A Forrester Consulting Thought Leadership Paper Commissioned By Cisco

Impact Of FCoE And Unified Fabric On Enterprise Storage Environments

Exploration Of The Benefits And Challenges Associated With Migration Toward Common SAN And LAN Infrastructure

February 2010

FORRESTER

Headquarters | Forrester Research, Inc.
400 Technology Square, Cambridge, MA 02139 USA
Tel: +1 617.613.6000 | Fax: +1 617.613.5000 | www.forrester.com

Table Of Contents

Executive Summary 2

Unified Fabric Proposes SAN/LAN Consolidation 2

Anticipating The Evolution Of Storage Networking 4

Exploration Of FCoE As An Emerging Option 7

Evaluating Real And Potential Benefits Of FCoE 10

Key Recommendations 13

Appendix A: Methodology 14

Appendix C: Demographics/Data 15

About Forrester Consulting
Forrester Consulting provides independent and objective research-based consulting to help leaders succeed in their organizations. Ranging in scope from a short strategy session to custom projects, Forrester's Consulting services connect you directly with research analysts who apply expert insight to your specific business challenges. For more information, visit www.forrester.com/consulting.

Executive Summary

In September 2009, Cisco commissioned Forrester Consulting to evaluate the current state of storage networking. The focus of this study is on the perceptions and adoption intentions of user firms regarding network fabric unification and specifically focusing on Fibre Channel over Ethernet (FCoE) as an enabling technology for this unification.

For the purposes of this study, Forrester conducted 101 online surveys with storage professionals in the US, as well as five qualitative interviews with storage management professionals. These interviews were conducted with current users of FCoE in their environments, as well as those who do not currently use FCoE. Forrester found adoption patterns of storage networking technologies and data about the needs of these users, which are summarized in the following paper.

It's Still New, But Fabric Unification Benefits Are Real

Forrester's study yielded four key findings:

- **Early adopters of FCoE are realizing benefits today.** Firms that have already implemented FCoE in portions of their data center environments are generally happy with the results. Benefits include overall reduction of cabling, reduced complexity of cabling and server-side network components, capital cost and power cost reduction, and improved organizational cooperation.
- **Confusion remains about what FCoE represents.** Overall awareness of FCoE and understanding of the potential benefits offered are limited at this time. Confusion about the difference between FCoE and traditional FC and iSCSI abound, and knowledge of the state of the protocol and the products currently on the market are the main areas where awareness lags.
- **There is a high level of openness to adopting new storage network architectures.** In spite of a high level of conservatism ascribed to data center experts, this survey shows a high level of willingness to consider new architectures and protocols. Qualitative interviewees stress that technology maturity and peer experiences will be critical to adoption, but most responded that they were open to, if not actively exploring, new options for network convergence.
- **Buyers are more likely to adopt FCoE on refresh.** Given the ongoing requirement for capital cost reduction in the data center, there is a low level of interest in a "forklift" upgrade to a unified fabric. Even if long-term cost benefits exist, the reality is that an investment in unification while existing equipment remains usable is not seen as favorable. Those who are already considering a server or network upgrade or those building out new data center facilities appear much more likely to consider unified fabric technology.

Unified Fabric Proposes SAN/LAN Consolidation

Networked storage was developed in response to the distributed computing era, where distinct individual servers were being deployed in large numbers. As opposed to mainframe computing, where workloads are aggregated on large, shared platforms, open systems servers function independently, with captive compute, memory, and storage dedicated only to the application running. As distributed computing increased, low storage utilization and performance were

observed. Utilization was low because the storage could not be shared, and performance was low because of a relatively small number of drive spindles available to each server. Enter the storage area network (SAN), which creates a network for servers to access shared storage, and large storage arrays that hold storage capacity for many workloads. Some of the potential benefits of shared, networked storage include improved capacity utilization, improved performance, more consistent data protection and consolidated management.

At the advent of the storage networking era, standard application networking technology was not up to the task of providing the performance and latency reduction needed. The solution was Fibre Channel (FC), a network designed to provide high-performance, low-latency, and traffic isolation for critical storage traffic. For years, FC has been effective, but, due to its specialized nature and relatively low volume of products sold, expensive. Additionally, its being a wholly separate protocol with distinct tools and best practices has made it hard for firms to hire qualified experts and internally develop the skills needed to manage it effectively. Much as we are seeing server architectures tending toward industry standard architectures for reduced cost and variability, storage networking is expected to follow a similar course.

Unified Fabric Is The Next Evolution of Data Center Networking

The combination of LAN and storage traffic on a common lossless 10 Gigabit Ethernet network is called Unified Fabric (UF). Unified Fabric is a consolidation of data center networks, with storage traffic flowing rapidly and without contention or latency on a common Ethernet with LAN traffic. While FCoE is a big part of the UF conversation, Unified Fabric provides the flexibility to run FCoE or IP-based storage such as iSCSI or NAS or some combination of these on a converged network. The advantages expected for Ethernet-based storage networking include the following:

- **Network consistency.** Currently, most environments must maintain two physically separate data center networks with completely different management tools and best practices. Moving storage traffic to Ethernet would allow for the storage and user application data to flow on the same physical network, or at least physically separated but similar network infrastructures.

