Coming on the heels of the release of last year's SCSI over IP (iSCSI) standard from the Internet Engineering Task Force, 2004 is seeing a modest increase in the number of iSCSI products entering the market. Questions abound over the fit for this protocol and for storage topologies based on it.

The following questions are intended to identify your company's view of the market for iSCSI technology.

QUESTION 1:

In its early development years, iSCSI had several prominent champions within the vendor community, including IBM and Cisco Systems. The early position of iSCSI advocates was that it would replace Fibre Channel as an interconnect for building storage area networks. With the delays in standards development, the party line seemed to change: FC would be used to build "core" fabrics, while iSCSI would be used to connect outlying servers to FC fabrics.

What is your position on the technical fit for the burgeoning technology?

EMC: Today, we believe that iSCSI; implemented in the current environment can be an excellent fit for consolidating storage for 2nd and 3rd tier applications. Maturity of the surrounding infrastructure (management systems, configuration automation, security mechanisms, the arrival of cost-effective 10 Gb Ethernet, etc.)is necessary for iSCSI to become a viable alternative to Fibre Channel as the standard interconnect for storage networks.

QUESTION 2

As an IP-based protocol, iSCSI is limited in terms of speeds to available bandwidth less overhead, which is generally interpreted to mean that the technology is capable of delivering roughly 75 percent of the rated speed of the TCP/IP network pipe in Mb/s or Gb/s. FC advocates have leveraged this as a major differentiator between FCP and iSCSI solutions.

How meaningful is this speed difference today? How meaningful will it be next year with the introduction of 10 GB/s IP nets?

EMC: Delivered bandwidth depends on I/O operation size for both iSCSI and Fibre Channel, but Fibre Channel is currently operating at 2.125 Gb/sec vs. 1.25 Gb/sec for Gigabit Ethernet. Clearly, available bandwidth has an affect on application performance in high transaction rate and/or high data volume applications and today, Fibre Channel is the best solution for those applications. Another determining factor is the affect of TCP/IP protocol stack processing on the host CPU. At higher transaction rates and/or bandwidth usage, the more stack processing required, which ultimately steals CPU cycles away from the application. Off-loading this stack processing on an iSCSI HBA (TOE Card) remedies this issue, but at a higher host connect cost, driving up the cost of deploying iSCSI.

QUESTION 3

Related to the above, how important is interconnect speed to applications? Haven't we made do with much slower storage interconnects in the recent past?

EMC: As stated above, it depends on the characteristics of the application and its criticality to the business. There are many applications that do not require the bandwidth capacity of Fibre Channel and it is these applications that are well suited for iSCSI.

QUESTION 4

Both FC fabrics and iSCSI SANs utilize IP-based applications for management. In the case of iSCSI, management (or control path) is handled in the same network pipe as data and SCSI command traffic. In FCP, the control path and data path use different wires.

From the standpoint of scaling, simplified infrastructure, and design elegance, iSCSI would seem to have the advantage over Fibre Channel's "dual network" design. What do you think?

EMC: An iSCSI SAN will most likely be provisioned on a physically separate LAN to guard against unauthorized access and to ensure full access to bandwidth. So in the near term, both iSCSI and Fibre Channel SANs will likely be deployed as separate networks to meet more demanding usage.

QUESTION 5

Both iSCSI and Fibre Channel use a serialization of SCSI, a channel protocol for storage I/O. The key technical difference is the transport used by each interconnect (TCP for iSCSI, FCP for FC fabrics).

If the two are more similar than dissimilar, why should a company field separate channel interconnect rather than use existing investments in networks to interconnect storage and servers?

EMC: Beginning with the last statement: There is a large installed base of mature, robust Fibre Channel SANs. One could argue that there is a large existing investment in FC networks as well. For SANs, there would need to be a compelling reason for those customers to replace those existing networks with their existing iSCSI.

On a technical basis, SCSI is not a protocol; it's an architecture and command set. Serializations of SCSI always differ in functionality, and hence cannot fully interoperate at the transport level (e.g., there's no such thing as a transport-independent SCSI address). Even an FCP to parallel SCSI bridge/router has to terminate and reissue SCSI commands; it cannot pass them through without change.

QUESTION 6

FC SANs are increasingly seen behind NAS heads, which are said to act as gateways to SANs and provide hosting for SAN management utilities.

Taking this design choice to the next level, what is your opinion about using NAS gateways to support both NFS/CIFS and iSCSI on the front end in order to aggregate storage traffic?

EMC: We believe that NAS/SAN integration using iSCSI is an excellent idea, allowing users to design storage networks that offer the flexibility to deploy specific network storage solutions (NAS or SAN) with the same equipment and management.

QUESTION 7

iSCSI standards do not seem to have been "held hostage" to proprietary vendor interests the way that FCP standards have been at ANSI (it is an established fact that vendors can develop FC switches that fully comply with ANSI standards, yet fail to be compatible with one another).

From the consumer's perspective, do you feel it's smarter to go with iSCSI-based technologies because of product interoperability?

