

# Lab Validation Report

## HP CN1000E CNA

Seamlessly Enabling Universal Network Convergence

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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 HP-branded Emulex 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.

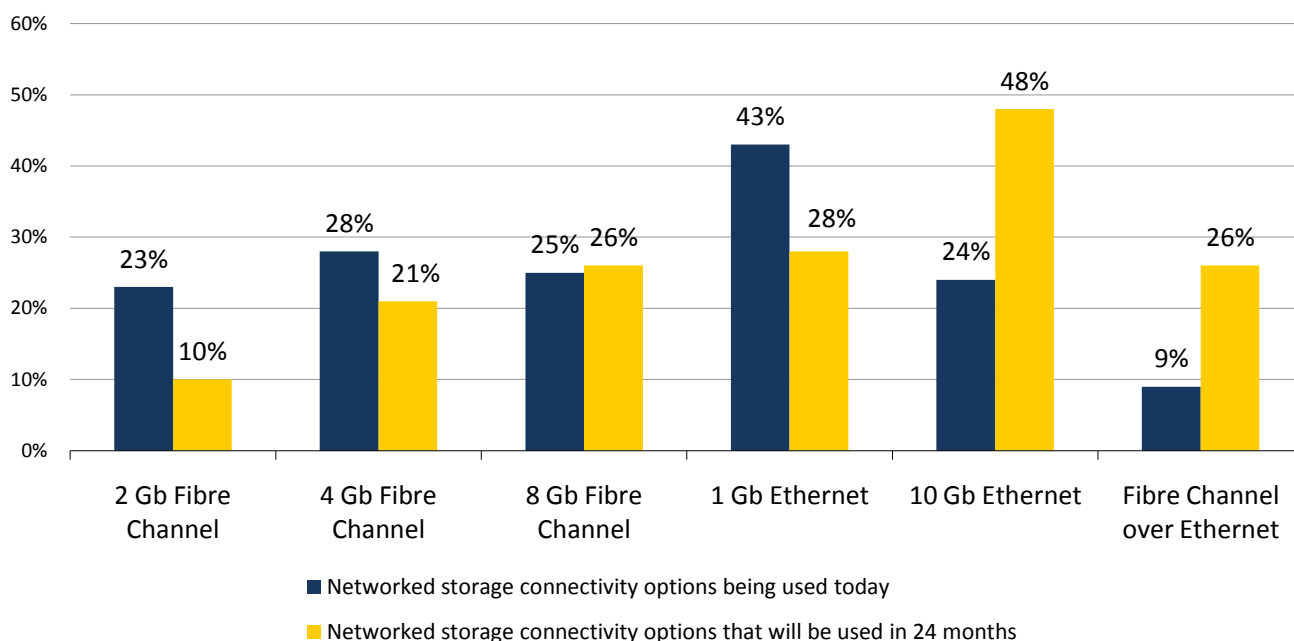
## Background

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, organizations are eliminating their monolithic legacy data centers and infrastructures and replacing them with consolidated, highly virtualized, flexible environments. Fibre Channel over Ethernet (FCoE), an industry standard protocol (ANSI T11) that maps Fibre Channel (FC) 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, “certified,” and is supported by most major vendors. HP’s 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 research<sup>1</sup> 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 FC storage networks have fueled a massive wave of storage consolidation in recent years. Driven by a set of challenges associated with the cost and

<sup>1</sup> Source: ESG Research, *Enterprise Storage Survey*, November 2008.

complexity of servers, a growing number of organizations are using server virtualization technology to consolidate servers in the data center. As these trends continue, a new wave of I/O or network consolidation, supported by traditional Ethernet-based network traffic and FC-based storage traffic, has begun to take form.

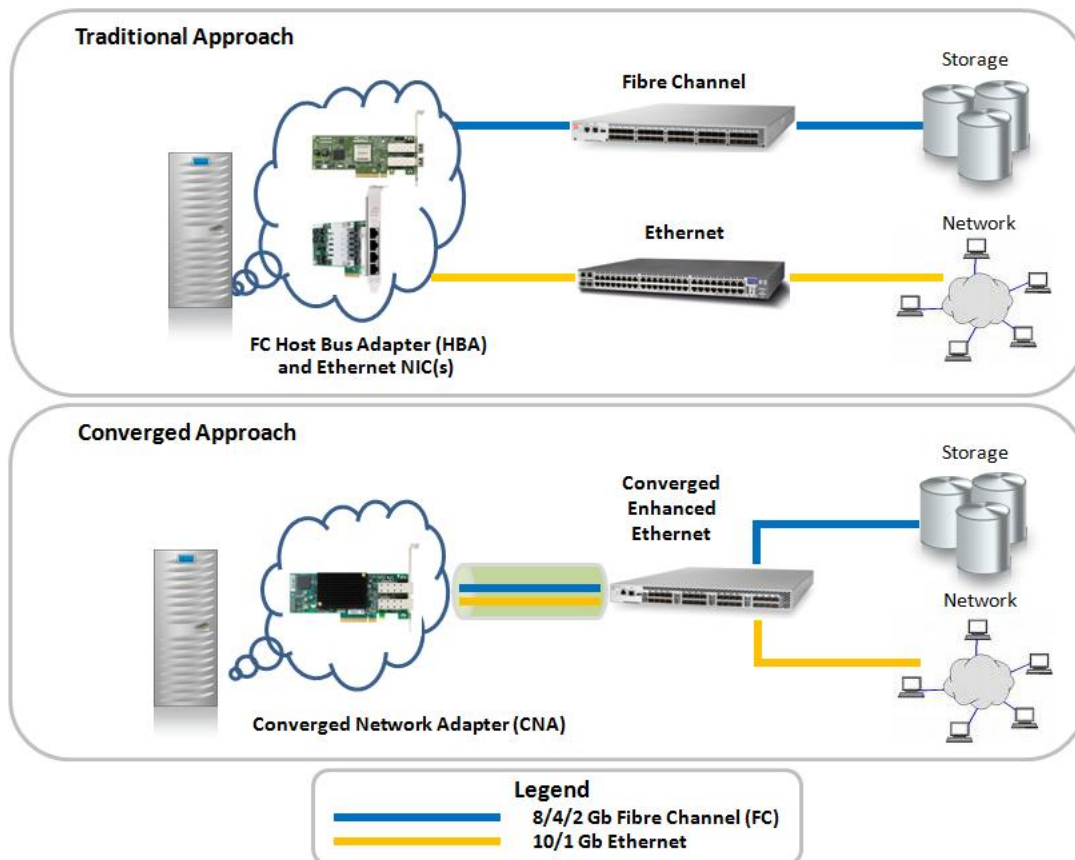
This is to be expected, as the intent of FCoE is not to create yet another separate data center protocol but to merge FC with 10GbE and gracefully migrate from existing FC to Ethernet over time. With organizations looking to reduce operating expenses and accelerate business processes, a converged network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

### Fibre Channel over Ethernet

FCoE maps FC 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 FC for networked storage connectivity.

