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## **Addressing Significant Growth Of Data With The iSCSI Protocol**

**A commissioned study conducted by Forrester Consulting on  
behalf of Dell**

September 16, 2008

FORRESTER®



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### Executive Summary

Growth of data is a concern for organizations worldwide as more business stakeholders and applications are generating more data that must be stored, accessed, and protected. Managing the costs and complexity of this process gets exponentially harder as the volumes increase and the stringency of regulations and expectations surrounding the availability, performance, and reliability of this information access grows. This paper is intended to explore the hypothesis that the Internet Small Computer System Interface (iSCSI) storage area network (SAN) protocol can help manage this growing body of data more easily and more cost-effectively. iSCSI uses standard Ethernet infrastructure to connect servers to back-end storage and is generally seen as simpler to manage and less costly to deploy than the Fibre Channel (FC) SAN protocol that is more entrenched within enterprise deployments. The question remains, though, whether iSCSI is seen as offering enough performance, reliability, and scalability to displace FC SAN. This Thought Leadership paper is intended to answer these questions through a combination of a quantitative survey of users of both protocols, as well as qualitative interviews with selected respondents from the quantitative survey.

Based on this survey of more than 200 US-, Europe-, and China-based respondents, Forrester found that:

- Fifty-one percent of respondents report using some form of iSCSI SAN within their storage environments.
- Fifty-three percent of iSCSI users described the implementation of iSCSI as either extremely or mostly easy, fast, and problem-free.
- iSCSI shows higher immediate adoption intentions than other emerging storage technologies surveyed, with 62% of firms showing clear near-term adoption intentions.
- Forty percent of respondents report data growth of 30% or more over the next three years.
- Forty-six percent of respondents rank expanding data capacity among their top-three storage priorities for the next 12 months, following data retention and archiving and data protection, which are also related to grappling with the growth of data.
- Database application data tops the list of expected sources of data growth, with 36% ranking it first and 72% ranking it among their top-three growth sources.
- Thirty-six percent of current users of virtual server technology report using iSCSI for that environment, second to FC.
- Twenty-one percent of customers are replacing FC outright with iSCSI.
- Staff familiarity with Transmission Control Protocol/Internet Protocol (TCP/IP) and Ethernet tops the list of motivations for adoption of iSCSI, with 61% of adopters ranking that among the top three.
- Pre-implementation concerns around security and performance well outweighed post-implementation problems related to security and performance among iSCSI users, and 31% of users reported no post-implementation problems whatsoever.

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- Far more than 50% of iSCSI users characterized the value they received from iSCSI in terms of initial acquisition costs, implementation costs, and ongoing running costs as good or excellent, and less than 5% characterized it as bad in any category.

Forrester recommends that companies should evaluate iSCSI SAN solutions as a means of addressing their data growth in a cost-effective and simple manner. The strong adoption numbers, combined with the overall positive experience that users reported from a broad range of geographies, industries, as well as company and storage environment sizes, lead Forrester to believe that the time has come for companies of all types and sizes to consider iSCSI for mainstream adoption. This paper explores the ways in which existing users have deployed the technology, the successes and issues they have seen, as well as the perceptions of those who have not deployed iSCSI in their storage environment.

### Introduction

In the summer of 2008, Dell commissioned a study to determine the current state of iSCSI adoption, the applications that it is commonly used for, drivers for adoption, experience of adoptors, and attitudes of those who have not yet adopted the protocol.

Specifically, Dell commissioned this study to determine the following:

- **Current iSCSI adoption trends:** The percentage of companies that currently use iSCSI, the applications they use it for, whether they use iSCSI alongside FC or exclusively, and if they use both protocols, whether they are planning to continue to use both or eventually converge on one or the other.
- **Data growth figures:** The size of storage environments today and the expectations for data growth that firms have over the next few years. Does geography, industry, or organization size have an impact on this? Is iSCSI used more or less in environments with high expected rates of data growth?
- **Experience with iSCSI among adopters:** The specific benefits that users of the protocol have seen, as well as any problems. The study compared preconceptions about iSCSI with the actual experience they had to see how accurate these ideas were.
- **Barriers to adoption among FC users.** The main reasons why companies currently do not use iSCSI, and some information on where these motivations arise from.

### Study Methodology

In the summer of 2008, Forrester Consulting conducted an online survey of 236 IT decision-makers and influencers across the US, the UK, the Netherlands, and China. In this survey:

- All respondents were filtered on use of centralized, networked SAN technology. Those not using any type of SAN were eliminated from the study.
- Fifty-nine percent of respondents were from the US, 14% were from the UK, 14% were from the Netherlands, and 14% were from China.
- Ten percent of respondents were from Global 2000 companies with more than 20,000; 11% were from very large organizations with 15,000 to 19,999 employees; 16% were from large organizations with 1,000 to 4,999 employees; 17% were from medium-large organizations with 500 to 999 employees; 25% were from medium-small organizations with 100 to 499 employees; and 21% were from small organizations with six to 99 employees.
- All respondents were knowledgeable of their company's storage environments and were also influencers or decision-makers in the planning and purchasing of storage solutions.
- Respondents were from a variety of industries.

### Storage Area Networking Challenges

The SAN is a critical component of any organization's application delivery capability. Effectively deploying storage to applications with sufficient availability and performance, while at the same time containing costs, is challenging. Firms frequently suffer from downtime or performance degradation

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due to poor architecture, misconfigurations, unexpected consequences of changes, or simple errors. The following factors drive cost and complexity in SAN:

- **There is a high rate of data growth.** The unceasing growth of data means that SANs and storage arrays are in a constant state of change. The process of adding, changing, and refreshing servers means that the SAN must change frequently, and each change presents an opportunity for error. The addition of new applications and expansion of the capabilities and functions of applications, as well as the increase in the resolution of media types, ongoing digitization of paper records, and the increased use of derivative copies of data for compliance, data mining, and data protection, means that the volume of data growth outpaces the rate of business growth. As it is unlikely that the pace of data growth will cease any time soon, finding ways to allow this growth to happen without excessive cost or loss of performance and availability is critical. Consistency and reduced complexity in the SAN can help significantly in achieving this goal.
- **It is hard to hire qualified SAN experts.** Unlike server, application, and network disciplines, there are few formal education programs for storage. Most storage administrators have learned their craft on the job, making it difficult for firms to hire qualified individuals to fill roles in their storage management organizations. FC SAN technology in particular has little connection to other disciplines, meaning that there is little skills transfer between storage and networking or server technologies, making it even more difficult to find qualified staff.
- **FC SAN requires costly, dedicated equipment.** Switches, server-side connectivity components, and cabling for FC SAN are costly, often five to 10 times the cost of standard Ethernet networking components. Furthermore, there are fewer vendors that offer FC components, so downward pricing pressure due to competition is limited. FC is less standardized than Ethernet, requiring complex interoperability testing each time a vendor brings to market a new product designed for FC SAN. Finally, FC components are not used anywhere else in the IT organization, so benefits from product familiarity, volume discounts, consolidation, and spare parts are limited.
- **Performance and data loss are critical issues with SAN traffic.** Sufficient performance and minimization of data loss are not options with SAN, as problems will lead to applications grinding to a halt. Deploying a SAN that is well architected and leverages an effective technology platform and protocol is critical to enabling the effective application networking required to connect servers to centralized storage.

## iSCSI Proposes To Simplify SAN Connectivity

The iSCSI SAN protocol uses standard Ethernet components to create a SAN, enabling: reduced hardware acquisition costs; consolidated organizational structures; lower training costs; increased ability to hire, train, and deploy SAN staff; more choices among vendors and products; increased purchasing leverage across the organization; increased spare parts; and increased potential for consolidation. Concerns around iSCSI revolve around performance, with detractors claiming that bandwidth is lower than FC and that the protocol itself is too chatty and not lossless or deterministic. Specific considerations related to the use of iSCSI include the following:

- **Reduced SAN acquisition costs.** FC SAN components are generally far more costly than standard Ethernet components. Every FC element in the SAN — from the switches themselves, to server connectivity cards, to cabling — are more expensive than the similar component in Ethernet. And often, storage vendors sell FC components through an OEM arrangement mark them up significantly, further widening the gap. Ethernet components

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are not subject to this markup, as they are often purchased directly from the networking vendor. As organizations buy significant volumes of Ethernet gear outside of SAN, there are often greater discounts to be had across the whole organization from consolidated purchasing compared with FC equipment, which is used only for storage.

