

The Truth about FCoE: Technology and Standards

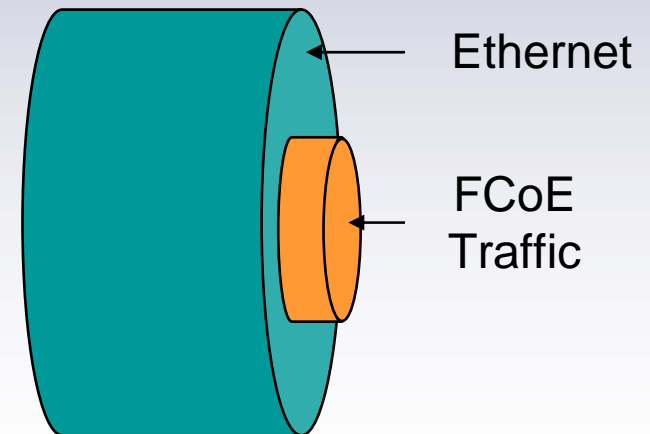
Claudio DeSanti

Fellow, Cisco Systems

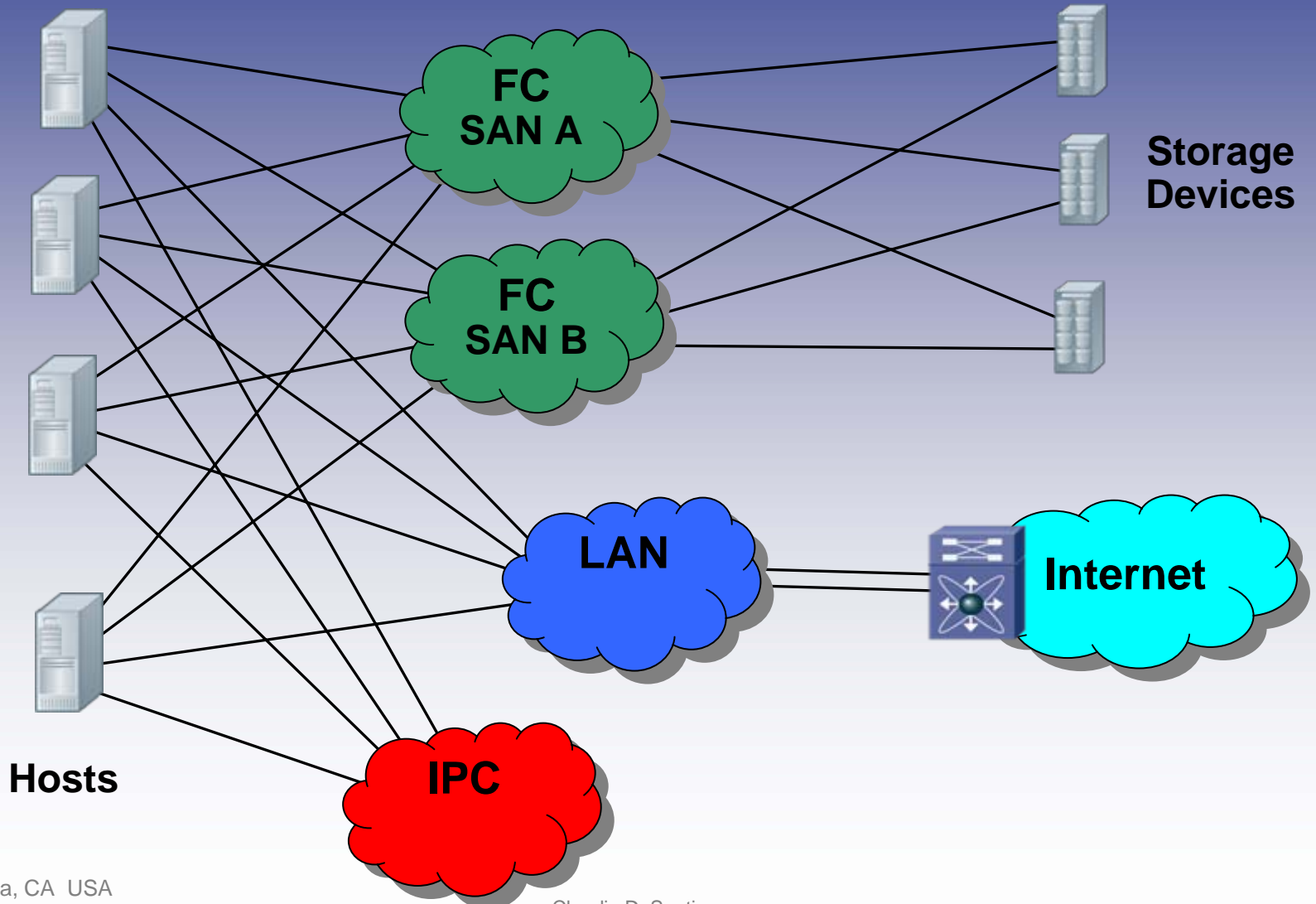
T11 FC-BB-5 & FC-BB-6 Chairman

Agenda

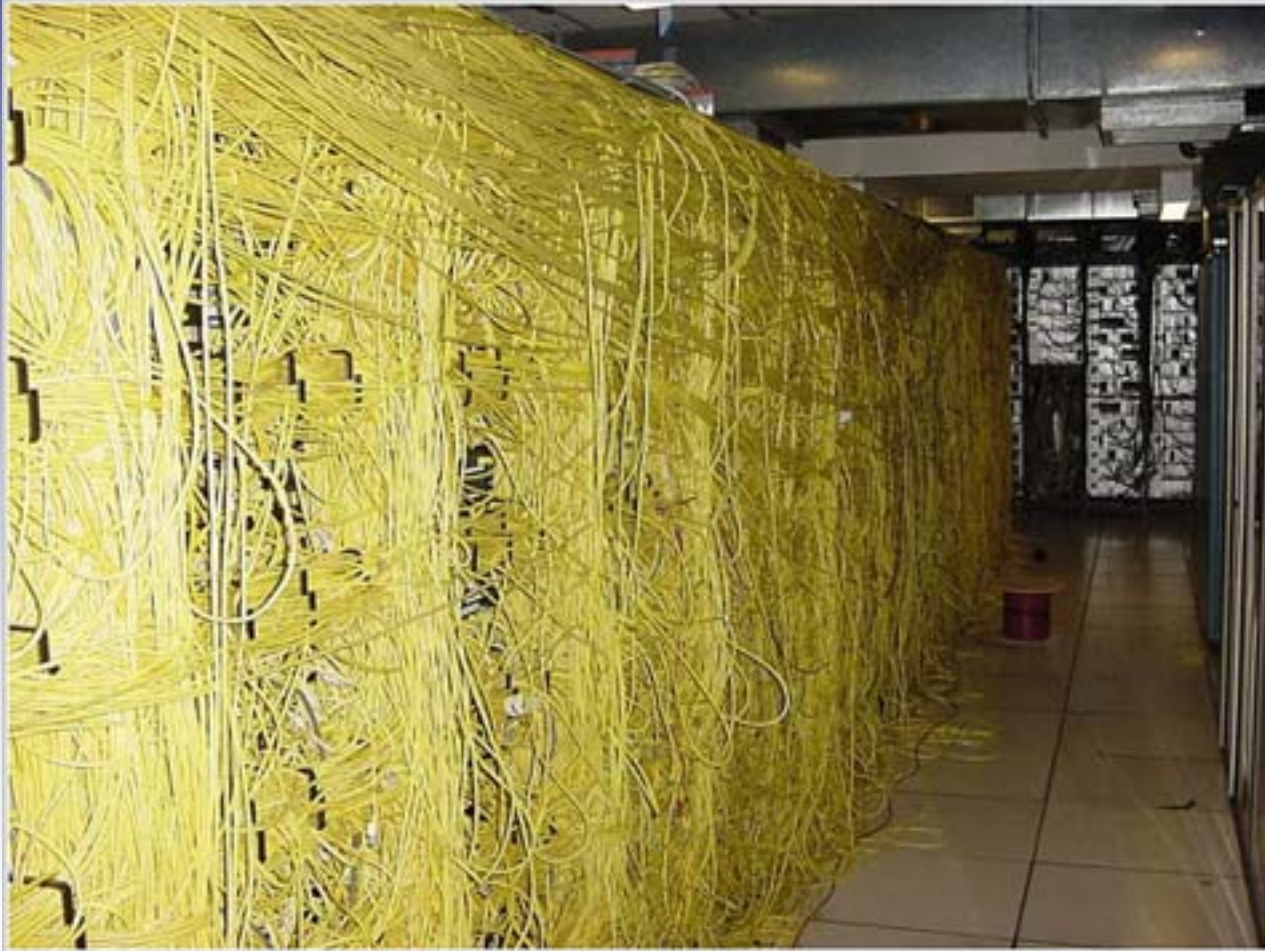
- I/O Consolidation with FCoE
- FCoE Standards
- FCoE Myths