Figure 2. Converging with FCoE



The FCoE standard picks up everything from the FC standard—except the cabling and the physical interface—and places it on top of an 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 FC and Ethernet onto a single card, a Converged Network Adapter (CNA)

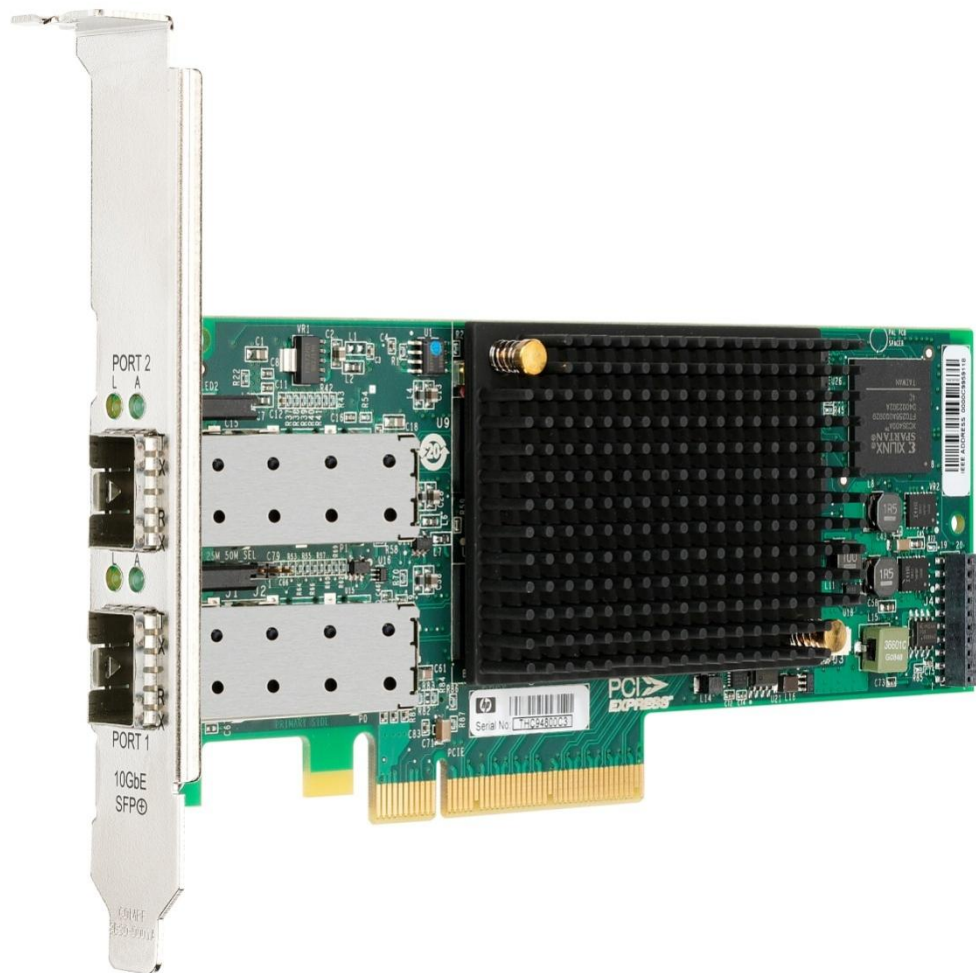
replaces the need for separate network interface cards (NICs) and FC host bus adapters (HBAs) while allowing organizations to replace separate edge or top-of-rack Ethernet and Fibre-Channel switches with DCB multiprotocol switches supporting Ethernet and Fibre Channel connectivity.

Consolidation and virtualization are the key data center initiatives for transitioning from existing, segregated, LAN/SAN infrastructure to 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.

### HP CN1000E Dual Port CNA

The HP CN1000E Dual Port CNA, seen in Figure 3, provides LAN and SAN connectivity over 10GbE network using FCoE and DCB functionality. The CN1000E has a PCIe Gen 2 X8 connection for server-side communication and two ports of 10Gbps Ethernet connectivity for network and storage connectivity.

*Figure 3. The HP CN1000E Dual Port CNA*



HP CN1000E Dual Port CNAs and Emulex FC HBAs share a common FC 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, HP CNAs are designed to enable consolidation, energy conservation, and savings.

