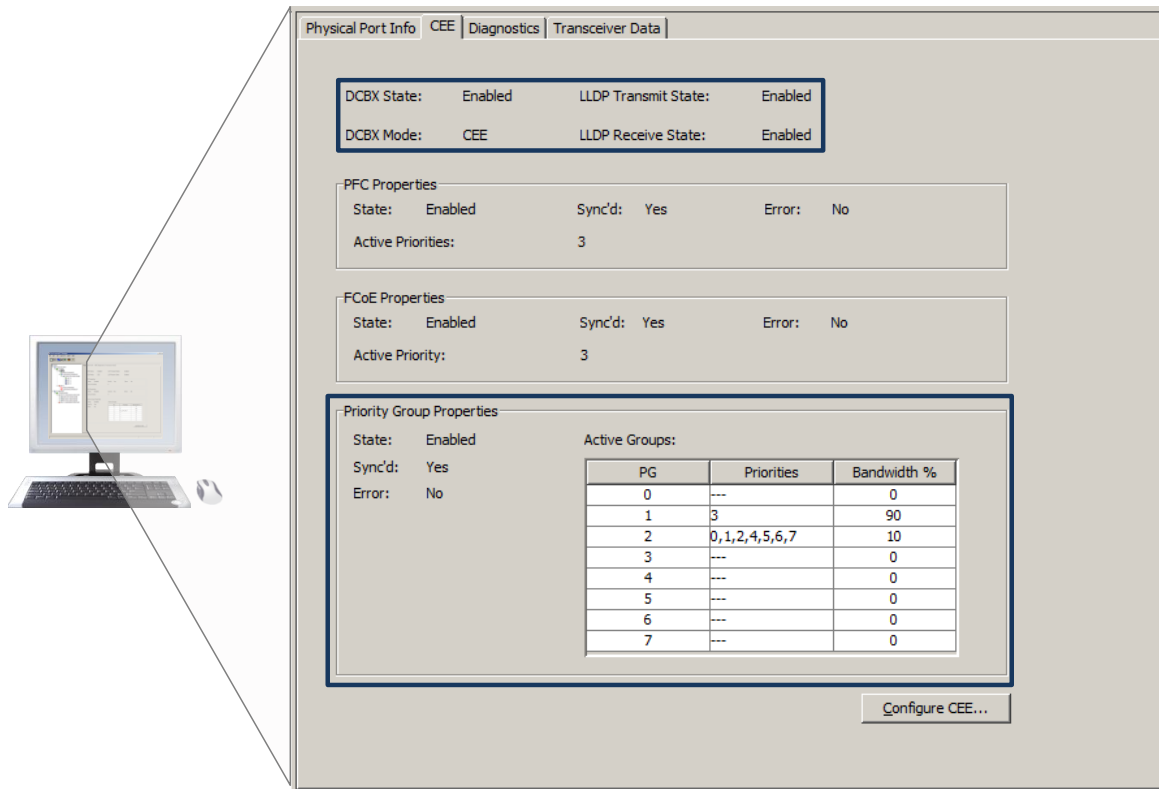
the driver package and OneCommand Manager were installed, OneCommand Manager was used to configure the OneConnect FCoE UCNA. As can be seen in Figure 5, the OneConnect FCoE UCNA was displayed, along with the existing traditional Fibre Channel HBA and showed both an Ethernet NIC and an FCoE adapter on port 1.

Figure 5. *OneCommand Manager*



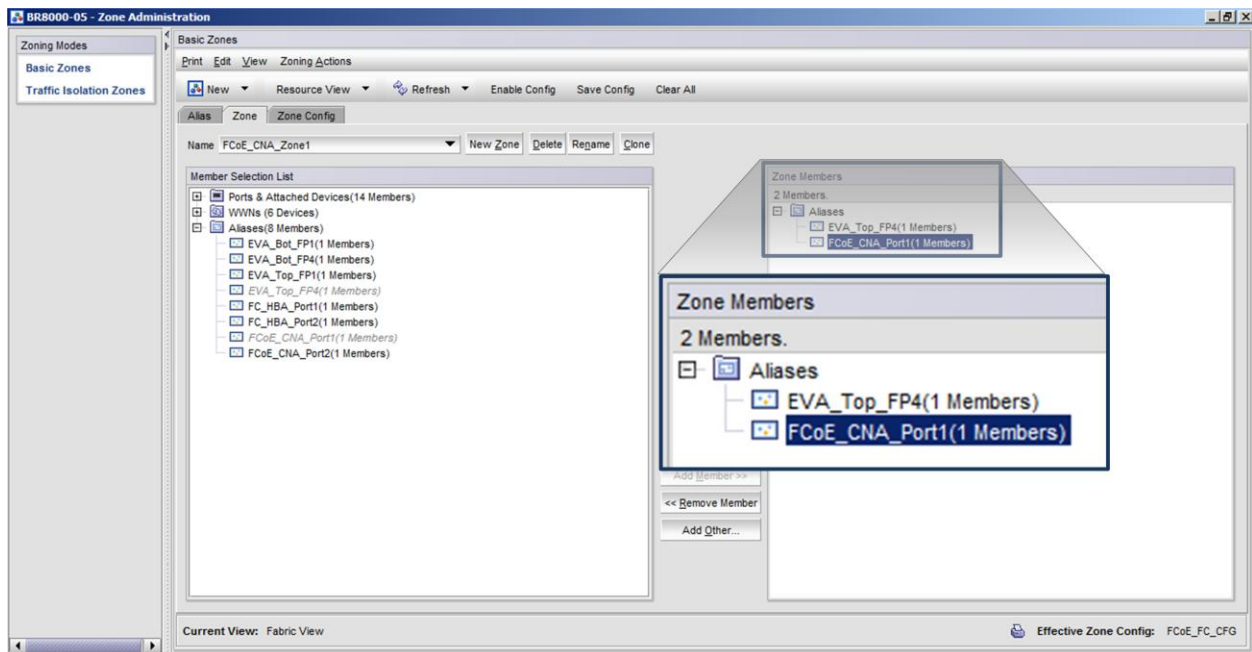
Additional tabs for the OneConnect UCNA provide configuration and verification of FCoE-specific parameters. The CEE tab, for example, shows Data Center Bridging state and mode as well as priority group properties as seen in Figure 6. Priority groups are configured on the converged network switch and allow administrators to set bandwidth allocation for Ethernet and Fibre Channel traffic to ensure that both protocols can get the bandwidth required by applications.