Current Data Center Structure



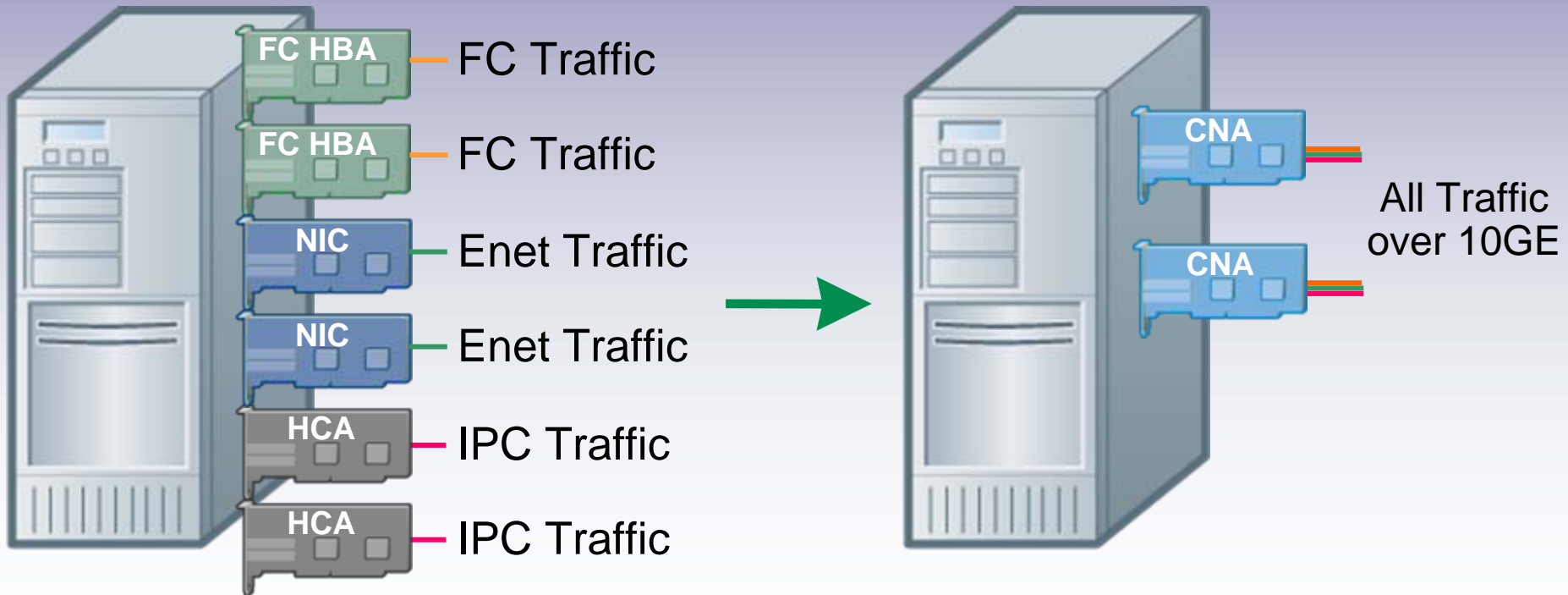
This is bad!



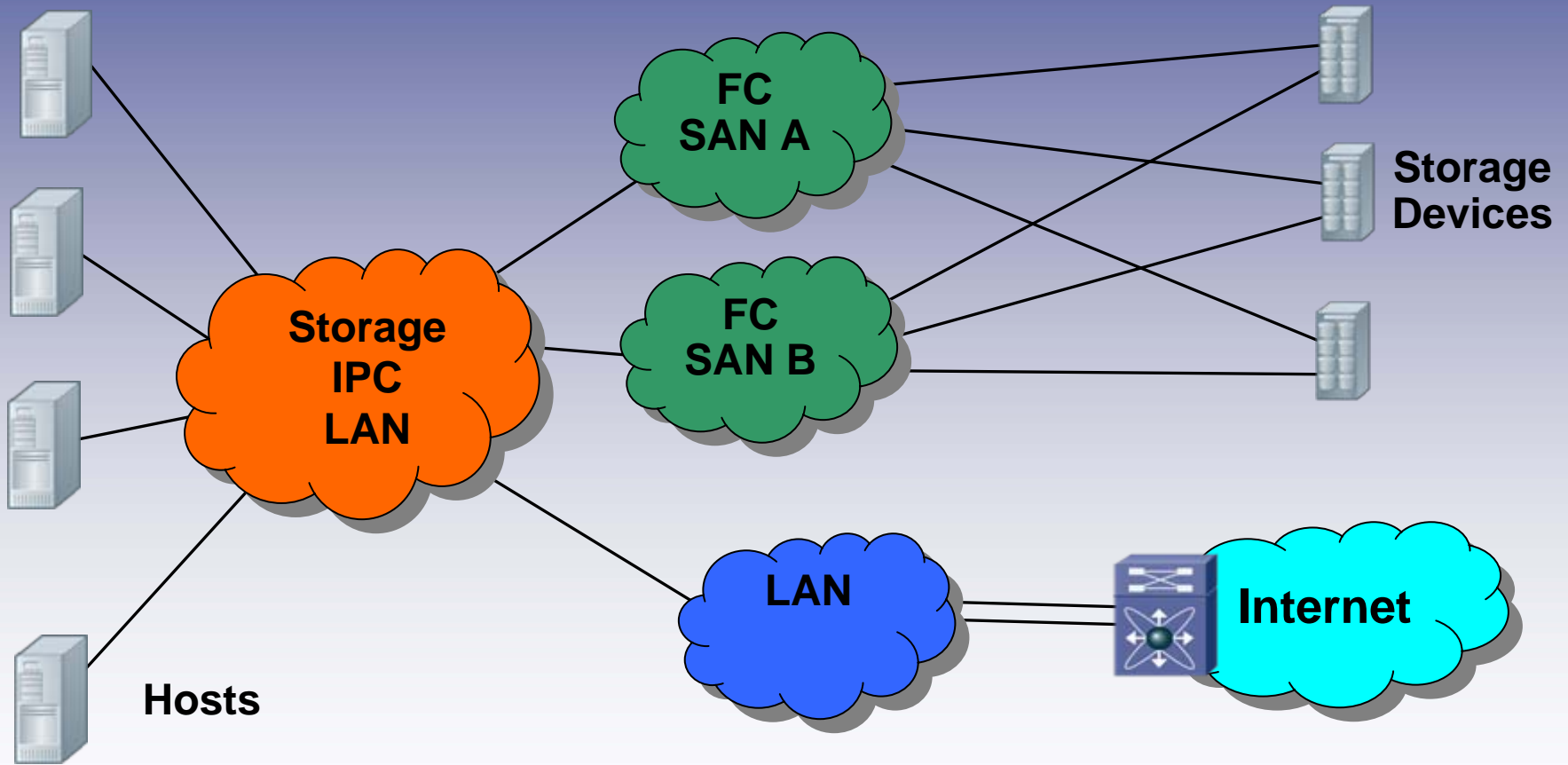
... here be dragons!

I/O Consolidation

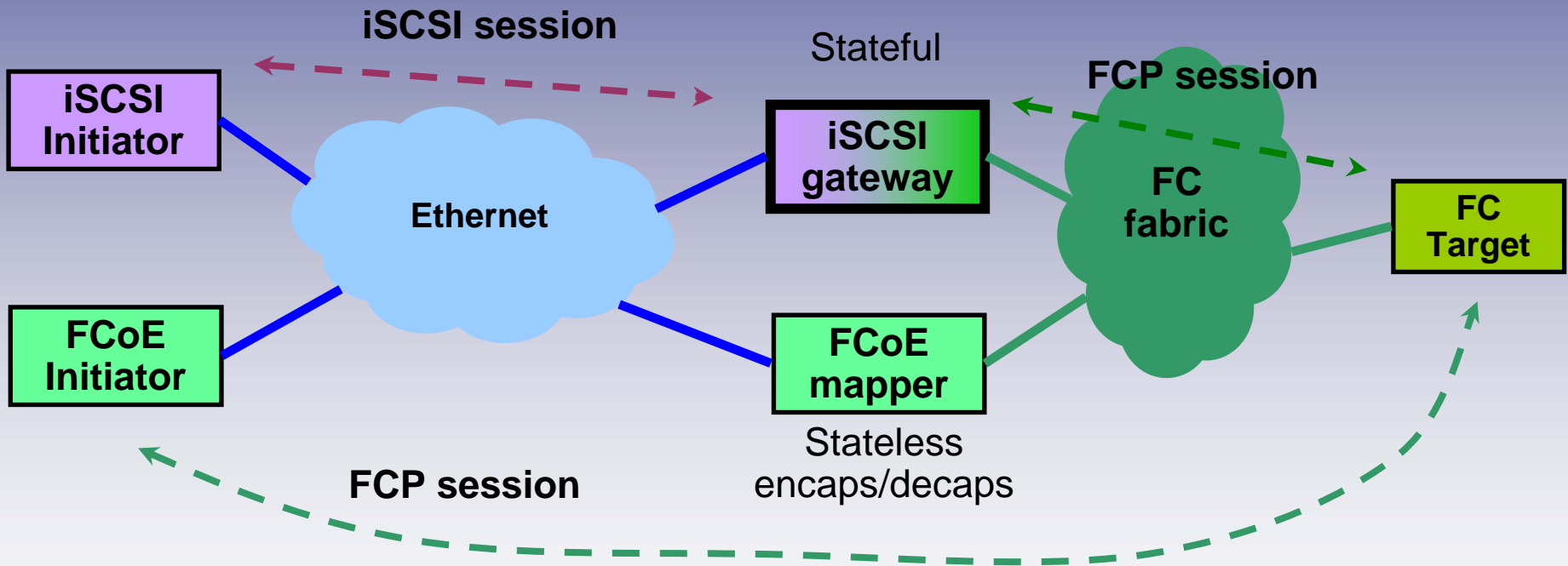
- Consolidate multiple types of traffic into a single link
- Fewer CNAs (Converged Network Adapters) instead of NICs, HBAs and HCAs
 - Less power consumption



