

# Software FCoE - A Case Study

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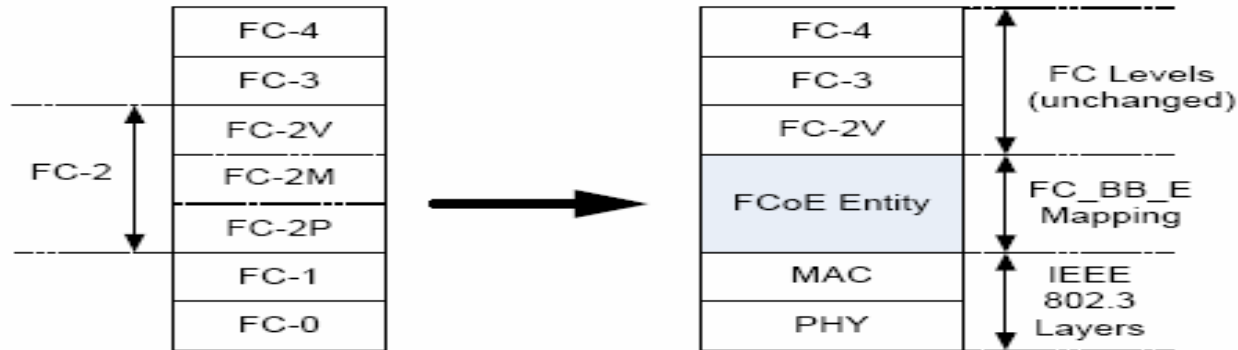
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# Discussion Topics

- ❑ Introduction to FCoE
- ❑ Software & Hardware FCoE solutions
  - ❑ Comparison
  - ❑ Advantages & Disadvantages
- ❑ Introduction to OpenFCoE (Software FCoE solution)
- ❑ OpenFCoE discussion
  - ❑ High level Code flow
- ❑ OpenSolaris FCoE
  - ❑ High level Architecture
  - ❑ Task Management framework
- ❑ Windows Software FCoE
- ❑ Configure OpenFCoE initiator and target

# Fibre Channel over Ethernet – An Introduction



## FCoE - Concepts

- ❑ Replace FC-1 & FC-0 with MAC & PHY
- ❑ Encapsulate FC frames into Ethernet frames
- ❑ Enhancements in Ethernet – e.g. Priority Based Flow Control

## FCoE - Benefits

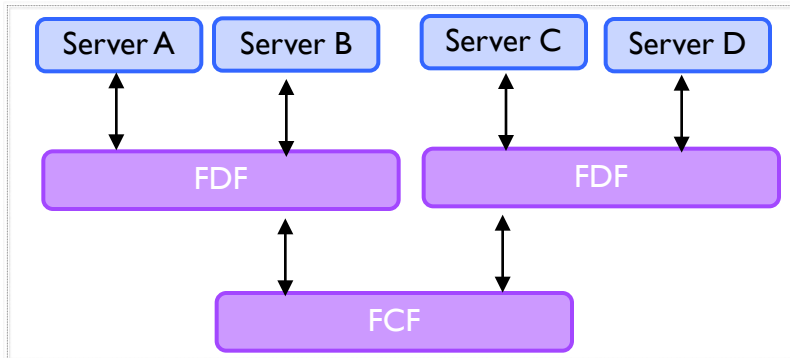
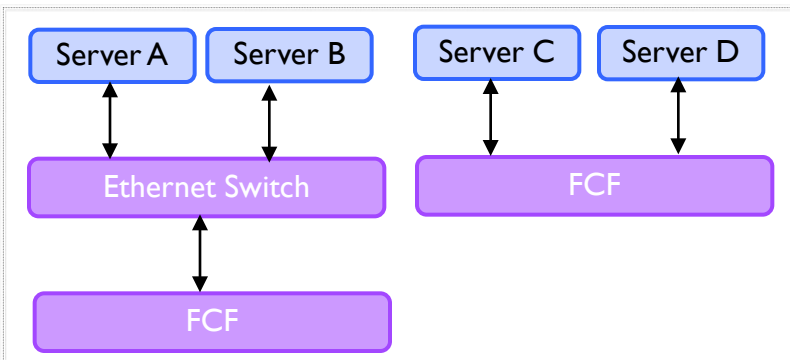
- ❑ Reduce server's n/w interfaces , cables & switches
- ❑ Reduce heat dissipation
- ❑ Reduce power required for IO and data center cooling
- ❑ Preserves SAN security & SAN mgmt infrastructure
- ❑ Hybrid deployment – FC infrastructure can be used

## FCoE - Protocol

- ❑ Uses Ethernet MAC Addresses
- ❑ FPMA & SPMA
- ❑ FIP Discovery – Solicitation & Advertisement
- ❑ Virtual Link Initialization – FLOGI & FDISC

# Developments in FCoE

- ❑ FC-BB-5 approved – June 2009
- ❑ FC-BB-6 under development – April 2011
  - ❑ Point-to-Point topology (OpenFCoE does not support true PTP)
  - ❑ Improvements for high BER Ethernet media (e.g. 10GBASE-T)
  - ❑ FCoE Data Forwarders (FDF)



## In FC-BB-5 –

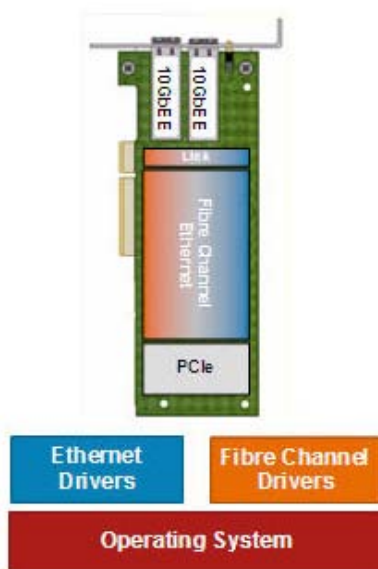
- ❑ Non-optimal forwarding
- ❑ FCF becomes performance bottleneck
- ❑ Multiple FCFs need multiple domain IDs – practical limitation

## FDFs –

- ❑ Optimal forwarding
- ❑ No performance bottleneck
- ❑ Share domain ID with controlling FCF
- ❑ Lightweight; provide routing, zoning info