- **Staff synergies.** Right now, the worlds of LAN and storage networking are separate, with different staffs that have different priorities, budgets, and people. Moving to storage on Ethernet would allow for these teams to cooperate much more closely, to speak the same language, and to share responsibility for a common network infrastructure that handles both types of traffic.

- **Lower cost.** Buying switching equipment at a higher volume can be expected to produce better pricing for clients. Parts sparing can be reduced in price if there is greater consistency across storage and LAN. Further, Ethernet is produced in higher volumes than FC equipment, so Ethernet products are generally cheaper to acquire, and the trend is likely to continue in that direction for the foreseeable future.

Technology vendors, buyers, and analysts generally agree that storage networking is moving to Ethernet, but consensus on when it will happen and, more significantly what it will look like is not as clear. For storage traffic to move on Ethernet switching, there needs to be a protocol to direct the flow of traffic and communicate between servers and storage devices. Currently there are three options for Ethernet storage protocols, including the following:

- **FCoE leverages similar skill sets and architectures as traditional FC.** FCoE uses a lossless version of 10 Gigabit Ethernet known by vendors as Data Center Ethernet (DCE), Converged Enhanced Ethernet (CEE) or Data

Center Bridging (DCB); all these terms represent IEEE enhancements to make the Ethernet lossless. A primary benefit of FCoE is its similarity in tools, best practices, and skill sets to traditional FC. Another is in its high-performance and switch-optimized latency reduction capabilities. Current downsides to FCoE include requirement to move to new switch platforms and lack of end-to-end support presently. FCoE at present can be deployed only at the server edge, but traffic must be converted to pure FC for transmission to storage arrays. However, starting at the server edge provides an evolutionary approach and least disruption to the existing LAN and storage environments while providing most of the cost-saving benefits of FCoE. FCoE switch and adapter capable products have been shipping for more than 18 months.

- **iSCSI uses standard Ethernet but can be deployed over Unified Fabric as well.** iSCSI has been available for some time as an end-to-end block-based storage protocol that can be deployed on standard or lossless 1 or 10 Gigabit Ethernet. Software on hosts, switches, and storage arrays can improve performance and overall usability by reducing latency and improving flow control to make Ethernet more viable for use in SAN. iSCSI is generally seen as a low-cost alternative to FC, with performance results varying based on use cases, architectures, and system selection. iSCSI is minimally supported on big box UNIX flavors, so most of the traction with this protocol revolves around Windows server and server virtualization workloads. Given that the same switches can be used for SAN and LAN traffic, attention to best practices for traffic separation is seen as a key success factor.

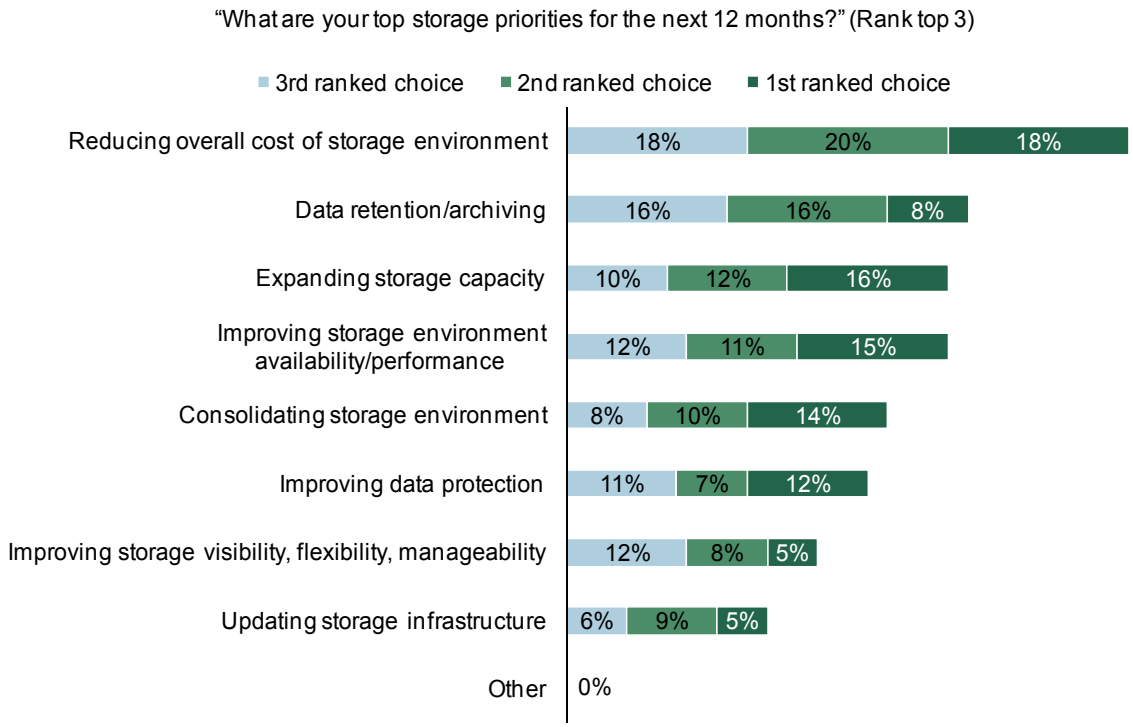
- **NFS is a file protocol that has capabilities with certain applications.** File protocols are traditionally used in most firms for general purpose departmental file storage and sharing, but in recent years NFS has gained traction in database and server virtualization workloads. Files have externally observable metadata, so using file protocols for application storage networking can allow for data to be classified and archived more readily. Additionally, NFS is seen to deliver significant ease of use benefits in storage network design and management, especially in environments that are server admin-centric.