- **More Ethernet standardization compared with FC.** As iSCSI uses standard Ethernet — a protocol that adheres more rigorously to accepted standards than does FC — interoperability is simpler, and competition is increased, placing greater downward pricing pressure on associated products. Vendors have to do less product-specific interoperability testing for iSCSI components, reducing their manufacturing costs and allowing products to come to market faster. Buyers can be less concerned about predeployment testing of iSCSI storage products, as the increased standards adherence means reduced likelihood of incompatibility. As the vendors in the space produce more similar products, the downward pricing pressure of iSCSI and Ethernet-based products in general becomes greater, leading to lower costs and shorter product innovation cycles.
- **Easier organizational unification and consolidation.** As every organization is familiar with Ethernet, the use of iSCSI can bring the storage team closer to the network and server teams. FC SAN is something of a black art to server and network teams; they are generally unfamiliar with the protocol and associated products, which often creates a significant political and cooperative divide between the teams, and this often detracts from collaboration and prevents alignment of priorities and initiatives. iSCSI proposes to bring the IT silos together around a common technology, allowing for overall cost savings through consolidation of staff and equipment. While there is likely to be political and cultural resistance to this type of consolidation, Forrester believes that it is in the best interest of the firm in the long run, provided that performance and architectural concerns are properly considered.
- **SAN simplification.** Ethernet is generally easier to manage than FC, due to both the inherent nature of the protocol and a higher level of familiarity among IT staff. The iSCSI protocol assigns unlimited IP addresses to initiators and targets, allowing for a granular and highly virtualized addressing scheme, unlike FC, which does more rigid zoning between the server host bus adaptor (HBA) and the storage array. This protocol flexibility is combined with widespread familiarity of the zoning and addressing properties of IP networking, which allows more people in the firm to capably participate in the SAN architecture process. For firms that are building a SAN for the first time, this benefit is particularly important, as hiring a new FC staff can be prohibitively cumbersome and costly, and failure to retain capable experts can lead to significant negative performance and availability impacts.
- **More component options.** With FC networking, there are few vendors and limited options for components. Multipathing software to manage redundant connections is costly and must be deployed by server administrators that are not experts in FC. With iSCSI, server-side connectivity can use standard network interface cards (NICs), TCP/IP offload engine (TOE) cards, or iSCSI host bus adapters (HBAs) for varying levels of performance acceleration. Switches can be physically isolated or combined with local area network (LAN) traffic using virtual LANs (VLANs) for traffic isolation in a consolidated switching environment.
- **Long-distance replication benefits.** When data is sent over long distances for the purpose of out-of-region data protection, it uses TCP/IP over Ethernet. In an FC SAN, the traffic must be translated from FC to TCP/IP for the data transmission. In an iSCSI SAN, this translation is not required as the data is natively passed on Ethernet links.

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- **Performance considerations.** FC networks are considered lossless, using flow control to ensure that all data is delivered. Traditional Ethernet is not considered to be lossless, using packet drops instead of flow control to manage congestion. Additionally, TCP/IP is considered to be a chatty protocol. Finally, current-generation FC networks are capable of running at 4 Gbps, whereas the majority of current data center Ethernet deployments run at 1 Gbps, although 10 Gbps Ethernet is gaining traction rapidly. All of these are seen as barriers to adoption of iSCSI as an enterprise-class SAN protocol, although many of these can be mitigated with current technology.

The chattiness issue can be overcome with physical or logical traffic separation, using either VLANs to isolate SAN traffic from LAN traffic that is being passed on the same physical switch, or dedicated Ethernet switches for SAN traffic that are separate from those used for LAN traffic, or by building.

The bandwidth concern is often less significant than it initially appears, as many FC SANs are using some components that don't support 4 Gbps, meaning that the whole network autonegotiates down to a lower data rate. Bandwidth is not the only consideration, and in many cases, it does not represent the bottleneck for organizations that are not using the full capabilities of a fast pipe. Additionally, there are some deployments of iSCSI multiplex traffic across several IP links, effectively increasing the bandwidth of the 1 Gbps Ethernet to several Gbps. Another approach to bandwidth optimization is scale-out architecture, which adds I/O bandwidth along with disk capacity increases. Finally, as 10 Gbps Ethernet is currently available and rapidly dropping in price, this additional bandwidth can be deployed selectively to accelerate traffic in bandwidth-constrained applications.

The lossless issue remains, although the rate of lost packets is relatively low, leading a large number of firms to have success with iSCSI without fully lossless Ethernet. Additionally, switching vendors and standards bodies are working on true lossless versions of Ethernet, which will further improve data reliability in 10 Gbps Ethernet.

## Current State — SAN Storage

SAN storage is a critical element of data center infrastructure. Organizations of all sizes in all industries report significant data growth rates and see addressing their ongoing growth of data as a primary concern within IT. This survey asked about the size and growth rates for these storage environments and found the following:

- **Thirty-eight percent of respondents report having more than 120 TB.** The survey looked at a wide variety of SAN sizes among respondents, from very small to very large. While the largest storage environment size band represented is less than 20 TB, the survey includes a significant number of respondents with larger environments. While several years ago only the largest environments had a petabyte of data, 14% of respondents to this survey report having more than that amount of raw storage (see Figure 1).
- **Forty percent of respondents report a growth rate of 30% or greater.** Clearly, data is growing significantly at all firms as more applications generate more content. Almost half of the respondents anticipate a growth rate of more than 30% over the next three years. But this number is not the atmospheric rate that some have predicted, and 59% of respondents anticipate growth of less than 30%. Granted, many firms have a difficult time predicting their actual growth, so many of these respondents may be underestimating, but Forrester would characterize the growth as significant but manageable, rather than out of control (see Figure 2).

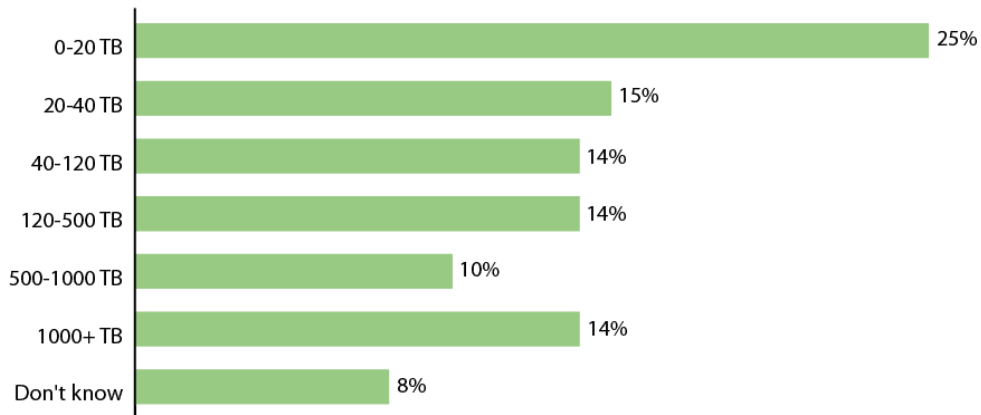


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- **Database application data tops the list of expected growth sources.** By far, database application data is the most significant source of growth according to survey respondents. Messaging and data warehouse data follow, but file content lags behind. It is interesting to note that this is the best estimate of growth, and as firms generate new types of content, and centralize their file storage infrastructure, files may contribute to higher-than-anticipated growth. This indicates that block storage protocols such as FC and iSCSI are likely to be key aspects of strategies to keep pace with the expected growth of data (see Figure 3).

**Figure 1: Overall Sizes Of Storage Environments**

How big is your Networked Storage Environment (in Raw Terabytes)?

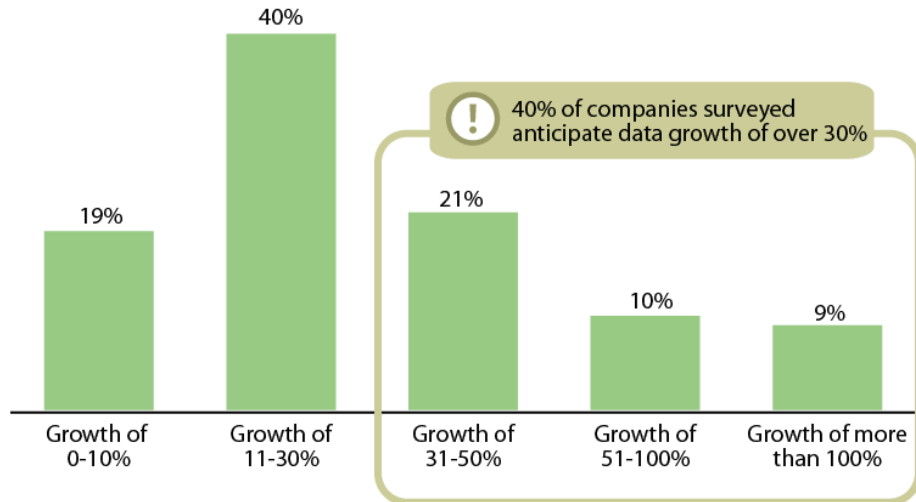


Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 2: Expected Data Growth Rates**

What do you anticipate your overall data growth rate to be over the next 3 years?