Figure 6. UCNA Enhanced Ethernet Information



Configuration of both Fibre Channel storage and Ethernet networking was exactly the same as with traditional Fibre Channel adapters and Ethernet NICs. Fibre Channel zoning of the converged networking switch for FCoE connectivity was also familiar, using exactly the same process as for traditional Fibre Channel SANs, as seen in Figure 7.

Figure 7. FCoE Converged Network Switch Management



ESG Lab measured less than 15 minutes from the first mouse-click to formatting Fibre Channel SAN-attached storage volumes on the FCoE attached server.

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 indicated 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. ESG Lab has confirmed that the Emulex OneConnect FCoE UCNA can drop into an existing data center environment using the same drivers, tools and techniques as existing Fibre Channel HBAs and provide transparent storage and IP network connectivity to reduce hardware, cabling and administration requirements.

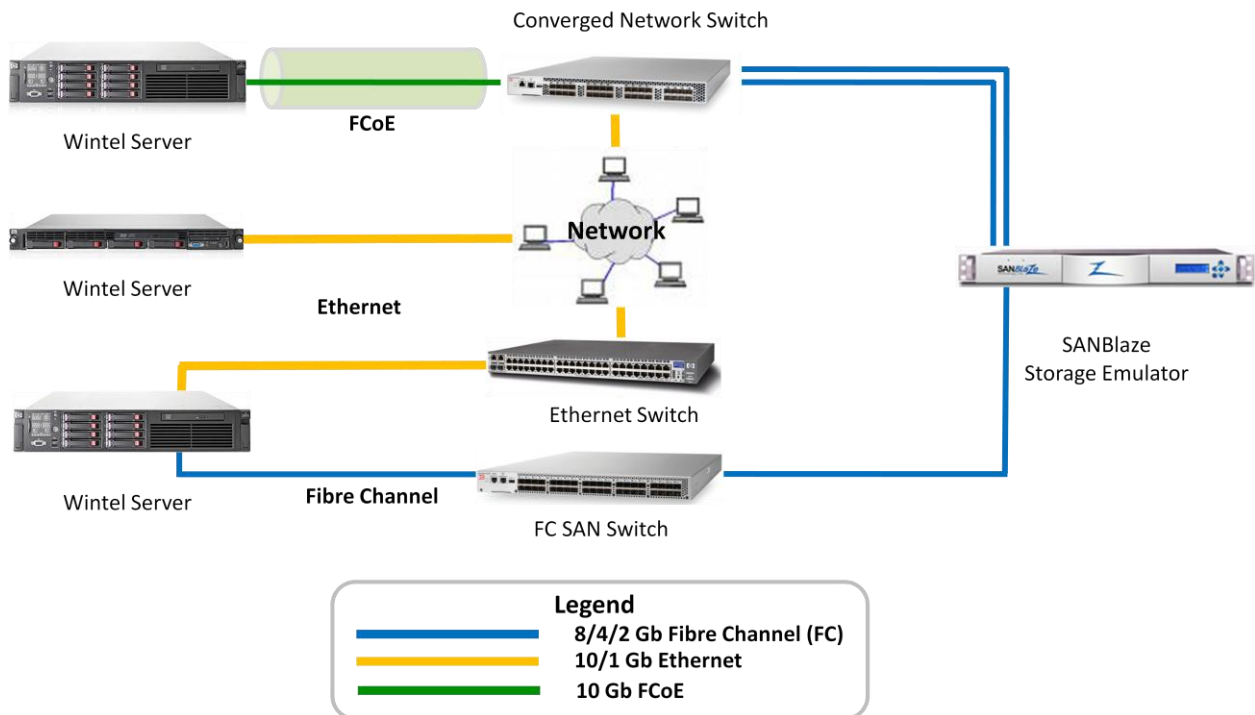
Ease of Management

The FCoE specification was defined with ease of integration with existing Fibre Channel networks in mind. Bridged FCoE support can be used to add new servers to a converged 10GbE fabric while existing investments in Fibre Channel switches and storage systems are preserved. Bandwidth allocation and management with priority groups is designed to ensure applications have the bandwidth they require, regardless of protocol.

