Fibre Channel over Ethernet

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What is Fibre Channel over Ethernet?

- An encapsulation protocol to carry Fibre Channel frames over Ethernet
- Standardized in T11
- Focused on SCSI FCP
  - Not interested in IP over Fibre Channel over Ethernet 😊
- A discovery protocol is being worked on
- Not an Intel invention
  - We're interested because we sell lots of Ethernet
  - Just one of many companies active in T11
SCSI transports from FCIA
From FC to FCoE

FC Levels (unchanged)

IEEE 802.3 Layers

<table>
<thead>
<tr>
<th>FC-4</th>
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<tbody>
<tr>
<td>FC-3</td>
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<tr>
<td>FC-2</td>
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<tr>
<td>FC-1</td>
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<td>FC-0</td>
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<td>FC-3</td>
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<tr>
<td>FC-2</td>
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<tr>
<td>FCoE Mapping</td>
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<tr>
<td>MAC</td>
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<tr>
<td>PHY</td>
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FCoE Frame Format

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
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<tbody>
<tr>
<td>Destination MAC Address</td>
<td></td>
</tr>
<tr>
<td>Source MAC Address</td>
<td></td>
</tr>
<tr>
<td>(IEEE 802.1Q Tag)</td>
<td></td>
</tr>
<tr>
<td>ET = FCoE</td>
<td></td>
</tr>
<tr>
<td>Ver</td>
<td></td>
</tr>
<tr>
<td>Reserved</td>
<td></td>
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<td>Reserved</td>
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<tr>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>Encapsulated FC Frame</td>
<td>(including FC-CRC)</td>
</tr>
<tr>
<td>EOF</td>
<td></td>
</tr>
<tr>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>Ethernet FCS</td>
<td></td>
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Comparison with iSCSI/AoE/etc.

• Bridgeable to existing FC storage infrastructure through high performance switches
  - Maintain use of current FC investments
  - Gateway device keeps little or no extra state over a standard FC switch

• Designed to be one part of an FCP based SAN
  - FC attached initiators and targets
  - Ethernet attached initiators and targets
  - FCIP inter-switch links
Separate LAN SAN topology
Consolidated LAN SAN
State of Open-FCoE.org

• Now
  – Functional initiator stack
    – Fibre Channel in software
    – FCoE encapsulation
    – Works over any Ethernet interface with pause support
    – Makes use of multi-MAC address support in kernel, or promiscuous mode if not available
  – FCoE development tools
    – Software target that works in p2p topologies (SCST based)
    – Software gateway that works with special FC adapter driver
    – Wireshark has an FCoE decoder already

• Next
  – Branch to focus on re-architecture
  – “library-ize”
Open-FCoE Current Architecture
Fabric/Port login overview

1. Fabric Login (FLOGI)
2. Login/Register with dNS
3. Query dNS for FCP capable nports
4. Port Login (PLOGI) into returned nports
5. scsi_scan_host()
Problems with Open-FCoE architecture

• Too many abstractions
• Too complicated
• Doesn't benefit existing FC infrastructure/HBAs
Future Direction of Open-FCoE stack

• Reworking code to be more integrated with existing Linux SCSI/FC code
  - Agree with James Smart's suggestions

• scsi_transport_fc provides basic objects and management interfaces

• libfc for building FC drivers with various combinations of hardware and software support
  - 3 supported SCSI data path options:
    - Full hardware/firmware FCP management
    - FCP and framing fully in software, frame level driver interface
    - FC sequence send/receive offload, FCP managed in software
  - Local and remote port state machines
    - Managed in either software, hardware/firmware, or some combination defined by the driver and support by libfc
libfc layering overview

Layer 0

```c
struct remote_port
struct local_port
struct session
```

Layer 1

```c
Remote Port State Machine
plogi()  RTV()
prli()  resp_handler(s)()
```

Layer 2

```c
Local Port State Machine
flogi()  RFT_ID()  discovery()
RPN_ID()  RSC()  resp_handler(s)()
```

Layer 3

```c
Exchange Manager
xmit_els()
recv_handler()
```

Layer 4

```c
xmit_seq()
recv_frame()
```

LLD

```c
xmit_frame()
recv_frame()
encapsulate/un pack
```
libfc remote port state machine
libfc ELS handling and exchange manager
Libfc sequence management / framing
libfc local port state machine
Talking Points

- **Scsi_transport_fc**
  - Session, local_port, remote_port
  - Sysfs/ioctl()

- **Libfc usage**
  - Fc_host
  - Fc_transport_template

- "library"
  - Libfc as a module not all in scsi_transport_fc

- **Target**

- **state_change_handler()**
  - reduces number of function pointers in fc_transport_template
  - Allows LLDs to define their own state machine flows