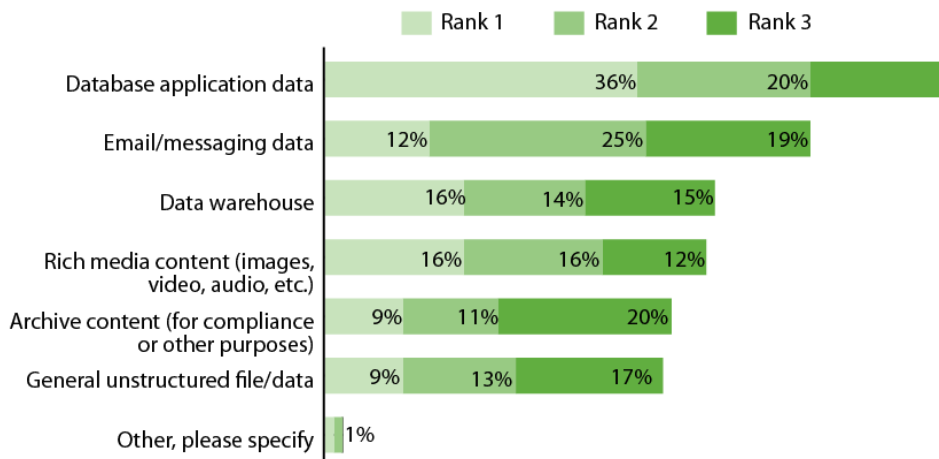
Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

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**Figure 3: Sources Of Data Growth**

What do you see as your most significant areas of data growth over the next three years?



Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Patterns Of iSCSI Adoption

iSCSI can be a powerful means of addressing the significant growth of data. While it has been available for several years, there appears to be a sharper rate of adoption under way as firms look to manage their data growth in a cost-effective manner. Adoption highlights include:

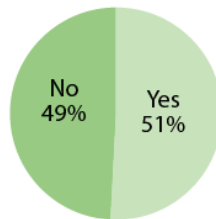
- **Fifty-one percent of respondents report using iSCSI today.** This number is high compared with adoption numbers from recent years, indicating that recent adoption of iSCSI has been quite significant. There appears to be some confusion evident in these numbers though, as the adoption of iSCSI in this question is higher than those who stated they had already adopted iSCSI when asked about emerging storage technologies in a subsequent question (Figure 7). In spite of this possible confusion about what really constitutes adoption of iSCSI, the number of people who claim to be using iSCSI is quite significant (see Figure 4).
- **China leads the survey in adoption of iSCSI, followed by the US.** Broken down by geography, China shows the strongest adoption of iSCSI, followed by the US, the UK, and the Netherlands. China is seen as an emerging market, with more greenfield storage environments, so it's interesting to note that in an environment with fewer preexisting preferences for a given storage protocol, there is higher adoption of iSCSI (see Figure 5).
- **Distribution of iSCSI adoption cuts across organizational sizes.** iSCSI has often been thought of as a protocol for smaller environments with less-demanding storage needs, but the data in this survey shows that there is significant adoption of iSCSI across a wide variety of organization sizes, including very large ones. While this data does not show how significant a portion of the storage environment is served by iSCSI, or which applications, it is clear that both small and large firms have an interest in the protocol (see Figure 6).

## Addressing Significant Growth Of Data With The iSCSI Protocol

- **Interest in iSCSI tops that of other surveyed emerging storage technologies.** When Forrester asked respondents about their interest in a variety of emerging storage technologies, including iSCSI, storage virtualization, 10 Gbps Ethernet, 8 Gbps FC, and Fibre Channel over Ethernet (FCoE), iSCSI showed the strongest near-term adoption intentions (see Figure 7).

**Figure 4: Overall Adoption Of iSCSI**

Are you currently using iSCSI as a SAN protocol?



Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 5: Geographic Affinity For iSCSI Adoption**

Are you currently using iSCSI as a SAN protocol? (Respondents that answered "yes")



Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 6: iSCSI Adoption By Organization Size**

Are you currently using iSCSI as a SAN protocol? (Respondents that answered "yes")



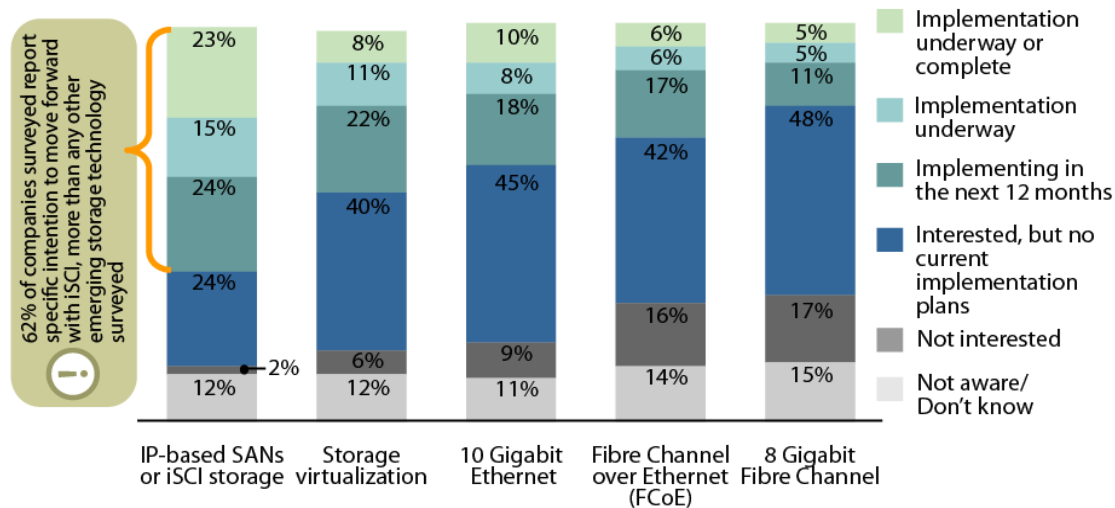
Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 7: Comparative Interest In Emerging Storage Technologies**

What is your highest level of awareness or interest related to the following technologies?



Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## The Impact Of Server Virtualization On iSCSI Adoption

Server virtualization and SAN storage adoption are directly linked, with a majority of vendors and user firms recognizing that the benefits of server virtualization require the use of centralized, networked storage. As such, server virtualization is widely seen as a key driver for any storage technology. Evaluating the relationship of server virtualization to iSCSI storage is a critical part of the story. According to our study:

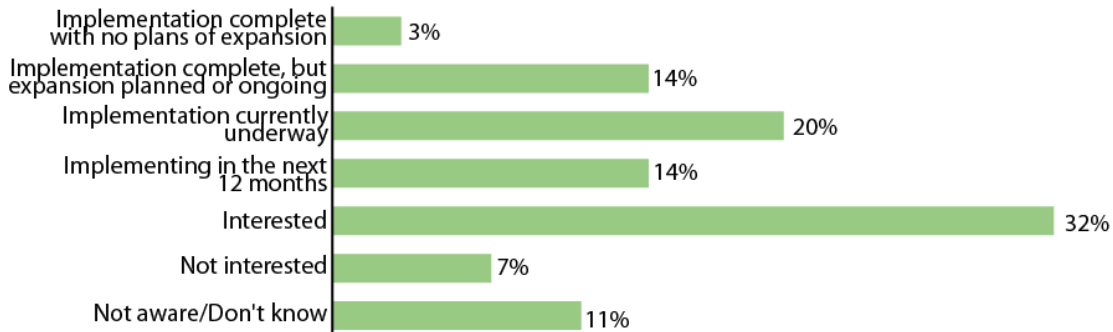
- Nearly every respondent reports interest in server virtualization.** When asked about plans for server virtualization, "Implementation Complete" and "Not Interested" were the least common responses, while "Interested" (which could be seen as tepid) was the most common single response; nearly every respondent expressed some ongoing interest in deploying or expanding server virtualization (see Figure 8).
- Interest in new adoption of server virtualization is strong among users of iSCSI.** Respondents who have already adopted iSCSI showed higher responses of "Implementing in the next 12 months" and "Interested" compared with those who do not use iSCSI. This may point to strong upcoming adoption of server virtualization among firms that use iSCSI, or point to growth of iSCSI as a SAN protocol for virtual server deployments (see Figure 9).
- Most existing server virtualization deployments are already in production.** Looking at the deployment phases for virtual server technology, the majority of respondents indicate that they are using server virtualization in some type of production setting (see Figure 10).