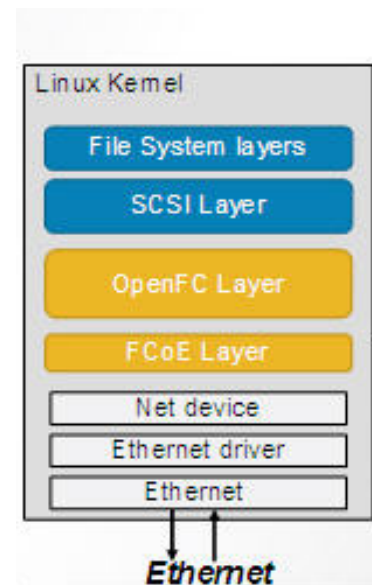
# Hardware & Software FCoE

- ❑ Implemented in hardware
- ❑ E.g. Converged Network Adapter (CNA)



- ❑ No performance issues, uses controller on card
- ❑ Cost is high

- ❑ Implemented in software (device driver)
- ❑ Works with 10 Gigabit Ethernet 10GbE NICs
- ❑ E.g. OpenFCoE & OpenSolaris FCoE

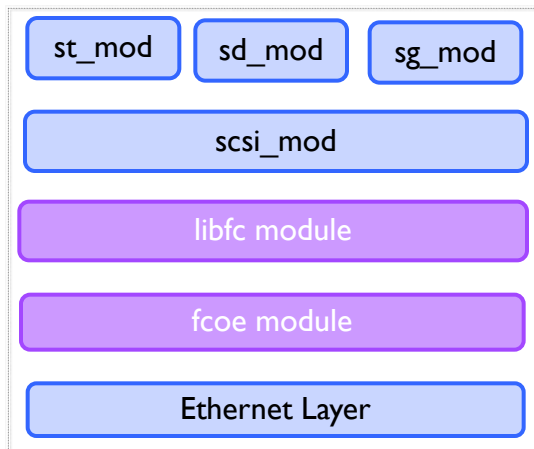


- ❑ Can have performance issues, uses host CPU cycles
- ❑ Cost lower than hardware solution

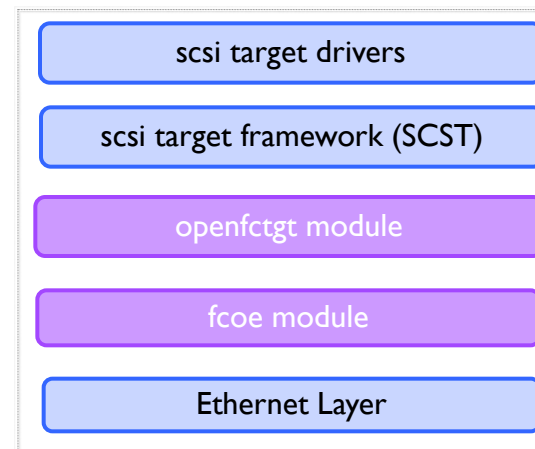
# OpenFCoE – An Introduction

- ❑ Open source project started by Intel on Linux
- ❑ Aim – develop native FCoE code for Linux - leverage Ethernet networks to connect to FC SAN
- ❑ Initiator available in kernel 2.6.29, target needs optimization
- ❑ Target uses SCSI Target infrastructure – SCST
- ❑ libfc module implements FC functionality
- ❑ fcoe module implements Encapsulation & De-encapsulation, Virtual Link establishment

