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The Storage Resource Guide:

iSCSI SANs – An Affordable, Enterprise-Class Alternative

Organizations of all sizes are faced with the same challenges when it comes to managing their storage – not enough capacity, a need for more efficient protection, and many others. However, one of the hottest technologies of the year, iSCSI SANs, can help you effectively manage your storage needs. With simpler management, lower costs and seamless growth, iSCSI is quickly becoming the more practical SAN choice over Fibre Channel in companies of all sizes.

You need a cost-effective, high-performance storage environment that's scalable for rapid growth and that will simplify your entire operation. Today, iSCSI storage solutions can deliver these enterprise-class features and performance gains. This E-Guide, featuring articles from Storage magazine, outlines iSCSI from the basics to best practices in the industry, including:

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Read about the industry's top storage products.
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IP-based SANs deliver the performance of Fibre Channel, but at a fraction of the cost.

iSCSI SANs are enterprise ready.
Are you ready for a better way to manage your storage?



QUALITY AWARDS II

EqualLogic emerges as top midrange array

In its first year in our survey, EqualLogic PS Series proved its mettle by unseating Sun FlexLine as the highest rated midrange storage array.

By Rich Castagna and Phil Goodwin

MIDRANGE STORAGE ARRAYS just might be the storage hardware category offering consumers the greatest breadth of choice. This year's Diogenes Labs—*Storage* magazine Quality Award for midrange arrays asked *Storage* readers to relate their experiences using 15 different midrange product lines, ranging from Apple Computer Inc. to Xiotech Corp. Our readers provided a total of 474 evaluations of these systems, with nine products garnering enough responses to be included as award finalists (see "Products included in the survey," p. 7). Readers rated these systems in five different categories—sales-force competence, product features, initial product quality, product reliability and technical support—using a 1.0-8.0 scale, where 8.0 is the most favorable score.

Our survey is designed to allow smaller vendors to compete on an equal footing with larger, more established vendors. We're always curious to find out if any emerging vendor is developing a "cult" following that might indicate a "best-in-class" opportunity for IT buyers. If the results of our 2006 survey are any indication, storage groups may want to take a look at EqualLogic Inc.'s PS Series arrays, which topped a wide field of products and eclipsed last year's winner Sun Microsystems Inc./StorageTek FlexLine. EqualLogic's win is especially noteworthy because it wasn't in last year's survey.

In the 2005 Quality Awards midrange arrays survey, we were struck by the high scores products received, indicating across-the-board satisfaction. In that survey, overall product scores ranged from 6.77 down to 5.75. This year's scores fell back to earth a bit, but still demonstrate general satisfaction among all of the midrange arrays. EqualLogic's overall score of 6.00 was only .05 better than that of Sun/StorageTek FlexLine (see "Overall rankings," p. 4). EqualLogic led the pack in four out of our five categories.

Sun/StorageTek FlexLine was a surprise winner last year, but its strong second-place showing this year proved that last year's results weren't a fluke. We separated the Flex-

Line and 6000 series in our survey, and the results were similar to those of last year, with the 6000 series dropping from fifth to sixth largely due to the addition of EqualLogic. The biggest positional changes occurred with Dell's CX Series (rebranded Clariion) and Network Appliance's (NetApp) Inc. FAS series. Dell fell from third place last year to ninth place this year, while NetApp dropped from second to fifth. Both vendors saw their scores decline by more than a full point. Hewlett-Packard (HP) Co.'s StorageWorks Enterprise Virtual Array (EVA) and Hitachi Data Systems (HDS) Corp.'s Thunder 9500 V improved to third and fourth, respectively. HDS' fourth-place finish was three positions higher than in 2005. While EMC Corp.'s Clariion and Dell's Clariion didn't track together in 2005, they did in 2006.

The largest number of responses was for EMC Corp.'s Clariion, with 118 evaluations; HP EVA was second with 67. The most represented industry was financial services, followed by healthcare and government/nonprofit. The distribution of respondents by company size was weighted slightly toward large organizations. The breakdown here was 28.3% from small organizations (less than \$100 million in revenue), 29.4% from midsize organizations (\$100 million to \$1 billion) and 42.3% from large organizations (more than \$1 billion). The majority of respondents are in operational roles, with only 6% from senior management. Storage administrators comprise 24.9% of the respondents, and 16.8% are storage managers.

Sales-force competence

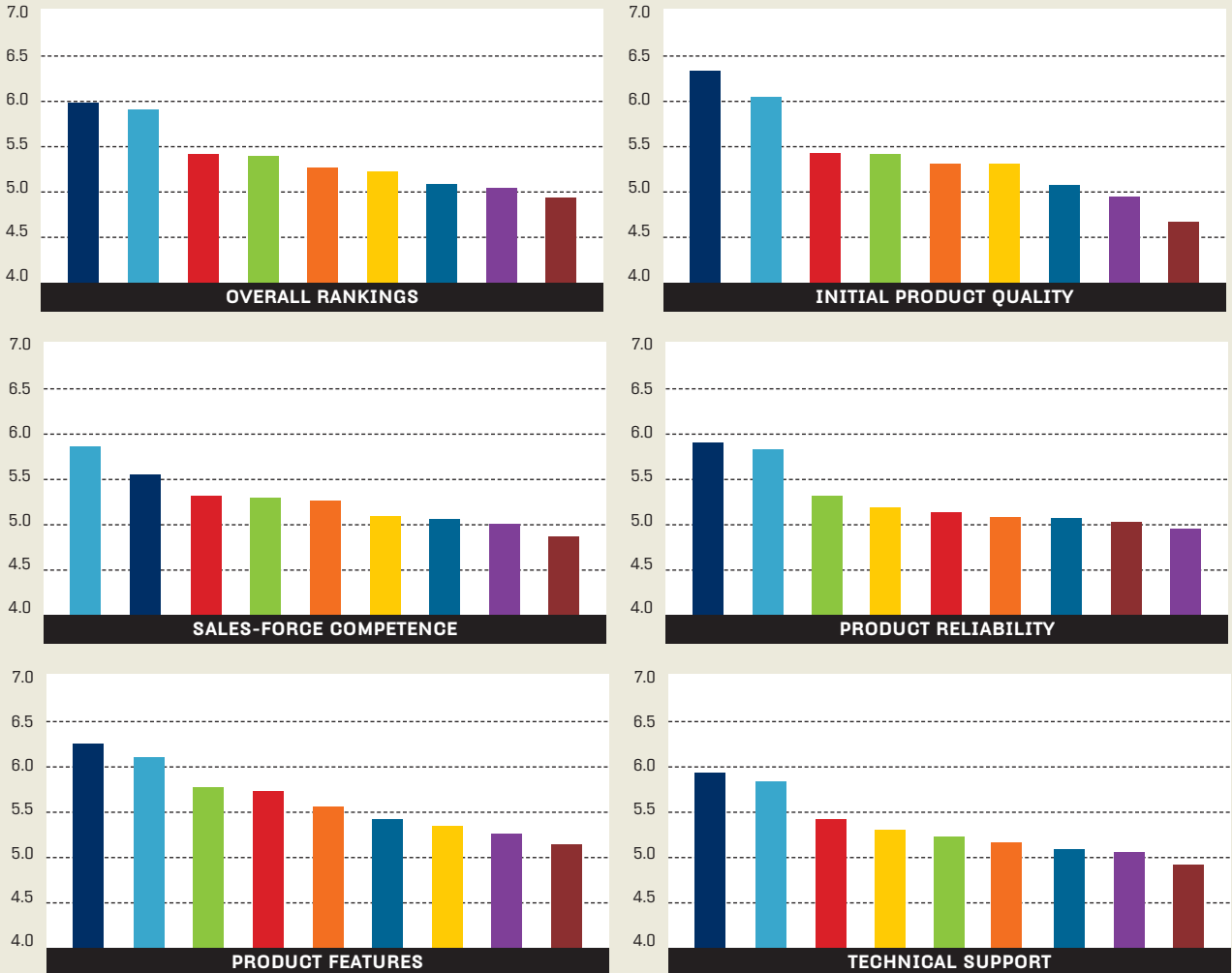
We've found a direct correlation between a vendor's sales-force competence and its overall results. Winners of prior Quality Awards have always finished in the top two in this category; in this survey, Sun's FlexLine topped all others with a 5.88 and EqualLogic was second with a 5.57, which was its lowest score in any category (see "Sales-force competence," p. 4). Comparing Sun's FlexLine results to the results for