## Addressing Significant Growth Of Data With The iSCSI Protocol

- Thirty-six percent of virtualization users are connecting via iSCSI, second only to FC.** While FC still maintains a strong lead over iSCSI in virtual server environment connections, iSCSI leads network file system (NFS) and direct attached storage (DAS). Non-networked storage limits the capabilities of a virtual server environment, so we would expect to see that option trailing behind; in fact, it is something of a surprise for it to be as high as it is. NFS is a newer approach to virtual server connection to storage, so this may be on the rise. In general, Forrester sees pros and cons associated with all three storage network protocols, and more guidance from vendors for virtual server technology to identify specific use cases for each would be beneficial (see Figure 11).

**Figure 8: Overall Interest In Server Virtualization**

What are your plans related to adoption of Server Virtualization Technology?

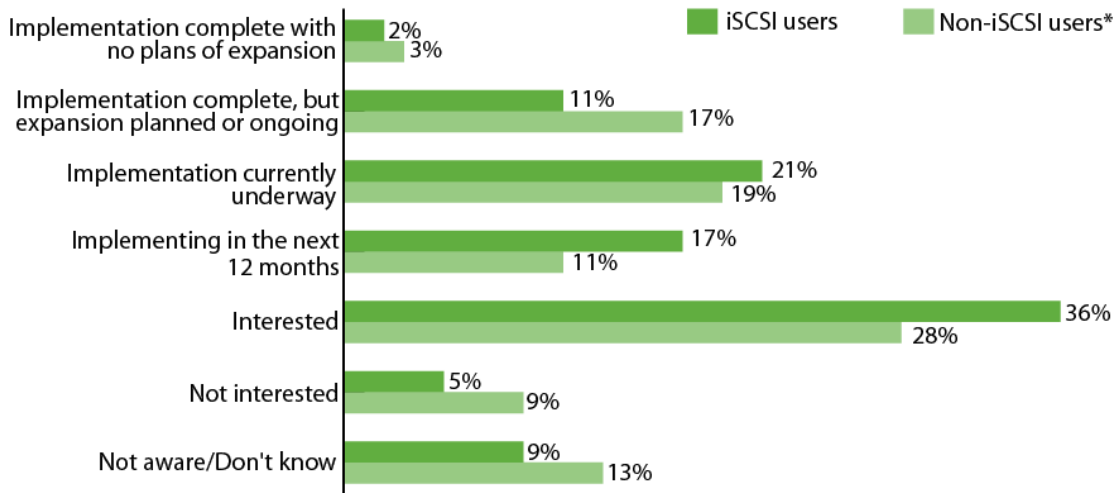


Base: 236 technology decision-makers

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 9: Interest In Server Virtualization Between iSCSI And Non-iSCSI Users**

What are your plans related to adoption of Server Virtualization Technology?



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol

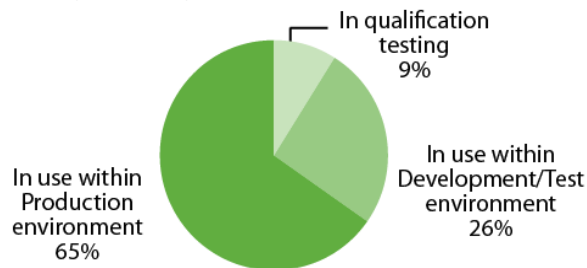
\*Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 10: Implementation Phases Of Virtual Server Deployments**

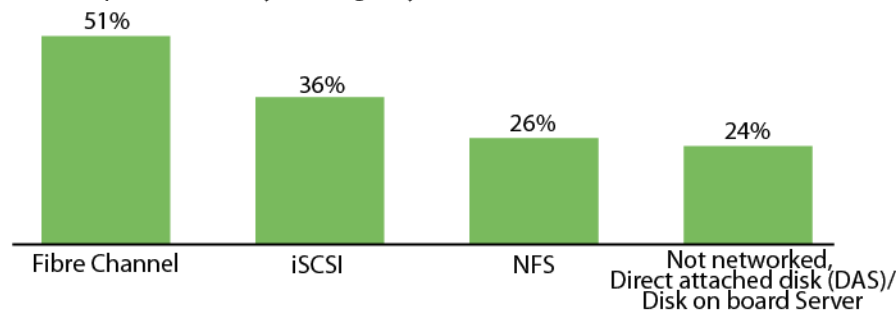
What phase of implementation is your deployment of server virtualization in currently?



Base: 85 technology decision-makers whose organizations have begun implementation of Server Virtualization  
Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 11: Distribution Of Protocols Used For Virtual Server Environments**

What Storage Network protocol(s) are you using for your Virtual Server Environment? (select all that apply)



Base: 85 technology decision-makers whose organizations have begun implementation of Server Virtualization  
Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## iSCSI User Experiences

The survey was split between respondents who currently use iSCSI in their storage environments and those who do not. This section looks at the responses of the iSCSI users to determine why they chose the protocol, what problems they are addressing in their storage environments, and how successful they have been in using iSCSI to address storage issues.

### Where iSCSI Fits In User Storage Environments

According to our study:

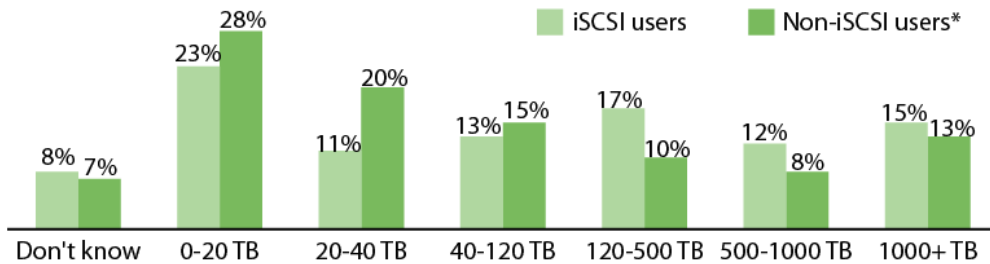
- **iSCSI adoption is distributed widely across environment sizes.** In relatively small storage environments, the distribution of iSCSI adoption is about equal to those that have not yet adopted iSCSI. However, in larger environments, the use of iSCSI goes up sharply, indicating that many large shops have found a place for iSCSI. Note that this does not mean that these respondents have replaced FC with iSCSI, just that they use iSCSI somewhere within their environment (see Figure 12).

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- Growth rates among iSCSI users are slightly higher.** It's not a huge difference, but 43% of iSCSI users predict growth of 30% or more over the next three years compared with 37% of respondents who don't use iSCSI. At a minimum, this seems to show that iSCSI users are not limited to low-growth environments, and there may indeed be some propensity toward solving high-growth-rate issues with an environment that includes iSCSI (see Figure 13).
- Many iSCSI deployments are first-time SANs, but FC displacement is growing.** The largest single response to the question asking for a description of the iSCSI deployment scenario is as a first-time SAN with iSCSI only; 31% of respondents selected that option. But 43% of respondents selected an option that describes some version of replacing an existing FC SAN with iSCSI (see Figure 14).
- FC displacement is more common among iSCSI users with large storage environments.** Not surprisingly, the first-time SAN deployments using iSCSI only are mostly small storage environments. Looking at the larger shops, there are many more respondents who say that they are doing some type of FC replacement with the iSCSI SAN protocol. Interestingly, the smallest response set across all sizes is the scenario of moving forward with both iSCSI and FC side by side (see Figure 15).

**Figure 12: iSCSI Adoption By Storage Environment Size**

How big is your Networked Storage Environment (in Raw Terabytes)?