## Initiator stack

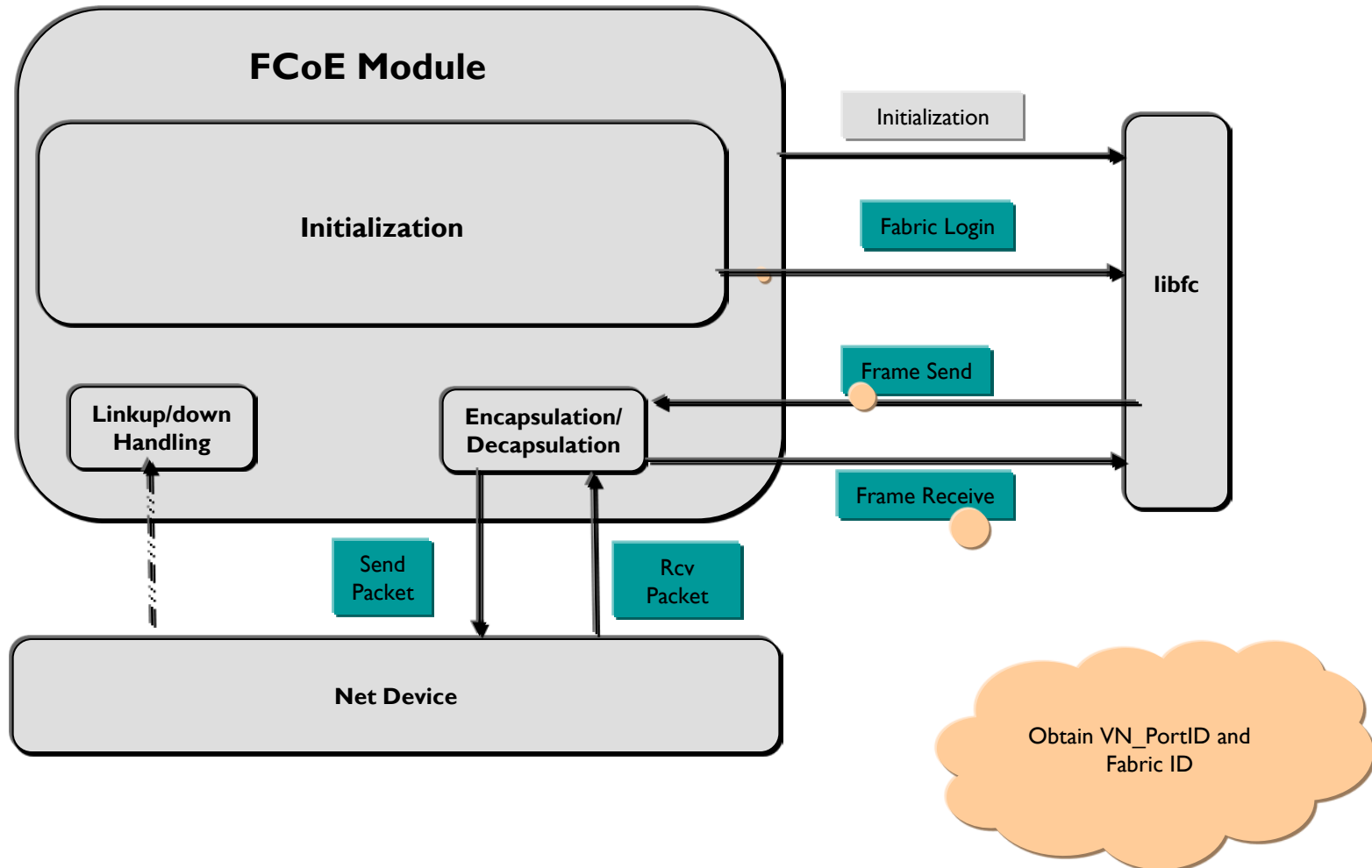


## Target stack

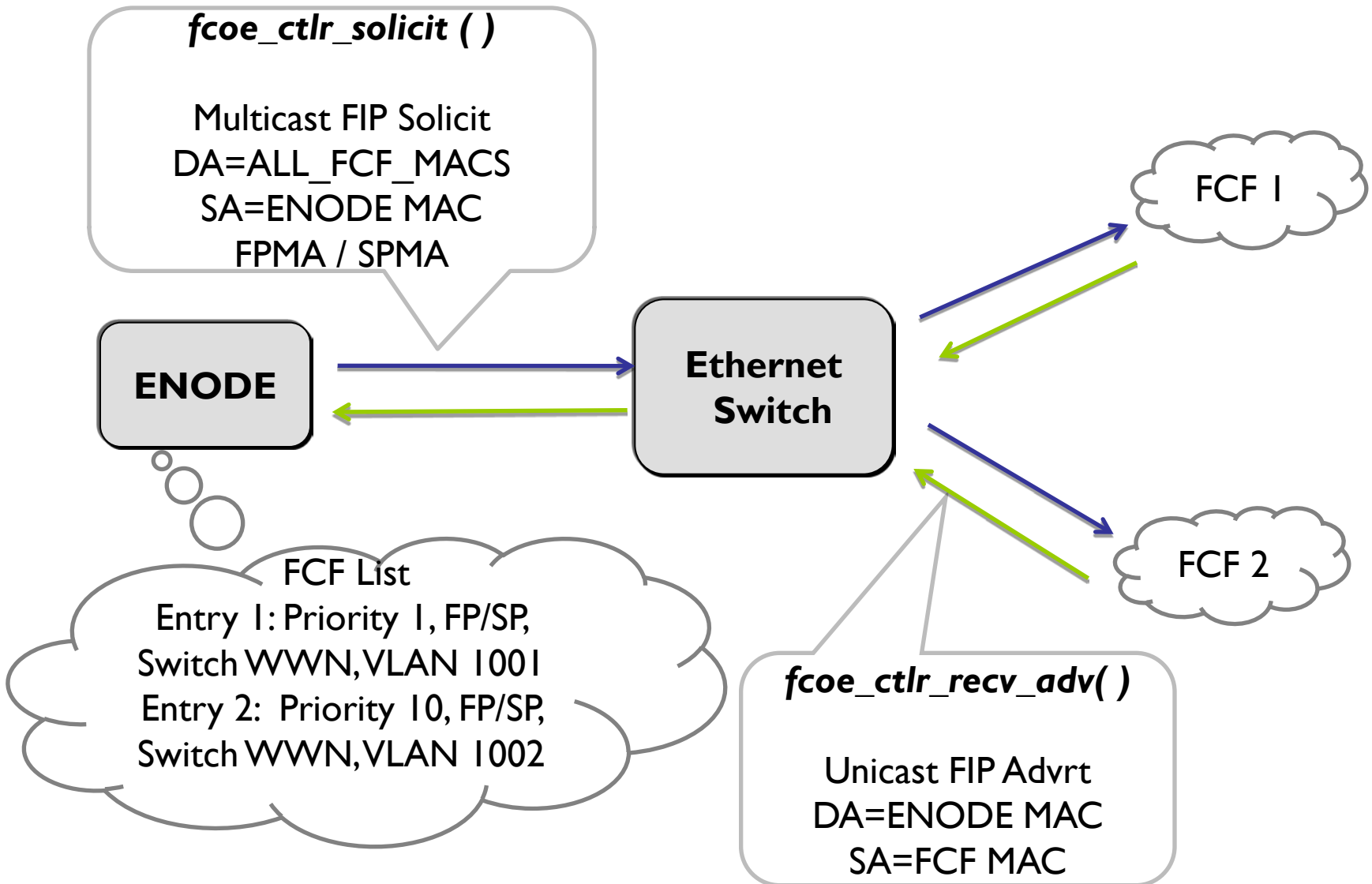


# OpenFCoE: Link Establishment

Kernel Space