ESG Lab Testing

To validate the interoperability and manageability of the OneConnect FCoE UCNA in an enterprise Fibre Channel SAN environment, ESG Lab ran several I/O tests using the test bed shown in Figure 8.

Figure 8. The Bandwidth Management Test Bed



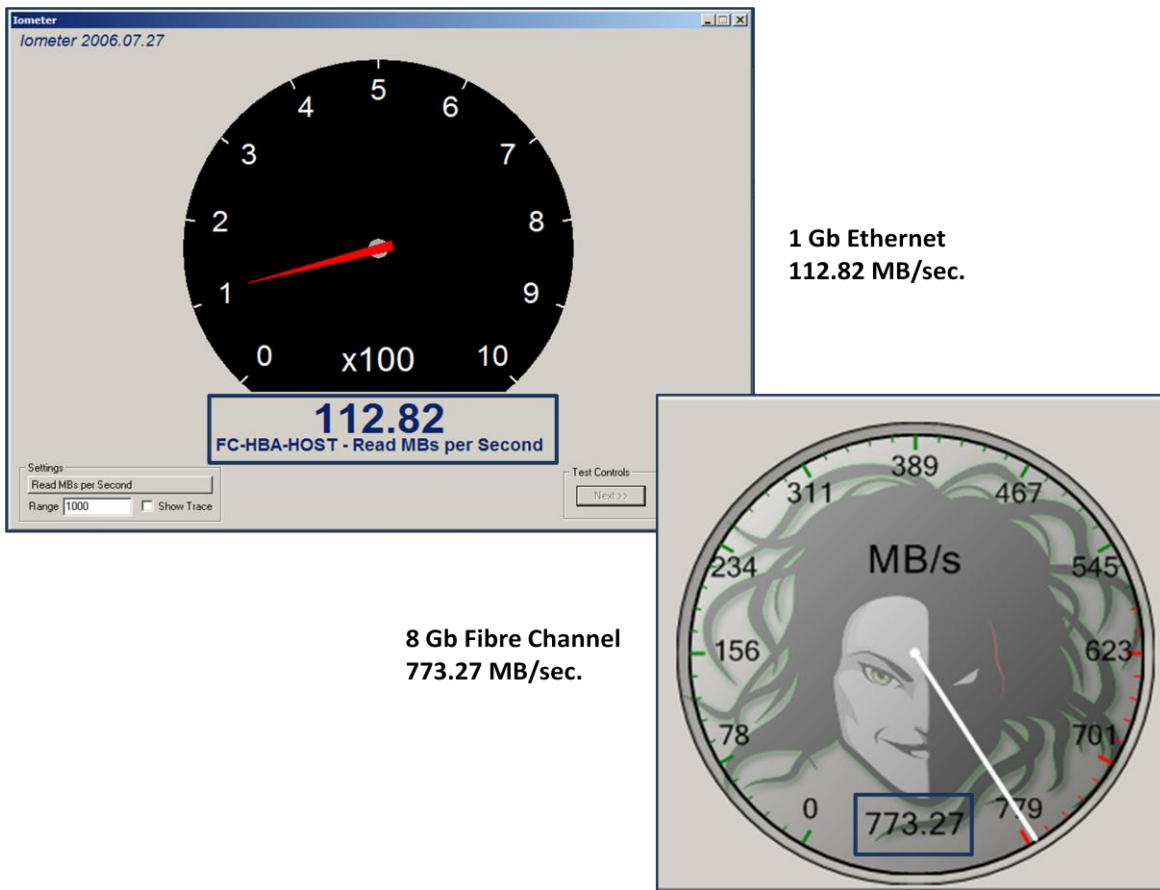
³ Source: ESG Research Report, [Global Green IT Priorities: Beyond Data Center Power and Cooling](#), November 2008.

ESG Lab tested dynamic bandwidth allocation using priority groups on the converged network switch. Dynamic bandwidth allocation enables administrators to assign and re-assign bandwidth to applications on the fly between the Fibre Channel and Ethernet domains. This provides more flexibility than is possible with separate Fibre Channel and Ethernet networks, where additional bandwidth can only be achieved by adding adapters or HBAs, and bandwidth cannot be shared across domains.

Priority groups were configured to guarantee 90% of available bandwidth to Fibre Channel traffic and 10% to Ethernet. A SANBlaze RAM-based storage emulator was used to provide access to storage volumes at line-rate speeds over both 8Gb Fibre Channel and 10Gb FCoE. A separate Wintel server was used to provide 10Gb network connectivity, SAN traffic was generated using Medusa Labs test tools and IP traffic was generated using the Iometer load generation utility.