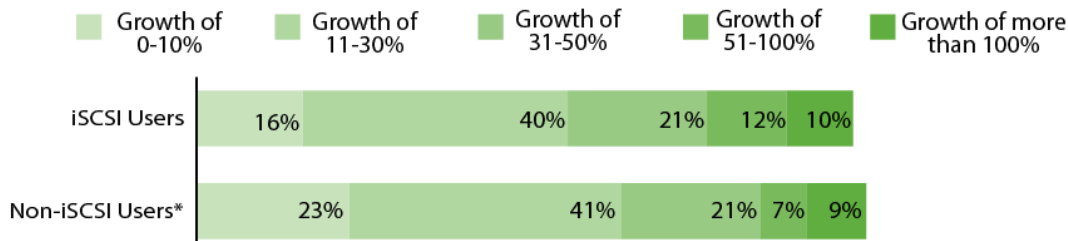
Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol

\*Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol

Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 13: Growth Rates Among iSCSI And Non-iSCSI Users**

What do you anticipate your overall data growth rate to be over the next 3 years?



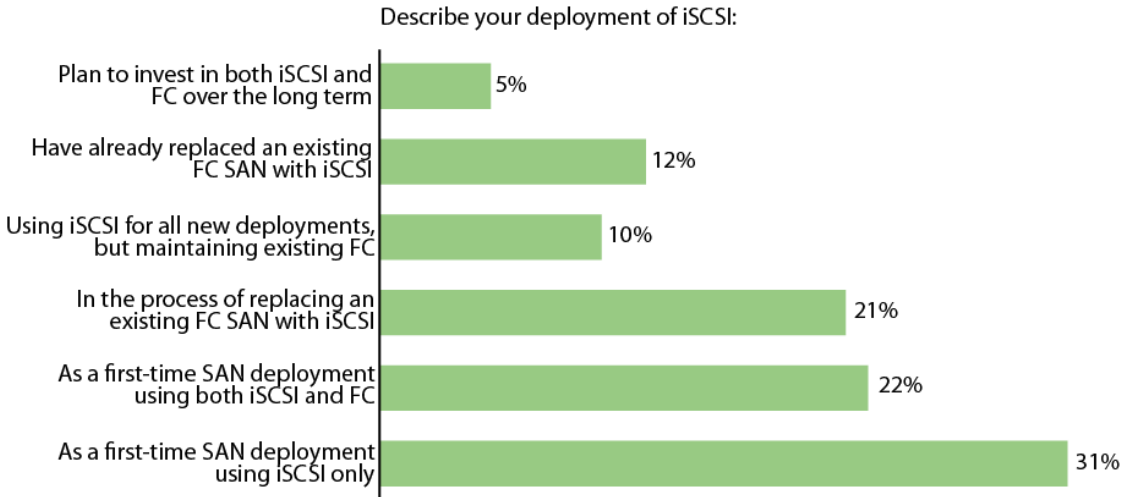
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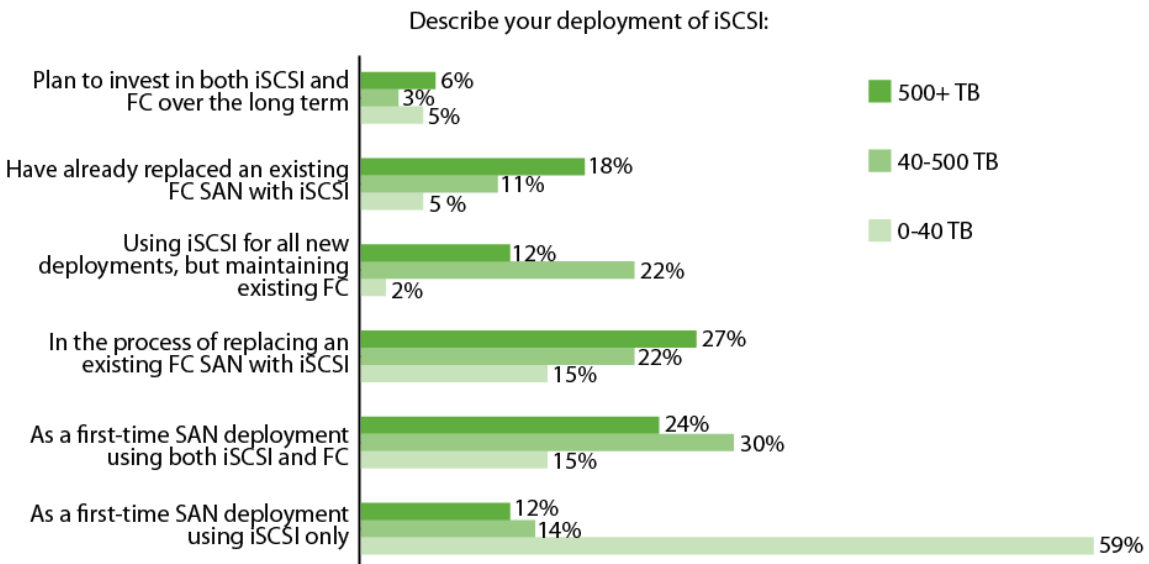
## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 14: Deployment Scenarios Among iSCSI Users**



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 15: Deployment Scenarios Among iSCSI Users With Varying Storage Environment Sizes**



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008



## Specific Experiences Of iSCSI Users

According to our study:

- **Staff familiarity and desire for converged SAN/LAN lead iSCSI motivations.** When asked why they chose iSCSI, the top two responses were staff familiarity with TCP/IP and Ethernet (61% of iSCSI users chose this as one of their top three motivations) and the desire for a converged SAN/LAN (23% ranked this as the No. 1 motivation). Following these were cost-related motivations, including both low upfront acquisition costs and low ongoing management costs (see Figure 16).

One interviewee who uses iSCSI described their staffing situation as follows: “We have a fairly large networking staff, and now that we’re looking at data as just another networking device, it’s a lot easier on everyone.”

Another iSCSI user pointed to increased self-sufficiency related to iSCSI: “We have seen fewer issues with iSCSI than FC, due to the greater expertise with the technology. Everything was always a phone call [to the vendor] with Fibre Channel. We are able to move forward on our own with iSCSI.”

- **Respondents report positive experiences with iSCSI implementation.** Fifty-three percent of respondents described their iSCSI implementation as extremely or mostly fast, easy, and problem-free. Forty-two percent pointed to some issues, but described the implementation as generally successful. No users of iSCSI described their experience as highly problematic (see Figure 17).

An iSCSI user pointed to significant ease of implementation, saying: “We didn’t find it difficult to put in. The installation was very simple for us.”

- **Pre-implementation concerns outweighed post-implementation issues.** Significant disparities were recorded relating to security and performance issues, where respondents indicated that they were concerned about these aspects of iSCSI usage but apparently did not encounter the problems that they expected. Interestingly, all categories of pre-implementation concerns outweighed the problems actually experienced except in the area of lack of staff knowledge about iSCSI architectures and best practices, indicating a need for more knowledge about the use of iSCSI. Also striking was the wide disparity between those with no initial concerns (6%) and those who had no problems after implementation (31%). This seems to be indicative of unnecessary concerns regarding the capabilities of iSCSI (see Figure 18).

Describing their experience related to performance, an iSCSI user stated that: “We haven’t had one problem with user complaints about response time.”

Another interviewee pointed to testing to alleviate performance concerns: “We did some benchmarking at the beginning — we had some SQL (with Web sites attached) and wanted to be sure responses were where we wanted. We tested and found the responses were very acceptable.”

## Addressing Significant Growth Of Data With The iSCSI Protocol

- iSCSI adopters report strong perceived value.** In terms of initial acquisition costs, implementation costs, and ongoing running and maintenance costs, more than 60% of respondents reported good or excellent value for all three categories. Between 31% and 34% of respondents pointed to a neutral value perception, and very few respondents indicated bad or very bad value (see Figure 19).

