StorageIO Industry Trends and Perspective
Fibre Channel over Ethernet (FCoE)

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If you have not yet heard of the emerging Fibre Channel over Ethernet (FCoE) technology or one of the vendor marketing terms including Data Center Ethernet (DCE), I/O Virtualization (IOV), Converged Network Architecture (CNA) or Data Center Fabrics leveraging a hybrid premium Ethernet with low latency and Quality of Service (QoS), rest assured, you will soon. This StorageIO Industry Trends and Perspective looks at what FCoE is, why it is important to be aware of and where it may fit in your environment in the future.

Background

Taking a step back for a moment, Fibre Channel is the underlying I/O connectivity technology that supports multiple concurrent upper level protocols (ULPs) for open systems and mainframe server to storage, storage to storage and in some cases server to server I/O operations. Fibre Channel ULPs include FC-SB2, more commonly known as FICON along with SCSI Fibre Channel Protocol (aka FCP) commonly referred to simply as Fibre Channel.

If you are currently using Fibre Channel for open systems or FICON for mainframe or mixed mode (Fibre Channel and FICON concurrently) and have no near term plans for migrating open systems storage to IP based storage using iSCSI or NAS, then FCoE is a technology that you want to keep an eye on moving forward in addition to near term 8Gb Fibre Channel (8GFC).

Does Fibre Channel over Ethernet (FCoE) replace or pose a competitive threat to iSCSI? In my opinion the answer is "No". FC and iSCSI are targeted at different needs, issues, value proposition and price points being complimentary in some environments along with Network Attached Storage (NAS) NFS and Windows CIFS file sharing as part of a tiered storage access model.

From a cost perspective, iSCSI has a bright future with its real competitive threat not from reduced cost Fibre Channel or more expensive FCoE; rather from NFS and CIFS based NAS co-existing on the same cost effective IP based networks with NAS based storage incorporating built-in file management and data sharing capabilities for ease of use and deployment.

Value Proposition

The business and technology value proposition benefits of converged or virtualized I/O connectivity include:

- Maximizing PCIe or mezzanine I/O slots
- Re-deployment for changing workloads
- Scale I/O capacity for servers and storage
- Leverage common cabling infrastructure
- Boost utilization of IT resources
- Leverage existing skill sets and tools
- Performance using 10Gb Ethernet

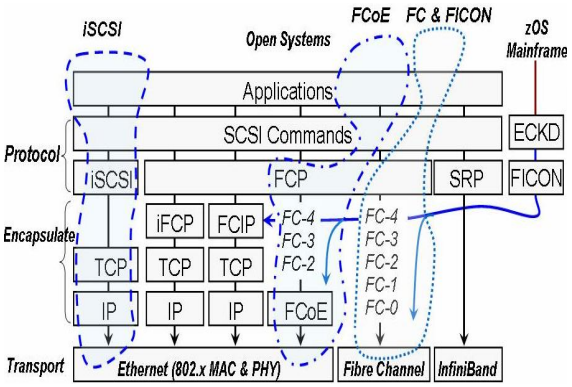

Figure-1 I/O protocols, transports, interfaces

The Technology

Ethernet supports multiple concurrent upper ULP (See Figure-1) for example TCP/IP,

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TCP/UDP along with legacy LAT, XNS and others similar to how Fibre Channel supports multiple ULPs including FICON for IBM mainframes, and FCP for open systems.

Over the past decade networking and storage I/O interfaces have been on a convergence course around industry standards providing flexibility, interoperability and variable cost to functionality options.

Propriety mainframe interconnects such as bus & tag (block mux) gave way to ESCON which was actually an early and propriety derivative implementation of quarter speed Fibre Chanel (less than 25MByte/sec). Later ESCON gave way to FICON that leverages common underlying open Fibre Channel components that enable FICON to co-exist with open systems Fibre Channel FCP traffic in protocol intermix mode.

Similarly, parallel SCSI evolved to UltraSCSI and separation of the SCSI command set from physical parallel electrical copper cables enabling SCSI on IP (iSCSI), SCSI on Fibre Channel (FCP), SCSI on InfiniBand (SRP) and Serial Attached SCSI (SAS) among others. Traditional networks including FDDI and Token Ring have given way to the many different 802.x Ethernet derivates.

iSCSI is an example of mapping the SCSI command set onto TCP/IP with a common implementation being on Gb Ethernet (GbE) or 10Gb Ethernet (10GbE).

Consequently the continuing convergence evolution is to leverage the lower level MAC (Media Access Control) capabilities of an enhanced Ethernet. With enhancements around quality of service to improve on latency allows Fibre Channel and its ULPs to co-exist on a peer basis with other Ethernet ULPs including TCP/IP.

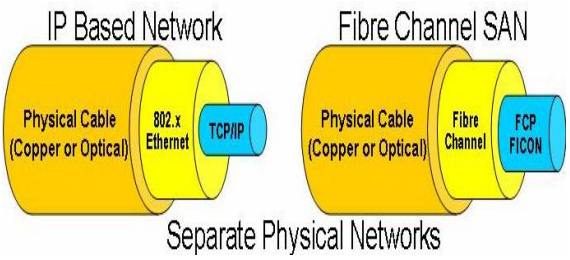

Figure-2 Separate I/O networks and cabling

For example, in Figure-2, the traditional model for cabling a LAN and SAN has separate physical copper or optical cables for each network, unless you are using DWDM (Dense Wave Division Multiplexing) based multiplexed optical network. With FCoE, the next step in the converged network evolution takes place with Ethernet being the common denominator (Figure-3) that supports both FCoE and other Ethernet based networks concurrently on a single Ethernet network.

