Fibre Channel over Ethernet

From Hype to Reality

Frederick Knight
FCoE is real

Demoing for 2 years
  - First public demo @ SNW – Oct 16, 2007
  - POC done in customer labs

Pre-standard Configurations
  - Available for about 1 year

Standard products now available
Agenda

- FCoE Hardware
  - Then and Now
- Hosts, Switches, Targets
- Ethernet Enhancements (DCB)
- FCoE Topologies
  - Then and Now
- FCoE Tomorrow
FCoE Hardware
Then (1st generation - discrete components)
- used lots of power
- required full size slots
- early adopters / proof of concept

Now (integrated solution)
- low power
- smaller size
- general adoption
FCoE NIC chips

- Then (1\textsuperscript{st} generation)
  - All Software
  - Some parts of DCB hard to do in S/W

- Now (2\textsuperscript{nd} generation)
  - Some H/W offload added
  - Lower CPU overhead
FCoE Switches

- Then (1st generation)
  - Stable Hardware
  - Firmware based on early draft of standard
  - Interoperated w/others at same draft level

- Now (2nd generation)
  - The Same Hardware
  - Firmware update to standard compliant
  - Broader Interoperability
FCoE Native Targets

- Then (1\textsuperscript{st} generation)
  - Based on 1\textsuperscript{st} generation CNA
  - Limited feature set
  - Limited Availability

- Now (2\textsuperscript{nd} generation)
  - Based on 2\textsuperscript{nd} generation CNA
  - Broad feature set
  - General Availability
Ethernet Enhancements (DCB)
- Priority Flow Control (802.1Qbb)
  In task group ballot
  Current implementations compatible with the standard

- Congestion notification (802.1Qau)
  In working group ballot

- Enhanced Transmission Selection (802.1Qaz)
  Still in the working group

- Expected by November 2009
FCoE Topologies
FCoE Topologies

Then and Now

- FCoE Interoperates with existing FC
  - Existing FC devices
  - Existing FC switches
- FCoE multi-vendor switch interoperation is the same as FC multi-vendor switch interoperation
FCoE Topologies

Then

- FCoE End points wired directly to FCoE switch
  - From FCoE initiators, or from FC initiators
  - To FCoE targets, or to FC targets.
- Some FCoE link errors were not detected
- No intermediate Ethernet switches
FCoE Topologies

Now
- FCoE End points wired directly to FCoE switch
  - From FCoE initiators, or from FC initiators
  - To FCoE targets, or to FC targets.
- Improved link error detection (via FIP)
- FCoE through 10Gb Ethernet DCB switches
- All traffic must still transit the FCoE switch
FCoE Topologies

Tomorrow

- Fabrics of FCoE switches
  - FCoE E-Node connectivity (Ethernet connecting FCoE switches) still coming
- Can connect FC ports today

![Diagram showing FCoE topologies]
FCoE in Top of RACK

FCoE Switch

42RU Rack

8 10GE Ports

8 10GE Ports

4 10GE Connections

3 4GFC

SAN A

SAN B

3 4GFC

2 10GE

2 10GE

10GE Backbone
FCoE in Top of RACK

FCoE Switch

Intermediate Ethernet Switches

42RU Rack

8 10GE Ports

8 10GE Ports

4 10GE Connections

2 10GE

2 10GE

10GE Backbone
Sample FCoE Deployments
Many host platforms
Many host O/S (ESX, Linux, Windows)
Regular FC storage
Customer Before FCoE

<table>
<thead>
<tr>
<th>26 Servers</th>
<th>Ethernet</th>
<th>FC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapters</td>
<td>26</td>
<td>26</td>
<td>52</td>
</tr>
<tr>
<td>Switches</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Cables</td>
<td>56</td>
<td>56</td>
<td>112</td>
</tr>
<tr>
<td>Uplinks</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

Access Layer with Cisco Catalyst and MDS switches
### Customer After FCoE

**Access Layer with Cisco Nexus 5020 + Expansion Modules**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Total</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapters</td>
<td>26</td>
<td>26</td>
<td>50%</td>
</tr>
<tr>
<td>Switches</td>
<td>2</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Cables</td>
<td>60</td>
<td>60</td>
<td>46%</td>
</tr>
<tr>
<td>Up links</td>
<td>8</td>
<td>8</td>
<td>0%</td>
</tr>
</tbody>
</table>
### Customer Cost Analysis