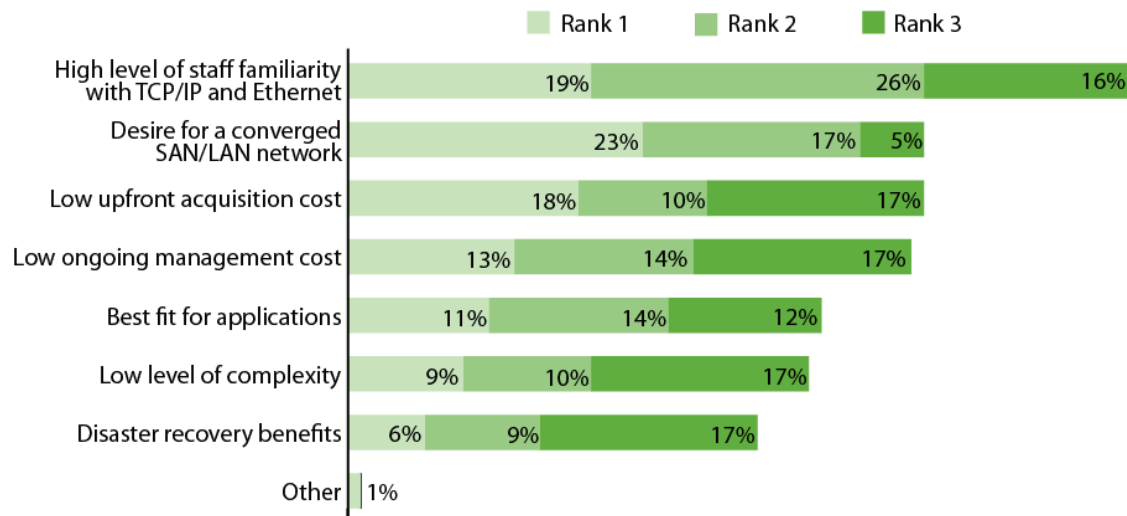
Some adopters of iSCSI didn't point to significant staff reduction benefits, but still found value in improved capabilities: "We aren't saving on staff. Availability issues and risks are greatly reduced, however."

- Overall perception of iSCSI is positive among current users.** The vast majority of iSCSI users in the survey, 69%, pointed to good overall value; 15% saw excellent value; 16% saw neutral value, and no iSCSI users saw bad or very bad value (see Figure 20).

An iSCSI user summed up their experience saying: "iSCSI is a factor in achieving our goals. It puts us in a situation where performance isn't even a question — 'of course it will be fast.'"

**Figure 16: Motivations For Selecting iSCSI Among Current Users**

What were your primary motivations for selecting iSCSI as a storage networking protocol?

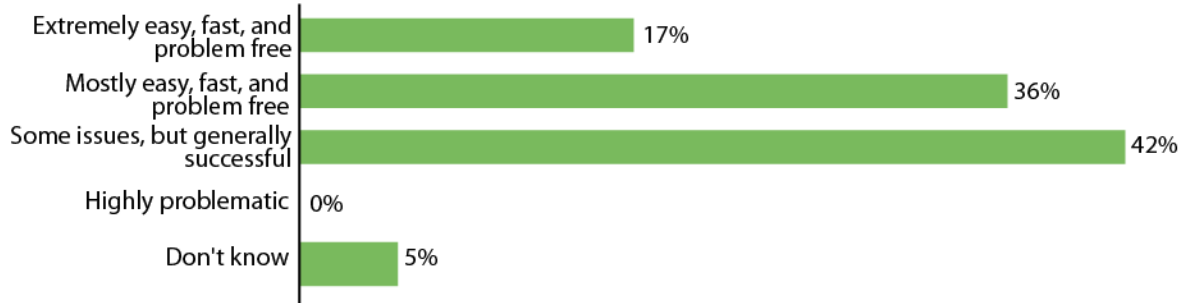


Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Addressing Significant Growth Of Data With The iSCSI Protocol

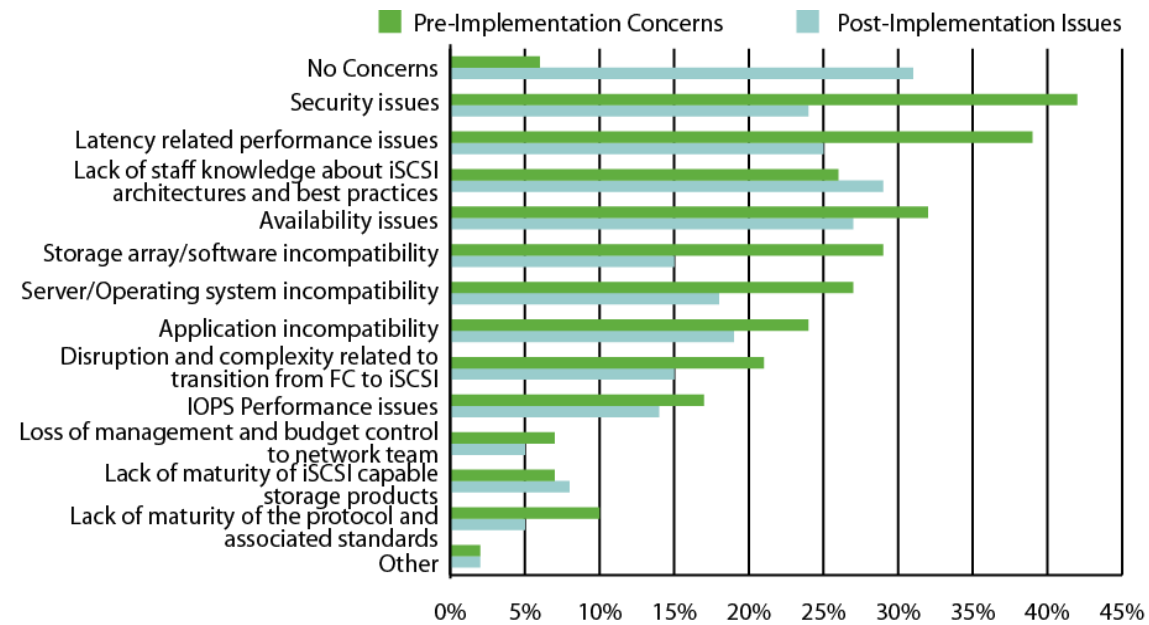
**Figure 17: Implementation Experiences Of Current iSCSI Users**

Characterize the experience you had with implementation of iSCSI SAN and associated storage arrays.



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 18: Comparison Of Pre-Implementation Concerns And Post-Implementation Issues Among iSCSI Users**

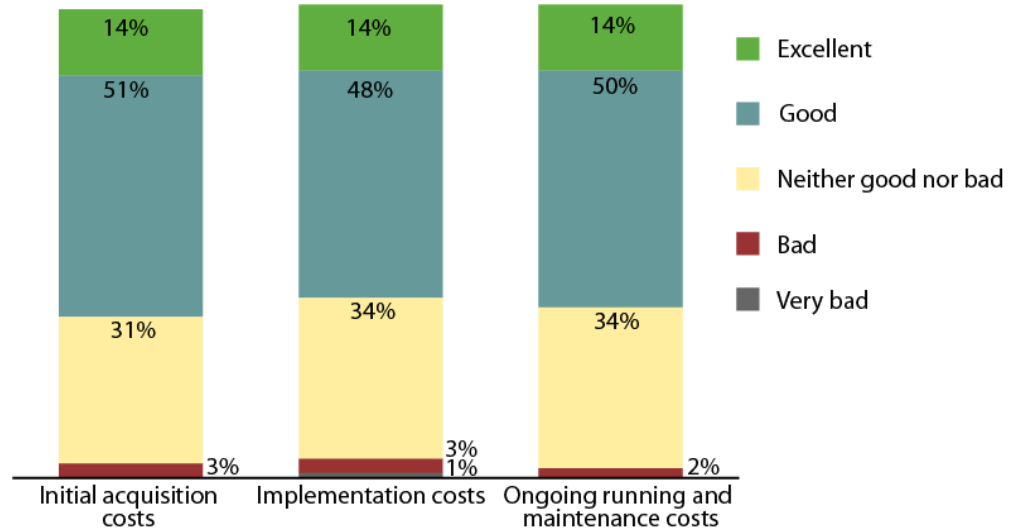


Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 19: Overall Perception Of Value Among Users Of iSCSI**

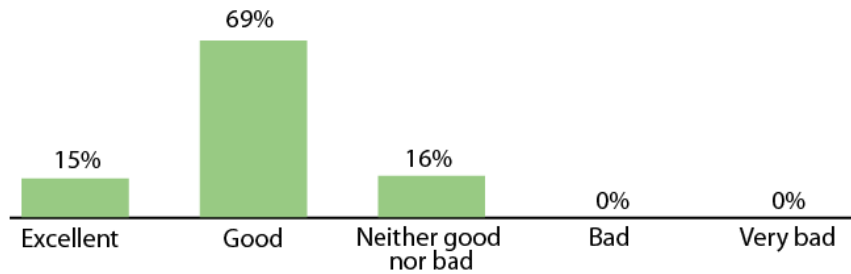
Concerning the following cost categories, how would you characterize the value you received with your iSCSI SAN and associated storage arrays and software?