EMC: Actually, FCP is not implemented by Fibre Channel switches. FCP is an FC-4 protocol that is transparent to FC switches operating at the FC-2 layer in much the same way as TCP (layer 4) is transparent to IP and Ethernet switches (layer 2 and 3). However, the competitive challenge the FC switch industry will face from iSCSI interoperability will likely resolve some of the issues surrounding interoperability.

QUESTION 8

At one point, vendors touted iSCSI as the foundational technology for building "SANs for the rest of us" – that is, companies that are not necessarily Fortune 500 status.

Do you embrace this view? And if so:

- ***What do "the rest of us" require a SAN for? What is the killer application for iSCSI SANs?***
- ***What is the advantage of iSCSI over burgeoning protocols for large-scale device interconnection like Serial Attached SCSI (SAS), which, with expanders, offers connectivity for up to 16,000 nodes?***
- ***With burgeoning drive capacity improvements, already at 200 GB for SATA and SCSI, can arrays be built with adequate capacity to meet the needs of SMBs without resorting to SANs?***
- ***With removable/exchangeable disk/tape hybrids, such as Spectra Logic's RXT platforms, can SMBs achieve capacity scaling requirements without deploying SANs at all?***

EMC: This is a slight exaggeration…Everybody does not need a SAN and the need for one is independent of the transport used. There are companies today that could

benefit by moving from a DAS environment to a SAN, and there are low cost SANs on the market (from EMC), but historically cost and lack of familiarity with Fibre Channel have been barriers. iSCSI offers low host connect cost along with the ability to leverage some existing infrastructure into a network environment that many small companies understand.

- SAS is a disk drive to controller interface (a back-end interface) and is not intended to support host to controller (front-end) traffic. A SAN based on SAS would be another specialized implementation like Fibre Channel is today.
- From a capacity standpoint, yes, but from an I/O standpoint, no. Even small companies will want to have the flexibility to move, manage, share and protect data through networking.
- Yes, but with performance penalties and they will need to accept being "married" to a unique technology.

QUESTION 9

What has happened to TCP Offload Engine (TOE) technology, once touted as a prerequisite for iSCSI SANs? Was it simply hype intended to keep Host Bus Adapter vendors from losing market share to vendors of simple NIC cards in an iSCSI world? Or, has TOE development proved more daunting than originally thought? Why aren't we hearing more about TOE?

EMC: The largest near-term opportunity for iSCSI is in servers below the size/cost at which Fibre Channel is justifiable, and the increase in processor performance in the past few years has made software initiators viable on that class of server.
On the target side, a dedicated high performance processor is more than enough to handle iSCSI at Gigabit Ethernet line rate, lessening the need for TOEs. TOEs are no longer a prerequisite at 1Gbit/sec, but a TOE will be essential for the near future with the impending deployment of 10 Gbit/sec Ethernet. We can expect to hear a lot more about TOEs as 10 Gbit/sec Ethernet deployment becomes a reality.

QUESTION 10

FC fabric advocates claim that FC fabrics are more secure than iSCSI SANs. What do you think?

- ***How is an FC fabric any more secure than an IP-based iSCSI SAN if it uses an out-of-band, IP-based, connection for fabric management?***
- ***How can FC advocates justify the claim that FCP remains a mystery to hackers, but also argue that the protocol is becoming more familiar and less of a training hurdle for customers?***
- ***Why have no FC switch vendors implemented the FCP security standards from ANSI in their products?***

EMC:

- FC fabrics are more secure because they are a physically separate network. If one deploys an iSCSI SAN as physically separate, then both approaches achieve the same result.
- This is a different issue. The risk of unauthorized access to the SAN management system is the same for Fibre Channel and iSCSI. TCP is probably the ultimate in being "familiar and less of a training hurdle" to customers, but most users do not have the specific knowledge of exactly how TCP works – which is needed to attack it. The same distinction applies to FCP. It's not a case of familiarity with the protocol, but where one gains access to the network. One has to be in the data center where the SAN is and then find a way to "plug in" without the SAN reporting it, which is next to impossible.
- There are no FCP security standards from ANSI and FC switches do not implement FCP. FC security features have been implemented in FC switches from all of the major vendors, and standardization is underway (but not complete).

QUESTION 11

Microsoft's iSCSI initiator seems to be winning mindshare among vendors (Cisco recently opted to use the Microsoft initiator in place of its own in Windows shops).

Do you support the Microsoft iSCSI initiator with your products? Does a target device also need to utilize Microsoft target definitions to work with a Microsoft initiator? (Microsoft says it does, some target vendors say it doesn't.)

EMC: EMC has qualified and supports the Microsoft iSCSI initiator. We have qualified our iSCSI target drivers to be compatible with Microsoft's drivers.

QUESTION 12

Some vendors seem to be suggesting that Fibre Channel is superior to iSCSI because of its end-to-end support of "native Fibre Channel drives."

Is there such a thing as a "native Fibre Channel drive" or are we really talking about SCSI drives with integral Fibre Channel to SCSI bridges in the electronics of the controller or disk?

