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Driving Innovation Through the Information Infrastructure

SPRING 2011

Unified Storage Networking

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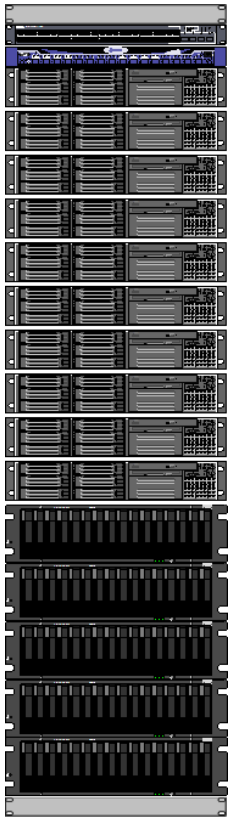
Demartek Company Overview

- Industry analysis with on-site test lab
- Lab includes servers, networking and storage infrastructure
  - Fibre Channel: 4 & 8 Gbps
  - Ethernet: 1 & 10 Gbps (with FCoE)
  - Servers: 8+ cores, very large RAM
  - Virtualization: ESX, Hyper-V, Xen
- We prefer to run real-world applications to test servers and storage solutions
  - Currently testing various SSD and FCoE technologies
  - We create our own data sets for application workloads
- Web: www.demartek.com

Agenda

- The Problem
- Buzzwords and Acronyms
- Key protocols and standards
- Technologies available now
- Advantages and disadvantages
- Effect on currently installed storage networks
- Demartek lab test results
- Futures, Commentary, Roadmaps

The Problem: Too Many Parts



- Rack Servers (each)
  - 4 NIC ports (1Gb)
  - 2 FC ports (4Gb)
- Disk Array
  - 2 NIC ports (1Gb)
  - 4 FC ports (4Gb)
- Totals?
  - Cables & switch ports
  - Adapter cards
  - Maximum bandwidth

The Solution: Converged Network

Combine lossless features of Fibre Channel with ubiquity of Ethernet

- Within a rack (short-term)
- Entire infrastructure (long-term)

New Buzzwords & Acronyms

- Converged Network: combined LAN and SAN network
- Data Center Bridging (DCB)
  - CEE: Converged Enhanced Ethernet
  - DCE: Data Center Ethernet (Cisco trademark)
  - EEDC: Enhanced Ethernet for Data Center
- FCoE: Fibre Channel over Ethernet
  - FCoCEE: FC over CEE
- CNA: Converged Network Adapter

How Can This Work?

- Enhance Ethernet so that it properly handles storage traffic
- Data Center Bridging (DCB)
  - A collection of architectural Ethernet extensions designed to improve Ethernet networking and management in the data center
- FCoE is the first major application for DCB

Data Center Bridging (DCB)

- Traffic Differentiation
  - Can distinguish LAN, SAN and IPC traffic
- Lossless Fabric
  - Required for SAN traffic
- Optimal Bridging
  - Allows shortest path bridging within data center
- Configuration Management
  - Works with existing systems