**KERN WEISSMAN, DIRECTOR OF NETWORK SYSTEMS
AT VELOCITY EXPRESS IN NEW YORK, UNDERTOOK
AN EXTENSIVE EVALUATION PROJECT BEFORE PURCHASING
HIS FIRM'S SUN FLEXLINE ARRAY.**

Rankings of midrange arrays

- EqualLogic Inc.
- Sun Microsystems Inc. (FlexLine)
- Hewlett-Packard (HP) Co.
- Hitachi Data Systems Corp.
- Network Appliance Inc.
- Sun (StorEdge)
- IBM Corp.
- EMC Corp.
- Dell Inc.



Based on a 1.0-8.0 scoring scale

its 6000 series is interesting because the 6000 finished sixth with a score of 5.17. In the case of FlexLine, 50% of systems were purchased through resellers, whereas 90% of the 6000s were purchased directly from Sun. Eighty percent of EqualLogic’s systems were purchased through a value-added reseller (VAR).

Sun FlexLine scored a 6.07 for “My sales support personnel are knowledgeable.” It also scored very well for “My sales rep is flexible” (5.97). EqualLogic had its highest ratings for “My sales rep keeps my interests foremost” and “My sales support personnel are knowledgeable.” EqualLogic’s weakest area was for the statement “My sales rep understands my business” (5.33).

Kern Weissman, director of network systems at Velocity Express in New York, undertook an extensive evaluation project before purchasing a midrange array. “We eventually narrowed it down to EMC, Hitachi and StorageTek,” says Weissman. “We fully realized

that all three would have worked.”

Eventually, Velocity eliminated EMC because of less-than-satisfactory performance and Hitachi because of its complex software, and settled on a Sun FlexLine array. “We didn’t have any strong bonds with any particular vendor of storage, so they weren’t really able to influence our decisions,” says Weissman.

Similarly, Trevor Rickards, server and storage administrator at Calgary, AB-based Compton Petroleum Corp., did a careful analysis of alternatives when his company was looking to replace its IBM DS4300. “Price was part of the initial discussions,” says Rickards, “but as we got further in, realizing the differences and how they each price, we very quickly discarded that because it looked like it was going to be a moot point for the amount of storage we were looking to buy.” Although the firm’s experience with the IBM array was positive, it opted for an EMC Clariion.



Hard-nosed bargaining is sometimes called for. “If you have to pay list price for an [HP] EVA, I think you’re paying way too much,” says David Salbego, Unix and operations manager at Argonne National Laboratory in Illinois. “They’re very willing to negotiate, but does that mean I know if I’m leaving money on the table or not?”

Rami Elyas, a member of the enterprise data storage and recovery services group at Lilydale Inc. in Edmonton, AB, says they put their trust in their VAR. “We worked closely with the VAR and IBM,” says Elyas. “We used the reseller because they know our business pretty well and it was a nonbiased view—they didn’t have much to gain whether we bought IBM or Hitachi or EMC.”

Product features

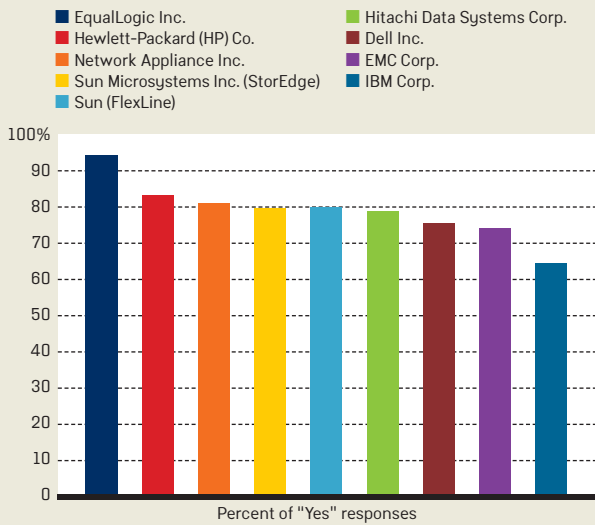
Software functionality differentiates storage arrays more than the underlying hardware. Thus, our survey places

an emphasis on software features, including snapshots, mirroring, remote replication and management tools. Respondents are asked to evaluate a product based on how well it meets their needs in these general areas, rather than by simply comparing product feature lists.

EqualLogic scored well in this category with a 6.26 rating—its second highest category score (see “Product features,” p. 4). PS Series users particularly like its snapshot functionality, giving it a solid 6.47 for the statement “This product’s snapshot features meet my needs.” It also received a 6.40 for “This product scales to meet my needs.” In fact, EqualLogic scored 6.0 or better for all statements in this section. This category generated the highest scores across the group, with even the low score—Dell’s 5.15—still quite respectable.

Compton Petroleum’s choice of an EMC Clariion was based largely on features. “The EMC had more flexibility for replication and allowed us to do better DR

All things considered, would you buy this product again?



planning,” notes the firm’s Rickards. Daily operations were also a key consideration. “Their management interface seems quite intuitive,” he says. “Their grouping of hardware monitoring is excellent—in a lot of ways much more detailed than what the IBM provided.”

Sun’s FlexLine received a 6.11 rating in the product feature category. FlexLine users responded to the statement “This product’s mirroring features meet my needs” with a 6.63. This was the highest statement score for any product; even though it was higher than any score posted by EqualLogic in this category, FlexLine’s overall category score was offset by four sub-6.0 ratings, the lowest of which was a 5.77 for “This product’s management features meet my needs.” These scores are still very solid, but substantially lower than FlexLine’s 7.03 average last year.