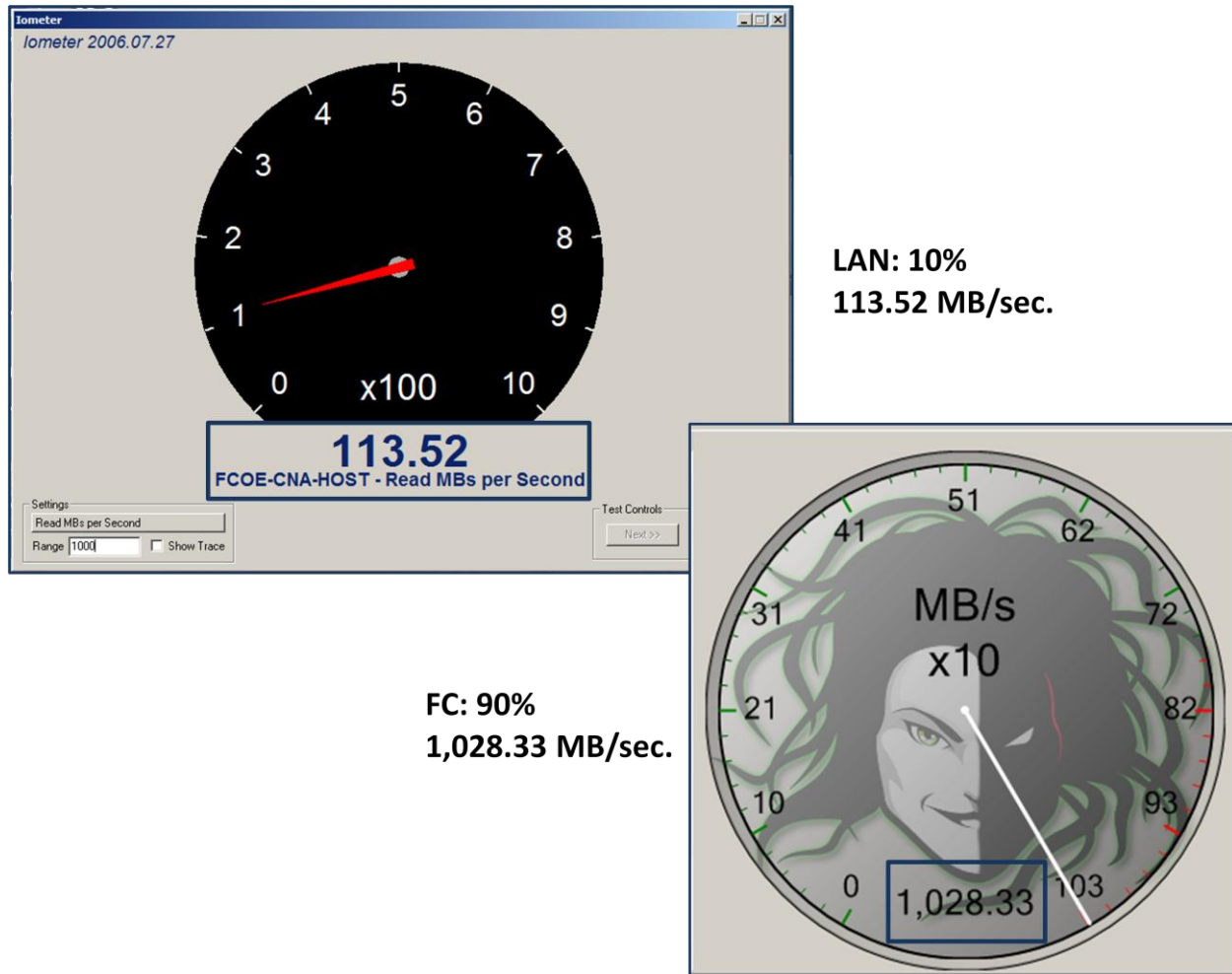
First, ESG Lab ran a baseline test on the server with the traditional 8Gb Fibre Channel HBA and a 1 Gb NIC installed. As seen in Figure 9, the speedometer from the Medusa Labs suite in the lower right showed that the Fibre Channel HBA was reading at 773.27 MB/sec and the speedometer from the Iometer tool in the upper left showed that the 1Gb NIC was reading at 112.82 MB/sec, both very near-line speeds.