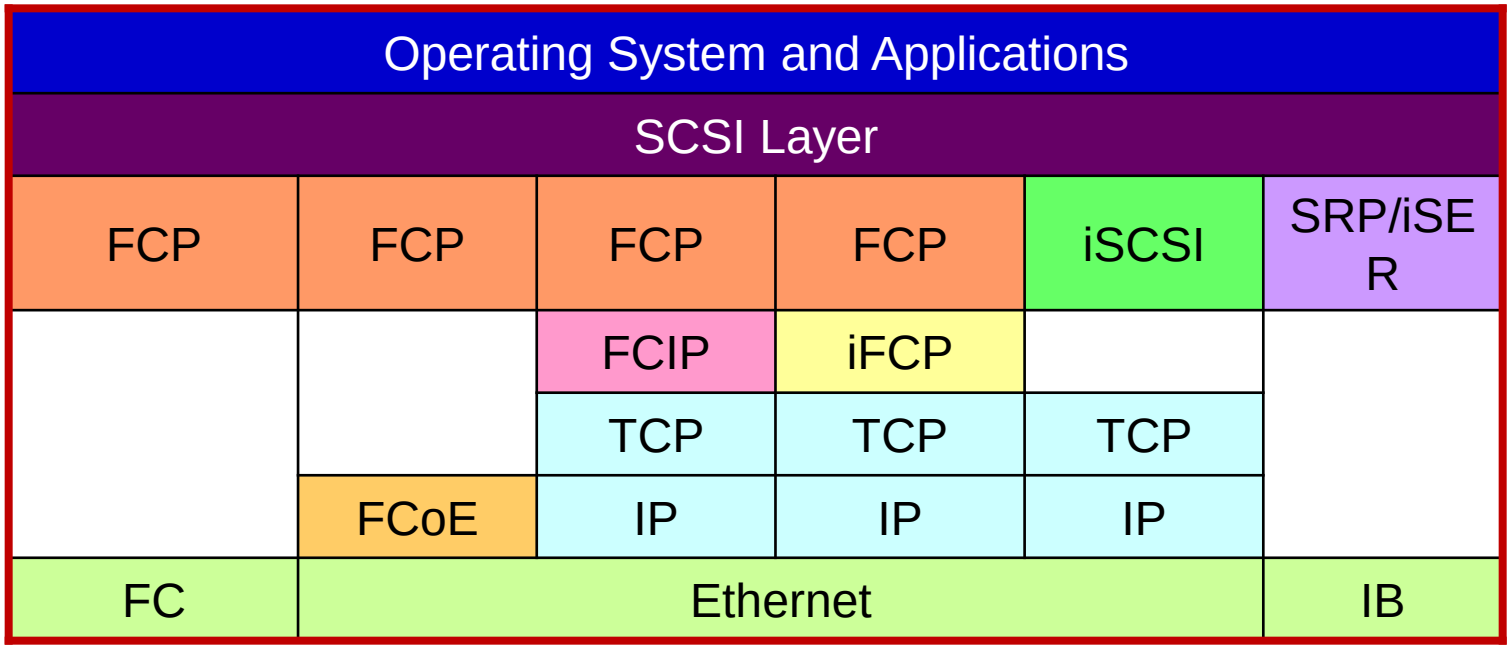
Key Protocols and Standards

- Ethernet
  - IEEE 802.1
    - 802.1Qau Congestion Notification
    - 802.1Qaz Enhanced Transmission Selection
    - 802.1Qbb Priority-based Flow Control
  - TRILL – Multipathing alternative
  - Technical working groups are making progress
- Fibre Channel (FC)
  - INCITS T11: FC-BB-5 (“FCoE”)
    - Approved June 2009

Fibre Channel over Ethernet

- FCoE places the FC protocol on a new physical link
  - Uses Lossless Ethernet (DCB) physical links
  - Protocol and behavior is the same as traditional FC
- FCoE fabrics must be built with FCoE/DCB switches
  - Interoperate with traditional FC fabrics
  - Support all FC advanced features
  - Operate identically on FCoE and FC fabrics

Storage and the OSI Model



Switch Technology Available

- DCB/FCoE switches
  - Blades for blade-architecture switches
  - Top-of-rack FCoE switches
- Contain technology for:
  - 10Gb Enhanced Ethernet (lossless)
  - Optional: 4 or 8Gb Fibre Channel
  - Support for FCoE traffic
  - Support for iSCSI traffic

Adapter Technology Available

- Converged Network Adapters (CNA)
  - Available from well-known FC HBA vendors
- 10GbE NICs
  - Available from well-known NIC vendors
  - Uses hardware/software combination
- These adapters require PCI-Express slots
  - Newer adapters work best with PCIe 2.0 or higher
- Chipsets/Controllers
  - Available for LAN-on-Motherboard (LOM) implementation from several vendors

Adapter Technology Available

- Offload characteristics
  - CNAs: FC & FCoE supported in hardware
  - 10GbE NICs: FC & FCoE supported by software
  - Ethernet: Similar to good server-class NIC
- Connectors
  - Copper: CX4 and SFP+ (10GBASE-CR)
  - Optical: SFP+ (10GBASE-SR)
- 10GBASE-T (RJ45, Cat 6a and 7)
  - FCoE adoption remains to be seen