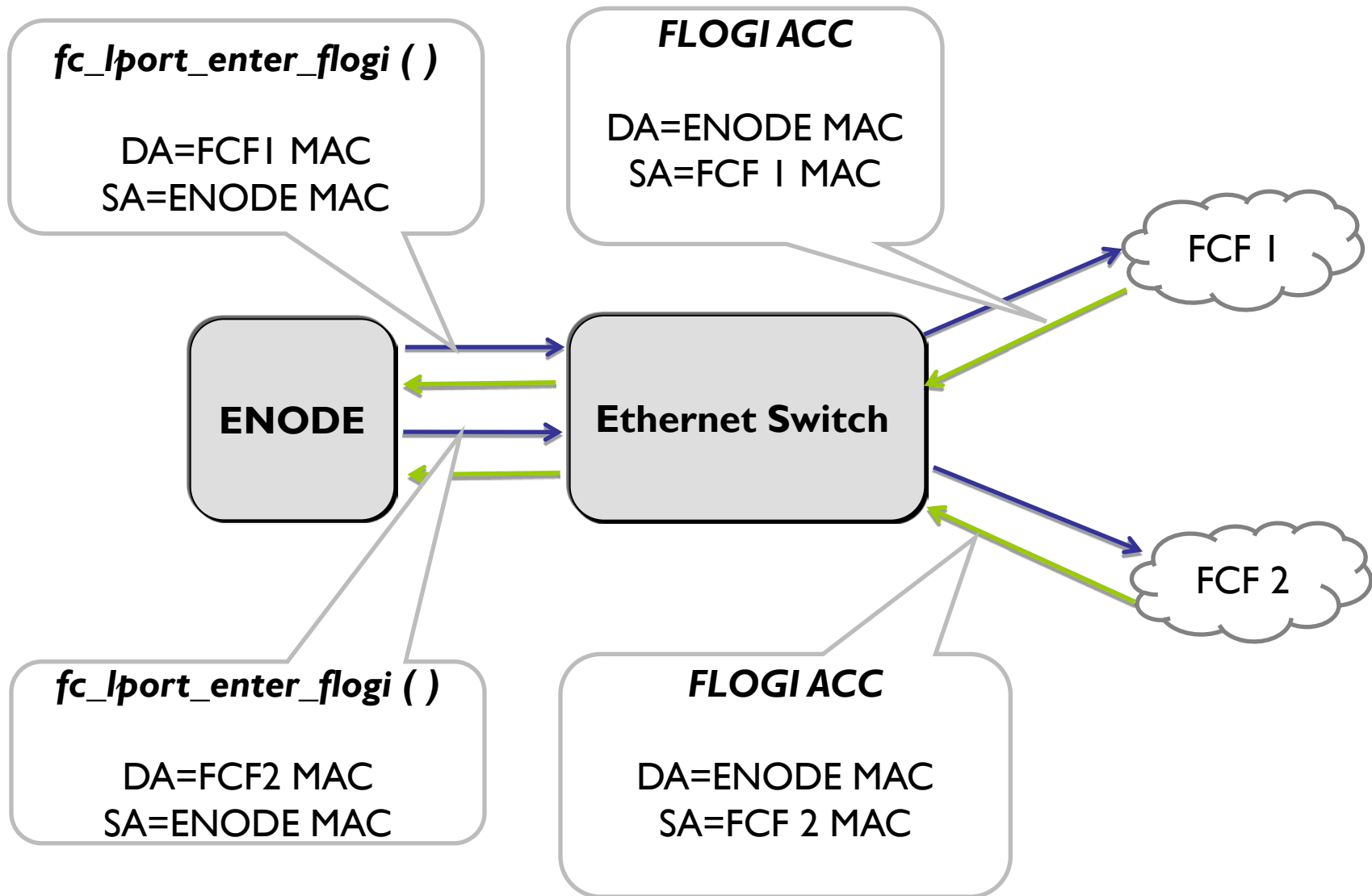


# FIP Discovery (Solicitation/Adv)

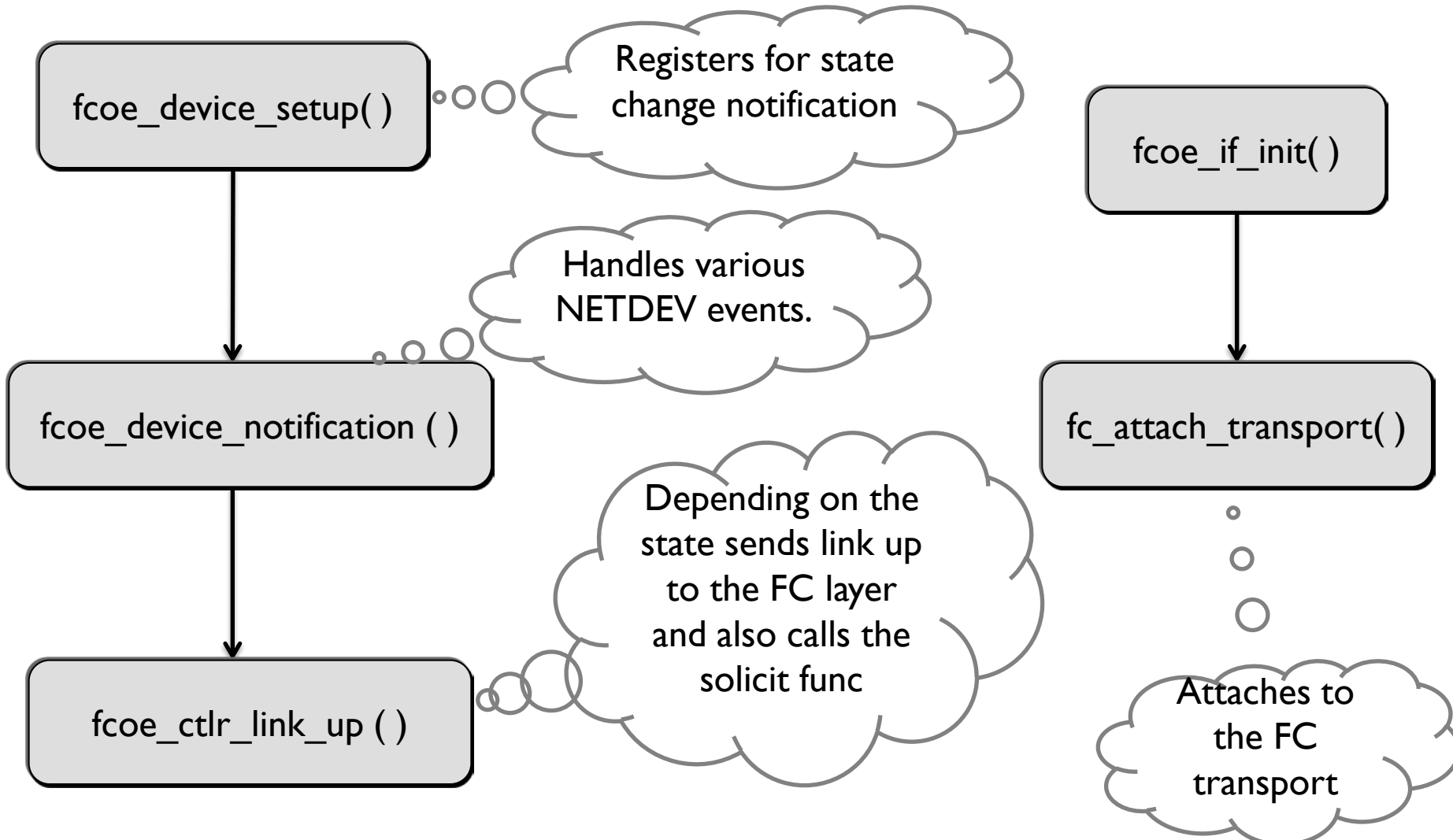