Figure 9. Near Line Speed throughput with 8Gb FC and 1Gb Ethernet



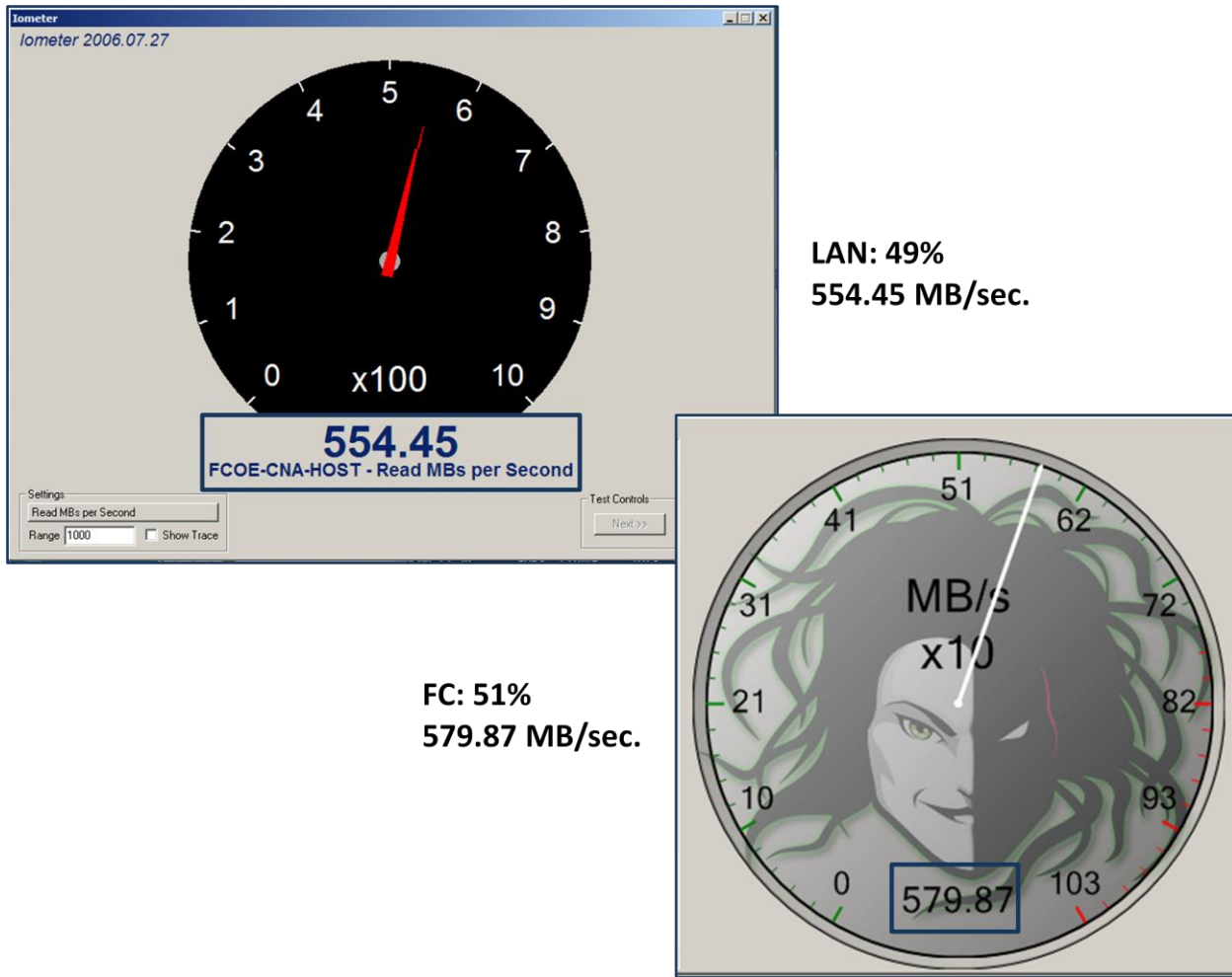
Next, the same workloads were run on the UCNA-attached server. The results are shown in Figure 10. Fibre Channel traffic is getting almost precisely 90% of the total bandwidth and Ethernet traffic is getting the remaining 10%.

Figure 10. Dynamic Bandwidth Allocation with 10Gb Ethernet: 90% FCoE Allocation, 10% LAN Allocation



With the workloads still running, ESG Lab changed the priority group settings in the converged network switch to re-allocate bandwidth. With two commands, allocation was changed to 50% for FCoE and 50% for LAN. Immediately after “Enter” was pressed, the traffic pattern changed to what is seen in Figure 11, with no disruption or interruption to I/O. At that point in time, FCoE traffic was getting 51% of the total bandwidth and LAN traffic was getting the remaining 49%.

Figure 11. Dynamic Bandwidth Allocation with 10Gb Ethernet: 50% FCoE Allocation, 50% LAN Allocation



Using a simple, single command, ESG Lab was able to dynamically re-allocate bandwidth from FCoE to LAN, with no disruption to service.

Why This Matters

Server and storage consolidation present challenges in large data centers when high-availability services must be provided to diverse, sometimes incompatible, technologies. Consolidating networks, servers and storage arrays using FCoE can potentially increase utilization and availability while reducing the amount of equipment that needs to be purchased, managed, powered and cooled.

The promise of new technology is alluring, but not if it disrupts the business. This basic tenet of IT is especially true for existing applications that rely on Fibre Channel storage networks. Mission-critical applications often need the field-proven stability and reliability of Fibre Channel SAN technology and these networks are typically managed by highly 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 they do with Fibre Channel, protecting the customer’s investment and skill set while giving administrators easy-to-control, precise bandwidth allocation, which is needed to protect storage access for critical applications.