Consolidated Data Center



Gateway-less FCoE



FC vs. FCoE

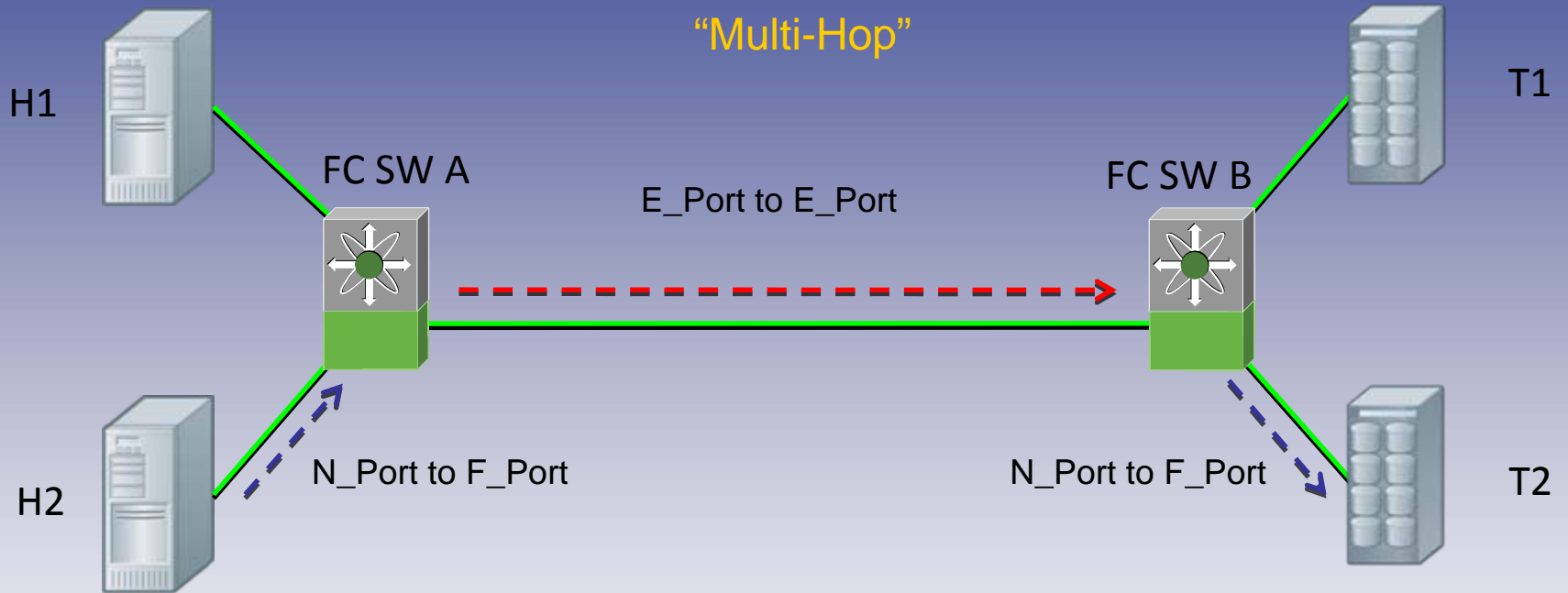


- Fibre Channel defines two architectural entities and the behavior of the links between them
 - FC Node: the end-point entity in a host, providing N_Ports
 - FC Switch: the FC frames switching entity, providing F_Ports and E_Ports
 - N_Port to F_Port: a link between a FC Node and a FC Switch
 - E_Port to E_Port: a link between two FC Switches

- FCoE virtualizes the FC constructs over Ethernet
 - ENode: a FC Node supporting FCoE on at least one Ethernet interface
 - FCF: a Switch supporting FCoE on at least one Ethernet interface
 - VN_Port to VF_Port: a Virtual Link between an ENode and an FCF
 - VE_Port to VE_Port: a Virtual Link between two FCFs

- While FC is a Layer 2 protocol, FCoE behaves as a Layer 3 protocol

FC Forwarding



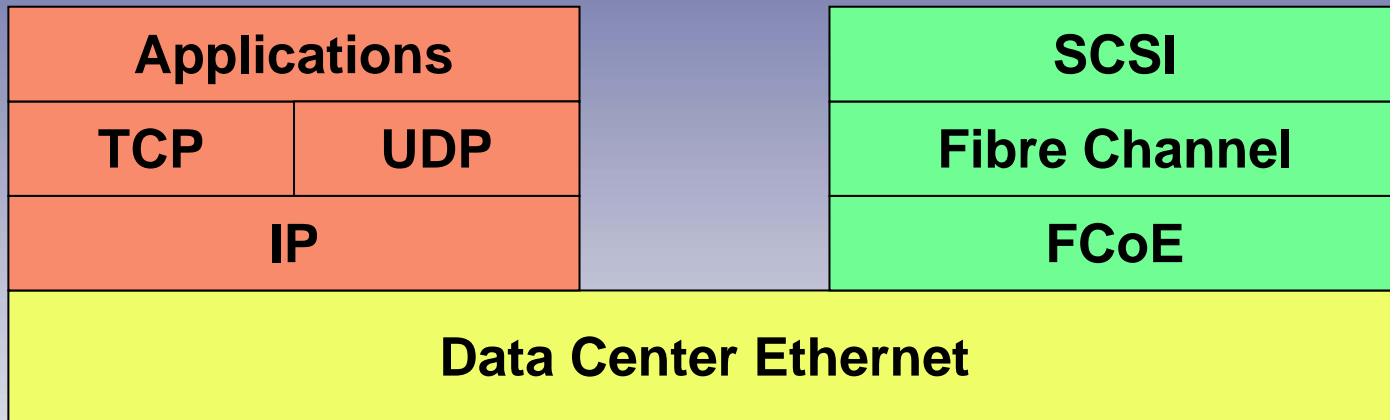
D_ID = FC-ID(T2)
S_ID = FC-ID(H2)
FC frame

D_ID = FC-ID(T2)
S_ID = FC-ID(H2)
FC frame

D_ID = FC-ID(T2)
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FC frame

FCoE: FC over Ethernet

- FCoE is a L3 protocol

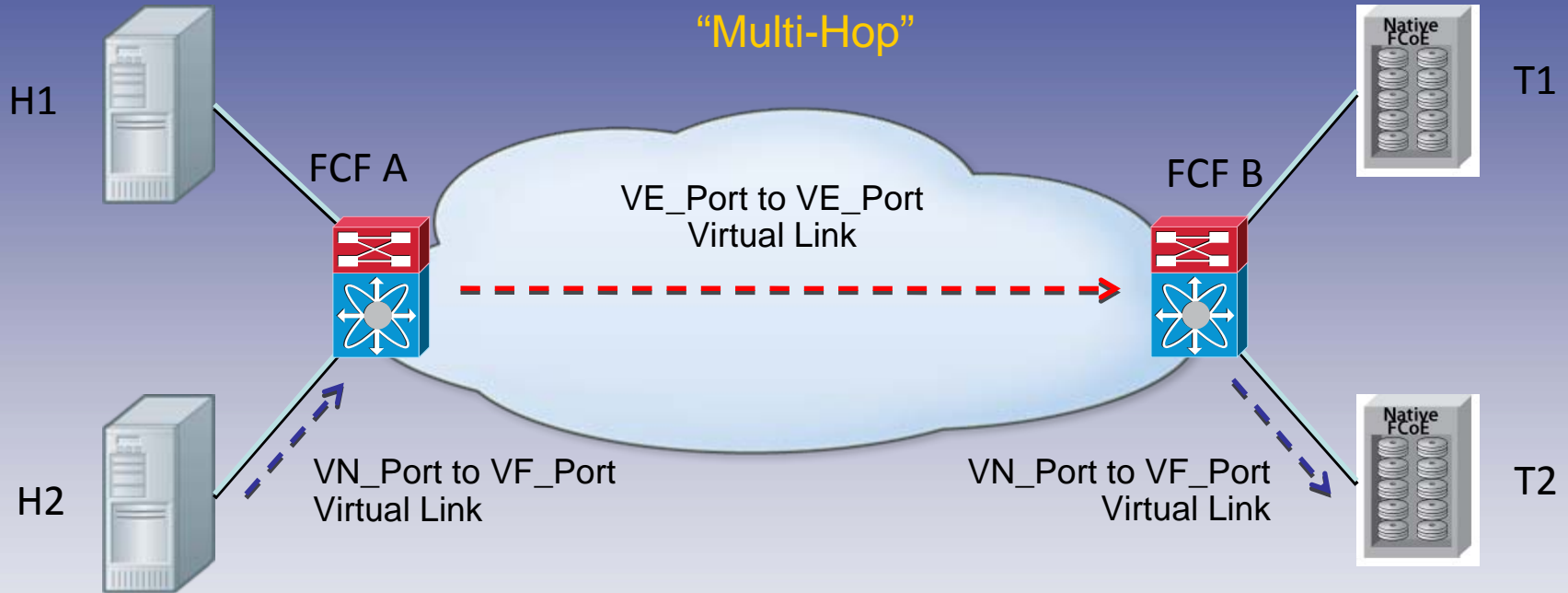


An FCoE forwarder (FCF) is explicitly addressed by an ENode (via its FCF-MAC address)

An FCoE forwarder receives FCoE frames addressed to its FCF-MAC address and forwards them based on the D_ID of the encapsulated FC frame

An FCoE forwarder rewrites the SA and DA of an FCoE frame

FCoE Forwarding



DA: FCF-MAC(A)
SA: FPMA(H2)
Encaps. FC frame
D_ID = FC-ID(T2)
S_ID = FC-ID(H2)