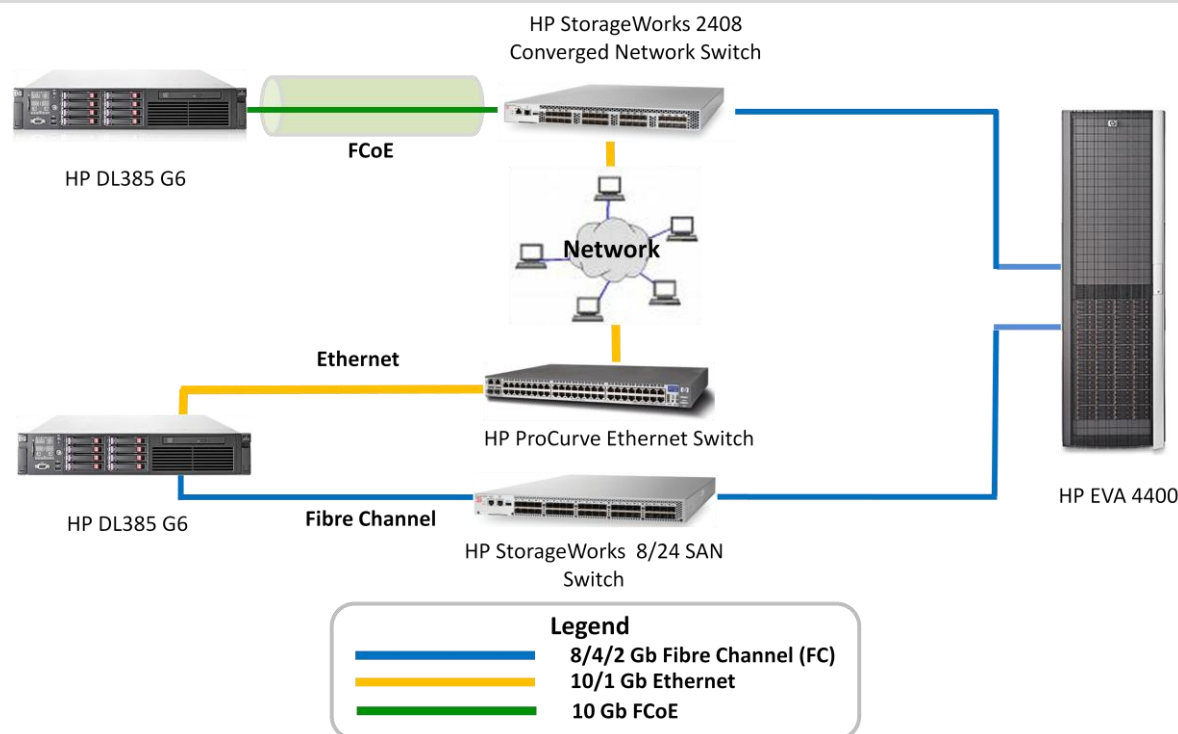
## ESG Lab Validation

ESG Lab performed hands-on testing of the HP CN1000E at Hewlett Packard's facility in Marlborough, MA. ESG tested the CNA's ability to provide transparent network and storage connectivity for industry standard HP ProLiant 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.<sup>2</sup> Two physical servers were running Microsoft Windows Server 2008. One server was configured to represent existing FC attached servers in a traditional data center setup as seen in Figure 4, with an 8Gb FC HBA attached to an HP StorageWorks 8/24 FC SAN switch as well as a 1-Gb Ethernet NIC attached to an HP ProCurve 1-Gb Ethernet switch. The second server was configured with a single HP CN1000E Dual Port CNA attached to an HP StorageWorks 2408 Converged Network Switch for converged network and storage connectivity. Both servers were presented storage from an HP StorageWorks EVA 4400 FC storage array.

Figure 4. The ESG Lab Test Bed



### ESG Lab Testing

ESG Lab first examined the procedures required to incorporate the CNA and FCoE into an existing FC environment, including the configuration of both the CN1000E and the Converged Network Switch. ESG Lab referred to the HP StorageWorks SAN Design Reference Guide<sup>3</sup> periodically throughout the installation process. It contains detailed information about HP SAN architecture, including Fibre Channel, iSCSI, FCoE, SAN extension, and hardware interoperability.

First, ESG Lab downloaded the CNA driver package and then the OneCommand Manager application, installing them both on the DL385 G6 server where the CN1000E CNA was physically installed. The drivers and software are easy to find in the storage networking section of the HP website. The entire process, from the first mouse click on HP's website through downloading and installing both the drivers and the OneCommand Manager—

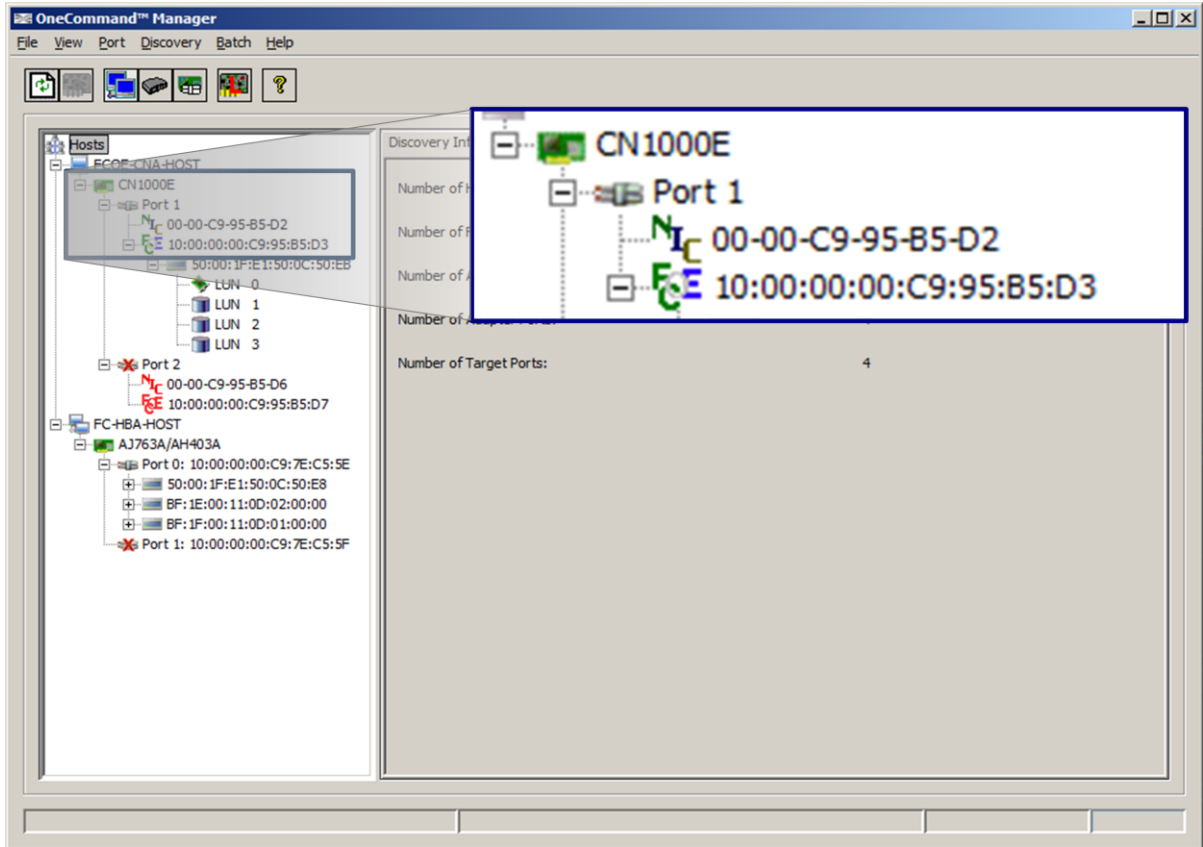
<sup>2</sup> Complete configuration details can be found in the Appendix.