The Bottom Line

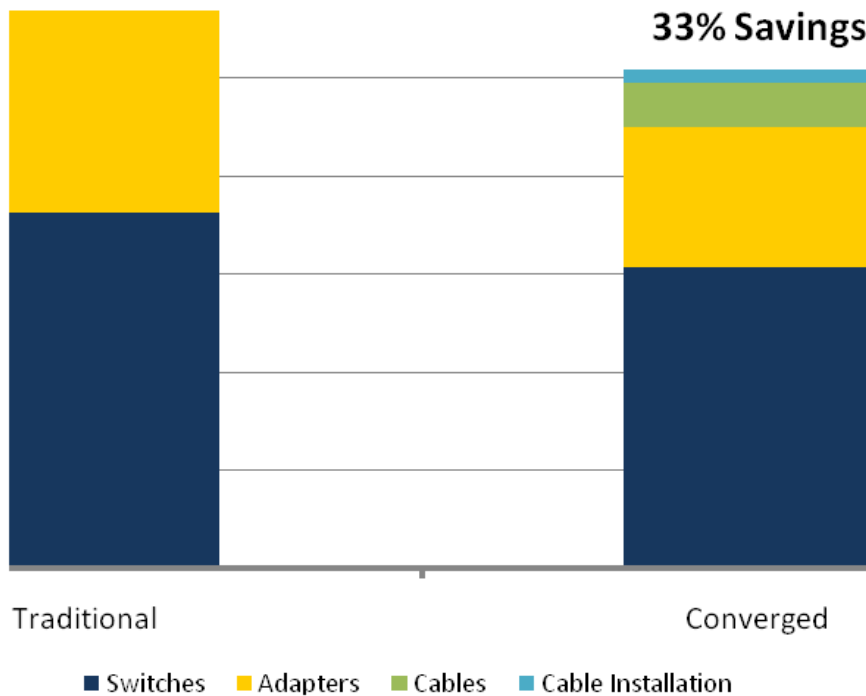
Organizations of all sizes are struggling to deliver IT services to meet the rapidly changing needs of the business. Data growth is unrelenting and IT budgets are constantly under scrutiny, so in order to meet increasingly demanding service levels, IT managers are looking for opportunities to consolidate. In order for this to be effective, IT not only needs to reduce capital costs, but more importantly needs to reduce operational costs, enhance scalability and performance and improve cycle times. Server virtualization is one technology that meets these requirements, and it therefore continues to be a top IT initiative. Emulex’s converged network offering also delivers these benefits by leveraging consolidated management using simple, familiar tools, reduced hardware and cabling requirements, strong performance and lower power and cooling requirements.

ESG Lab created a simple cost of implementation model based on a typical data center environment with a requirement to add 100 new servers to an existing environment with a 4Gb Fibre Channel SAN and 1Gb LAN infrastructure. ESG Lab chose to make the comparison using 4Gb Fibre Channel because it fits better with where most environments are today. In the data center, 4Gb Fibre Channel is much more common than 8Gb.

Costs were broken down into two major categories: capital expenditures, including switches, NICs and HBAs as well as cables; and operational expenses, including power and cooling as well as cable installation. Hardware costs were calculated using online pricing from major vendors, power requirements were taken from hardware manufacturers’ specification sheets and operational expenses were estimated based on interviews and conversations with IT managers responsible for managing large enterprise data centers.⁴

Figure 12 shows the relative capital expense a typical end-user would incur to implement 100 servers with a traditional combination of 4Gbps Fibre Channel SAN and Gigabit Ethernet infrastructure versus implementing 100 servers using a single, converged network with 10GbE and FCoE.

Figure 12 Traditional LAN/SAN Infrastructure vs. Converged Network- Capital Expenses



⁴ Assumptions and Parameters can be found in the Appendix.

Figure 13 shows the annual power and cooling expenses for the switching and network adapters in both scenarios.

Figure 13. Traditional LAN/SAN Infrastructure vs. Converged Network – Power and Cooling