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 20: Characterization Of Total Experience By iSCSI Users**

How would you characterize your overall experience with your iSCSI SAN and associated storage arrays and software?



Base: 121 technology decision-makers whose organizations are currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Perceptions Of Non-iSCSI Users

For the portion of firms that don't use iSCSI today, it's important to understand why they don't. Are there specific attributes of iSCSI that cause them to disqualify it for their environment? Are there aspects of FC that they value too much to let go? Is it possible that they just didn't consider iSCSI, or didn't know enough about it to allow them to select it? The survey attempted to discover the answers to these questions, with the following results.

### Impact Of Years Of Experience Using FC SAN

The survey measured how long non-iSCSI users have been using FC and found that:

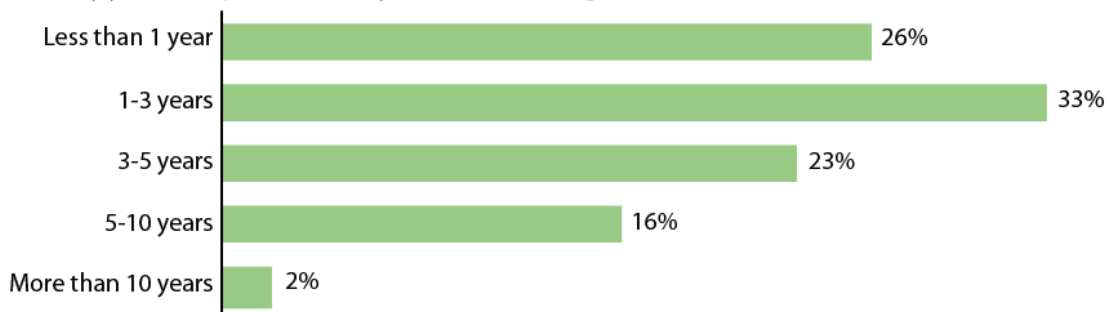
- **Most users have been using FC for one to five years.** The most common response was between one and three years, with 33%. Only 2% of firms reported using FC for more than 10 years (see Figure 21).
- **The number of years using FC did not correlate with willingness to consider iSCSI.** In general, firms that had been using FC for longer did not indicate that they were more or less willing to adopt iSCSI in the future. In fact, firms with a longer tenure of FC indicated willingness to adopt iSCSI, with 45% of those with more than three years of using FC and 40% with three or less years of experience with FC saying they might consider iSCSI (see Figure 22).

Users who do not currently use iSCSI sometimes point to cost benefits, as well as acceptable performance, as a reason for them to consider iSCSI. One interviewee stated: "Performance and price are our two biggest concerns. I honestly think iSCSI would be a better cost picture and has the performance we need."

Another FC user pointed to the greater maturity and capability of current-generation iSCSI products compared with those of several years ago: "If I were making the decision today, I would probably select iSCSI, but we purchased three years ago, when it was not popular at all."

**Figure 21: Respondents' Amount Of Experience Using FC**

How many years of experience does your firm have using an FC SAN?



Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol  
Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 22: Impact Of Experience Level With FC On Likelihood To Adopt iSCSI**

Do you have any intention of introducing iSCSI into your storage environment in the future? (Respondents who answered “yes”)



Base: 47 FC users with more than 3 years experience with that protocol

\*Base: 68 FC users with 3 or less years experience with that protocol

Source: “Managing Data Growth,” a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## FC User Perceptions Of Specific SAN Protocol Features

FC SAN users are a highly dedicated group of users who have invested significant time and energy in building expertise and deploying solutions with FC. Interestingly though, the perceptions of iSCSI among this group were not tremendously negative. Respondents who use FC only indicated that:

- **Security and compatibility top the list of valued FC features.** Fifty percent of respondents ranked security among their top three most valued features of FC SAN, and 50% said the same about server and operating system compatibility. The security issue is an interesting one, as FC networks generally have less-specific security provisions enabled, but they are seen as more secure because the specialized protocol is rarely hacked. iSCSI leverages mature TCP/IP and Ethernet security capabilities, but may be seen as more vulnerable due to more widespread knowledge of the system, and from mixed traffic on a common network and the possibilities of breaches due to misconfiguration (see Figure 23).

Interestingly, performance was not as big a factor in selecting FC over iSCSI. One interviewee who does not use iSCSI stated that: “I have performance concerns where [storage] is a shared resource, but Fibre Channel has a similar problem.”

Another interviewee indicated that they did not have the capability to measure performance requirements, but rather depended on perception of FC strength: “It was a gut feel for us to choose [Fibre Channel]. Once we got as big as we are, we knew we needed Fibre Channel to get the performance we need.”

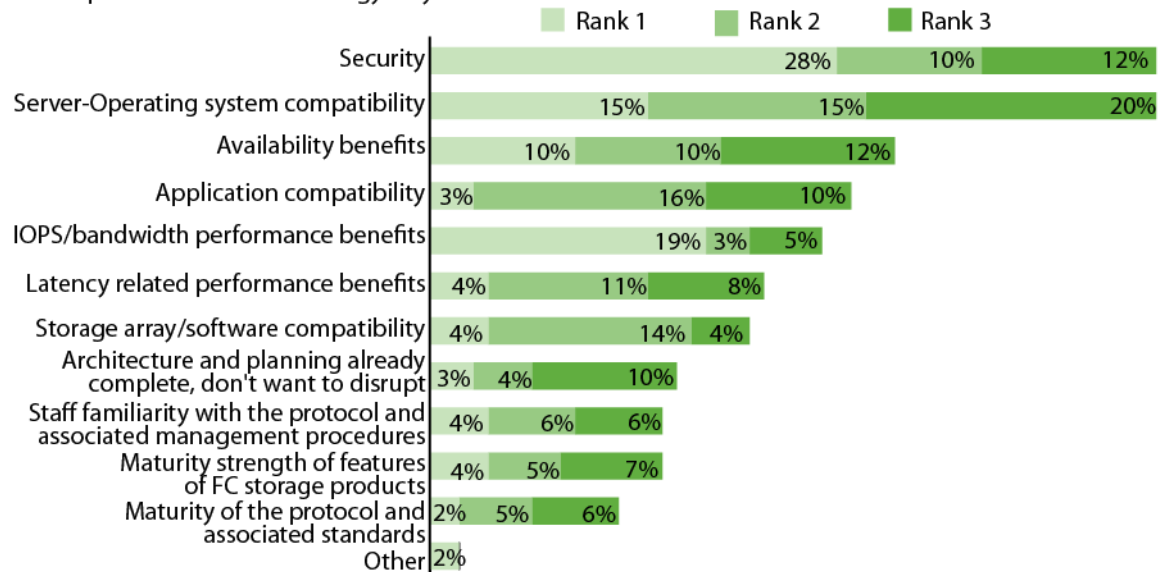
- **Security also tops the list of concerns about iSCSI, but many expressed no concerns at all.** Consistent with the value seen for FC security, concerns about the security of iSCSI SAN topped the list, with 36% of respondents claiming that security was among their top three concerns about iSCSI. However, 25% of FC SAN users stated that they had no concerns about the use of iSCSI (see Figure 24).

Workload sharing and application compatibility concerns came through in one interview, where the FC user stated that: “We have a lot of data we might move to the SAN, and I’m not sure how that workload sharing would work out [using iSCSI].”