“It’s been extremely easy to expand,” says Velocity Express’ Weissman of his firm’s Sun FlexLine. “We went from 2TB to 4TB.” He also likes how he can reconfigure without disrupting production. “One of the best things about it is how you can dynamically change your settings without taking anything down,” he adds.

Initial product quality

The initial product quality section brought out both the highest and lowest category scores of any section. Scores ranged from EqualLogic’s 6.30 down to Dell’s 4.67 (see “Initial product quality,” p. 4). EqualLogic had very consistent scores across the category, ranging from a low of 6.13 for “This product was installed without defects” to a high of 6.40 for “This product offers good value for the money.” Scores for Sun’s FlexLine were similarly consistent across the range of statements. As with EqualLogic’s PS Series, Sun FlexLine recorded its highest score for the statement “This product offers good value for the money” (6.30).

Dell prides itself as a low price “value” leader in the

Windows server and PC markets, but this perception apparently hasn’t translated into the storage array market. In our survey, Dell scored a 4.64 on our “value” statement, which was lower than EMC’s rating of 4.77 for the same statement with identical hardware. The value perception might be influenced by Dell’s other scores in this category, all of which were below 5.0 except for the statement “This product installed without defects” (5.00). In the survey, the overall perception of value very closely matched the overall order of finish.

Product reliability

“It’s astounding to me, but I have not had one single disk failure yet,” says Weismann, referring to Velocity Express’ Sun FlexLine array after nearly two years of use. That level of reliability might be a stretch for most storage managers, but it underscores the faith we place in the reliable operation of installed hardware.

In contrast to the initial product quality category, which had the widest scoring spread, product reliability had the narrowest. In fact, less than one point separated EqualLogic’s top finish (5.92) from EMC’s 4.98 (see “Product reliability,” p. 4). All other vendors finished above 5.00. EqualLogic recorded its highest ratings (6.20) in this category for two statements: “This product meets my service-level requirements” and “This product requires very few unplanned patches.”

In all of our prior surveys, products that did well on the statement “Patches can be applied nondisruptively” also did well overall. This proved true once again. EqualLogic’s lowest score in this section was for this statement (5.20), which might indicate a low overall score. However, the good news for EqualLogic was that the other vendors were rated even lower in this area (below 5.0) with the exception of Sun FlexLine, which had a 5.40. HP’s EVA and EMC’s Clariion recorded scores of 4.46 and 4.44, respectively.

Patches and firmware upgrades continue to be a thorn in the side of midrange array administrators. “For the money you’re paying—you’re well into six figures, if not more—you shouldn’t have to take these things down or quiet all the hosts on the SAN just so that you can do a firmware upgrade,” says Salbego at Argonne National Laboratories, which has two HP EVAs installed. “That’s an industry-wide issue, not just HP EVA.”

Technical support

In most of our surveys, we’ve been surprised to find that product support hasn’t been a big differentiator. However, this year’s midrange survey provided as broad a spectrum of scores as the other categories. EqualLogic was again the winner, posting a 5.96 (see

“Technical support,” p. 4). Sun FlexLine finished a close second with a 5.85. Sun’s 6000 series had its highest ranking in this category, placing two spots behind its FlexLine sibling with a 5.31. This scenario was exactly the same as last year’s for that company’s products.

Because many midrange array systems are sold through resellers, we were interested in how those partners were viewed by customers. In many cases, the reseller provides initial (Level 1) technical support. When we posed the statement “My vendor’s third-party partners are knowledgeable,” EqualLogic recorded a score of 6.07. Moreover, the company’s partners can apparently resolve most problems themselves, as users awarded the statement “Problems rarely require escalation” with a score of 6.13.

Although EqualLogic had the best scores for partner knowledge, it was hardly a runaway. Both HP and Sun FlexLine scored 6.00 on the knowledge of their partners. “[Sun FlexLine’s] onsite people are just absolutely fantastic,” says Velocity Express’ Weissman. “They go over and above.” Even IBM, which otherwise had lackluster results, recorded a solid 5.75 in this area. “Whenever I have called their support, they’ve been excellent,” says Compton Petroleum’s Rickards. “They’ve set up the exact scenario that I’ve got in their lab and have always been able to duplicate the problems.”

Elyas at Lilydale Inc., which is also an IBM DS4300 user, says, “The support has been really good. We’ve always been able to get the parts here within a day.”

In our survey, the differentiator was the need to escalate problems. For this statement, Sun fell to a 5.53, HP to 5.30 and IBM to 4.67.

Would you buy the same system again?

When we ask respondents to tell us if they’d make the same purchase decision again, we rarely find a correlation between a positive response and the order of finish. Buying decisions are often influenced by many factors beyond the technical attributes of a product. However, this survey yielded a reasonably close correlation. Ninety-three percent of EqualLogic’s customers said they’d make the same purchase decision again (see “All things considered, would you buy this product again?” p. 6). Most of our other vendors had positive responses that ranged between approximately 75% and 82%. Sun’s FlexLine and 6000 series both received an 80% positive response rate, despite very different placements in the overall standings. IBM trailed the field significantly, with just 62.5% of its

Products included in the survey

The following vendors and products were included in the 2006 Diogenes Labs-Storage magazine Quality Award survey for midrange arrays:

Apple Computer Inc.
Xserve RAID*

BlueArc Corp. Titan 2000 Series*

Compellent Technologies
Storage Center*

Dell Inc. CX Series

EMC Corp. Clariion CX series

EqualLogic Inc. PS Series

Hewlett-Packard (HP) Co.
StorageWorks Enterprise
Virtual Array (EVA) series

Hitachi Data Systems Corp.
Thunder 9500 V Series

IBM Corp.
FAS*t*, DS4000 or DS6000

LeftHand Networks Inc. SAN/iQ*

Network Appliance Inc.
FAS200 or FAS900 Series

Pillar Data Systems Axiom 500*

Sun Microsystems Inc./
StorageTek D-series, FlexLine
FLA200 or FLA300

Sun StorEdge 6920

Xiotech Corp. Magnitude 3D*

*Didn’t receive a sufficient number of responses to be included in the final survey results.

About our survey

The Diogenes Labs-Storage magazine Quality Awards are designed to identify and recognize products that have proven their quality and reliability in actual use. The results are derived from a survey of qualified Storage readers who assessed products in five main categories: sales-force competence, product features, initial product quality, product reliability and technical support. Our methodology incorporates statistically valid polling that eliminates market share as a factor. Our objective is to identify the most reliable product on the market regardless of vendor name, reputation or size. Products are rated on a 1.0-8.0 scale, where 8.0 is the most favorable score.

For this year’s midrange arrays survey, 354 respondents provided 474 valid system evaluations. This year’s response rate is about 10% higher than last year’s, but carries the same +/- 5% margin of error with a 95% confidence factor.

midrange users indicating a willingness to repurchase. This represents a 17.5 point drop for IBM from 2005.