<sup>3</sup> [http://h20000.www2.hp.com/bc/docs/support/SupportManual/c00403562/c00403562.pdf?jumpid=reg\\_R1002\\_USEN](http://h20000.www2.hp.com/bc/docs/support/SupportManual/c00403562/c00403562.pdf?jumpid=reg_R1002_USEN)



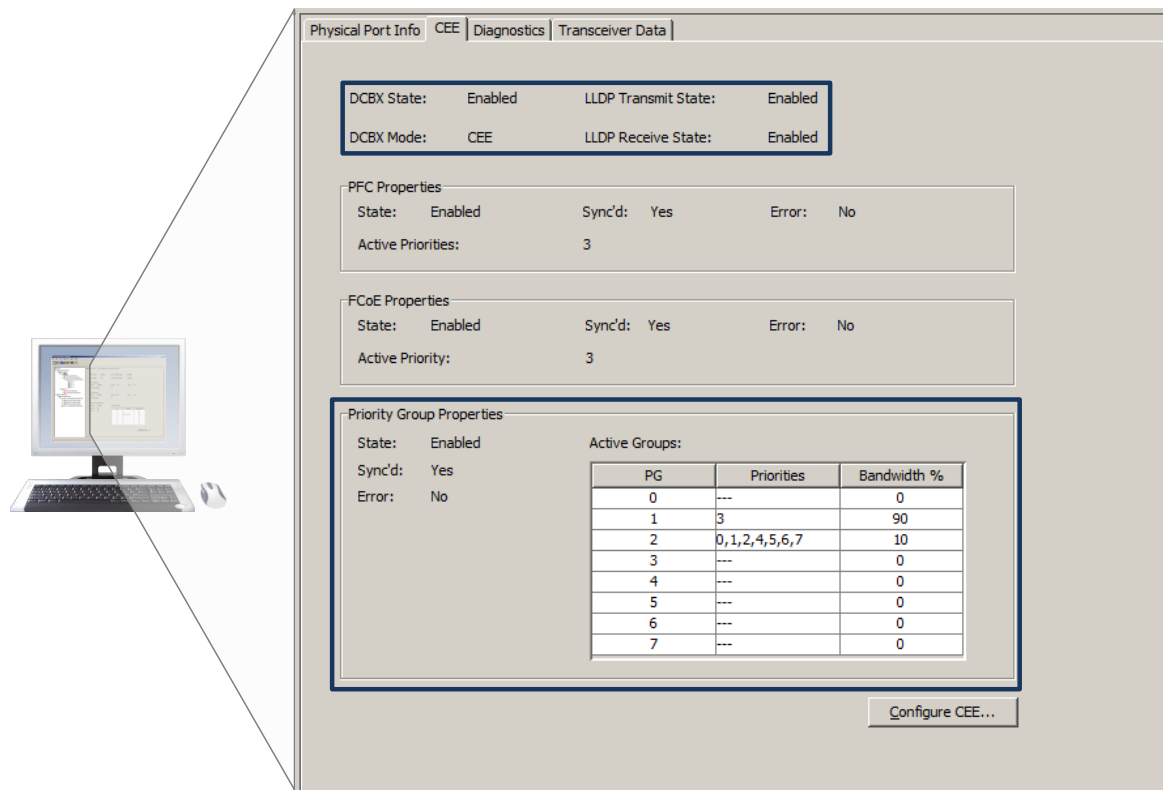
including rebooting after installing the drivers and software—took nine minutes. Once the driver package and OneCommand Manager were installed, OneCommand Manager was used to configure the CN1000E. As can be seen in Figure 5, the CNA was displayed along with the existing traditional FC HBA and showed both an Ethernet NIC and an FCoE adapter on port 1.

Figure 5. OneCommand Manager



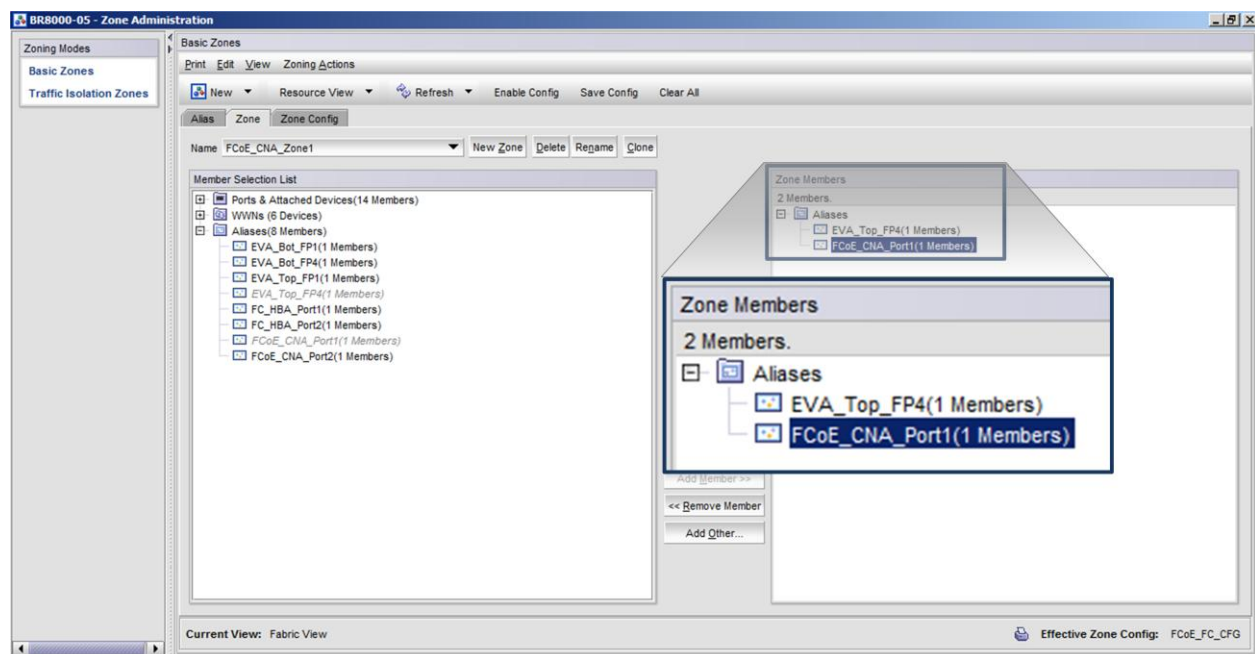
Additional tabs in the CN1000E provide configuration and verification of FCoE-specific parameters. The CEE tab, for example, shows Data Center Bridging state and mode as well as priority group properties as seen in Figure 6. Priority groups are configured on the Converged Network Switch and allow administrators to set bandwidth allocation for Ethernet and Fibre Channel traffic to ensure that both protocols can get the bandwidth required by applications.