## FIP (FLOGI / ACC)

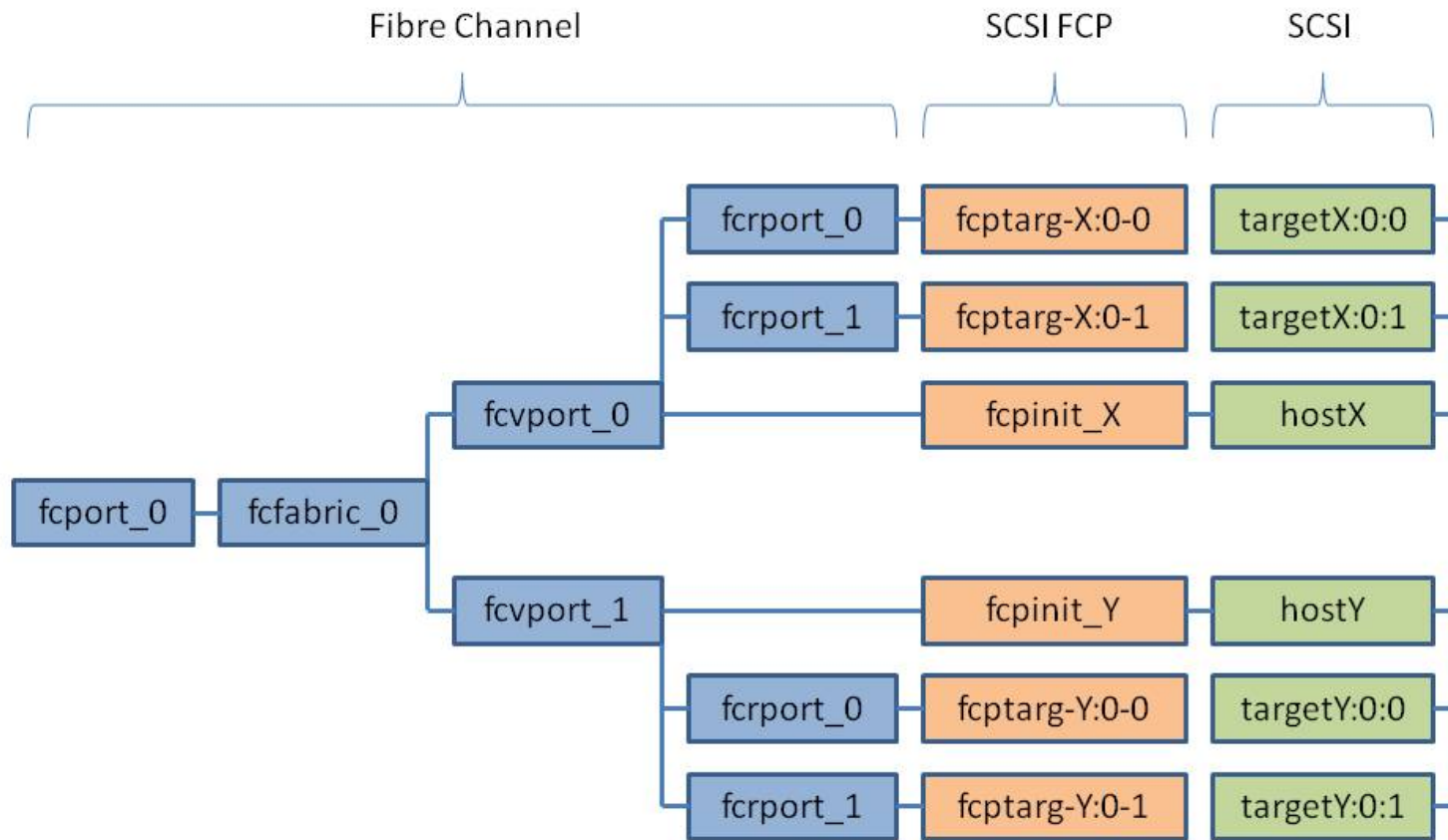


# Open FCOE (FCOE\_INIT Flow)

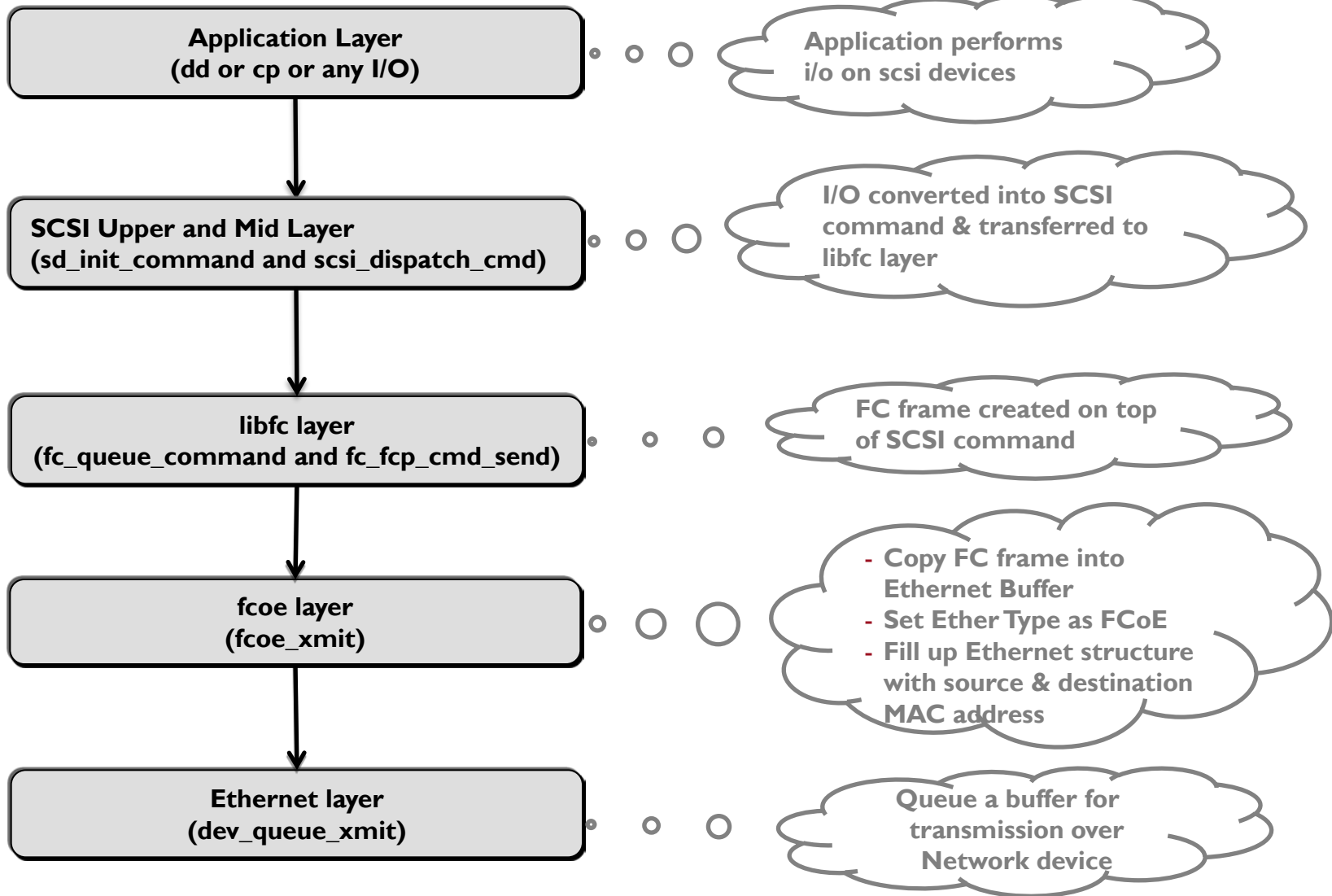