In cases where respondents have two or more midrange systems, we asked them to evaluate each one. In these cases, we compare the scores to determine which system is preferred in a head-to-head match-up. EqualLogic again came out on top, winning four out of seven such comparisons (57.1%). FlexLine was preferred in 52.4% of cases (11 out of 21), while EMC Clariion was preferred 41.3% of the time (26 out of 63). Dell Clariion was preferred just 22% of the time (six out of 27). These results don’t relate to future buying intentions, but rather offer the perfect vision of 20/20 hindsight.

Kudos to EqualLogic

Clearly, users of the EqualLogic PS Series feel they’ve purchased something special. Time will tell if the company can continue to deliver in a top-flight manner ... but the top is always a good place to start. ☉

Rich Castagna is Editor-in-Chief of Storage. Phil Goodwin is president of Diogenes Analytical Laboratories Inc.

*iSCSI SANs,
hardware-based
tape encryption,
high-capacity
disk drives,
virtualization and
thin provisioning
will be must-have
technologies
next year.*

By Alan Radding

HOT TECHNOLOGIES FOR 2007

IF THE STORAGE INDUSTRY IS ANYTHING, it's dynamic. But some things never change: the need for more storage capacity and the endless search for better, less tedious ways to protect data.

Storage magazine's editors have reviewed technology developments, product introductions and storage standards (see "Storage standards to watch in 2007," p. 22) over this past year to identify those we expect will become the hot storage technologies in 2007. Some of these technologies, like iSCSI SANs and virtualization, have appeared in these pages for years. This coming year, however, both appear poised to cross a major threshold. Other selections, like hardware-based tape encryption, are based on new technologies that attempt to address a single issue: stemming the tide of identify theft and misappropriation of corporate secrets resulting from lost data tapes.

STORAGE STANDARDS TO WATCH IN 2007

Storage standard	Description
Fabric Application Interface Standard (FAIS)	A standard developed by the INCITS T11 committee, FAIS provides a standard interface to intelligent Fibre Channel (FC) switches. It allows a management product to address any FAIS-compliant intelligent switch without knowing the API of the specific switch. As intelligence moves into the network in the form of smart switches, this standard makes it possible for management application vendors to write to a single interface, yet run on intelligent switches from different vendors.
N_Port ID Virtualization (NPIV)	Another T11 standard, NPIV enables multiple virtual servers to share I/O through a single physical port by providing a means of assigning multiple FC IDs to a single N_Port, thereby enabling zoning and masking of virtual hosts. The major switch and component vendors—Brocade Communications Systems Inc., Cisco Systems Inc., Emulex Corp., McData Corp. (in the process of being acquired by Brocade) and QLogic Corp.—support NPIV. This standard makes it possible for multiple virtual hosts to share a single physical port yet be treated as if each virtual host had its own physical port, which is necessary for masking and zoning.
Storage Management Initiative Specification (SMI-S)	Version 2 of SMI-S adds specifications for host-based controllers, storage enclosures, support for file-system quotas, volume protection, and consistency management for snapshot and replication.
Federal Information Processing Standard (FIPS) 140-2	FIPS 140-2 is a government mandate that specifies encryption requirements for protecting sensitive information within computer and telecommunications systems. It defines four levels of security and 11 areas related to the secure design and implementation of the cryptographic module. Support for this standard is essential for any product used in the government, and it's being widely adopted by nongovernment organizations that might someday do business with the government.

Thin provisioning, long championed by a single storage system vendor, 3PAR, has gained the attention of many more vendors and is showing up in more products. We expect thin provisioning to become an essential disk-array feature because it saves money by avoiding the need to overbuy storage. Disk-drive technology continues to defy predictions of how much data can be packed onto a disk. The storage industry will introduce 1TB disk drives in 2007 and even greater capacity drives will follow soon after. Other new technologies—data deduplication, continuous data protection (CDP), data classification and information lifecycle management (ILM)—look promising, but need more time to mature and gain acceptance (see “Not hot in 2007,” p. 24).

Our picks for the hot storage technologies in 2007 follow. Specific vendor or product references are representative examples of each category.

iSCSI SANs

Midsized organizations were early adopters of iSCSI because of its low cost and easy implementation. Previously, 1Gb/sec was about as fast as IP networks ran, but that didn't matter. “Performance wasn't a concern. The big benefit was cost,” says Steve Meckling, net-

work services administrator at Shiloh Industries Inc., a manufacturer of auto-industry components in Valley City, OH.

iSCSI has been steadily gaining momentum. According to a recent report from Framingham, MA-based research firm IDC, the iSCSI protocol is expected to capture more than 10% of storage systems revenue and an even greater percentage of capacity by 2008. In the early days of storage networking, large enterprises viewed iSCSI SANs as “training wheels” that would someday grow into a Fibre Channel (FC) SAN for industrial-strength performance. FC has steadily progressed from 2Gb/sec to 4Gb/sec. But IP/Ethernet recently leapfrogged FC in the performance race with 10Gb/sec Ethernet over copper. At 10Gb/sec, iSCSI offers a faster pipe than FC, and will continue to hold that edge even when FC gets to 8Gb/sec in a couple of years.

However, iSCSI was never just about performance. “The elevator pitch for an iSCSI SAN is that it saves money by using Ethernet; but what users really like are the features they get automatically with iSCSI SANs—load balancing, snapshots

and more,” says Stephen Foskett, director of strategy services at GlassHouse Technologies Inc., Framingham, MA. “iSCSI SAN is definitely happening.”

For the enterprise, the issue now is coexistence. “Places with FC SANs are installing iSCSI SANs, too. They want alternatives. iSCSI won't replace FC; rather, it lets large companies make storage decisions based on business needs,” says Mike Karp, senior analyst, Enterprise Management Associates, Boulder, CO. “Almost every storage product vendor is supporting iSCSI these days,” he adds. Even enterprise storage vendors like EMC Corp. and IBM Corp. have embraced iSCSI.

In terms of cost, iSCSI SANs still have the edge over FC. For example, Shiloh Industries currently operates 17TB of storage using four EqualLogic Inc. iSCSI SANs, which cost approximately \$40,000 each.

Hardware-based tape encryption

The reasons to encrypt data became obvious this year: a succession of incidents in which backup tapes disappeared; federal directives mandating government agencies encrypt stored data; and 34 states currently requiring companies to inform anyone whose identity might have been compromised by lost data.

There are a number of ways to encrypt stored data—at the host, through a network-based appliance, within the storage device or tape library—but the tape device promises the fastest performance with the least impact. We may be going out on a limb with this prediction, but we expect hardware-based tape encryption to become the preferred choice of the largest enterprises with mainframe-based data centers.

These data centers back up sensitive data for hundreds of thousands, if not millions, of customers. They need reliable performance and transparent operations. “These are the companies that manage data on tape for the long term,” says Robert Amatruda, IDC’s research director, tape and removable storage.

For the rest of the IT world, hardware-based tape encryption will appear in the next generation of LTO devices, LTO-4, probably beginning sometime in 2007. The LTO-4 products will probably involve little or no price premium over today’s nonencrypting LTO drives, notes Robert Abraham, president and senior analyst, Freeman Reports, Ojai, CA.