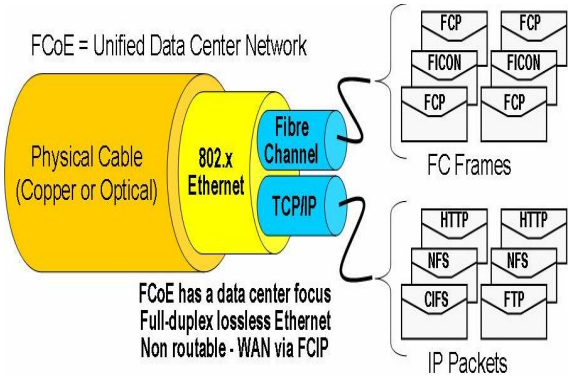

Figure-3 Common cabling separate networks

There has been confusion in the industry about FCoE being a wide area technology and perhaps in the future that may be the case, however for the foreseeable future, FCoE is for local environments and not for long distance use.

Unlike iSCSI which maps the SCSI command set onto TCP/IP, or FCIP which maps Fibre Channel and its ULPs onto TCP/IP or UDP for long distance data transmission to enable

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remote replication or remote backup, FCoE runs native on Ethernet without the need to run on top of TCP/IP for lower latency in a data center environment.

For long distance scenarios such as enabling Fibre Channel or FICON based remote mirroring, replication or backups to support business continuance (BC), disaster recovery (DR) or high-availability (HA), use FCIP or DWDM or SONET/SDH or time division multiplexing (TDM) MAN and WAN networking solutions and services.

Strategies and Recommendations

Moving forward, premium or low latency Ethernet (aka Data Center Ethernet) will compliment traditional or volume Ethernet based solutions leveraging various degrees of commonality. For storage related applications that are not planned to be migrated to NAS or iSCSI, FCoE address and removes traditional issues and perceptions about Ethernet based TCP/IP overhead, latency and non-deterministic behavior preserving experience and knowledge associated with Fibre Channel and FICON tools and technologies.

New switching platforms and infrastructure components capable of supporting data center Ethernet and FCoE based technologies are appearing in the market place. New switches that can be upgrade to support FCoE have been announced or available for early evaluation. A the recent Storage Networking World (SNW) in Orlando FL several vendors demonstrated a proof of concept technology demonstrator including host adapters, switches and a storage system supporting FCoE. Vendors that have announced support for FCoE include Brocade, Cisco, Emulex, Intel, NetApp and Qlogic.

As to when to use FCoE, well given that the technology is very much in its infancy existing for all practical purposes as a technology demonstration or vendor qualification vehicle, the reality is that it will be sometime in 2009 or early 2010 before FCoE is ready for mission critical prime-time mass adoption in enterprise environments outside of early adopter or corner cases scenarios.

For existing open systems and IBM mainframe environments that are using Fibre Channel and FICON, the next upgrade option is to go from 4GFC to 8GFC and then in 3 years or so, re-asses where 16GFC is at along with the status of FCoE ecosystem. For open systems environment heavily invested in Fibre Channel, the natural progression will be from 4GFC to 8GFC with some attrition due to shifting over to iSCSI and NAS for some applications.

For environments not as heavily invested or committed to Fibre Channel, the opportunity to jump over to 10GbE based iSCSI will be appealing for some. For those who do make the commitment for at least one more round of Fibre Channel at 8GB, in 3 to 4 years time, you will have the decision to stay the legacy Fibre Channel course assuming 16GFC is read, jump to FCoE at 10Gb or the emerging 40Gb, jump to iSCSI or some combination.

Given that FCoE will require a different, more expensive variant of Ethernet, iSCSI can continue to leverage the low cost economic value proposition that continues to enable it to expand its footprint.

Now for those who want to argue that the one and only true converged network is or will be around IP, don't worry, you will have plenty to debate and discuss as is currently taking place in the industry as to why FCoE is not needed while FANs, LANs, SANs, MANs, WANs, POTs and PANs continue on their course of convergence. Keep in mind however to look at and evaluate interfaces to interfaces,

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protocols to protocols for apples to apples comparisons.

Closing Comment

With FCoE, the preverbal Ethernet technology elephant will have more than just stuck its trunk under the I/O and SAN connectivity tent and once in the tent, you have the option for a converged network if you chose to go that route. To what degree and path you take will come down to your timing, preferences, budget and other criteria along with vendor storage offerings and support. Continue to monitor FCoE along with 8GFC adoption and ecosystem development by switch, adapter, server, operating system as well as storage vendors and 3rd party management tool vendors.

For now, if you are an enterprise environment using Fibre Channel and or FICON, FCoE should be on your radar as part of your long term strategic planning for server and storage I/O connectivity. As with other techniques and technologies, align the applicable solution to meet your particular needs and address specific pain points while being careful to not introduce additional complexity.

Where to learn more:

You can learn more about storage networks, interfaces and protocols in chapters 4 Storage and I/O Networks), 5 (Fiber Optic Essentials) and 6 (Metropolitan and Wide Area Networks) of "Resilient Storage Networks" (Elsevier ISBN 1555583113) at www.storageio.com including additional information about I/O virtualization and Fibre Channel over Ethernet.

Learn more about green and associated Power, Cooling, Floor-space and environmental topics visit www.greendatastorage.com.

See the following links to learn more about FCoE, I/O Virtualization and related topics:

www.fcoe.com
www.fibrechannel.org
www.storageioblog.com

About the author

Greg Schulz is founder of the StorageIO Group (www.storageio.com), author of the book *Resilient Storage Networks — Designing Flexible Scalable Data Infrastructures* (Elsevier) and creator of the power, cooling, floor-space, environmental (PCFE) "Green" related portal www.greendatastorage.com.