Advantages & Disadvantages

- Advantages
  - Reduced number of cables
  - Reduced number of adapters
  - Reduced number of switches (over the long term)
  - Retain existing management software
- Disadvantages
  - Possible single points-of-failure
    - Single adapter
    - Single switch
  - Organizational issues

Organizational Issues

- In typical large shops today, networking and storage are separate departments
  - Networking: Dynamic (more changes)
  - Storage: Stable (fewer changes)
- Other areas of convergence
  - Consider voicemail & email
- Those that learn networking and storage will be in the best position

Effect on Current Storage Networks

- Can use and coexist with existing storage networks
  - Converged switches can pass FC traffic to existing FC SAN switches or to FC targets
  - Existing storage management software should work with FCoE technology

Expected Deployment Phases

Expecting a slow, deliberate process

- 2008 – 2009
  - Early adopters, top-of-rack-switch, connects to existing storage networks
- 2010 – 2011
  - Core networking support and wider adoption of FCoE adapters, some FCoE storage targets
- 2011+
  - More native FCoE storage targets

Demartek Lab Test Results

- Past Testing:
  - Conducted FCoE “First Look” in May 2008
  - Participated in FCoE “Test Drive” in June 2008
  - Other vendor-specific server and storage configurations tested in 2010
- Current Testing:
  - Testing with various adapters, switches and storage in the Demartek lab in 2011

FCoE General Comments

- Storage infrastructure changes slowly
- Should be considered in long-term planning, new equipment acquisitions and data center build-outs
- Standards
  - FCoE (FC-BB-5) is now a standard within the T11 committee
  - INCITS 462-2010 has been approved as a standard, available for purchase in July 2010

Roadmaps

- FC: 16-Gbps by 2011 (2H??)
  - SAN interface has a future
  - Disk drive interface approaching end-of-life
- Ethernet: 40 & 100 Gbps specifications (IEEE 802.3ba) ratified in June 2010
- FCoE will follow Ethernet roadmap
- Infiniband: 10, 20, 40 Gbps now, expecting 56 & higher

Future Technology Outlook

- Higher-speed adapters will require servers with PCI-Express 2.0 (or higher) slots
- Vendors are scrambling for LAN-on-Motherboard (LOM) design wins
  - Expect to see 10GbE on server motherboards
  - Look for possible 10GbE + FCoE on server motherboards in the future
  - Expect to see both copper and optical connections available directly on server motherboards

Future Technology Outlook

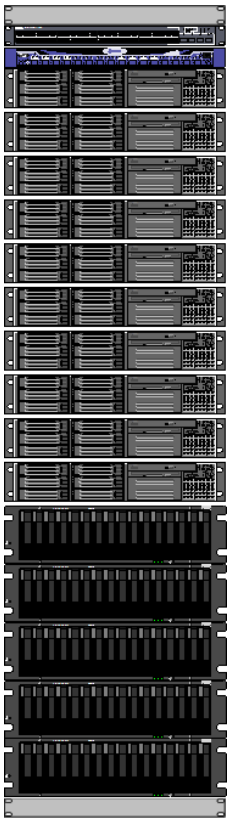
- As interface speeds increase, expect increased usage of fiber-optic cables and connectors for most interfaces
  - At higher Gigabit speeds, copper cables and interconnects become too “noisy” except for short distances (within a rack or to adjacent racks)

Cabling

- Single-mode fiber (SMF)
  - 9 µm (microns), very-long distance, yellow
- Multi-mode fiber (MMF)
  - 62.5 µm or 50 µm, medium distance
    - Orange: OM1 (62.5 µm), OM2 (50 µm)
    - Aqua: OM3 and OM4 (both 50 µm)
  - 10GbE is best with OM3 or OM4
  - OM3 and OM4 also will support 40GbE & 100GbE
- Cable deployments change very slowly, so choose 10GbE cabling wisely

Before and After

- Compare parts list with DCB & FCoE
  - Cables & switch ports
  - Adapter cards
  - Maximum bandwidth
- What can be eliminated?



Demartek FCoE Resources

- Demartek has compiled a free comparison reference guide of FCoE and the other storage networking interfaces, which is updated periodically and includes roadmap information. This also includes cable distances and speeds.
  www.demartek.com/Demartek_Interface_Comparison.html

- Demartek FCoE Zone
  - http://www.demartek.com/FCoE.html

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