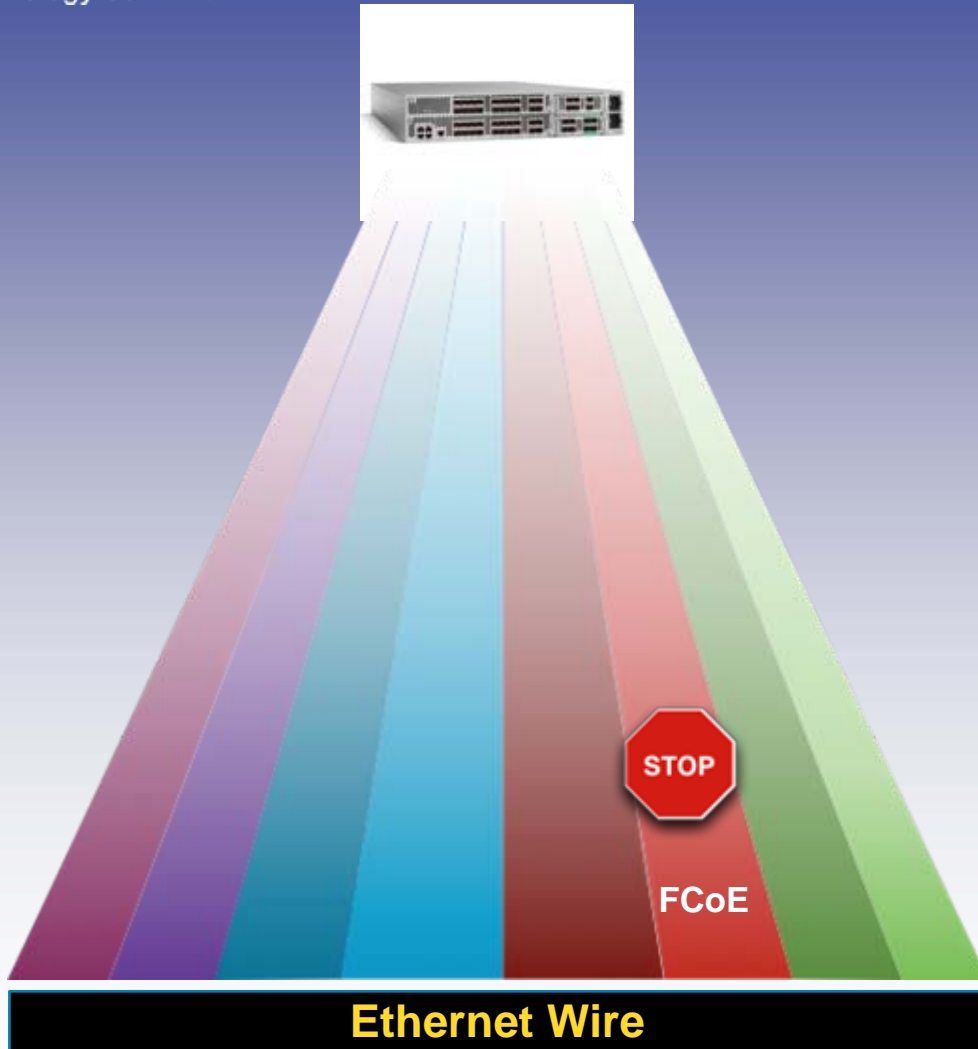
DA: FCF-MAC(B)
SA: FCF-MAC(A)
Encaps. FC frame
D_ID = FC-ID(T2)
S_ID = FC-ID(H2)

DA: FPMA(T2)
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I/O Consolidation With FCoE

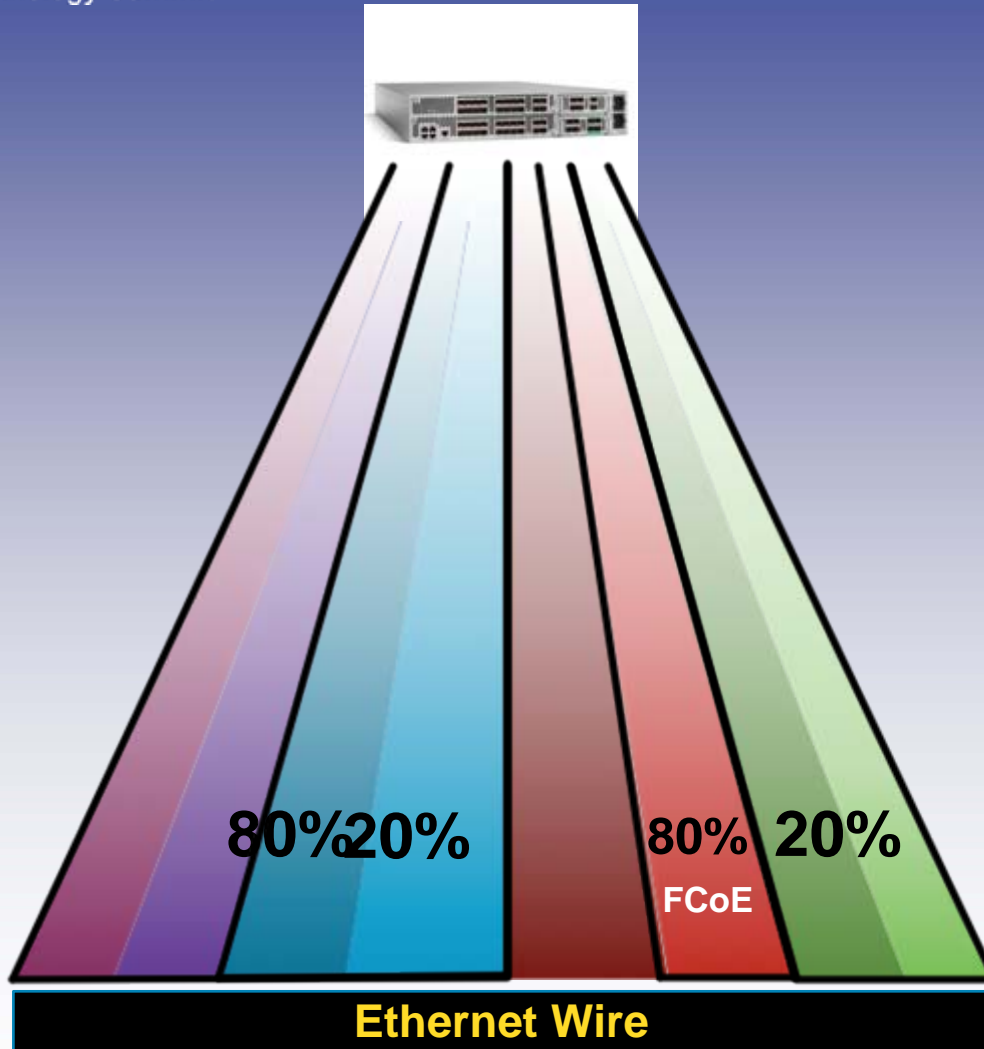
- Provides seamless connection to the installed base of existing SANs and LANs
- Requires:
 - Lossless Ethernet for FCoE itself
 - Additional Ethernet extensions to transport multiple types of traffic over the same links
- **PFC** (Priority-based Flow Control) is the technology of choice to implement lossless Ethernet
- **ETS** (Enhanced Transmission Selection) is the technology of choice to transport multiple types of traffic over the same links
- **DCBX** (Data Center Bridging eXchange protocol) is the protocol to ensure consistent parameters for PFC and ETS

PFC: Priority-based Flow Control



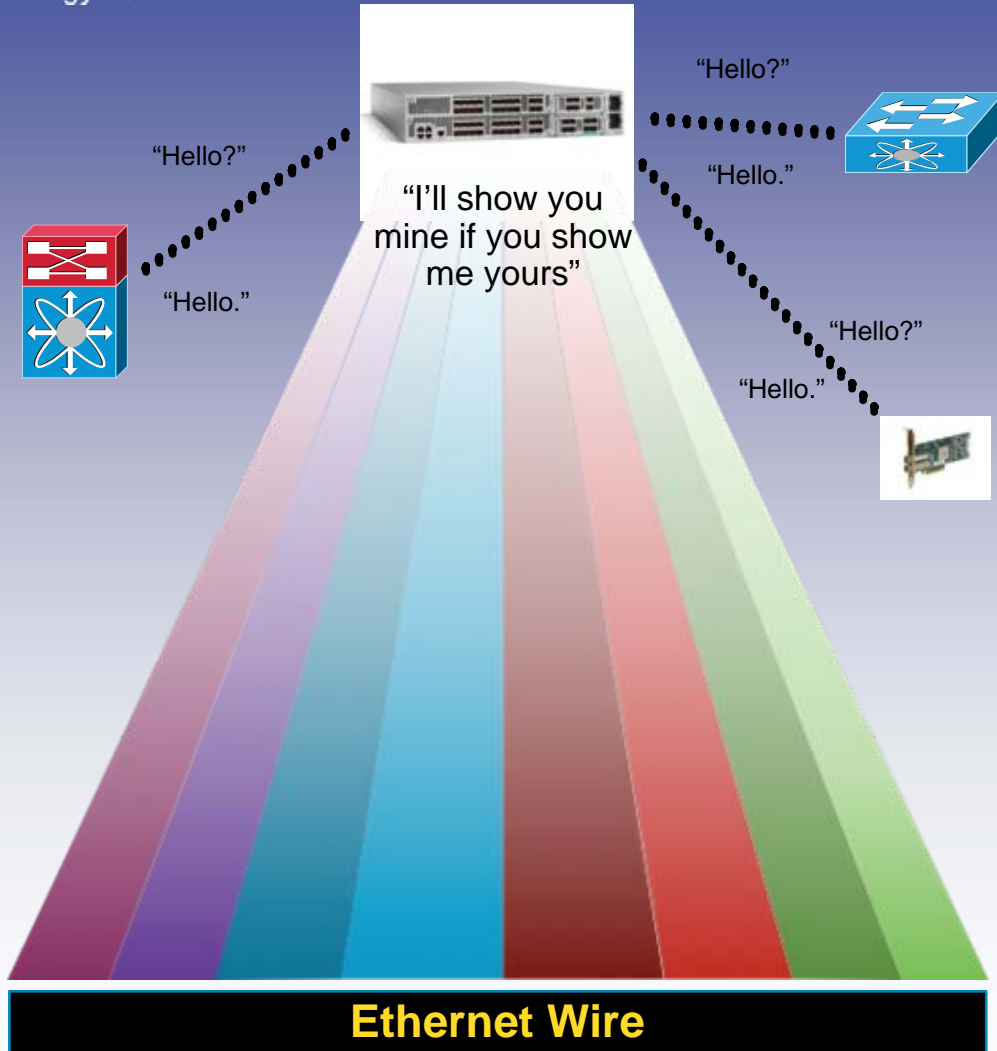
- The VLAN Tag defines 8 priorities for Ethernet traffic
- PFC enables Flow Control on a Per-Priority basis
- PFC enables lossless and lossy Priorities at the same time on a wire
- PFC enables FCoE to operate over a lossless Priority independent of other Priorities

ETS: Enhanced Transmission Selection



- Groups Priorities in Traffic Classes
- Assigns bandwidth percentages to Traffic Classes
- Can guarantee bandwidth to Traffic Classes
- Enables carrying multiple types of traffic over a wire