## Addressing Significant Growth Of Data With The iSCSI Protocol

**Figure 23: Most Valued Features Of FC SANs**

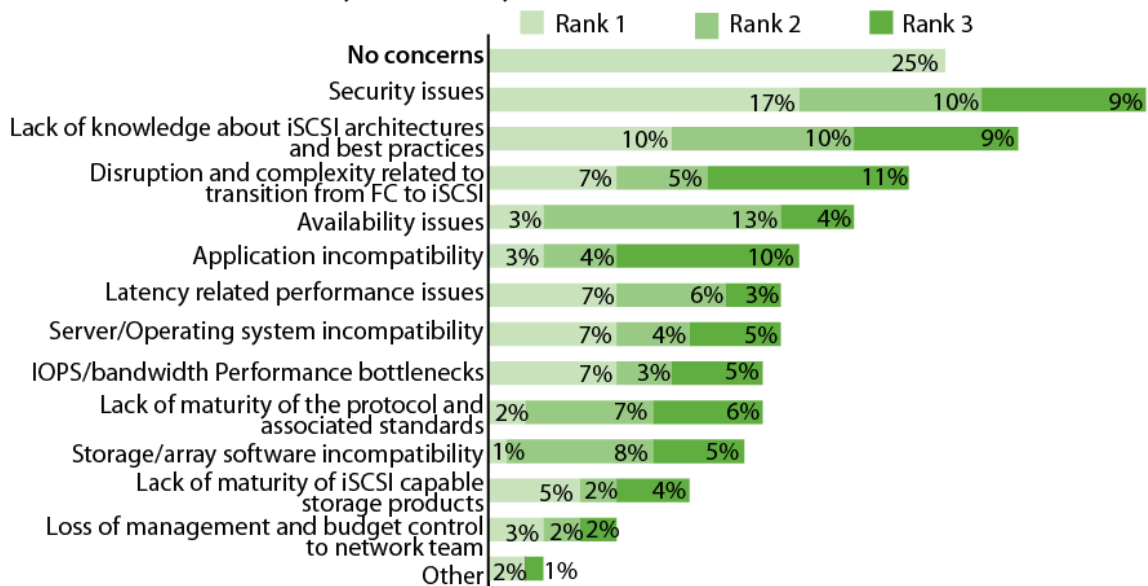
What aspects of FC SAN technology do you value most?



Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 24: FC Users' Concerns About iSCSI**

What, if any, concerns do you have related to use of iSCSI-based SAN?



Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

## FC SAN User Interest In Adopting iSCSI And Other Technologies

To better understand the intentions of FC users who don't currently use iSCSI, the survey asked about adoption intentions for several emerging storage technologies, including iSCSI. This portion of the study revealed that:

- **A significant portion of FC users showed intention to adopt iSCSI.** Forty-two percent of all respondents who don't currently use iSCSI said that they have some intention to do so in the future. This goes against the commonly held perception of a rift between iSCSI and FC proponents, with nearly half of those that don't currently use iSCSI showing a willingness to do so (see Figure 25).
- **FC users show similar levels of interest in FCoE and in 8 Gbps FC.** Sixty-two percent and 57% of respondents who don't use iSCSI today stated that they were very interested or moderately interested in 8 Gbps FC and FCoE, respectively. Interestingly, those with an interest in FCoE were more likely to express an interest in the protocol as a bridge to an iSCSI SAN or as a hybrid FCoE and iSCSI network, rather than as a long-term SAN solution (see Figure 26).

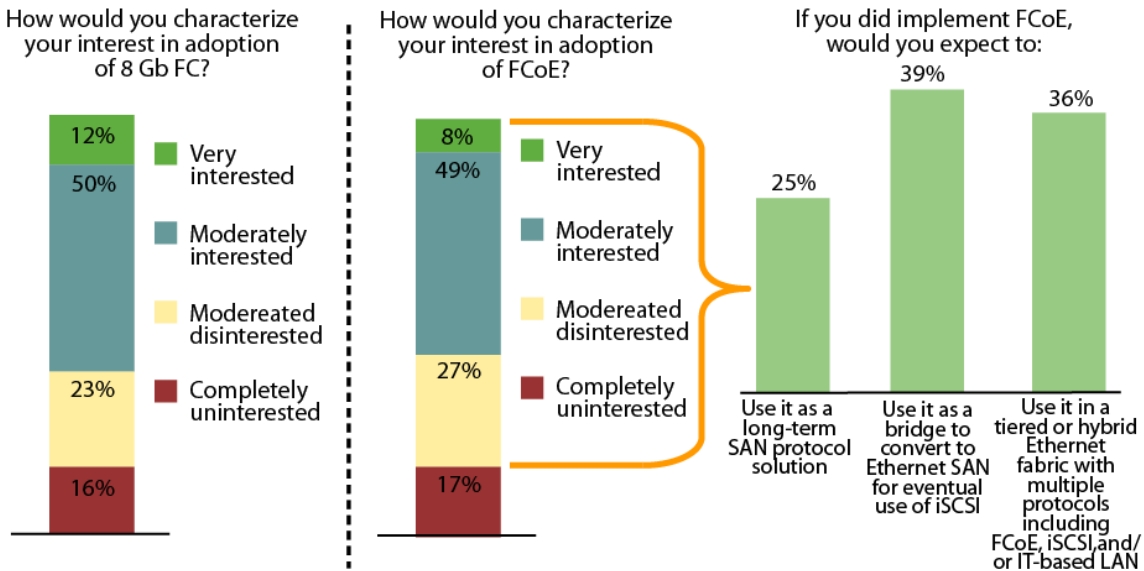
**Figure 25: Forty-Two Percent Of FC SAN Users Have Some Intention To Deploy iSCSI**

Do you have any intention of introducing iSCSI into your storage environment in the future?



Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008

**Figure 26: Alternative Technologies For Non-iSCSI Users**



Base: 115 technology decision-makers whose organizations are not currently using iSCSI as a SAN protocol  
 Source: "Managing Data Growth," a commissioned study conducted by Forrester Consulting on behalf of Dell, June 2008



## Conclusions

### iSCSI Adoption Inhibitors

In order to further accelerate the iSCSI storage market, Forrester believes that the following inhibitors to adoption need to be resolved:

- **Political resistance to the organizational changes associated with iSCSI.** For larger firms, iSCSI represents a change in the budgeting process of storage environments. Firms that have distinct storage and network teams are likely to have some difficulty associated with the SAN budget moving from the storage team (which buys and manages FC equipment) to the network team (which buys and manages Ethernet equipment, used for iSCSI).
- **Concerns about security within iSCSI SAN implementations.** There is a strong perception of security issues among users of iSCSI (prior to implementation) and those who have not adopted iSCSI. Vendors should focus on this area in terms of messaging about iSCSI's current strengths and capabilities, and they should bolster the functionality as needed to assuage the concerns of potential adopters. Users considering iSCSI should seek clear education on the subject to make sure that unfounded concerns do not hinder the adoption of a potentially beneficial architecture.
- **Less-than-adequate performance analysis for SANs in general.** Most firms that are deploying SAN technology use trial and error to determine performance requirements. Without the ability to measure IOPS and application performance needs, it is very difficult to know whether performance will truly be a bottleneck for a given storage environment. Storage switching costs are extremely high, so in the absence of more actionable performance analytics capabilities, converged systems that offer FC and iSCSI options may be a good choice. However, there are costs associated with changing configurations and running dual-protocol networks. Vendors should work to provide clear tools and recommendations that help users determine what performance levels are required for their particular use cases.
- **A lack of clear best practices around iSCSI deployments.** Even current, successful users of iSCSI still point to a lack of best practices around how to build an effective iSCSI SAN. The convergence of SAN and LAN can provide significant economies of scale, but it also means that SAN switches will be purchased from vendors and integrators that might not know as much about SAN architecture as the storage experts that offer FC products. Users should seek out best practices to make sure that they are putting the right products and architectures in place. Vendors of iSCSI-related products should be very clear about how best to deploy the technology.

### iSCSI Adoption Accelerators

Specific current benefits of iSCSI that are likely to strongly resonate with buyers in the SAN space include the following:

- **Reduced cost of hardware acquisition.** In an environment of significant data growth and tight budgets, the promise of reduced hardware costs, simpler environments, and greater staff synergies are extremely compelling. As the cost of Ethernet continues to decline and performance gets better and better, the acquisition cost advantages of iSCSI will be increasingly compelling to prospective buyers.

## Addressing Significant Growth Of Data With The iSCSI Protocol

- **Simplification of SAN architecture and management.** Hiring FC experts is not getting easier as data growth continues. For user firms that want to manage their own environments and reduce their dependency on vendors for short-term staffing and costly consulting services, iSCSI can offer storage that leverages a more familiar skill set.
- **Unification between SAN and LAN.** There is significant potential for improved economies of scale from unification between SAN and LAN for both large and small organizations. More spare parts, better volume discounts, fewer server-side interfaces, reduced costs for cabling, along with other less tangible benefits of common management can add up to significant savings.
- **Greater familiarity with iSCSI options.** As more firms become used to iSCSI as an option for their enterprise storage environments, the resistance to the protocol appears to be waning. Storage is a very conservative segment of the data center, and buyers want to know that their choices are robust and broadly adopted. Momentum matters significantly here, and it appears that iSCSI is gaining traction, which is likely to cause further growth.