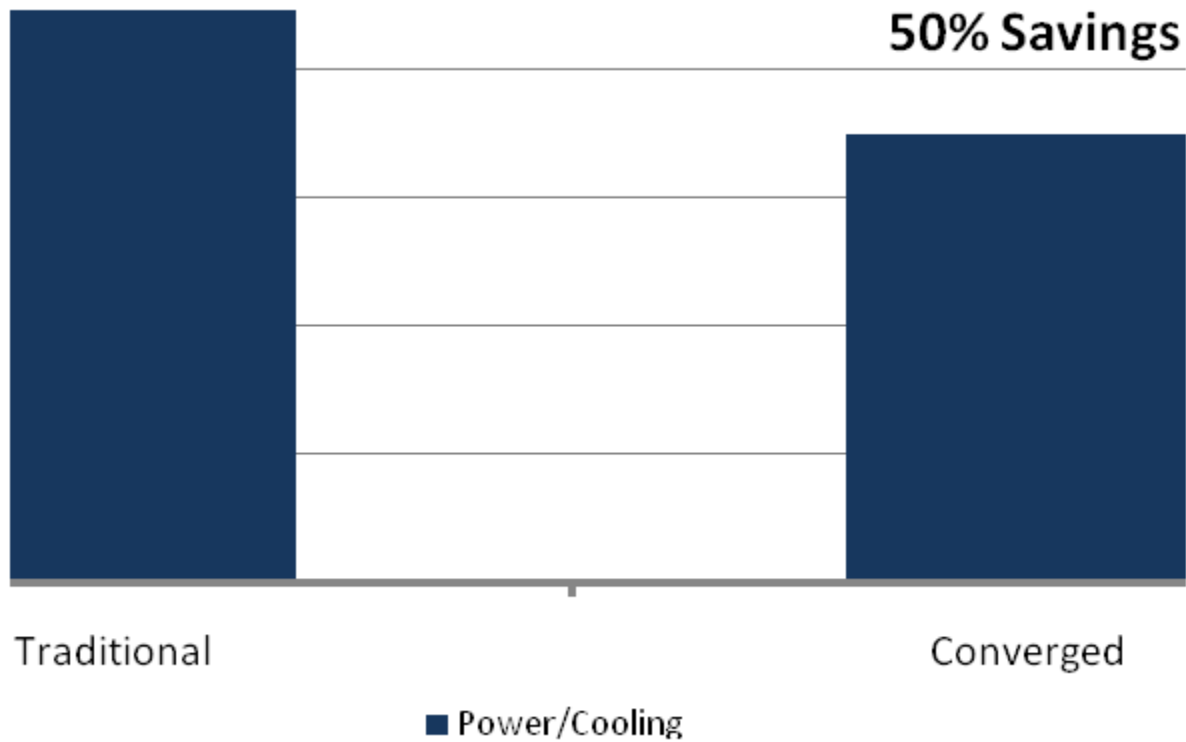


Table 1 shows the detailed results of ESG Lab’s calculations, with cost savings broken out by category.

Table 1: Relative Costs of Converged Ethernet and Traditional LAN/SAN

	Switches	Adapters	Cables	Cable Installation	Power/Cooling over 3 years
Traditional LAN/SAN Infrastructure	\$362,916	\$242,000	\$54,500	\$95,000	\$41,749
Converged Network Infrastructure	\$307,452	\$142,900	\$45,200	\$13,200	\$21,025
Savings	15%	41%	17%	86%	50%

What the Numbers Mean

- Consolidating to a 10Gb converged network infrastructure resulted in significant cost savings in both capital and operational expenditures compared to a traditional LAN/SAN infrastructure.

- Operational expenses such as power/cooling and cable plant maintenance showed significantly higher cost savings over the cost of switches and adapters due to the large reduction in cabling and number of switches. As the environment scales over time, these savings can really add up.

Why This Matters

IT managers are being challenged to do more with less. Maintaining multiple separate networks is very expensive due to data growth, stagnant or shrinking budgets, and the rising costs of space and power. A shared, consolidated network infrastructure is easier to manage and more cost-effective than disparate SANs and LANs. Consolidated, simplified networks can also improve the availability and serviceability of the infrastructure that hosts the applications organizations use to run their businesses.

ESG Lab validated that a network strategy using the Emulex OneConnect FCoE UCNA and converged Ethernet reduces the number of required networks and cables as it consolidates networking and storage traffic, leveraging existing tools and processes. This provides investment protection and enables seamless migration to a highly available converged network with fewer ports, cards and cables—translating directly to lower operational costs to the business over time.

ESG Lab Validation Highlights

- ☑ The Emulex OneConnect FCoE UCNA was recognized by both OneCommand Manager and Windows as a Fibre Channel HBA and a 10GbE NIC without any special software or configuration required.
- ☑ The Emulex OneConnect FCoE UCNA used the same lpfc drivers as all standard Emulex Fibre Channel HBAs.
- ☑ The management experience administering the OneConnect FCoE CNA is essentially identical to any other Emulex Fibre Channel HBA.
- ☑ The OneConnect FCoE UCNA was able to participate in a Fibre Channel fabric with 8Gb Fibre Channel HBAs and share the same storage array without any compatibility or interoperability issues.
- ☑ The priority groups feature on the converged network switch was able to allocate bandwidth between Fibre Channel and Ethernet applications precisely and on the fly with no disruption or interruption in service.
- ☑ ESG Lab estimated that an organization can use FCoE to add new servers to their existing Fibre Channel SANs with minimal added cost of acquisition with no additional administration costs and with fewer cables, adapters and switches to power, cool and manage.

Issues to Consider

- ☑ While the T11 committee has approved the FCoE standard and sent it up for public review, the DCB or Enhanced Ethernet standards are still being ratified. Having said that, forward-thinking IT managers with existing investment in Fibre Channel fabrics would be wise to begin investigating this technology sooner rather than later.
- ☑ Upgrading from traditional Fibre Channel to FCoE in one fell swoop is potentially problematic, requiring replacement of SAN and network switches as well as HBAs. The good news is that FCoE, deployed in its most likely scenario—when adding new servers—integrates seamlessly into existing SAN and LAN environments without having to replace existing Fibre Channel infrastructure. As that SAN and LAN infrastructure ages and needs to be replaced, users migrate to FCoE organically.
- ☑ While administration and troubleshooting should be easier with a single console for both Fibre Channel and Ethernet connectivity, as well as fewer cards and cables, there are potential conflicts of IT culture: joining the Fibre Channel and Ethernet networking teams together.

The Bigger Truth

As organizations continue to transform their data centers and server virtualization continues to proliferate, servers, storage and networking devices must be added to keep pace with business demands. As a result, businesses are spending upwards of 70% of their IT budgets on operations.