Figure 6. CNA Enhanced Ethernet Information



Configuration of both FC storage and Ethernet networking was exactly the same as with traditional FC adapters and Ethernet NICs. FC zoning of the HP 2408 DCB switch for FCoE connectivity was also familiar, using exactly the same process as for traditional FC SANs, as seen in Figure 7.

Figure 7. HP 2408 FCoE Converged Network Switch Management



ESG Lab measured less than 15 minutes from the first mouse click to formatting FC 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.<sup>4</sup> 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 HP CN1000E can drop into an existing data center environment using the same drivers, tools, and techniques as existing FC HBAs and provide transparent storage and IP network connectivity to reduce hardware, cabling, and administration requirements.

## Ease of Management

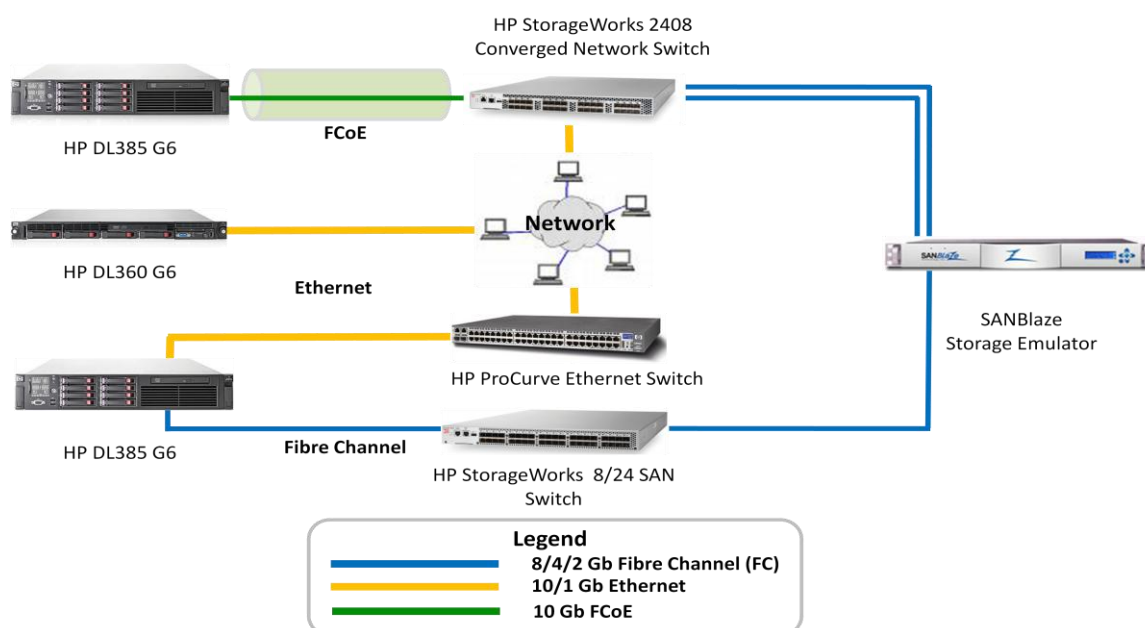
The FCoE specification was defined with ease of integration with existing FC networks in mind. Bridged FCoE support can be used to add new servers to a converged 10GbE fabric while existing investments in FC switches and storage systems are preserved. Bandwidth allocation and management with priority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

HP takes ease of integration further with the HP SmartStart utility, delivered with HP ProLiant ML and DL series servers and supporting HP ProLiant BL blade servers to provide step-by-step server deployment assistance. From array configuration and OS installation to the update of optimized ProLiant server support software, SmartStart helps administrators ensure a stable and reliable configuration.

## ESG Lab Testing

To validate the interoperability and manageability of the CN1000E Dual Port CNA in an enterprise Fibre Channel SAN environment, ESG Lab ran several IO tests using the test bed shown in Figure 8.

Figure 8. The Bandwidth Management Test Bed



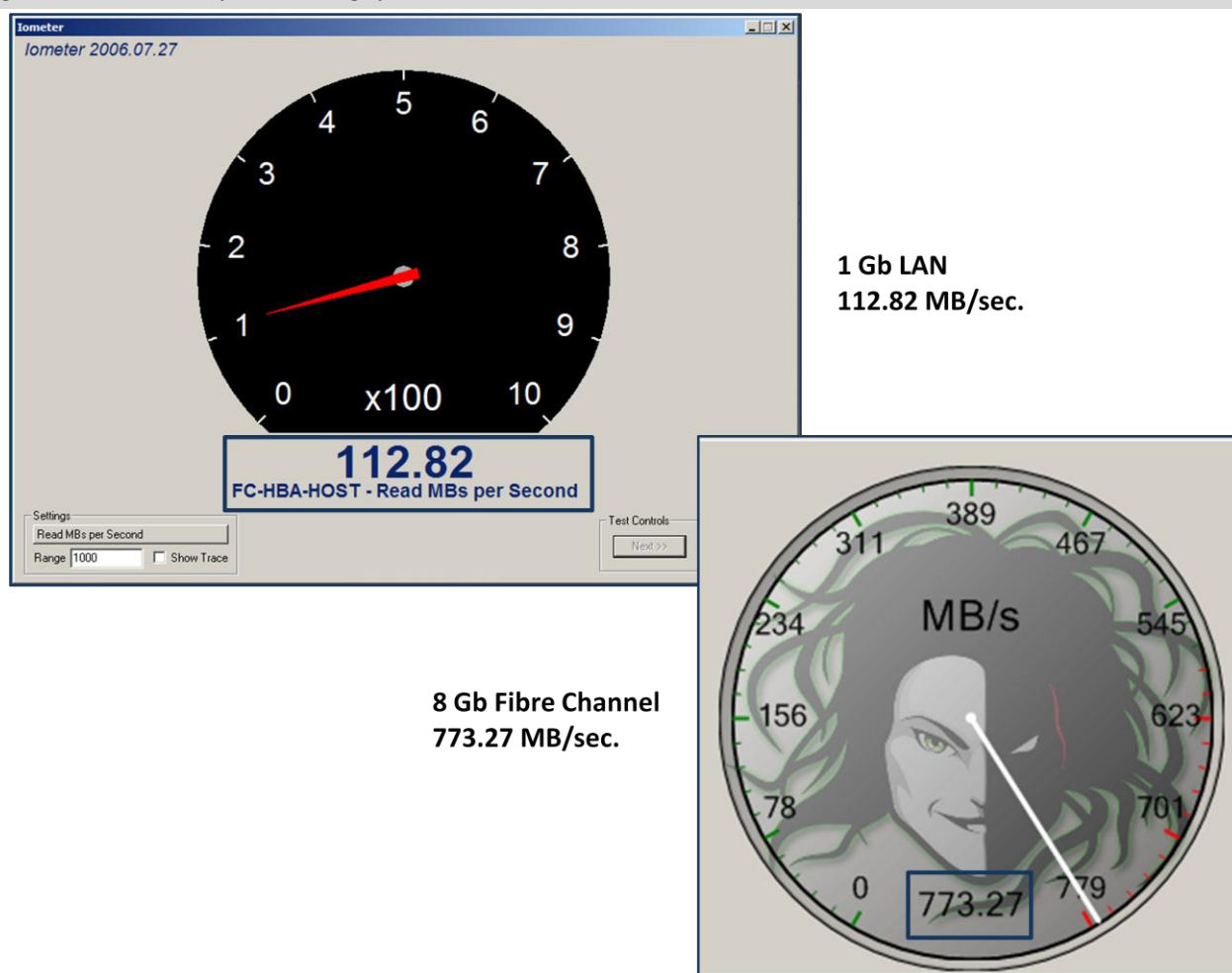
<sup>4</sup> Source: ESG Research Report, [Global Green IT Priorities: Beyond Data Center Power and Cooling](#), November 2008.