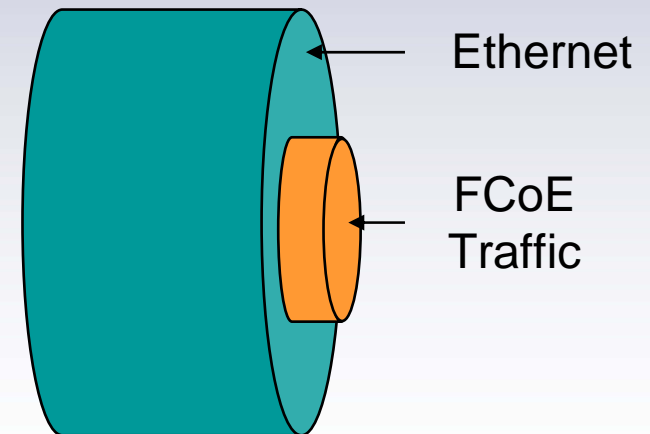
DCBX: Data Center Bridging eXchange



- Allows network devices to advertise their capabilities over a link
 - Enables hosts to get proper configuration from the network
 - Enables switches to verify proper configuration
- Provides support for:
 - PFC
 - ETS
 - Applications (e.g., FCoE)

Agenda

- I/O Consolidation with FCoE
- FCoE Standards
- FCoE Myths

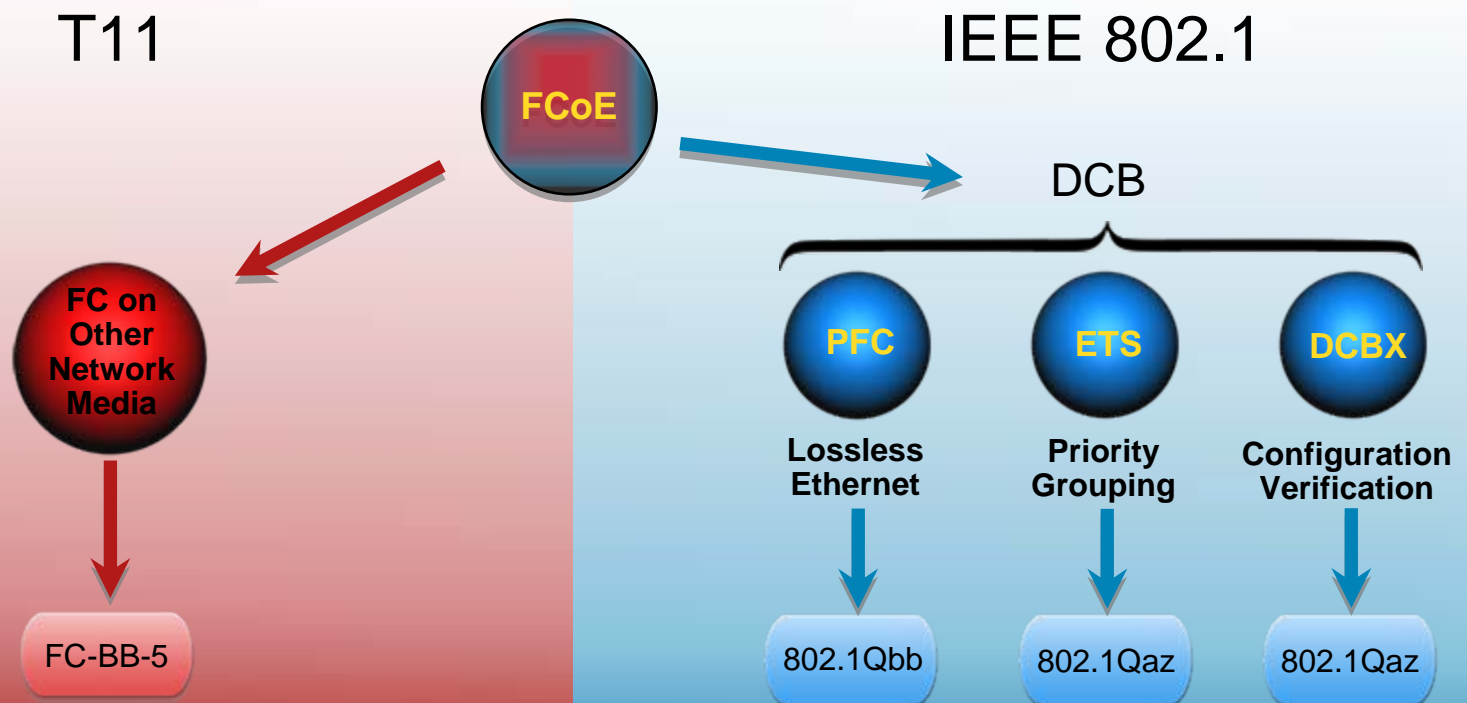


Why Standards?

- Customers care about standards because:
 - Enable interoperability
 - Prevent vendor lock-in
 - Provide flexibility and choice
- Standards specify how to solve specific problems
 - E.g., "if you want to put more than one traffic class on Ethernet, this is how you do it"
 - E.g., "If you are interested in FCoE, this is how you do it"
- Standards, like software, go through versions and updates to add new functionality

Standards for FCoE

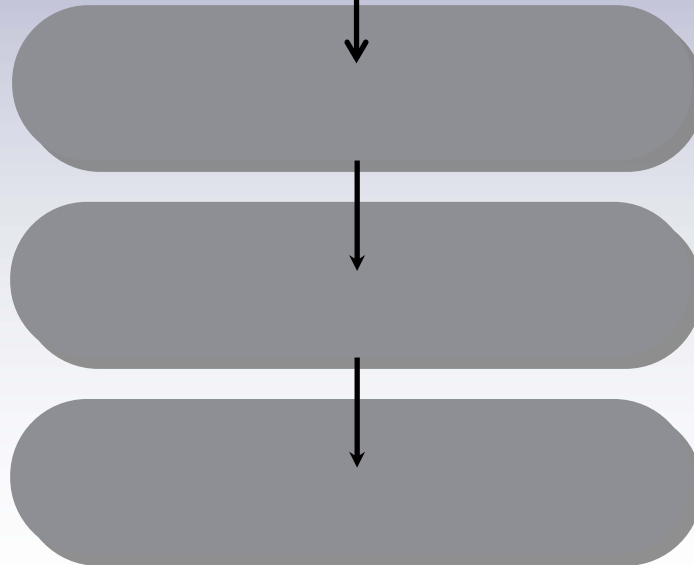
- FCoE is fully defined in the FC-BB-5 standard
- FCoE works with additional technologies to make I/O Consolidation a reality



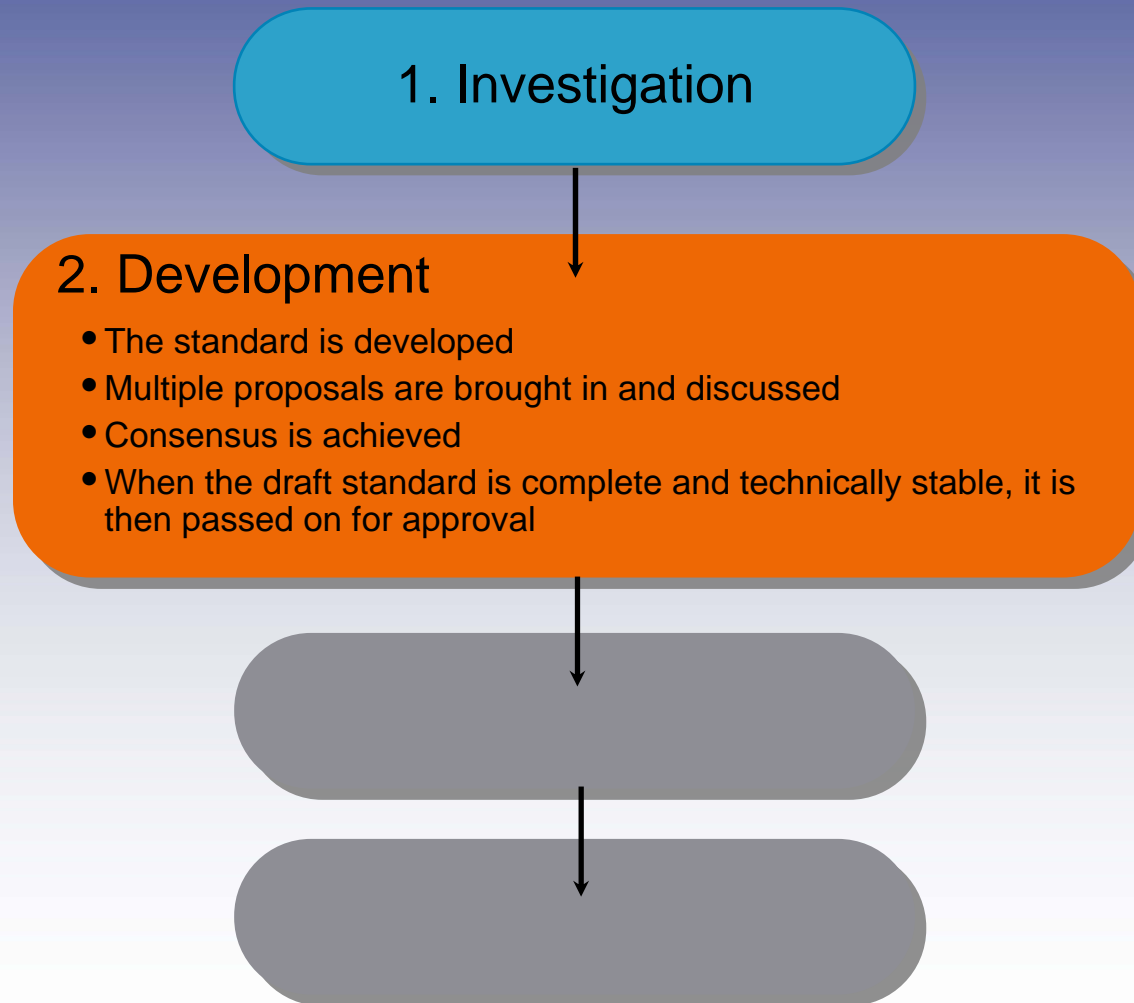
When Are Standards “Done?” (1)