# FC – SCSI interaction in OpenFCoE

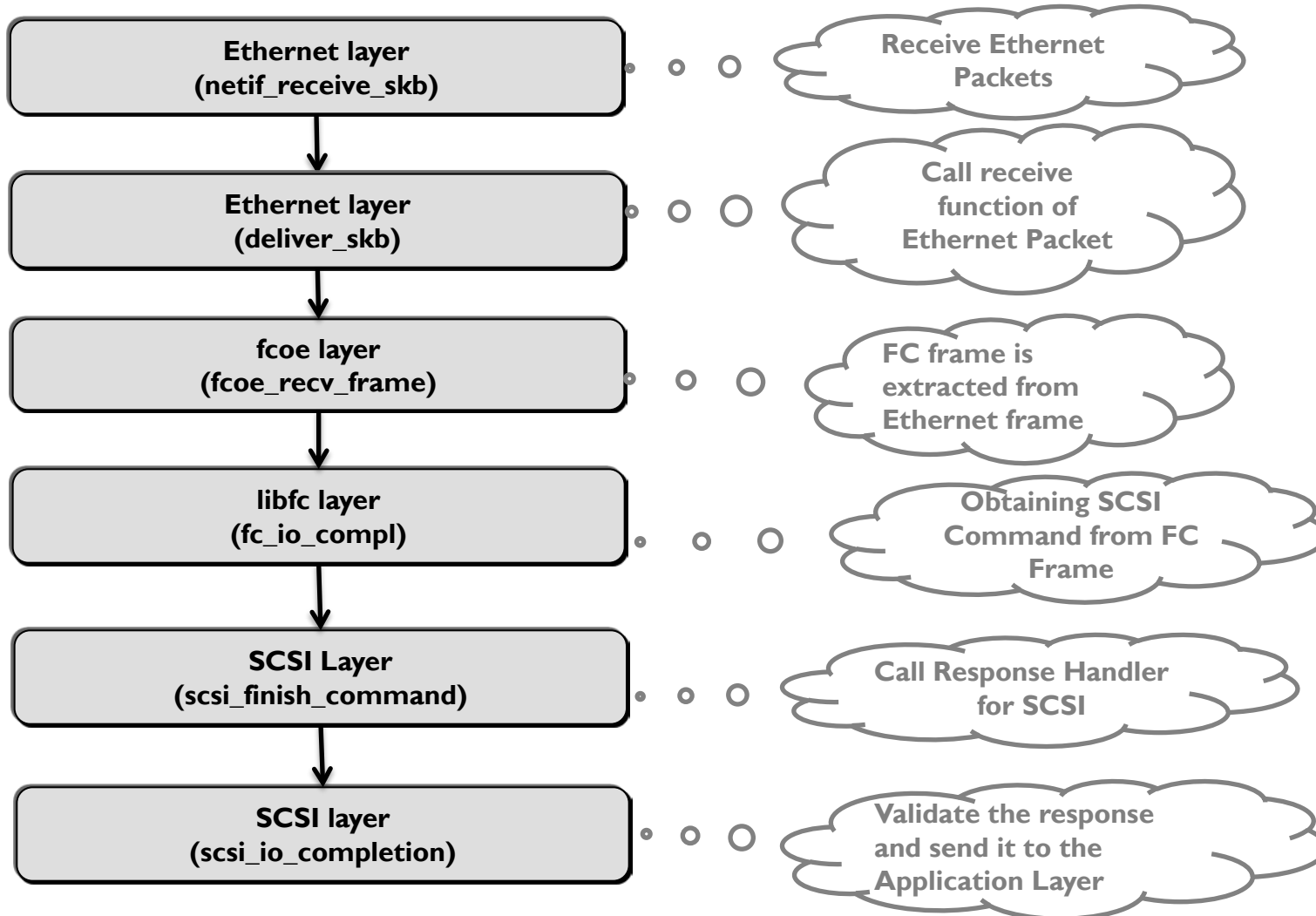
Fibre Channel subsystem device tree attached to SCSI (using scsi\_transport\_fc)