EMC: This is false argument. Front end interfaces and back end interfaces are separated by a controller and the fact that both front and back end interfaces are the same does not make the design of the controller any more efficient or less costly than a controller that supports FC and say, SATA. Additionally, there are native Fibre Channel disk drives, but attaching it to a SAN is difficult because FC disk drives use the FC-AL protocol over copper, whereas SANs use FC-SW over optical. These protocol and media incompatibilities add complexity and seriously weaken an end-to-end implementation.

QUESTION 13

Fibre Channel fabrics do not seem to respond to Metcalfe's Law of networks, which states that the value of a network should increase and cost per node should decrease as more nodes are deployed. Fibre Channel fabrics seem, in fact, to become more difficult to manage as they scale (in many cases eliminating many of the value gains promised by vendors) and, in general, remain the most expensive platform for data storage. FC fabric per port costs have been extremely slow to decline.

By contrast, per port costs of GigE switches and GigE NICs have fallen dramatically in only a two to three year time frame. 10GbE is expected to follow this pattern as well.

From a cost standpoint, does iSCSI have a better story to tell than Fibre Channel to price-sensitive consumers?

EMC: As the market leader in Enterprise-Class fabrics, we have deployed 1000+ port fabrics at many of the world's leading companies that are centrally and easily managed; provide good scalability and high reliability. It's been our observation that Fibre Channel Switch and Director per port prices have been declining at about a 20% annual rate.

Certainly the price erosion of Ethernet equipment is more dramatic by virtue of the shear volume of product that ships in a given year, allowing manufacturers to reach their break-even point much quicker than in the Fibre Channel space, where the unit volume is tiny in comparison.

All that being said, the answer to the question is yes, iSCSI does have a better cost profile for cost sensitive customers, providing that iSCSI will meet the customers' performance and scalability needs.

QUESTION 14

The industry has given mixed messages about the fit for iSCSI: Is it a data center technology because that is where the big switches are located, or is it an "edge technology" because workgroups and departments do not require the speeds and feeds of data centers? What is your take?

EMC: Where iSCSI fits best is not a matter of real estate, but rather it's a throughput performance question. One can find literally oceans of small servers racked up in data centers providing 2nd and 3rd tier services and the aggregate storage capacity can be in the petabyte range. Companies would like to consolidate all of this fragmented storage on a SAN, but the current cost of HBAs are prohibitive. This is an excellent example of a data center-class application where iSCSI would be the preferred solution. In a small organization, six servers and two storage arrays is the data center and iSCSI may be a cost-effective solution here, unless the throughput requirements stipulate that Fibre Channel is required and if the criticality of the application justifies the expenditure. The same six servers, two arrays in a fortune 500 company would be considered an "edge" deployment.

QUESTION 15

With Simple Network Management Protocol (SNMP), Dynamic Host Communications Protocol (DHCP), and other established protocols in the IP world, it would seem that iSCSI will hit the ground running with services that were missing altogether from FCP. Is this an advantage in your opinion?

EMC: We certainly agree that the potential for services such as DHCP, SNMP, VLAN and Kerberos have the potential to add value and functionality not found in Fibre Channel. The industry needs to work on adapting these technologies to work in a storage network environment. SCSI is a client/server architecture, although it differs in some fundamental ways from the client/server systems found in IP networking.

QUESTION 16

Some vendors are "dumbing down" their Fibre Channel products to facilitate their deployment in SMBs. Is this your strategy and what do you see as the benefits and drawbacks of such an effort?

EMC: Actually the opposite is happening. Switch vendors are adding intelligence to their products to automate the configuration process and simplify management and at the same time, they are lowering their prices. If you recall, the issue with SMBs is cost and ease of use. EMC is working with its switch suppliers to deliver low cost, easy to deploy and manage SAN solutions targeted at SMBs.

QUESTION 17

Does iSCSI offer anything that FC fabrics do not to facilitate storage virtualization?

EMC: Yes. DHCP can theoretically be used to redirect storage traffic for the purposes of replication, back up and recovery or data repurposing. The application of DHCP for this purpose is not automatic.

QUESTION 18

Describe the products that your company is developing that support iSCSI.

EMC: EMC has several iSCSI-based solutions available now. We offer an iSCSI storage adapter for our high-end Symmetrix DMX line and we have iSCSI to Fibre Channel gateway solutions that we source from McDATA and Cisco. EMC plans to offer native iSCSI connectivity on its platforms as well.

QUESTION 19

Compare key pricing and capability differences for your iSCSI solutions versus comparable FC solutions.

EMC: There is virtually no difference in the cost of an iSCSI array compared to a Fibre Channel array. This because the cost of the host connectivity logic is small compared to the overall cost of an array. Our array products carry all of the same feature/functionality regardless of host interconnect type.

QUESTION 20

Does iSCSI contribute to data protection in a networked storage world? If so, what?

EMC: In the case of EMC, our data protection mechanisms are independent of host interconnect type.