Anticipating The Evolution Of Storage Networking

Understanding the history of storage networking; recognizing that we are most likely at the beginning of a major shift in technology adoption; and gaining insight into what it will look like, when it will happen, and how best to build the foundation for it is critical and is the goal of this section of the paper. The key goals of the quantitative survey and the qualitative interviews include the following:

- **Identification of the key priorities in storage environments.** We asked respondents what their top storage priorities are for the next 12 months. Not surprisingly, in a year of fiscal crisis and all around cost cutting, reduction of overall cost comes up as far and away the most critical priority. Behind cost control, archiving issues, performance and availability, and meeting growth requirements resonated strongly among respondents (see Figure 1).

Figure 1
Cost Reduction Is Top Priority For Storage Decision-Makers

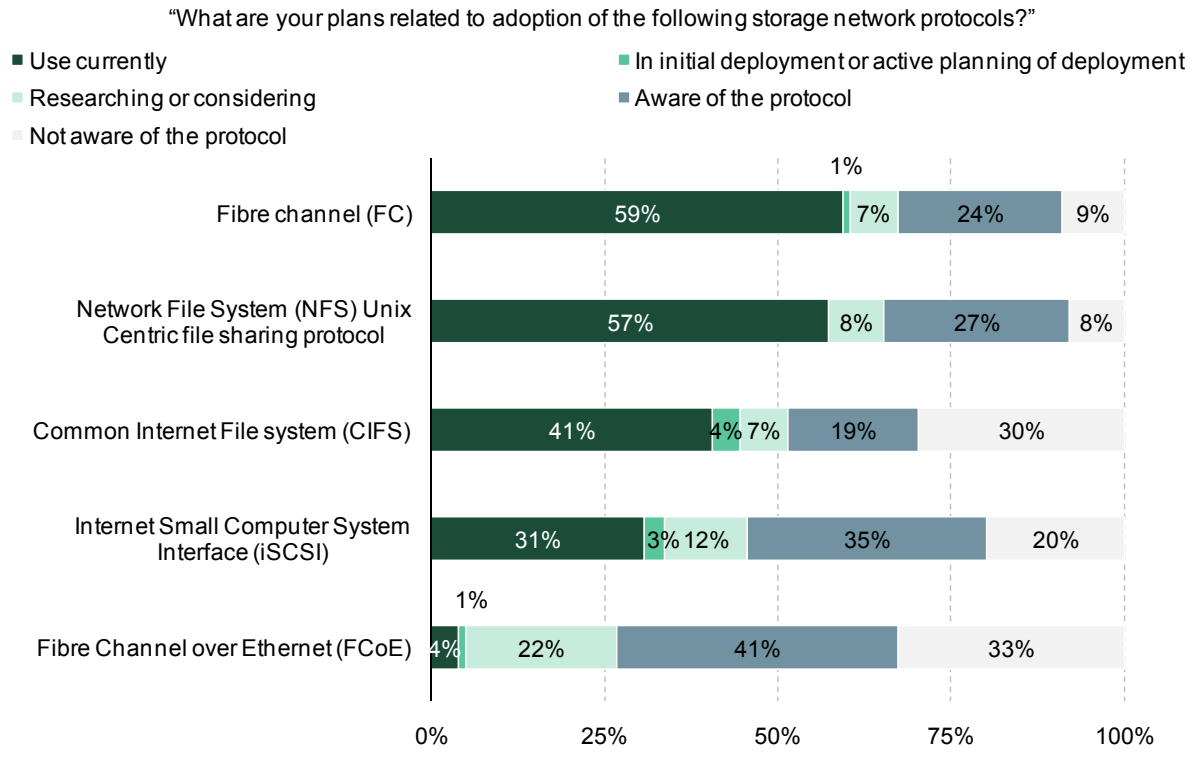


Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

- **The landscape of storage protocols currently in use.** Recognizing that the character of the transformation of the storage network to Ethernet will depend heavily on the protocols that govern the traffic, an understanding of current protocol selection and awareness is critical. According to this survey, there is a wide variety of protocols currently in use. FC continues to dominate the current usage among block protocol options, but iSCSI shows strong current adoption and FCoE has high awareness for an emerging option. Among file protocols, NFS shows strong adoption and awareness, which is important for its increasing potential as an application networking protocol that could be an enabler for UF (see Figure 2).