For big data centers, IBM and Sun Microsystems Inc./StorageTek introduced encryption built into their tape drives. IBM introduced data encryption on System Storage TS1120 tape drives. These drives encrypt data at tape speed, avoiding the need for host-based encryption that eats host CPU cycles. Sun offers the StorageTek Crypto-Ready T10000 tape drive, which supports a variety of operating systems, including z/OS, Solaris and Windows.

The enterprise products don’t come cheap. The Sun

product costs \$37,000, plus a \$5,000 charge to turn on the encryption feature. The IBM product is \$35,000. Encryption appliances like those from Decru Inc. (now owned by Network Appliance Inc.), NeoScale Systems Inc. and Vormetric Inc., as well as upcoming LTO-4 drives will be less expensive than tape-encryption drives from IBM and Sun; however, IBM’s and Sun’s products appeal to enterprises that run large mainframe data centers. “These data centers want an end-to-end storage solution,” says Amatruda. “They want native tape drives and don’t want the uncertainty of dealing with little companies.”

While the enterprise products aren’t for every organization, once LTO-4-based tape encryption becomes available, expect tape-drive encryption to become more of a commodity with appropriate pricing.

High-capacity disk drives

Various experts periodically predict that magnetic disk is approaching its capacity limit, as the magnetic dots can’t get smaller or be packed closer together. Yet engineers always find a new way to stuff more data onto a disk.

“Think of it as the relentless march of Moore’s Law,” says Peter Steege, enterprise disk segment marketing manager at Seagate Technology LLC. This year, perpendicular disk-recording technology, which stacks data vertically on the disk, is enabling Moore’s Law.

Using perpendicular technology, Seagate expects to introduce a 1TB disk drive in 2007 with larger disks to follow. A 2TB disk drive within a few years is quite likely. Current enterprise-class SATA drives boast a 1.03 million hour mean time between failures (MTBF). The 1TB drives will have a 1.2 million hour MTBF. Other vendors, primarily Maxtor Corp. (acquired by Seagate) and Western Digital Corp., are expected to follow with similar capacity disks.

The 1TB enterprise-class SATA disk drives are coming along just as data centers are feeling the squeeze to store more data while conserving rack space, floor space and energy. “The array vendors are asking for bigger capacity drives,” says Steege. A 750GB drive requires no more power than a 500GB drive. A 1TB drive will deliver 50% more capacity per watt than existing drives using the same enclosure.

Although extremely large drives present challenges in terms of RAID rebuilding time, storage managers are welcoming them. “We’re definitely interested in the 1TB disks,” says Seth Mitchell, infrastructure team manager at Slumberland Inc., which has a chain of more than 100 mattress stores in the Midwest. Today, Slumberland uses 500GB FC disks. The larg-

NOT HOT IN 2007

<i>Technology</i>	<i>Barrier</i>
Data deduplication	The benefits are obvious, but complicated issues around distributed data and backup need to be resolved. Maybe next year.
Continuous data protection (CDP)	Hailed as a block-data recovery innovation, CDP vendors are now shifting to file-based data. Expect CDP to become part of more widely used backup, disaster recovery and replication products.
Data classification	Data classification is critical to achieving data tiering, regulatory compliance and information lifecycle management. Most organizations, however, are only just starting the necessary internal investigation of these fairly new products.
Information lifecycle management (ILM)	Everyone wishes it were ready, but too many pieces of the solution, like data classification, aren’t here yet. Analysts are saying 18 to 24 months. Keep your fingers crossed.

REPORT CARD ON OUR 2006 PREDICTIONS

2006 prediction	What happened
E-mail archiving	If there's a large or midsized company today that's not implementing or considering e-mail archiving, it must not have a functional legal department.
Remote-office support	Under pressure to rein in IT costs, remote offices have become the first to lose local tech support. Hello consolidation.
Serial-attached SCSI (SAS)/SATA	SATA has become ubiquitous for second- and third-tier storage. SAS is steadily gaining traction. For Tier-1 storage, parallel SCSI and Fibre Channel still rule.
Virtual tape, disk-based backup	The performance benefits of disk-based backup are undeniable, but tape still holds the price and portability advantage. Both have a place in the enterprise.
Midrange arrays	Given the flurry of midrange array product introductions and enhancements from leading vendors, storage managers purchased a lot of them in 2006 and, according to our surveys, mostly liked what they bought.

er drives will save the store money because its array vendor, Compellent Technologies, charges by the spindle. Expect to see the drives deployed in high volume, low-performance situations such as archiving, data retention, compliance and backup to disk.

Virtualization

Two years ago, we picked virtualization as one of the hot technologies for 2005. Well, as the old saying goes, "If at first you don't succeed, try, try again." (See "Report card on our 2006 predictions," this page.) In 2007, we expect virtualization to embed itself throughout the infrastructure. "When virtualization is used right, it will be everywhere," says GlassHouse Technologies' Foskett.

Virtualization shows up in practically every part of networked storage and is a central component to any unified storage strategy. Any automated heterogeneous storage management strategy will require a virtualization layer to mask the complexities and intricacies of the underlying storage devices. We don't think 2007 will see the issue of where to put virtualization resolved, but we do believe that there won't be any question about its value.

File virtualization will be especially hot in 2007. With NAS growing rapidly in the data center, Robert Stevenson, managing director, storage practice at New York City-based TheInfoPro Inc., says in 2007 storage managers will focus on improving their file content with file virtualization products such as Acopia Networks Inc.'s Adaptive Resource Switch (ARX) and EMC's Rainfinity.

Thin provisioning

The best way to understand thin provisioning is to think about airline overbooking. By analyzing passenger behavior, airlines know that a certain number of passengers won't show up at departure. So they sell more seats than they have available.

"[Thin provisioning] is no different than overbooking," says Greg Schulz, founder and senior analyst, The StorageIO Group, Stillwater, MN. "You tell each host that it has more storage available to it than it actually has, knowing that it's unlikely to need all that storage anytime soon."

The key to thin provisioning is to track usage closely and install more physical capacity before you need it. "A lot of vendors are offering thin provisioning today. The difference is how well they track and predict capacity usage," says Schulz.

3PAR pioneered thin provisioning, but other vendors, such as Compellent, LeftHand Networks Inc. and Network Appliance have jumped in, says Mark Bowker, analyst, Enterprise Strategy Group, Milford, MA. Pillar Data Systems Inc. will add thin provisioning to its Axiom array early next year and Bowker expects more companies to do the same.

Thin provisioning differs from storage on demand. With storage on demand, the extra capacity is physically resident in the array, but not accessible until you purchase the key and provision it. In thin provisioning, there's no extra physical capacity. When you need more physical disk, you just plug it into the array when it arrives. As far as the hosts are concerned, the capacity, fully provisioned, has always been there.