1. Investigation

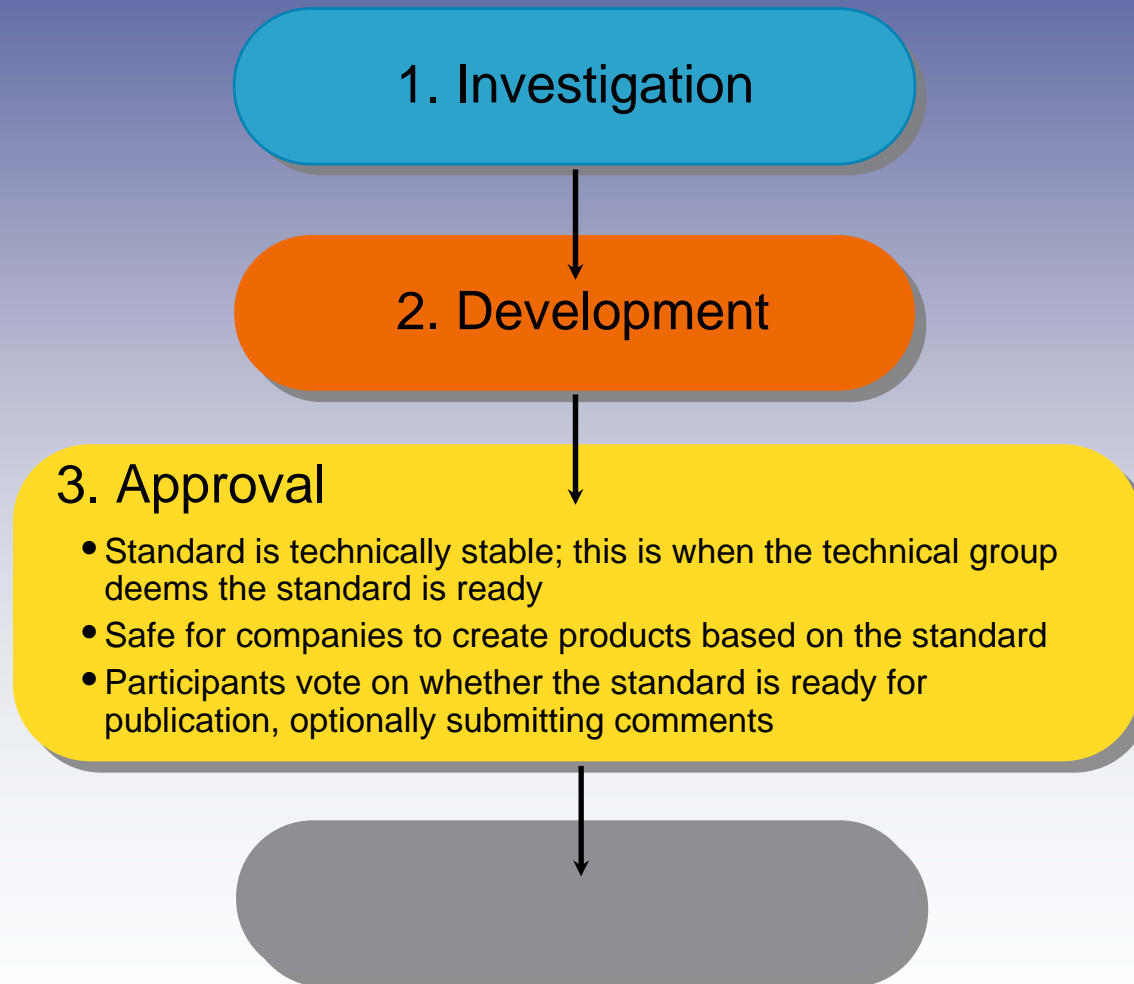
- People investigate the need for a standard technology to solve a specific problem
- If there is a recognized need, a project proposal is created and gets started
- Project usually begins by creating a working group or task group



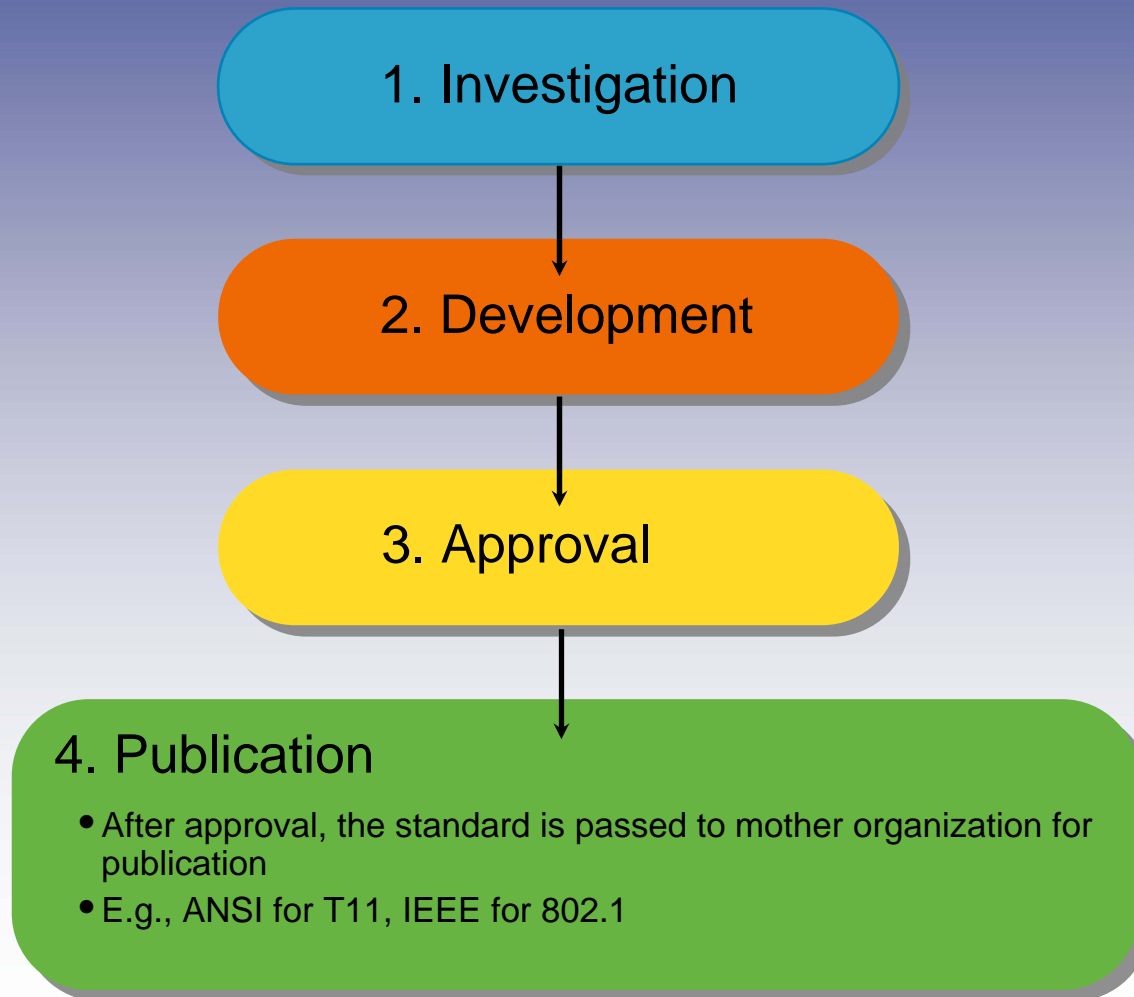
When Are Standards “Done?” (2)



When Are Standards “Done?” (3)



When Are Standards “Done?” (4)



When Are Standards “Done?” (5)

Standard is technically stable,
a.k.a. “Done”, when it moves from
Development to Approval phase



1. Investigation

2. Development

3. Approval

4. Publication

Status of FCoE Related Standards



Technically stable in October, 2008
Completed in June 2009
Published in May, 2010



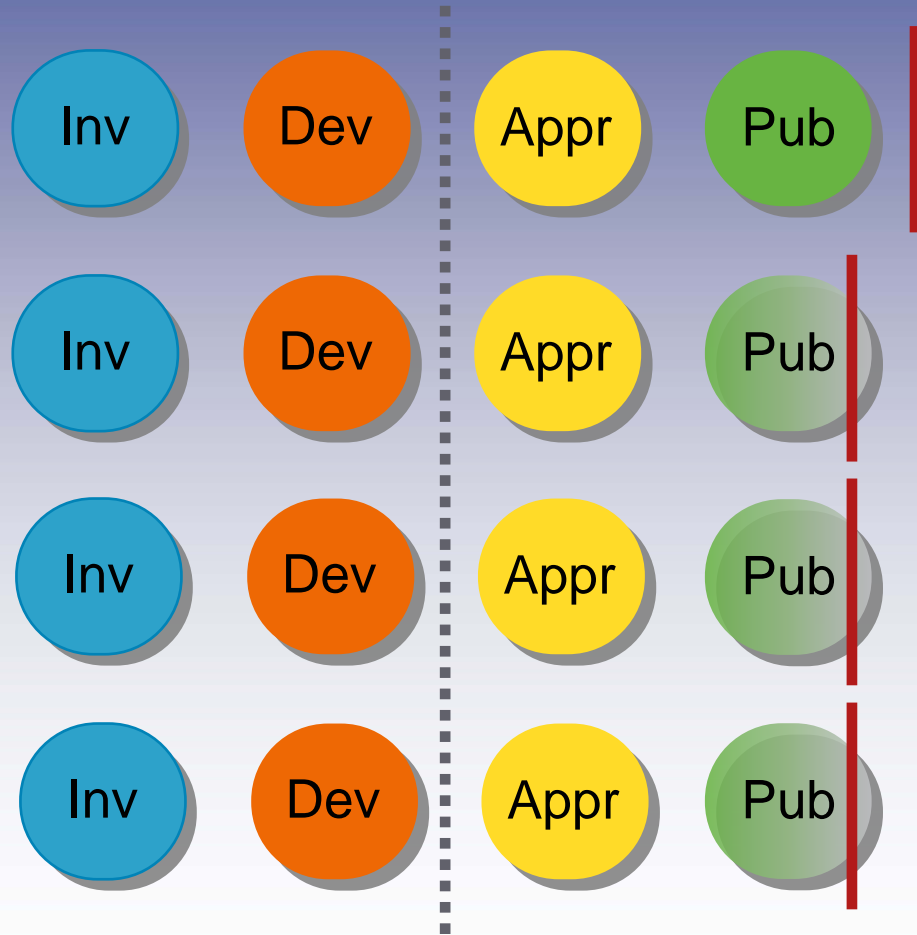
Completed in May 2010,
awaiting publication



Completed in November 2010,
awaiting publication



Completed in November 2010,
awaiting publication



More Specifically...