In a recent ESG survey,⁵ 54% of IT managers polled indicated their organizations would be basing new technology decisions on their ability to reduce operational costs and 42% indicated improving business processes would be their most important criteria. Converged networks should be an attractive solution for IT departments looking to reduce footprint and complexity in the data center while streamlining administration. It should be noted that in this same survey, reducing capital costs went from tied for second place in 2009 down to fifth place in 2010. ESG has had numerous conversations with organizations that validate this research, with some organizations stating they can get all the capital they need—provided they can show it will help to reduce operational expenses.

ESG Lab found that a converged infrastructure enables users to reduce both capital and operational expenses while increasing flexibility and service levels with a simplified architecture. Fewer network switches, cards and cables, with more efficient silicon technology, result in less power being consumed and less heat generated, while administrative burdens are reduced with far fewer devices and connections to manage.

Leveraging familiar tools and processes, DCB and FCoE provide a smooth upgrade path for the migration of storage traffic from an isolated Fibre Channel storage network to a converged Ethernet fabric. It is ESG Lab's opinion that FCoE is a compelling technology and potentially a better fit than iSCSI for organizations with significant existing investment in Fibre Channel. It enables companies to retain existing Fibre Channel infrastructure, keeps existing Fibre Channel management tools in place, provides the same level of performance guarantees and has the potential of reducing costs. This final consideration of cost is a significant variable in the FCoE adoption equation. Given the present economy and the pressure IT is under to reduce costs, compelling FCoE pricing could be used to accelerate adoption faster than any marketing pitch or certification.

ESG Lab has seen FCoE in action, with Emulex OneConnect FCoE UCNA's providing converged server connectivity to a LAN and a SAN. Running alongside Emulex Fibre Channel HBAs and managed from the familiar Emulex OneCommand Manager application, Emulex OneConnect UCNA's worked with field-proven drivers and tools. Emulex's OneConnect UCNA platform provides the flexibility to choose not only the right protocol (choice of Ethernet, iSCSI or FCoE), but also the right performance and price point to address changing business needs. Emulex is able to provide attractive price points by offering an innovative pay-as-you-go pricing model so users only pay for the services they need, when they need them.

ESG believes that organizations should take a good, long look at this architecture and consider how they could benefit from building highly flexible compute resource pools that can adapt to multiple network technologies—without requiring significant moves, adds or changes. Simply put, network convergence makes sense. If you don't have to have more than one network, why would you? This type of cost savings and flexibility should be well-received by organizations planning their data center transformations.

⁵ Source: ESG Research Report, [2010 IT Spending Intentions Survey](#), January 2010.

Appendix

Table 2. ESG Lab Test Bed

Servers	
HP DL 385 G6– 1 Emulex OneConnect FCoE UCNA OCe-10102-F	Microsoft Windows Server Enterprise 2008 SP2 FC Storport Miniport Driver: 7.2.30.16
HP DL 385 G6– 1 HP StorageWorks 82E PCIe 8Gb Fibre Channel Dual Port Host Bus Adapter	Microsoft Windows Server Enterprise 2008 SP2 FC Storport Miniport Driver: 7.2.30.16
HP DL 360 G6– 1 Emulex OneConnect FCoE UCNA OCe-10102-F	Microsoft Windows Server Enterprise 2008 SP2 FC Storport Miniport Driver: 7.2.30.16
Switches	
HP StorageWorks 2408 Converged Network Switch	Firmware 6.3.0b
HP StorageWorks 8/24 SAN Switch	Firmware 6.3.0c
HP ProCurve 3500-24 Switch	
Storage	
HP StorageWorks EVA 4400	12x 146 GB 15K Fibre Channel
SANBlaze Storage Emulator	2 ports 8Gb FC, 2 ports 10Gb FCoE

Table 3. Cost of Acquisition/Ownership Assumptions and Raw Data

Cost of Acquisition/Ownership Assumptions	
Average U.S. Commercial power cost	\$.0937/kW-hr ⁶
Average data center cooling costs	80% of power costs
Intra rack cable installation and testing	\$50
Inter rack cable installation and testing	\$200
Traditional Discrete SAN and LAN Infrastructure	
4Gb SAN switch ports (10x 24-port switches)	240
4Gb FC HBA ports	200
1Gb managed Ethernet switch ports (10x 64-port switches)	640
1Gb Ethernet NIC ports	600
Copper Ethernet cables	1200
Optical FC cables (5M)	400
Optical FC Uplink cables (15M)	20
Optical LAN Uplink cables (15M)	40
Annual switch, NIC and HBA power consumption(KwH)	79,459
Converged Network Infrastructure	
CEE 10Gb Ethernet ports ⁷	216
CEE 8Gb FC ports ⁸	72
10Gb UCNA ports	200
SFP+ direct attach cables	200
Optical FC Uplink cables (15M)	20
Annual switch and UCNA power consumption(KwH)	40,015


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⁶ As of Dec. 09 according to the US Energy Information administration http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html
⁷ Each HP 2408 CEE switch has 24 10Gb Ethernet ports and 8 8Gb FC ports.