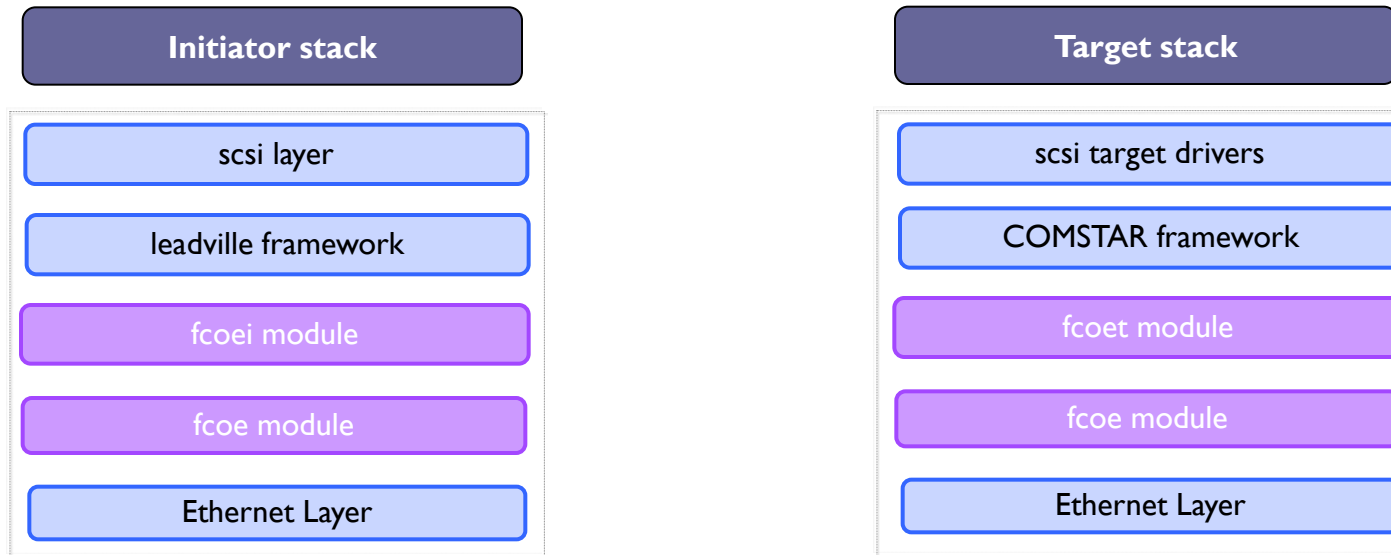
# OpenFCoE - Transmit Flow



# OpenFCoE - Receive Flow



# OpenSolaris FCoE – An Introduction



- ❑ Uses existing framework in OpenSolaris
  - ❑ COMSTAR (Common SCSI Target framework)
  - ❑ Leadville (SCSI Initiator Stack)
- ❑ Uses 3 new drivers
  - ❑ fcoei (uses services provided by fcoe)
  - ❑ fcoet (uses services provided by fcoe)
  - ❑ fcoe (common to both initiator & target)
- ❑ Part of source code in fcoet & fcoei has been ported from OpenFCoE
- ❑ OpenSolaris FCoE has both initiator and target stacks implemented

# FCoE Task Management

OpenSolaris FCoE

fcoet layer  
fcoet\_rx\_frame()

fcoet layer  
fcoet\_process\_unsol\_fcp\_cmd()

COMSTAR layer  
fct\_post\_rcvd\_cmd()

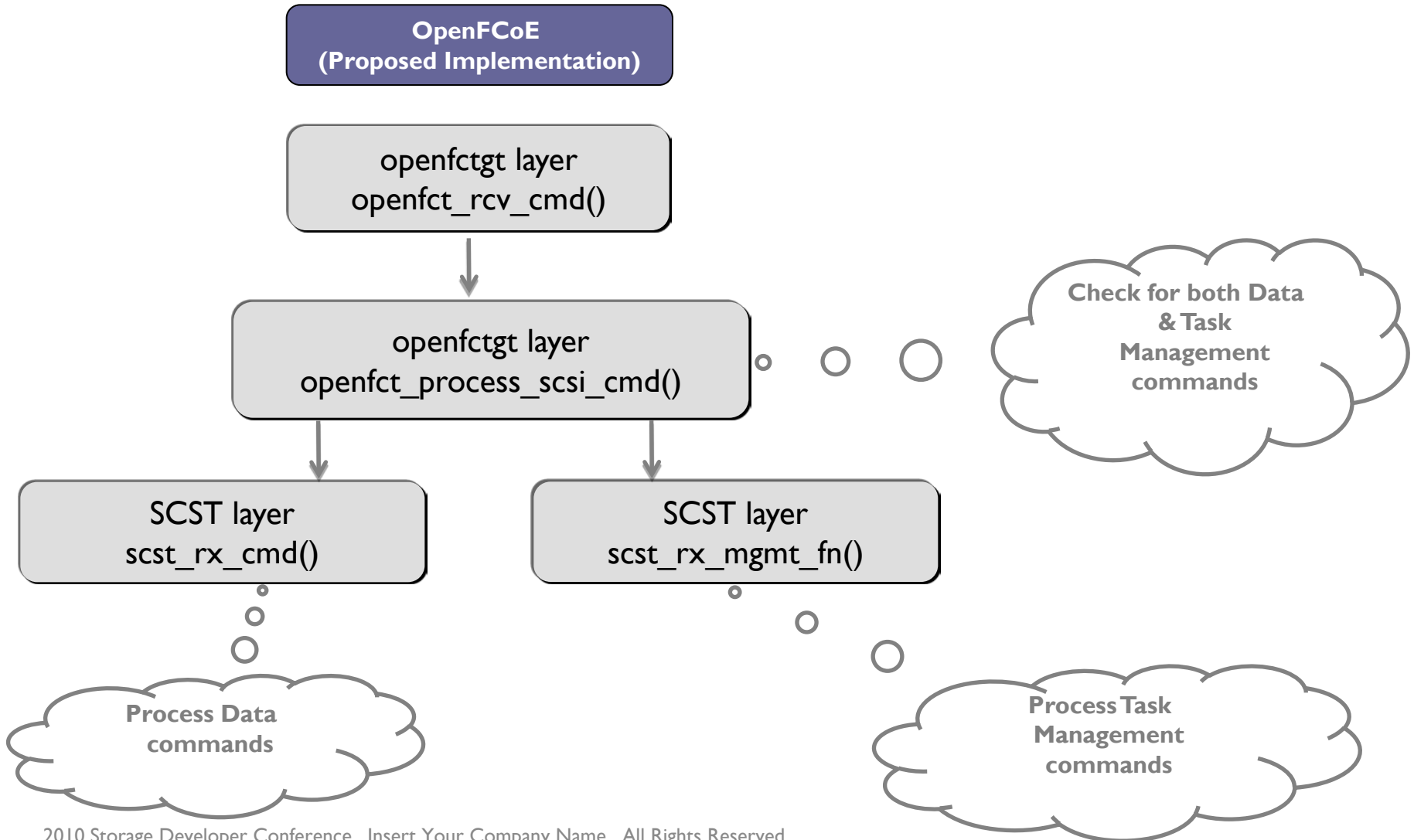
OpenFCoE

openfctgt layer  
openfct\_rcv\_cmd()

openfctgt layer  
openfct\_process\_scsi\_cmd()