Standard / Feature	Status of the Standard
IEEE 802.1Qbb Priority-based Flow Control (PFC)	Passed Sponsor Ballot awaiting publication
IEEE 802.3bd Frame Format for PFC	Passed Sponsor Ballot awaiting publication
IEEE 802.1Qaz Enhanced Transmission Selection (ETS) and Data Center Bridging eXchange protocol (DCBX)	Passed Sponsor Ballot awaiting publication

The FCoE Standard

- T11 FC-BB-5
 - Supports the full Fibre Channel fabric functionality
 - ENodes and FCFs
 - VN_Port to VF_Port Virtual Links
 - VE_Port to VE_Port Virtual Links
 - Working Group established in June 2007
 - Technically stable in October 2008
 - Completed (forwarded for publication) in June 2009
 - Published by ANSI in May 2010

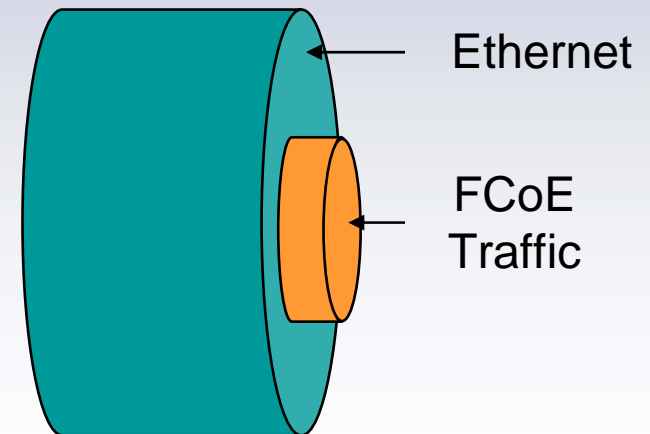
- T11 FC-BB-6
 - Developing additional FCoE functionality
 - Fabric-less operation (VN_Port to VN_Port Virtual Links)
 - Distributed FCF
 - Working Group established in August 2009

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Agenda

- I/O Consolidation with FCoE
- FCoE Standards
- FCoE Myths

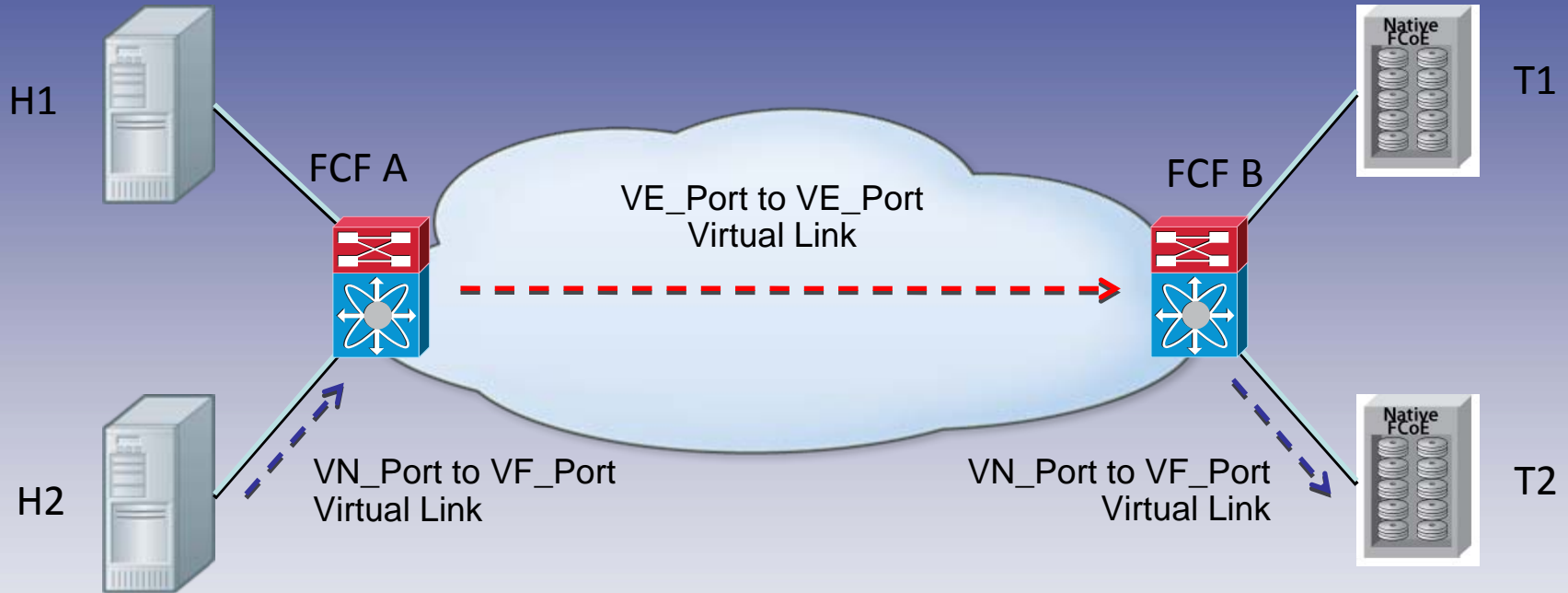


FCoE Myths (1)

- There are no standards for FCoE
 - See the previous slides
- FC-BB-6 means the FCoE standard is not done yet
 - Standards are like operating systems – they add features to previous versions
 - Different versions (e.g., FC-BB-4, FC-BB-5, FC-BB-6) have different features
 - FC-BB-5 fully defined the FCoE fabric functionality
- FC-BB-5 does not support multi-hop FCoE nor end-to-end FCoE
 - See next slide

FCoE Fabric

Multi-Hop and End-to-End



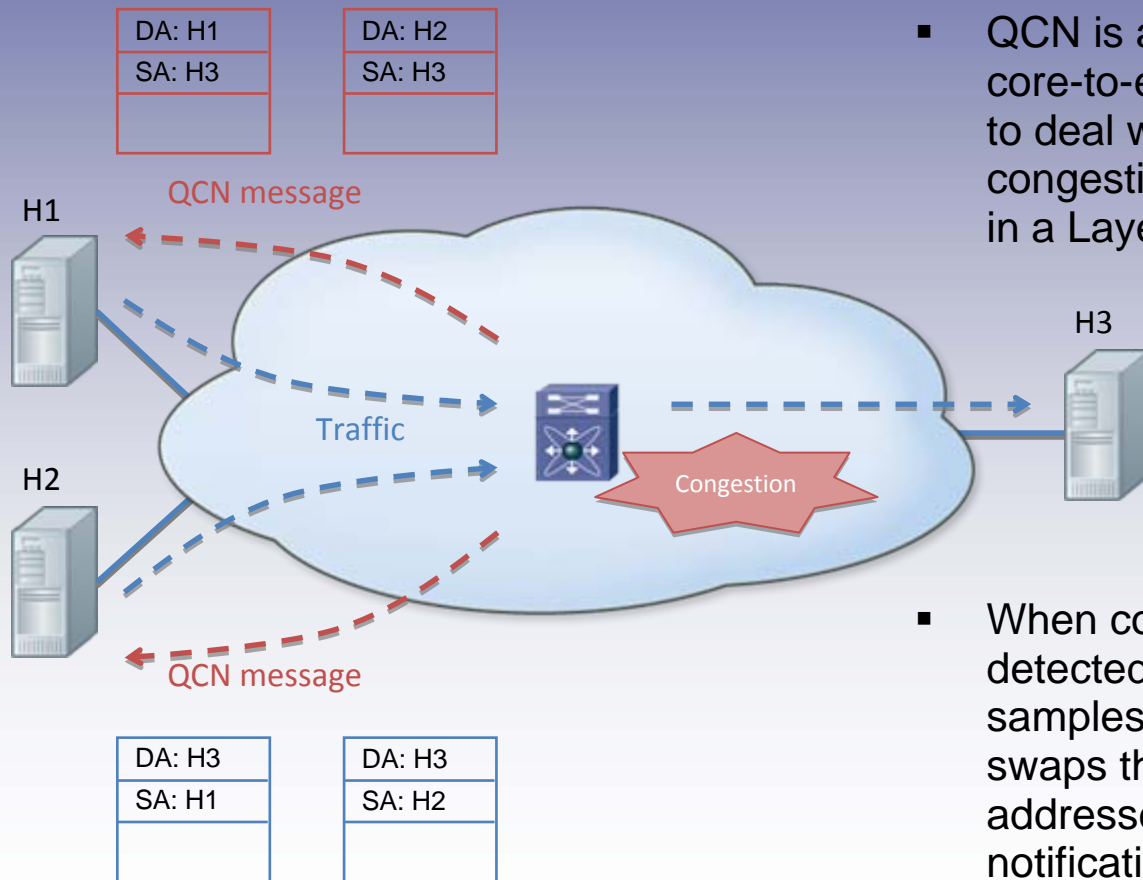
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FCoE Myths (2)