Figure 2
Storage Protocol Selection And Awareness

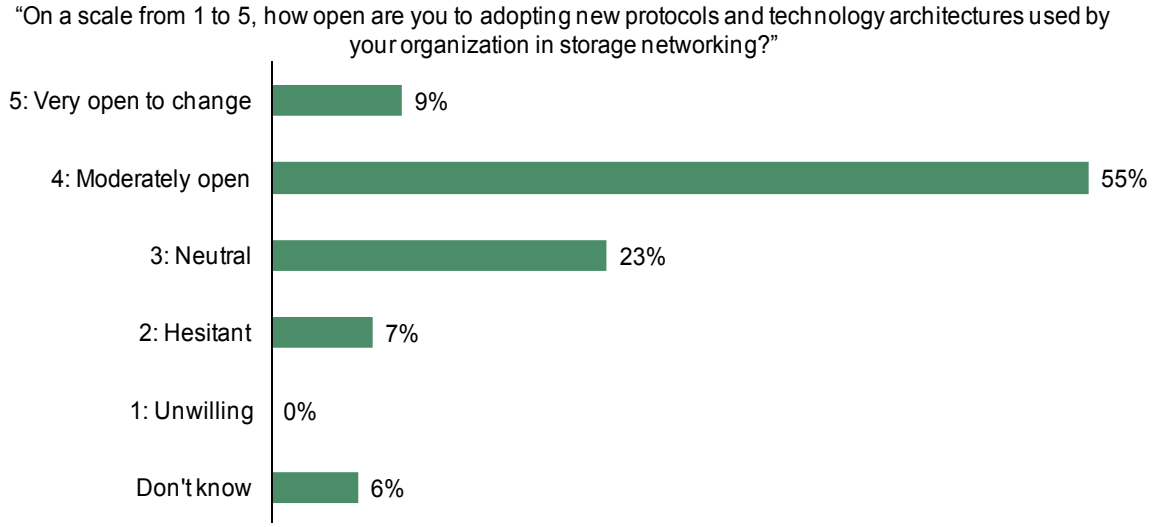


Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

- **Openness to introduction of new storage network architectures.** Storage buyers are notoriously conservative, and with good reason. Introduction of new technology or changing processes in the storage environment is risky and disruptive and has deep implications for the short- and long-term running of the business. So, if UF requires change, an understanding of willingness to undertake this change is critical to predicting the likelihood of the shift in storage networking coming to pass. Contrary to the widely held conservatism, respondents to this survey report that they are by no means unwilling to consider change in storage networking architectures. Sixty-four percent report being "moderately open" or "very open" to change of this type. Only 7% state they are "hesitant," and none say they are unwilling. This appears to support the notion that change is afoot and that the benefits of such a change are plausibly seen to have the ability to outweigh the risks and costs of making the change (see Figure 3).

Figure 3
Openness To Change In Storage Protocols And Architectures



Base: 101 respondents with knowledge of storage purchasing and operations

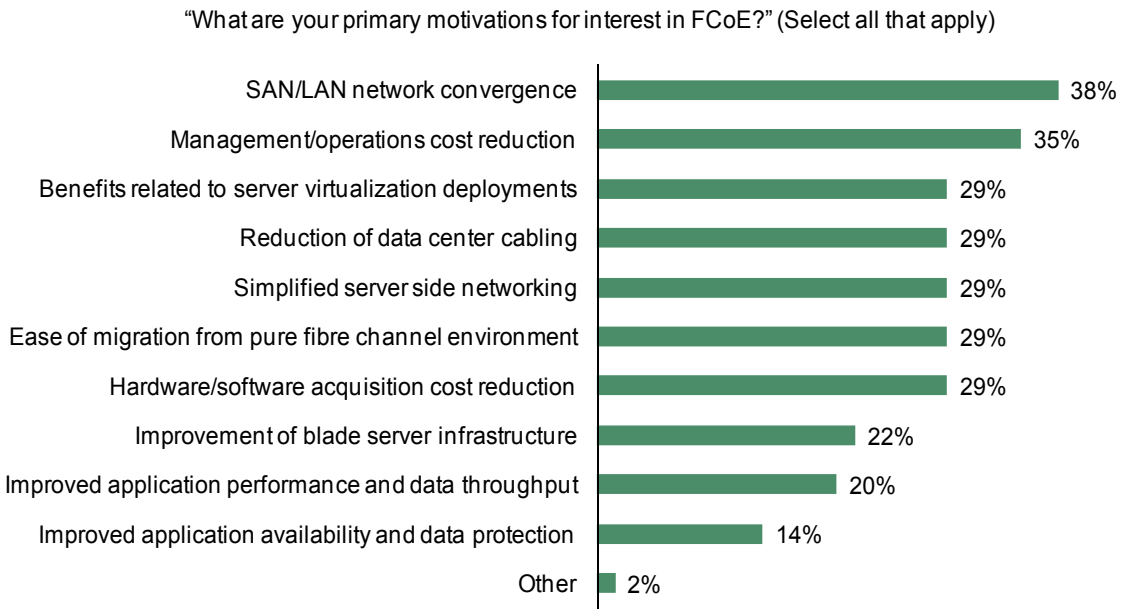
Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

Exploration Of FCoE As An Emerging Option

Recognizing that the storage network is in some stage of shift to unification, and knowing that FCoE is an emerging enabling technology, this section is intended to shed further light on the benefits and drawbacks of FCoE that can be gained from the quantitative survey and interviews conducted. Understanding FCoE drivers early will serve potential buyers well as they craft their strategy for their next generation of storage networking. The picture of FCoE that emerges from this study includes the following:

- **Convergence and cost reduction are primary motivators for FCoE.** According to respondents, the main reason that they are interested in FCoE is for eventual convergence of SAN and LAN technology, and the management cost benefits associated with such as shift. One interview respondent stated that his firm was "Interested in managing SAN connectivity the same way as LAN and realizing a staff cost reduction in this manner" (see Figure 4).