#### Cost per server

<table>
<thead>
<tr>
<th>Component</th>
<th>FC and Ethernet</th>
<th>FCoE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>$300</td>
<td>$200</td>
</tr>
<tr>
<td>FC HBA (2-port)</td>
<td>$1200</td>
<td>-</td>
</tr>
<tr>
<td>1GbE NIC (2-port)</td>
<td>$800</td>
<td>-</td>
</tr>
<tr>
<td>10GbE FCoE CNA (2-port)</td>
<td>-</td>
<td>$1800</td>
</tr>
<tr>
<td>FC switch (2-ports)</td>
<td>$2400</td>
<td>-</td>
</tr>
<tr>
<td>1GbE switch (8-ports)</td>
<td>$2800</td>
<td>-</td>
</tr>
<tr>
<td>FCoE switch (2-ports)</td>
<td>-</td>
<td>$4000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$7500</strong></td>
<td><strong>$6000</strong></td>
</tr>
</tbody>
</table>

20% reduction
Customer 2

- HP DL580 w/ESX 3.5 U3 (w/MPIO) – MS 2k3 & 2k8 guests – QLE8042
- Nexus 5010/5020
- FAS3140 native FCoE
Customer 3

- Dell PowerEdge R900 w/ESX 3.5 U3 (w/MPIO) – MS
  2k3 & 2k8 guests – QLE8042
- Nexus 5010/5020
- FAS6080 native FCoE
Customer 4

- Dell PowerEdge R900 w/ESX 3.5 U3 (w/MPIO) – MS 2k3 & 2k8 guests – QLE8042
- Nexus 5010/5020
- FAS3140 native FCoE
"We have been testing our new FCoE infrastructure over the last few months and have been impressed most by the performance," said Howard Eddy, vice president of Information Technology at Subaru New England. "For instance, we are seeing over 75% greater performance on SQL versus our existing DAS solution. We've also been able to dramatically reduce our overall complexity for our storage and networking by streamlining down to a single network technology: Ethernet."
Customer 5

- Dell PowerEdge R6850 and Sun X4100 w/ESX 3.5 U3 (w/MPIO) – MS 2k3 & 2k8 guests – LPe21002
- Nexus 5010/5020
- FAS3140 native FCoE
Customer 6

- HP DL380 w/ESX 3.5 U3 – MS 2k3 and 2k8 – LPe21002 and QLE8042
- Nexus 5010/5020
- FAS3170 native FC and native FCoE

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- HP DL380 w/ESX 3.5 U3 (w/MPIO) – MS 2k3 & 2k8 guests – LPE21002 and QLE8042
- Nexus 5010/5020
- FAS3140 native FCoE
Customer 8

- Intel Xeon EM64T w/MS 2k3 (w/MPIO) – LPE21002
- Nexus 5010/5020
- FAS3140 native FCoE
Customer 9 After

Diagram showing the network topology of Customer 9 After with devices such as Nexus 7K, Nexus 5K, FC HBA, HDS or EMC disk, and CNA connected through FC, Ethernet, and FCoE.
FCoE SNW Demo Topology

INITIATOR
- 10GigE loss-less Switch
- Brocade CNA
- Emulex CNA
- Intel 10G SA
- Mellanox SA
- Qlogic CNA

SWITCH
- Brocade
- Cisco
- Finisar

Target
- Storage Array
- Storage Array
- Storage Array
- Storage Array

Additional Components Provided By:
- Amphenol
- molex

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FCoE Futures
FCoE Futures

- Three Previous plugfests
  - Two were FCoE specific
  - One Ethernet Focused (DCB)
- Next FCoE Plugfest
  - Nov 16-20 2009
  - University of New Hampshire Interop Lab
  - Multi-Vendor
  - Includes DCB features
FCoE Futures

- FC-BB-6 efforts began in June 2009
  - FC-BB-5 is the standard that contains the approved FCoE
  - FC-BB-6 is the standard that will contain the next version of FCoE

- FC-BB-6 plans to include
  - Direct MAC to MAC transfers
    - Probably negotiated through the FCoE switch
  - Direct End Point to End Point configurations
    - No switches (but just 2 nodes)
  - Bit Error rate examinations
  - Other good ideas we come up with

- But we’re still working on it
Summary

- FCoE is real
- Demoing, POCs, and pre-standard products available for a long time
- Standard products now available
- Finalization of IEEE standards will only expand the available FCoE topologies