ESG Lab tested dynamic bandwidth allocation using priority groups on the HP 2408 switch. Dynamic bandwidth allocation enables administrators to assign and re-assign bandwidth to applications on the fly, between the FC and Ethernet domains. This provides more flexibility than is possible with separate FC 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 FC 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 8-Gb Fibre Channel and 10Gb FCoE. An HP DL360 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.

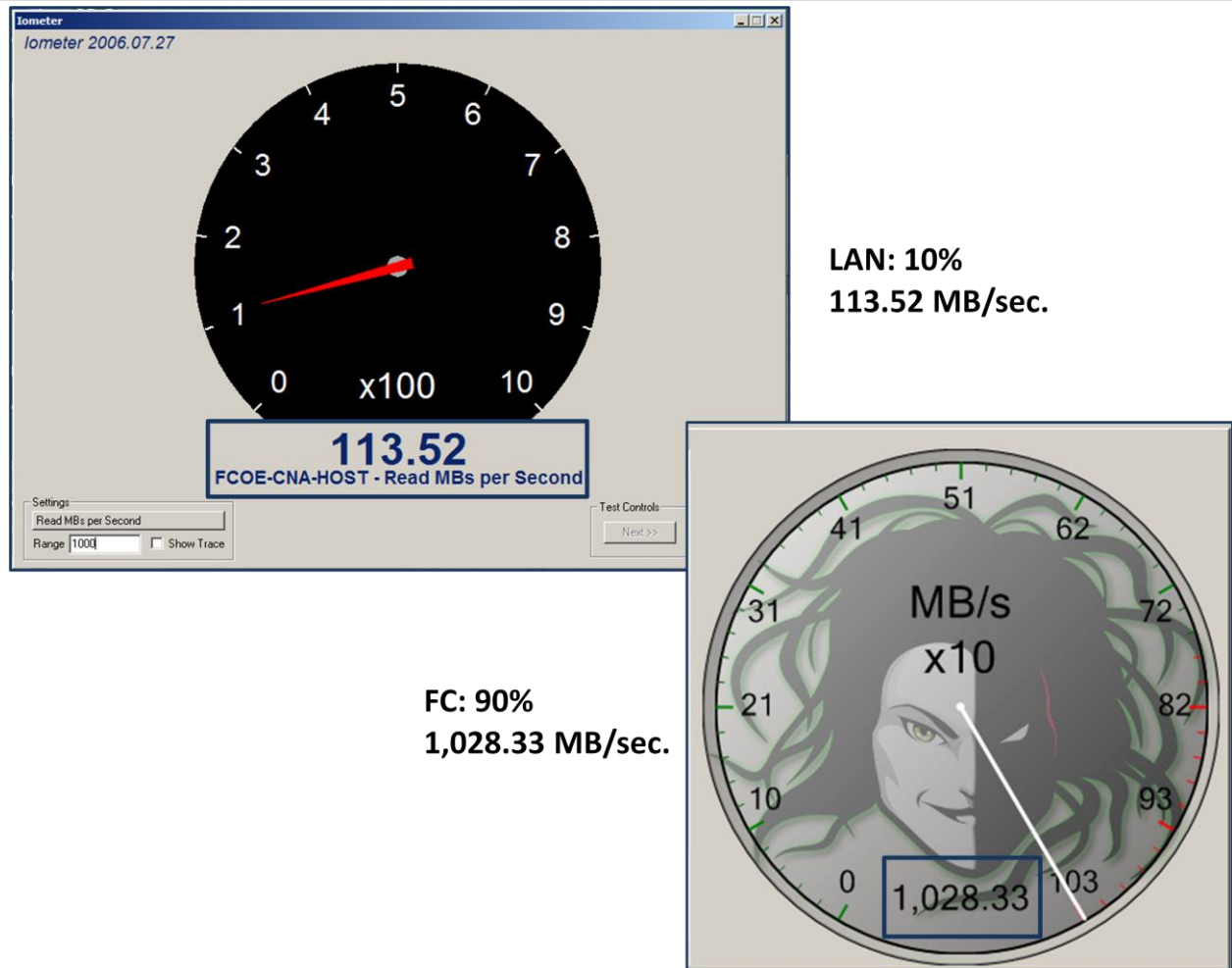
First, ESG Lab ran a baseline test on the server with the traditional 8Gb FC HBA and a 1-Gb NIC installed. As seen in Figure 9, the speedometer from the Medusa Labs suite in the lower right showed that the FC HBA was reading at 773.27 MB/sec and the speedometer from the Iometer tool in the Upper left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