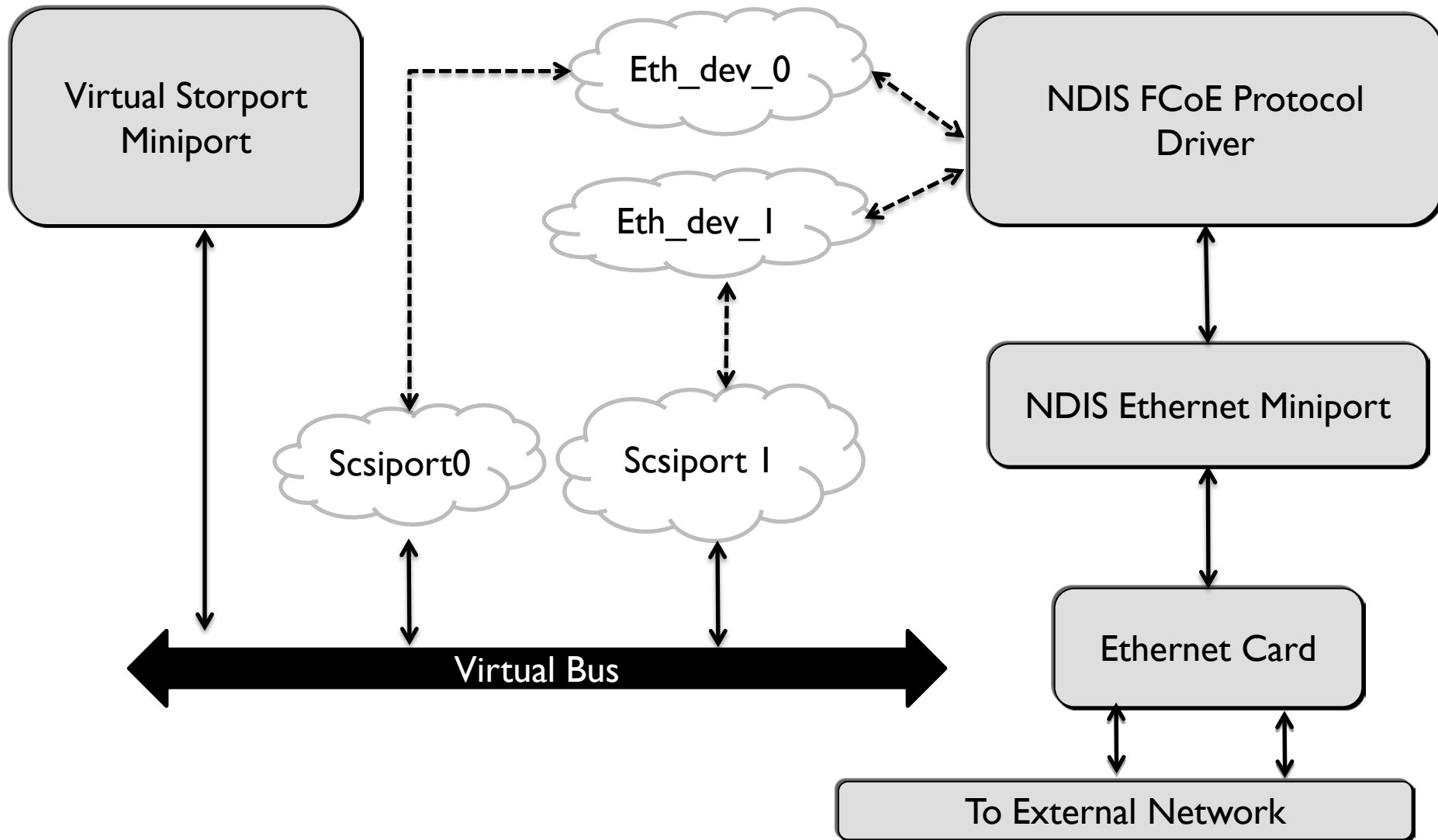
SCST layer  
scst\_rx\_cmd()

# FCoE Task Management





# Software FCOE in Windows (Block Diagram)



# Software FCOE in Windows

NDIS Protocol Driver	Virtual Bus Driver	Virtual Storport Driver
<ul style="list-style-type: none"><li>❑ Handles FC / FCoE protocol stuff.</li><li>❑ Interacts with NDIS Ethernet miniport driver</li><li>❑ First driver to start in stack</li></ul>	<ul style="list-style-type: none"><li>❑ Acts as virtual bus driver for virtual storport miniport.</li><li>❑ Bridge between storport and protocol driver</li></ul>	<ul style="list-style-type: none"><li>❑ Used when there is no physical device to talk to. For e.g. Ram Disk.</li><li>❑ Exposes Ethernet ports as Scsiport to storage stack</li></ul>

**Pros**

- ❑ Useful in testing environments
- ❑ Uses 10G Ethernet card

**Cons**

- ❑ Complex implementation involving multiple drivers
- ❑ Performance

# OpenFCoE Initiator and Target - Configuration

- ❑ FCoE Team at Patni configured OpenFCoE initiator & target
- ❑ Updates done to Quickstart guides on OpenFCoE.org

## Observation 1 :

Execution of "fconfg eth0 enable" command hangs, call trace logged in syslog.

## Resolution :

Perform Target setup followed by Initiator setup. i.e., Execute "fconfg ethx enable" command in FCoE Target, before executing "echo "ethX" > /sys/module/fcoe/parameters/create" Command in FCoE Initiator.

## Observation 2 :

Execution of "fconfg eth0 enable" command fails with following error -

```
[r...@fcoe ~]# fconfg eth0 enable
fconfg: fcc_fcoe_config: FCoE create of eth0 failed
fconfg: fcc_fcoe_config: error 95 Operation not supported
fconfg: fcc_fcoe_config: exiting at fcc_fcoe.c:142
```

## Resolution :

Transmission and Reception of PAUSE are not set to ON.  
It can be set to ON by using command "ethtool -A tx on rx on"

# OpenFCoE Initiator and Target – Configuration (contd)

## Observation 3 :

During build of SCST module, error message related to "page member not in scatterlist structure" is logged in syslog, when kernel 2.6.29 is used.

## Resolution :

For FCoE Target setup, use 2.6.23 kernel. Using higher kernels leads to such problem. Page member has been removed from Scatterlist structure in 2.6.29 kernel.

## Observation 4 :

Loading of module `scst_disk` fails with following error message-  
[r...@fcoe ~]# modprobe `scst_disk` FATAL: Errorinserting `scst_disk`  
(/lib/modules/2.6.23/extra/dev\_handlers/scst\_disk.ko): Invalid argument

## Resolution :

- i) `cd <path-to-scst>/trunk/scst/src`
- ii) Open Makefile and check `CONFIG_SCST_STRICT_SERIALIZING` flag is defined. If it is not, define it. (`EXTRA_CFLAGS += DCONFIG_SCST_STRICT_SERIALIZING`)
- iii) Build SCST module.
- iv) Build `openfctgt` and `fcoe` modules.

## Observation 5 :

Loading of openfctgt.ko module fails with following error message –

```
[r...@fcoe ~]# insmod /home/FCoE_Target/open-fcoe-target/openfctgt.ko  
insmod: error inserting '/home/FCoE_Target/open-fcoe-target/openfctgt.ko': -1 Invalid module  
format
```

## Resolution :

Check whether openfc module is loaded by using lsmod command.

If yes, remove the module by using "rmmod openfc" command.

Load openfctgt.ko module.

- <http://www.netapp.com/us/communities/tech-ontap/tot-fcoe.html>
- <http://open-fcoe.org>
- [http://open-fcoe.org/rwlove/fc\\_sysfs.jpg](http://open-fcoe.org/rwlove/fc_sysfs.jpg)

# Q & A