Figure 4
Primary Motivations For Interest In FCoE



(Multiple responses accepted)
Base: 65 respondents with knowledge of storage purchasing and operations and interest in adopting FCoE

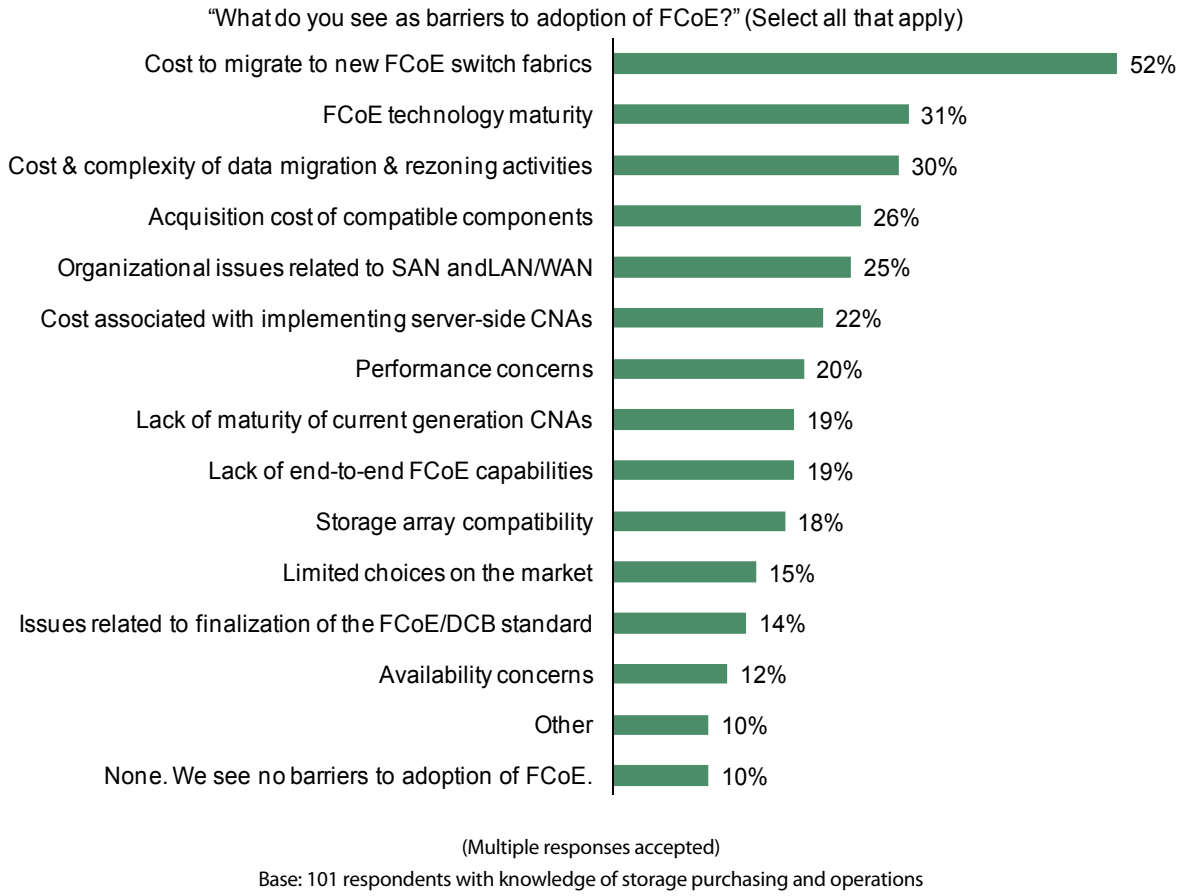
Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

- **Fabric migration cost is the greatest barrier.** Consistent with the conservatism of storage decision-makers, cost to migrate the switching environment to FCoE is by far the most common barrier to use of FCoE described by survey respondents. Coordinating migration with upcoming refreshes was identified by interviewees as a way to mitigate and defray some of these costs. A storage director we talked to stated that his firm would "wait for a growth opportunity before investing, rather than doing rip and replace." Current users of FCoE report success with an evolutionary approach to UF, fitting the edge of the network with converged infrastructure, and setting the stage for full convergence later as products become available. Many adopters are doing this upon server/network refresh, upgrade, or new data center investments (see Figure 5).