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



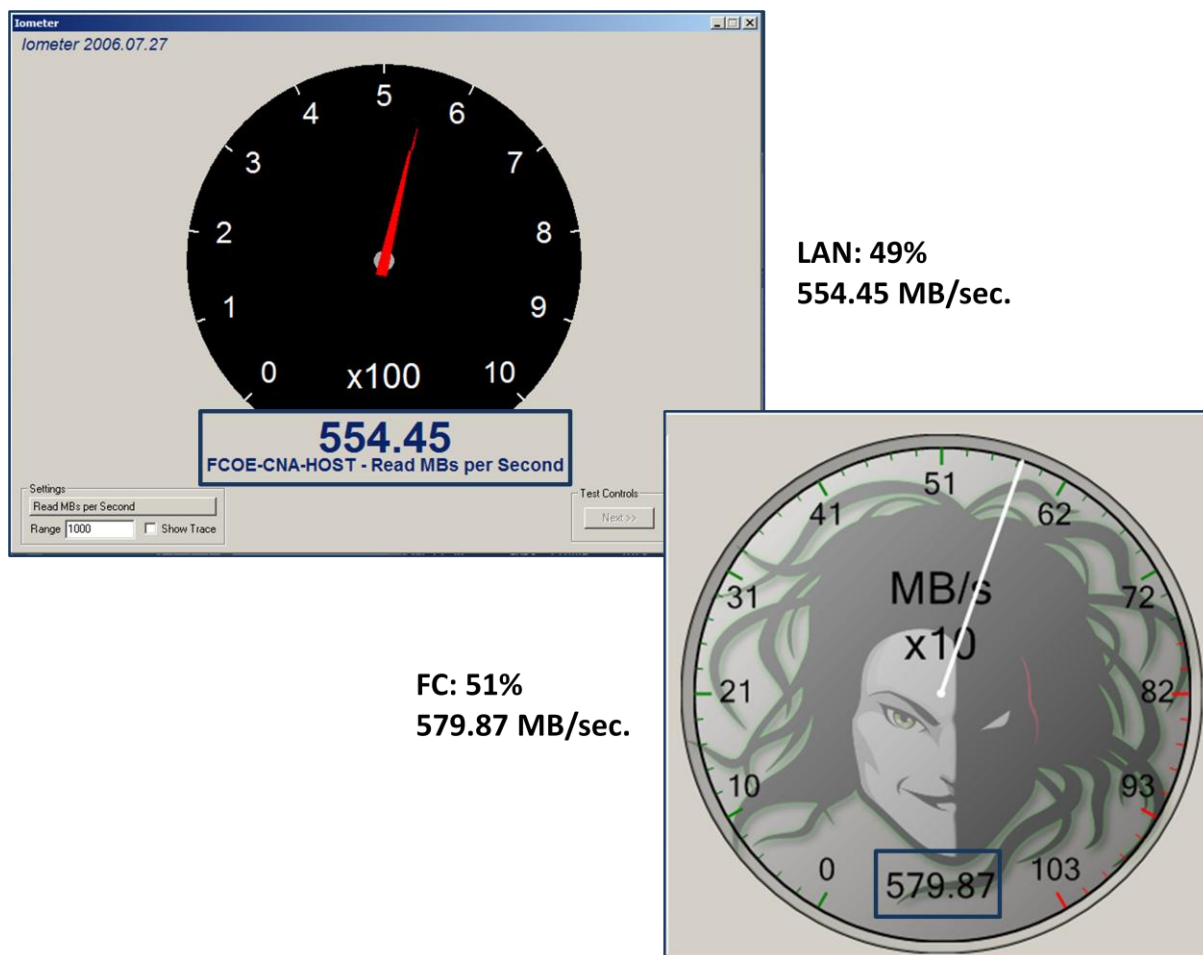
Next, the same workloads were run on the CNA-attached server. The results are shown in Figure 10. FC traffic is getting almost precisely 90% of the total bandwidth and Ethernet traffic is getting the remaining 10%.

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 HP 2408 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 IO. 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 which rely on a FC storage networks. Mission critical applications often need the field-proven stability and reliability of FC 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 FC, 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

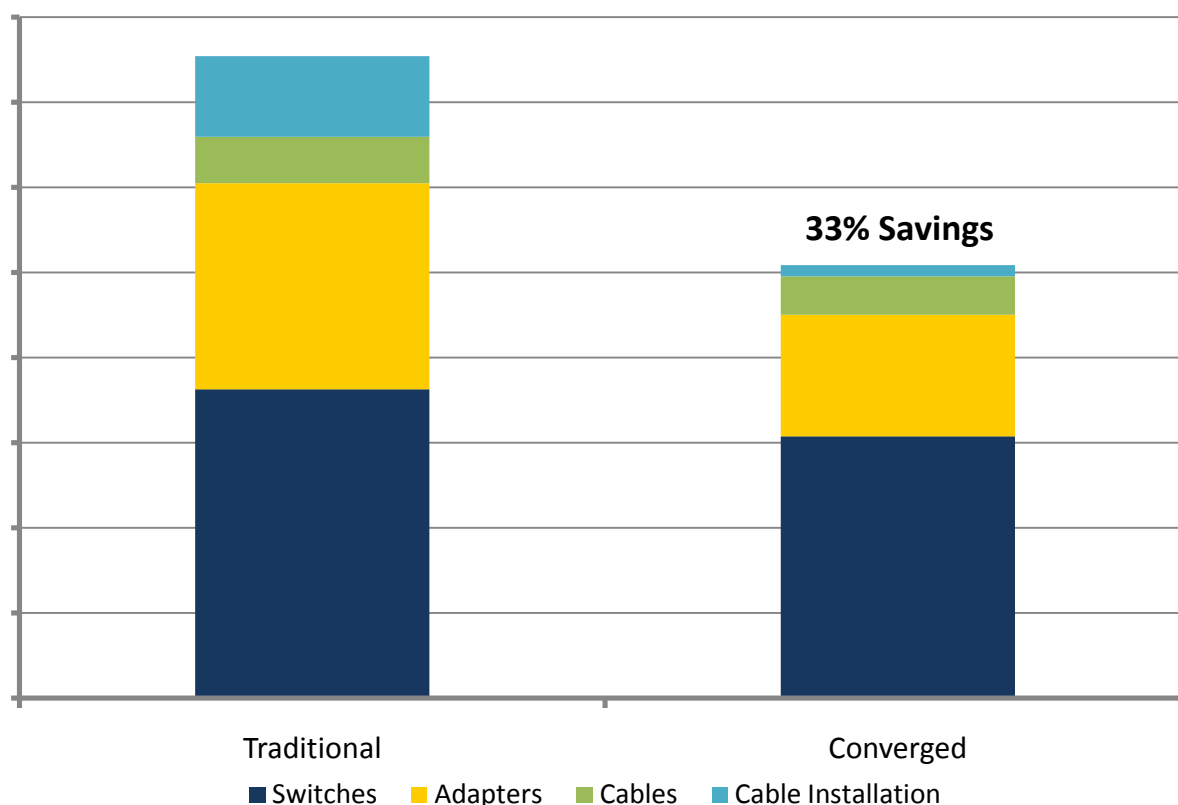
Organizations of all sizes are struggling to deliver IT services to meet the rapidly changing needs of the business. Data growth is unrelenting and IT budgets are constantly under scrutiny, so in order to meet increasingly demanding service levels, IT managers are looking for opportunities to consolidate. 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. HP'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 FC SAN infrastructure and 1Gb LAN distribution. ESG Lab chose to make the comparison using 4Gb FC because it fits better with where most users environments are today. In the data center, 4Gb FC 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 HP and other 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.<sup>5</sup>