Poised to take off in 2007

Those are the five technologies we feel will be "hot" in 2007. Large enterprises with mainframe data centers will find tape-based hardware encryption an enticing solution to securing corporate data. Small and midsized organizations have gravitated to iSCSI SANs and more will follow. Now large organizations can add iSCSI SANs to their infrastructure to give them options when aligning storage with business needs.

Almost every organization can take advantage of large-capacity disk drives for backup, compliance or archiving. Thin provisioning provides what amounts to just-in-time storage acquisition, which saves money. Finally, even though we've listed virtualization as a hot technology before, trust us: This is the year virtualization, especially file virtualization, *really* becomes hot. ☉

Alan Radding is a frequent contributor to Storage.

▶▶ AirClic

A top wireless provider's real-world experience with deploying advanced SAN features on iSCSI.

AIRCLIC® BUILDS TIERED STORAGE ENVIRONMENT WITH EQUALLOGIC® SAS AND SATA ARRAYS

AirClic, Inc., headquartered in Newtown, Pennsylvania, develops software and provides mobile information services to more than 500 customers worldwide. The company was founded in 1999, and today its 50 employees are primarily focused on developing mobile handset solutions that provide a simple, cost-effective means for a mobile workforce to capture and exchange information using wireless devices. Captured customer data flows back through AirClic's hosted Oracle®-based middleware application from which customers can access data through a simple network request. With AirClic archiving their data for up to 30 days and making it available to them, customers avoid having to manage infrastructure that directly integrates to the handsets.

PERFORMANCE AND SCALABILITY FOR RAPID GROWTH

Customer data in AirClic's Oracle database must be available 24 x 7, requiring a dependable, high performance storage infrastructure. It was clear to Vice President of Technology Andy Monroe that AirClic's direct attached storage was not a viable long-term solution in terms of performance or scalability for the rapidly growing business. His original perception was that only a Fibre Channel SAN would support the performance requirements of his highly transactional database,

but being in a wireless business where everyone understood TCP/IP, he decided to take a look at iSCSI solutions after evaluating mid-range arrays from EMC Corporation, Network Appliance, Inc., and others.

EQUALLOGIC SIMPLIFIES ENTIRE OPERATION

According to Monroe, selecting EqualLogic was an easy decision. He particularly remembers the sales representative saying that he would have an array up and running in 20 minutes – Monroe assumed it was just a sales gimmick, but was thrilled to discover it was true. Another vendor had taken six hours to get an array up and running, and even then Monroe's staff spent a great deal of time setting up a volume. "I have a very intelligent staff," he says, "and the fact that it wasn't obvious how to create a volume and get it to the server just boggled our minds." EqualLogic's ease of administration is a big benefit. It allows Monroe to use existing knowledge assets and not have to hire or train staff on Fibre Channel. The architecture of the EqualLogic PS Series arrays enables him to scale easily without downtime. The other vendors could not offer this, and for an organization that is growing rapidly and requires "five nines" availability of customer data, non-disruptive scalability is key.



COMPANY:

A leading provider of mobile business process solutions

INDUSTRY:

Software

PLATFORM:

Microsoft® Windows®
2003, Red Hat® Linux

APPLICATIONS:

Oracle9i, 10g, DataGuard;
Microsoft SQL Server,
Exchange; VERITAS®
NetBackup™ Enterprise;
VMware®

CHALLENGES:

Needed high-performance storage environment for growing highly transactional database requiring 5-9s availability

SOLUTION:

Tiered EqualLogic environment: PS3800XV arrays (15K RPM SAS drives) support high transaction data, PS100E arrays (7200 RPM SATA drives) support e-mail, files, and other databases

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Visit www.airclic.com

Monroe originally purchased two PS100E arrays to provide a networked storage environment only for the Oracle database supporting the mission-critical middleware. Oracle is run with two servers, a primary and standby that can be used for load balancing and failover. To ensure safe and easily recoverable data, Monroe then connected two other sets of primary/standby Oracle servers to the EqualLogic array for data mart and reporting applications. Realizing that simple management and scalability could change his entire operational infrastructure, Monroe decided to virtualize as many servers as possible using VMware and EqualLogic, ultimately consolidating 25 standalone servers for applications ranging from pre-production testing, e-mail and corporate accounting onto 5 servers running VMware. Says Monroe, "We would never have done that without the EqualLogic SAN – that's what really motivated our server consolidation."

MULTIPLE EQUALLOGIC TIERS MATCH ARRAYS WITH SERVICE LEVELS

Monroe was able to build a tiered storage environment by purchasing two additional EqualLogic arrays, this time selecting the new high-performance PS3800XVs. Because the hosted middleware data is turned over very quickly with large amounts of random I/O, AirClic needs very fast, high-performance storage rather than lots of space. The 15K RPM SAS disk drives in the arrays deliver that, outperforming Fibre Channel arrays from larger vendors in apples-to-apples testing Monroe set up. To ensure support the performance levels needed for his Oracle databases. He conducted benchmark tests with Oracle's Orion Calibration utility using small random I/O workloads to simulate transactions. On an EqualLogic PS3800 and an EMC® CX-500i, both with the same number of disks running at the same speed – 15K RPM, Monroe says, "We were seeing about 4,000 IOPS on the EMC unit and about 4,200 IOs per second (IOPS) on the EqualLogic unit."

"Tiered storage is a really big win for us – we just plug it in, and anything we need will migrate there automatically. We can scale independently according to our needs." Other non-transactional data including Exchange, engineering designs, other Oracle data-

"Tiered storage is a really big win for us – we just plug it in, and anything we need will migrate there automatically. We can scale independently according to our needs."

*– AirClic's Vice President of Technology,
Andy Monroe*

bases, and VMware servers reside in another storage tier, using the PS100E arrays with 7200 RPM SATA disk drives. "Anything of value we now put on the SAN, including source code, documentation, everything," says Monroe.

Databases are protected with Oracle DataGuard asynchronous replication to an off-site location. Snapshots using EqualLogic's built-in capabilities are completed for extra protection in addition to standard backup to tape. Says Monroe, "We hadn't thought about using snapshots before, but now I'm pretty much addicted to it. We take a snapshot before doing any kind of maintenance – the other night a server upgrade failed, so we restored to a snapshot and were back up and running in a matter of minutes."

Monroe says the EqualLogic SAN's impact on AirClic has been dramatic. The system is simple, fast to set up, and easy to scale and manage. Monroe and his staff no longer worry about the impact of the company's success on storage infrastructure – knowing they can scale easily without disruption is a tremendous relief. Says Monroe, "Storage is something we don't have to think about any more – so we can focus more on our customers and less on infrastructure. It's taken a big load off of our operations."

SIMPLIFYING NETWORKED STORAGE

EqualLogic PS Series solutions deliver the benefits of storage consolidation in an intelligent, enterprise-class storage system that is easy to install, manage and grow. Let us show you what simplifying networked storage can mean for your business, visit our web site at www.equallogic.com.



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Unstoppable iSCSI

iSCSI is not only here to stay, it's likely to take a leading role in many storage shops.