- You need QCN (802.1Qau) for End-To-End FCoE

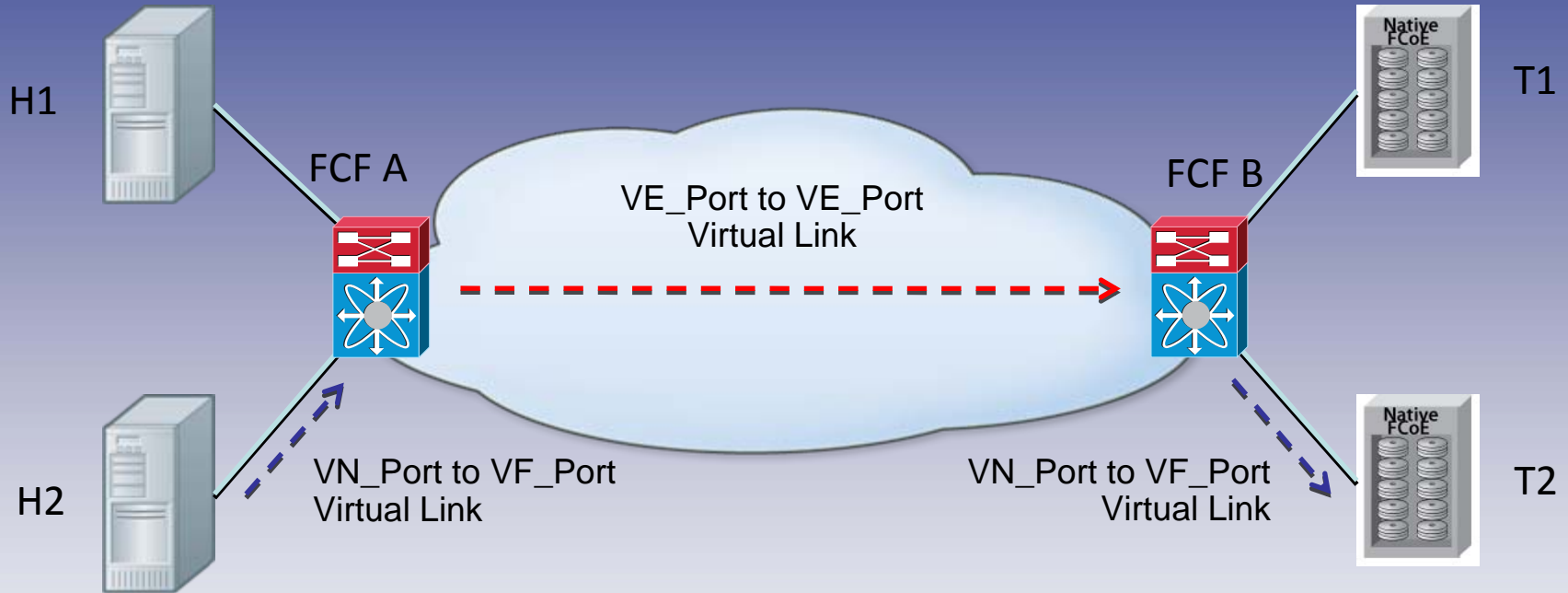


- QCN is a statistical core-to-edge protocol to deal with persistent congestion situations in a Layer 2 network

- When congestion is detected the core switch samples some frames, swaps their MAC addresses, and sends notifications backward

FCoE is a Layer 3 Protocol

QCN is a Layer 2 technology



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SA: FPMA(H2)
Encaps. FC frame
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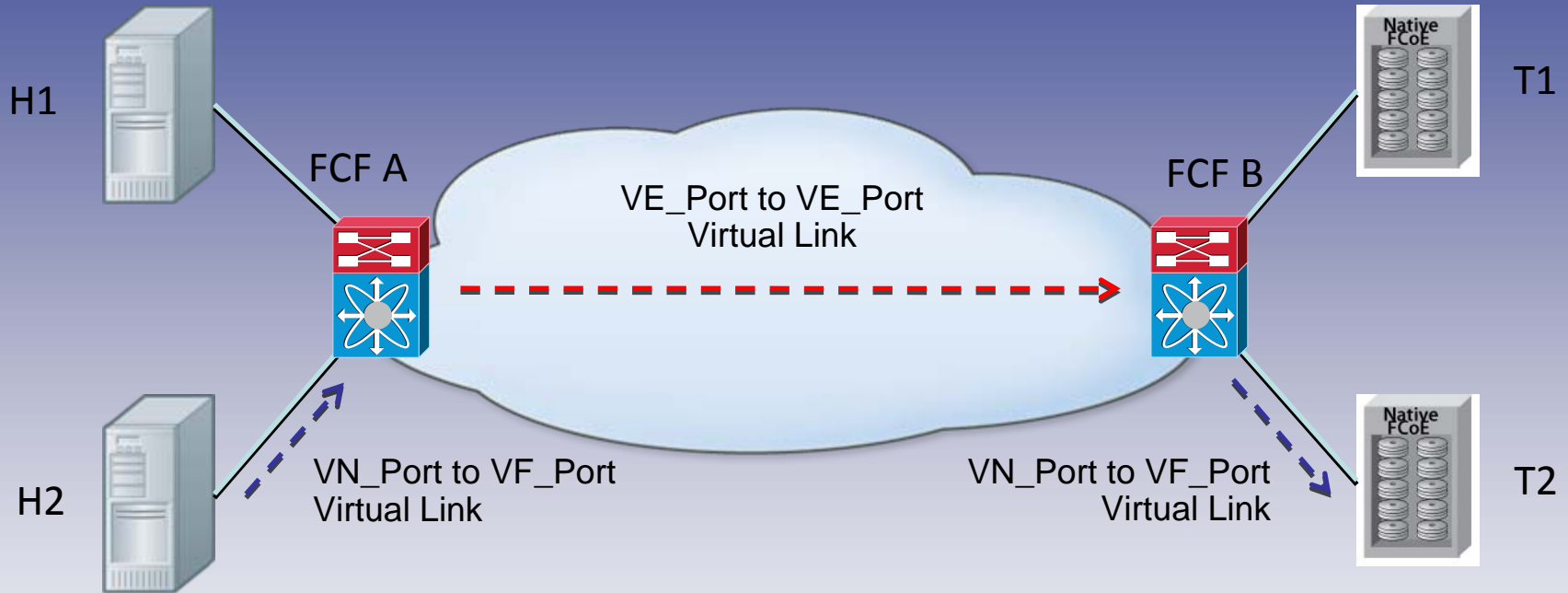
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FCoE Myths (3)

- You need TRILL to run FCoE
 - TRILL is an alternative way to Spanning Tree to forward Ethernet frames in an Ethernet network
 - Defined by IETF
 - Also supports multipathing
 - Has nothing to do with congestion

FCoE is a Layer 3 Protocol

Independent from the Ethernet forwarding scheme



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Encaps. FC frame
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For Additional Information...

- Published by Cisco Press:
<http://www.ciscopress.com/>

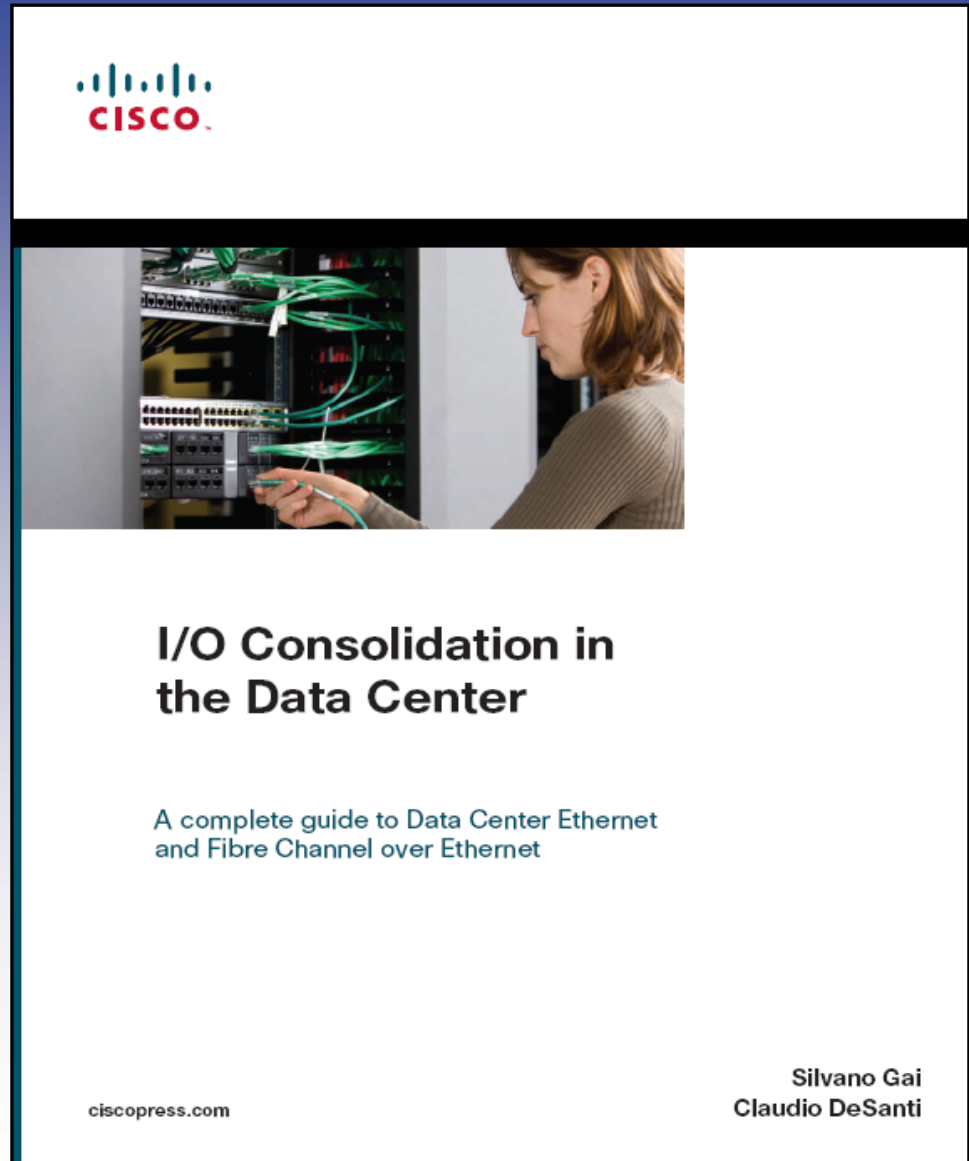




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Thank you!

Questions?