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



<sup>5</sup> 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*

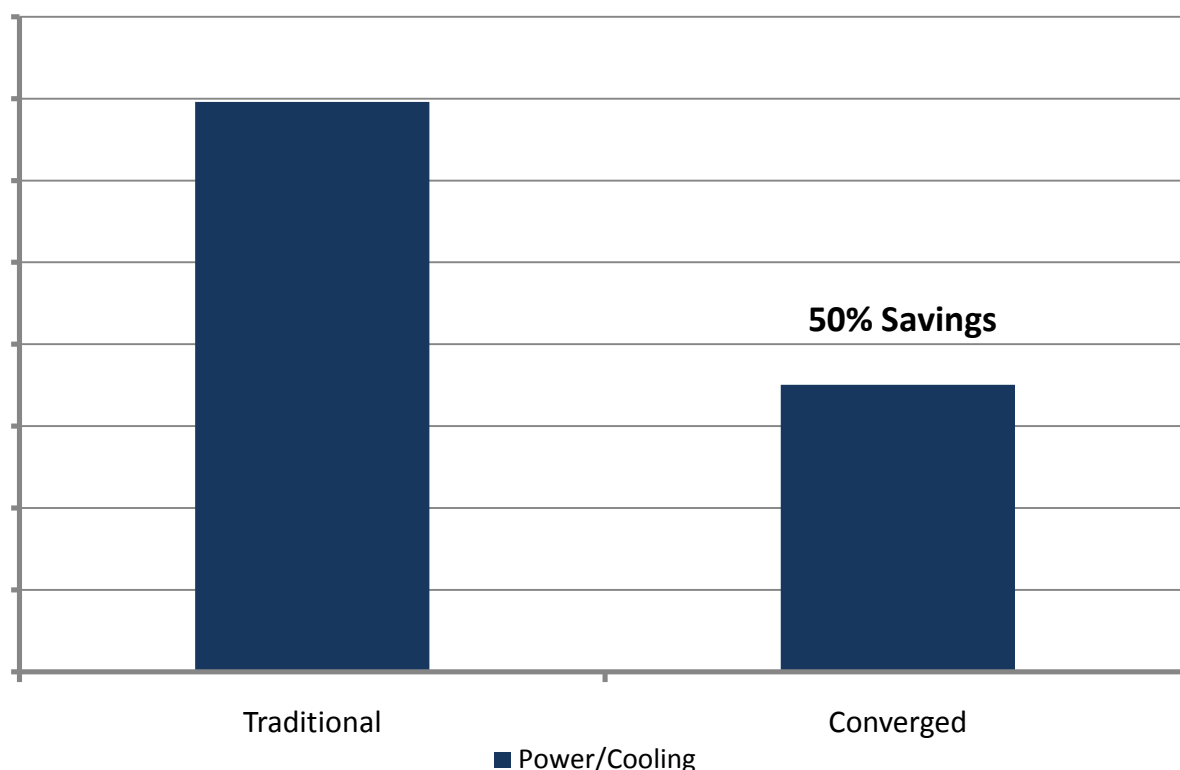


Table 1 shows the detailed results of ESG Lab’s calculations, with cost savings broken out by category.

*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 HP CN1000E Dual Port CNA 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 HP CN1000E Dual Port CNA was recognized by both OneCommand Manager and Windows as a FC HBA and a 10GbE NIC, without any special software or configuration required.
- ☑ The CNA used the same lpfc drivers as all standard Emulex FC HBAs.
- ☑ The management experience administering the CNA is essentially identical to any HP-branded Emulex FC HBA.
- ☑ The CNA was able to participate in a Fibre Channel fabric with 8Gb FC HBAs and share the same storage array without any compatibility or interoperability issues.
- ☑ The priority groups feature on the HP 2408 Converged Network Switch was able to allocate bandwidth between FC 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 FC 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 FC fabrics would be wise to begin investigating this technology sooner rather than later.
- ☑ Upgrading from traditional FC 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 FC 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 FC and Ethernet connectivity as well as fewer cards and cables, there are potential conflicts of IT culture: joining the FC 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,<sup>6</sup> 54% of IT managers polled indicated their organizations would be basing new technology decisions based 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 FC 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 FC infrastructure, keeps existing FC 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 HP CN1000E CNAs providing converged server connectivity to a LAN and a SAN. Running alongside HP-branded Emulex HBAs and managed from the familiar Emulex OneCommand Manager application, HP CNAs worked with field-proven drivers and tools. Tens of thousands of customers have taken advantage of HP's decades of IT experience to deploy rock solid FC and iSCSI SANs. HP's CNA provides the flexibility to choose not only the right protocol, but also the right performance and price point to address changing business needs.

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.

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<sup>6</sup> Source: ESG Research Report, [2010 IT Spending Intentions Survey](#), January 2010.

## Appendix

*Table 2. ESG Lab Test Bed*

Servers	
HP DL 385 G6– 1 HP StorageWorks CN1000E PCIe 10Gb CNA	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 HP StorageWorks CN1000E PCIe 10Gb CNA	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**

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

<sup>7</sup> As of Dec. 09 according to the US Energy Information administration [http://www.eia.doe.gov/cneaf/electricity/epm/table5\\_6\\_a.html](http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html)

<sup>8</sup> Each HP 2408 CEE switch has 24 10Gb Ethernet ports and 8 8Gb FC ports.



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