WE'VE WATCHED iSCSI grow from a standard into a real technology that has spawned specific products, to the point where there are a large number of vendors providing iSCSI products. More importantly, we're seeing user adoption of iSCSI growing rapidly.

The vast majority of iSCSI customers still have Fibre Channel (FC) in their SANs. However, iSCSI has gained a substantial foothold without necessarily displacing FC, and the iSCSI juggernaut appears to be unstoppable.

There's a great deal of value in networking storage, but the majority of IT shops still use DAS to some extent. FC has failed to reach the ubiquity of other computer networking technologies largely because of its cost and complexity. The Enterprise Strategy Group (ESG) believes that IP-based networking, with iSCSI as a fundamental technology, has the potential to raise the level of adoption to reach the masses. We're just on the threshold of iSCSI becoming a prevalent and widely adopted technology, but there are signs the technology could surpass FC in the not-so-distant future.

iSCSI has momentum

FC isn't about to go away, but over time it could be relegated to just high-end applications. The continued existence of FICON (and even ESCON) is evidence that technologies remain useful despite the introduction of attractive alternatives. With so much invested in current FC infrastructures and the internal politics of who "owns the network" with iSCSI such a strong factor, the continued use of FC is assured for a long time to come. The technology is making strong inroads with companies of all sizes and among all industries.

ESG performed in-depth research focusing on iSCSI adoption, surveying 511 companies of all sizes and across all industries. Here's a summary of our findings:

- **iSCSI ADOPTION IS IN THE "EARLY MAINSTREAM" STAGE.** Of the 511 companies and organizations that were

surveyed, 17% have iSCSI deployed in a production environment and another 20% plan to deploy an iSCSI SAN. Early adopters and planned adopters represent 37% of the companies we surveyed. Based on these statistics, ESG believes iSCSI is well within the "early mainstream" of market adoption.

- **THERE'S SIGNIFICANT ACTIVITY ACROSS ALL MARKET SEGMENTS, BUT ADOPTION IS HIGHEST IN COMPANIES WITH BETWEEN 1,000 AND 4,999 EMPLOYEES.** Twenty-two percent of small enterprise organizations (those defined as having 1,000 to 4,999 employees) surveyed have deployed an iSCSI SAN, followed by 19% of large enterprise (20,000 or more employees) firms, 17% of midmarket (100 to 999 employees) companies, 12% of enterprise (5,000 to 19,999 employees) firms and 11% of small organizations (fewer than 100 employees).



• **LOWER COSTS AND EASE OF MANAGEMENT ARE KEY REASONS WHY EARLY AND PLANNED ADOPTERS ARE EMBRACING iSCSI.** Lower capital and operational costs are the primary reasons respondents have implemented—or plan to implement—an iSCSI SAN. The ease-of-use aspects of iSCSI also rank very highly. Respondents feel iSCSI will provide lower operating costs, ease of deployment and management, and will allow them to leverage their current IT skills, which equates to iSCSI being easier to manage over its life cycle vs. Fibre Channel.

• **EARLY ADOPTERS ARE SATISFIED OR VERY SATISFIED WITH THEIR iSCSI SANs.** iSCSI early adopters rated every aspect of their iSCSI SANs positively, including network performance, operational costs, capital costs, app performance, reliability for mission-critical apps, interoperability, ease of installation and ease of management.

• **iSCSI PERFORMANCE IS STILL MISUNDERSTOOD.** Many of those who plan to implement iSCSI storage have concerns about performance, but still intend to go forward with iSCSI SANs. Some nonadopters would reconsider deploying an iSCSI SAN if they had documentation proving iSCSI performance was sufficient for their needs.

Lower capital and operational costs are the primary reasons respondents have implemented—or plan to implement—an iSCSI SAN.

• **EARLY ADOPTERS VALIDATE THAT PERFORMANCE ISN'T AN ISSUE.** Our quantitative research and qualitative interviews consistently confirm that iSCSI performance isn't an issue. Eighty-seven percent of early adopters were very satisfied or satisfied with iSCSI network performance, while 82% were very satisfied or satisfied with iSCSI application performance. Early adopters ranked network performance and application performance as the two highest attributes in overall customer satisfaction, hopefully helping to dispel the concerns of planned adopters and nonadopters.

• **CURRENT iSCSI SANs ARE USED MAINLY FOR TIER-1 AND TIER-2 APPLICATION PRIMARY STORAGE.** Fifty-eight percent of early adopters use iSCSI for their Tier-2 application primary storage, with 50% using iSCSI for their Tier-1 app primary storage, an indication that users are confident in the capabilities of their iSCSI SANs. Planned adopters are also principally interested in using iSCSI for Tier-2 application primary storage, but a significant percentage (36%) are planning to use iSCSI for Tier-1 primary application data. Early adopters and planned adopters currently use or expect to use iSCSI for a number of other apps, including secondary storage, digital archiving and disaster recovery.

• **iSCSI DEPLOYMENTS ARE ADDITIVE TODAY, BUT THE DATA INDICATES THAT iSCSI WILL REPLACE FC SANs OVER THE NEXT THREE YEARS.** While the majority of early adopters have implemented iSCSI for separate SAN buildouts, this will change over the next three years. The majority of early

iSCSI adopters who also have an FC SAN infrastructure plan on replacing FC SAN deployments over the next three years significantly or to some degree. This is a strong and clear indication that early adopters of iSCSI are gaining confidence in the technology and that it's proven its value over FC.

• **FILE-BASED CONTENT IS THE NO. 1 APPLICATION TYPE FOR CURRENT AND PLANNED iSCSI SANs.** Some 74% of early adopters are using their iSCSI storage for file-based content, followed by database (45%), email (44%) and collaboration (37%) applications. Planned adopters attached the same level of priority to these application types.

• **10 GIGABIT ETHERNET WILL INFLUENCE iSCSI ADOPTION.** Several data points from ESG's research indicate a relationship between the deployment of 10Gb Ethernet and increased adoption of iSCSI. First, ESG discovered a direct relationship between usage of and interest in iSCSI and usage of and interest in 10Gb Ethernet. Second, ESG found that 26% of iSCSI planned adopters say they wouldn't purchase an iSCSI storage system without support for 10Gb Ethernet, and that more than half of these planned adopters would prefer 10Gb Ethernet support. Finally,

25% of iSCSI nonadopters say that deployment of 10Gb Ethernet in their organization would cause them to reconsider iSCSI.

• **NONADOPTERS FIND EXISTING NETWORKED STORAGE SOLUTIONS MEET THEIR CURRENT REQUIREMENTS BUT WOULD RECONSIDER DEPLOYING iSCSI AT SOME POINT.** The main reason why most nonadopters don't currently plan to implement an iSCSI SAN is their belief that their existing SAN and NAS solutions meet their current requirements. These users are also clearly interested in maximizing the investment their organizations have made in existing SAN/NAS resources. This apparent concern over investment protection is reflected in the fact that many of these nonadopters say they would reconsider iSCSI once their current networked storage assets reach end of life or full depreciation.