- **Virtual servers lead expected FCoE workload types.** Interviewees are clear that they expect to take an application-by-application approach to moving toward FCoE and UF in general. In terms of which would benefit most, virtual server workloads and throughput intensive workloads such as business continuity, disaster recovery, and data warehousing, as well as benefits related to networking for blade servers, are mentioned highly as likely beneficiaries of FCoE. FCoE enhances server virtualization initiatives with the availability of standard and uniform server adaptors known as Converged Network Adaptors (CNAs), which support LAN and all forms of storage networking, eliminating the need for separate NICs and HBAs from the servers. To highlight this point, one interviewee stated that "Virtual server vendor support for FCoE would be a critical factor for

acceptance." A current user pointed to significant benefits currently, even though he has "no FCoE running in physical server environments, only in virtual" (see Figure 6).

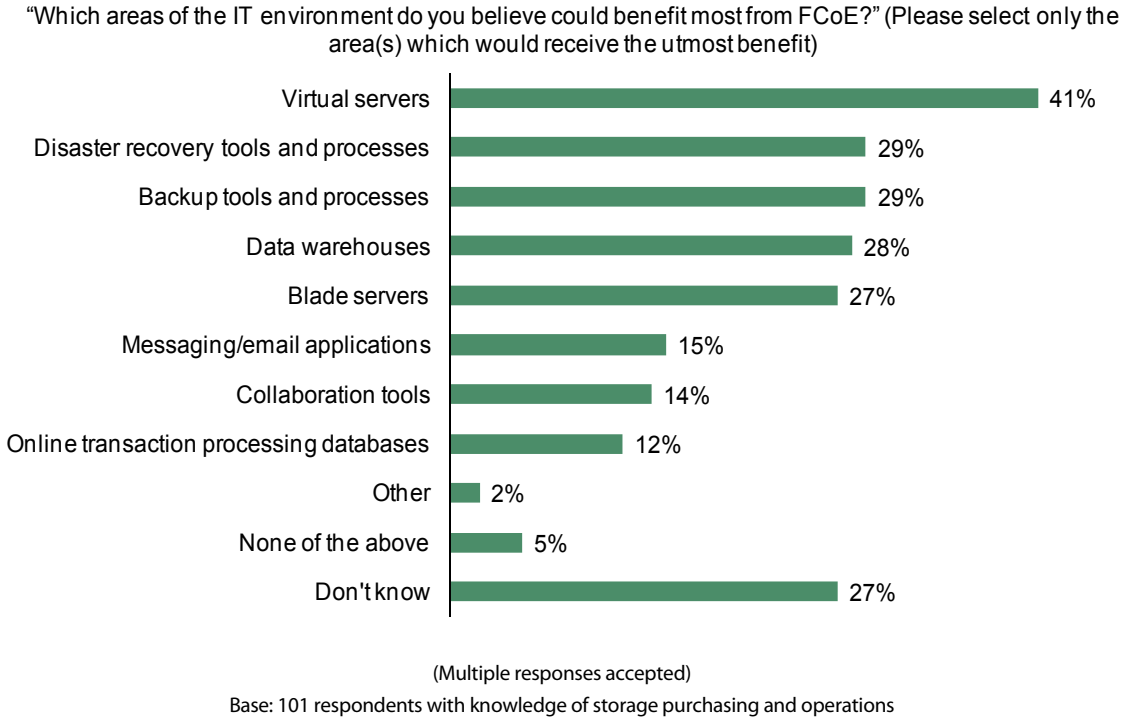
Figure 5
Barriers To Adoption Of FCoE



(Multiple responses accepted)
Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

Figure 6
Workloads Most Likely To Benefit From FCoE



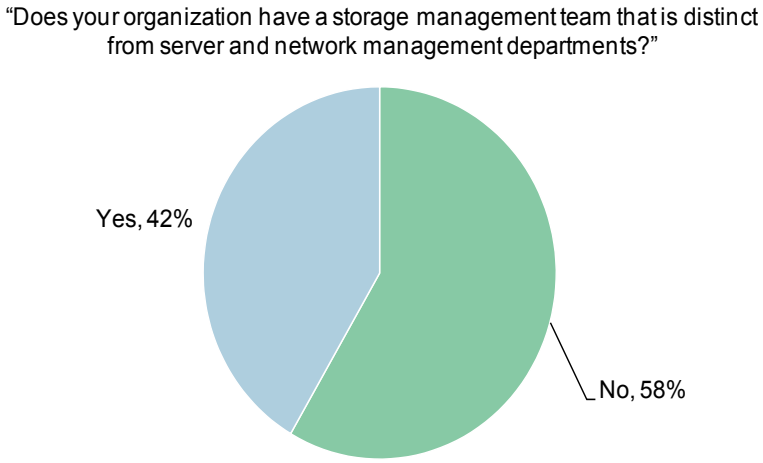
Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

Evaluating Real And Potential Benefits Of FCoE

To better understand possible as well as already realized benefits of FCoE, Forrester interviewed decision-makers at several storage environments — some that already use FCoE and some that do not. Among these interviews, respondents point to a number of benefits and perceptions related to adoption of FCoE, and the key findings include the following:

- **Organizational factors need attention but can be addressed.** Convergence of network architectures requires convergence of organization structures, as using common technology will require cooperation among teams that are often separate currently. According to the survey, 42% of survey respondents state that they currently have a SAN management team that is distinct from LAN management, and anecdotal evidence suggests that this rate is much higher among larger firms (see Figure 7). One interviewee that currently uses FCoE advises potential adopters to "get on one team to manage SAN and LAN together." But a potential user downplayed the hurdle, stating that his firm "would not have political issues with moving storage under network — people working on storage are already expecting to move given awareness of network convergence trends."