Just the tip of the iceberg

This ESG research study finds iSCSI to be a viable alternative to FC that users are implementing in increasingly larger numbers. It's being used in a number of ways, including mission-critical applications within companies and organizations of all sizes and across different industries. iSCSI will continue to advance and flourish with accelerating adoption in the years ahead. 🍷

Tony Asaro is a senior analyst for Enterprise Strategy Group, Milford, MA.

WHY iSCSI?

IP-based SANs deliver the performance of Fibre Channel, but at a fraction of the cost.

iSCSI – THE NEW STANDARD FOR NETWORKED STORAGE

Although the price of storage hardware has been decreasing, the voracious demand for data and the accompanying increase in administrative costs threaten to swamp all other factors in reducing the total cost of ownership. The compound annual growth rate for storage is 68%, while administrative costs run seven times the cost of hardware. Mid-range businesses are stuck with inefficient direct-attached storage (DAS) or forced to invest resources in complex and often proprietary technologies. There is also no guarantee that hardware will work together, and storage management remains cumbersome, at best. What is needed is a standard for networked storage that brings the benefits of consolidated storage to a broad range of businesses.

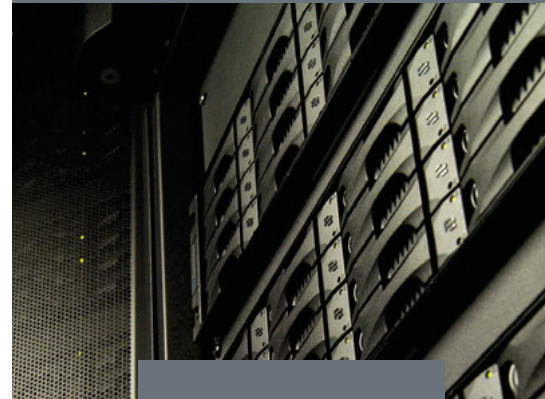
Developed by the Internet Engineering Task Force (IETF) as a response to the need for interoperability in networked storage, iSCSI lets businesses leverage existing skills and network infrastructure to create IP-based SANs that deliver the performance of Fibre Channel, but at a fraction of the cost.

HOW IT WORKS

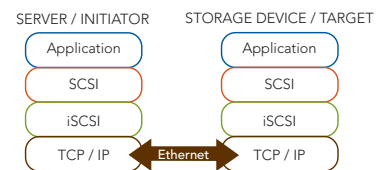
iSCSI is built on two of the most commonly understood protocols: SCSI and Ethernet, the dominant standards for storage and networking. Utilizing an ordinary IP network, iSCSI transports block-level data between an iSCSI initiator on a server and an iSCSI target on a storage device. The iSCSI protocol encapsulates SCSI commands and assembles the data in packets for the TCP/IP layer. Packets are sent over the network using a point-to-point connection. Upon arrival, the protocol translates data back to SCSI. Security is provided through iSCSI authentication and virtual private networks (VPNs), as needed.

When an iSCSI initiator connects to an iSCSI target, the storage is seen by the operating system as a local SCSI device that can be formatted as usual. The process is transparent to applications, file systems, and operating systems. By consolidating storage with an iSCSI SAN, different platforms can share the same storage, greatly improving utilization and efficiency. Multi-protocol switches enable co-existence between iSCSI and Fibre Channel SANs.

The New Standard



iSCSI lets businesses leverage existing skills and network infrastructure to create IP-based SANs that deliver the performance of Fibre Channel, but at a fraction of the cost.



To access iSCSI storage, all a server needs is an iSCSI initiator connected to a network. An initiator can be an iSCSI driver with a standard network card or a card with a TCP offload engine (TOE) to reduce CPU utilization. Also available are HBAs that offload both TCP and iSCSI. On the target side, storage devices similarly implement the iSCSI protocol stack.

With the advent of Gigabit Ethernet, iSCSI can deliver performance comparable to a Fibre Channel SAN. Recent advances in 10GB Ethernet make iSCSI superior to any other storage solution.

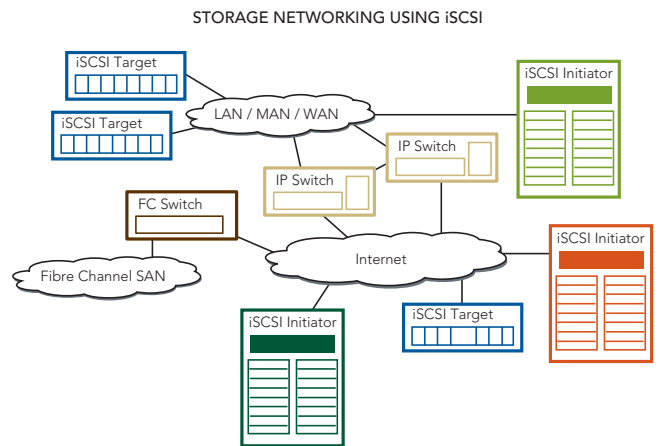
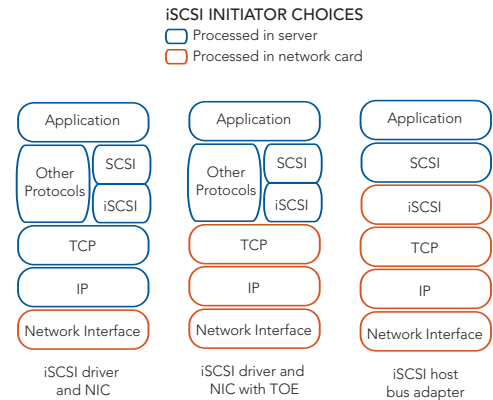
BENEFITS OF iSCSI

- Simplified deployment and management: appliances can be set up with minimal effort, typically in 20 minutes or less.
- Enables cost-effective, scalable, secure, and highly-available SANs.
- Leverages existing management skills and network infrastructure.
- Delivers performance comparable to Fibre Channel.
- Provides interoperability using industry standards.
- Implemented by the top system, storage, and network providers.

With iSCSI, businesses can get a handle on storage administration expenses without retrofitting their existing network infrastructure or investing in hardware that quickly becomes obsolete. Enabling low cost, interoperable, and high performance SANs, iSCSI is about to revolutionize the world of networked storage.

To view other Coffee Break Bulletins or to learn more about EqualLogic, visit us at www.equallogic.com.

All major operating systems support iSCSI initiators. With dynamic discovery methods, high performance offload engines, and scalable host connectivity, iSCSI provides a cost-effective solution for simplifying and managing networked storage.



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EqualLogic, Inc., is the leading provider of enterprise-class midrange storage area network (SAN) solutions that provide enterprises of all sizes the best return on investment in the storage industry. The company's PS Series family offers an affordable, easy-to-manage alternative to traditional storage systems and gives customers a range of choices in performance, capacity, and cost. EqualLogic's dynamic virtual storage technology delivers simple set up, automated management, reliable data protection, on-demand scalability, and multiple tiers of storage in a single SAN. EqualLogic PS Series SANs integrate seamlessly with a host of industry-leading storage solutions from its broad family of technology partners.