Figure 7
Separation Of SAN And LAN Management Teams



Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

- **Timing is key with a transition to FCoE.** The cheapest technology option is often the one that is already paid for. Granted that older equipment can in some cases drive up costs of management so much that this does not hold, but for the most part, it's hard to make a business case for replacement of gear that still has useful life remaining. However, when the opportunity for refresh or the need for a brand new investment is presented, this can be a key opportunity to move forward with new technology adoption. One interviewee confirmed this approach stating strongly positive financial results when they "moved forward with FCoE in a greenfield opportunity where they needed to build a new data center."

- **Cable management simplification is a key benefit.** Even though FCoE is currently an edge-only technology, supporting server-side connections but having minimal support for traffic to storage arrays, existing users appear to be realizing benefits from such a conversion. A current user points to "simplified cable management and resulting error reduction, shortened time to deployment, and improved airflow" as significant benefits of the move to FCoE. The benefits can be attributed to the performance jump to 10 Gb that diminishes the requirement for link aggregation across multiple lower bandwidth connections, as well as the convergence of SAN and LAN interfaces reducing the need for separate connections and management tools. One interviewed user stated that prior to implementation of FCoE, he "used to have eight cables per server, which was extremely hard to manage. Virtual server adoption had been a significant driver of this complexity." Implementation of FCoE allowed this environment to reduce its server connections to just two cables for physical redundancy, with both cables used for simultaneous SAN and LAN traffic.

- **Speed of provisioning servers can be increased.** Server virtualization has allowed user environments to deliver servers more quickly to application teams, but the storage for those servers has been slow to evolve. FCoE users have pointed to an ability to accelerate this process. One that was interviewed for this study stated that a major

benefit attributed to FCoE is time savings to bring up new virtual servers/guest images complete with storage and networking." Scalability of servers was also increased for a user that stated that his "previous architecture was not designed for their high server count or density."

- **Users are likely to compare iSCSI to FCoE.** Given the multiple options for protocols, it's not hard to understand that adopters or potential adopters of FCoE look at multiple protocol options. One FCoE user indicated that he felt that "there would have been too much retrofitting to get iSCSI working in their environment" and further that "having experience with traditional FC made FCoE an easy transition." A user that has not adopted FCoE but is aware of Ethernet storage stated that "we have looked at iSCSI, but from what we are hearing, we are more comfortable with FCoE; it is closer to FC which we are familiar with." A move to UF does not require a binding decision on this point though, as the same network can be used for both FCoE and iSCSI simultaneously. This allows for users to try both before selecting one or to use both depending on performance or application requirements.

KEY RECOMMENDATIONS

This study was designed to explore current adoption experience and interest in Unified Fabric and FCoE specifically as a protocol option for this unification. Some of the key conclusions from the quantitative survey and qualitative interviews include the following:

- **The move to Unified Fabric is coming.** Users in the storage arena point to a high level of interest in UF and a willingness to change architectures and protocols. Cost reductions are in strong demand and unification is expected to yield cost benefits and management simplification.
- **The change will be gradual — Unified Fabric is a multistep journey** Forklift upgrades are just too risky, disruptive, and capital-investment intensive. Adopters of UF are likely to proceed on an application-by-application basis, focusing on best-suited areas first. Coordination with refresh cycles or new infrastructure investments can be seen as a best practice. To get there, buyers should evaluate Ethernet storage options that support UF prior to reinvesting heavily in traditional FC networking.
- **Begin implementation at the server level.** Implement FCoE/Unified Fabric at the server access layer first. This will allow investment protection for existing FC infrastructure while building the foundation for unification, At least two devices are required for this: a lossless 10 Gigabit Ethernet switch for server connectivity that can forward Fibre Channel frames and a multifunction server adapter that supports both LAN and SAN server connectivity called Converged Network Adaptors (CNAs).
- **FCoE offers consistency with FC skills and processes.** Users of FCoE as well as evaluators of the technology point to the consistency with FC as a key benefit for FCoE, especially in comparison with iSCSI that is seen to be a more significant departure from status quo.
- **Organizational structure is a key piece of the puzzle.** The shift to UF is a significant one, which will require not only new technology but also changes in the way technology is managed. In many environments today, SAN and LAN teams have separate processes and tools and rarely cooperate toward common objectives. Moving toward unification will require a strong foundation of collaboration among these teams.

Look for a near-term business case in server-side network components. The most tangible near-term benefit current adopters of UF point to is reduction of complexity in cable management, server adaptors, and access switch ports. This can reduce errors, speed provisioning, improve power consumption, streamline changes, and reduce staff costs. If you are working on a justification study for FCoE adoption, look to server network connections as low-hanging fruit that can provide a significant financial impact.

Appendix A: Methodology

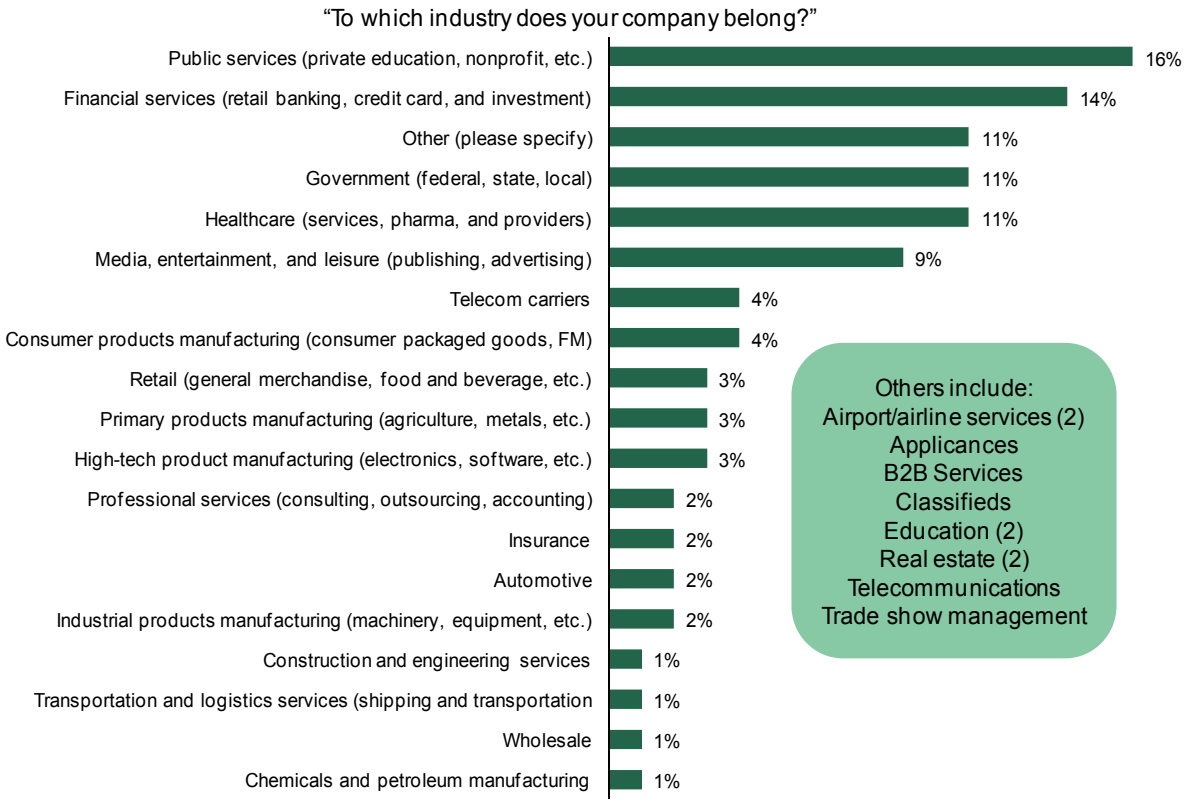
For this study, Cisco commissioned Forrester Consulting to conduct an online survey of 101 storage decision-makers in the US and also five in-depth interviews with these professionals to evaluate current storage trends. Questions provided to the participants asked about current storage management, priorities, and goals, as well as interest in Fibre Channel over Ethernet technology specifically. For the interviews, Forrester spoke with three individuals not using FCoE currently and two Cisco-provided interviews of individuals using FCoE. The study began in September 2009 and was completed in October 2009.

Respondents of this survey fell into the following demographic categories:

- 101 respondents worked for organizations based in the US.
- Respondents represented a broad range of industries (see Figure 8).
- Respondents represented medium to large organizations (see Figure 9).

Appendix C: Demographics/Data

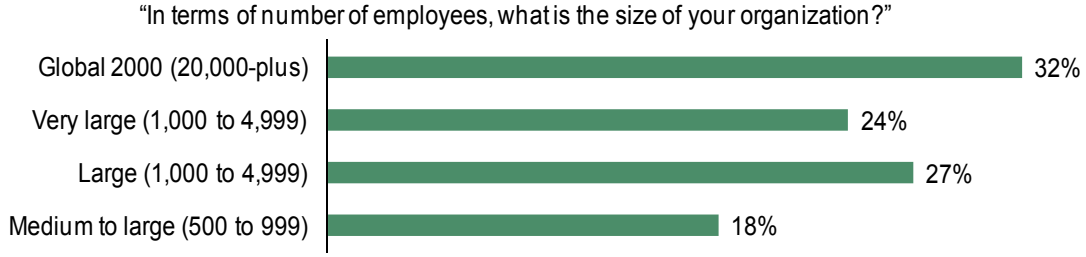
Figure 8
Respondents By Industry



Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009

Figure 9
Respondents By Employee Size



Base: 101 respondents with knowledge of storage purchasing and operations

Source: A commissioned study conducted by Forrester Consulting on behalf of Cisco, October 2009