



128GFC OVERVIEW

Scott Kipp

skipp@Brocade.com

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128 Gigabit Fibre Channel Introduction

- FCIA released the 128GFC MRD as 12-515v0
- 128 Gigabit Fibre Channel (128GFC) will enable high speed parallel links between two ports
 - 4 lanes of 32GFC form 128GFC
- This parallel solution will not match the capabilities of SFP+ and these limitations will be investigated in this presentation
- Single-lane SFP+ based Fibre Channel will remain the dominant type of Fibre Channel because of it's flexibility and user base



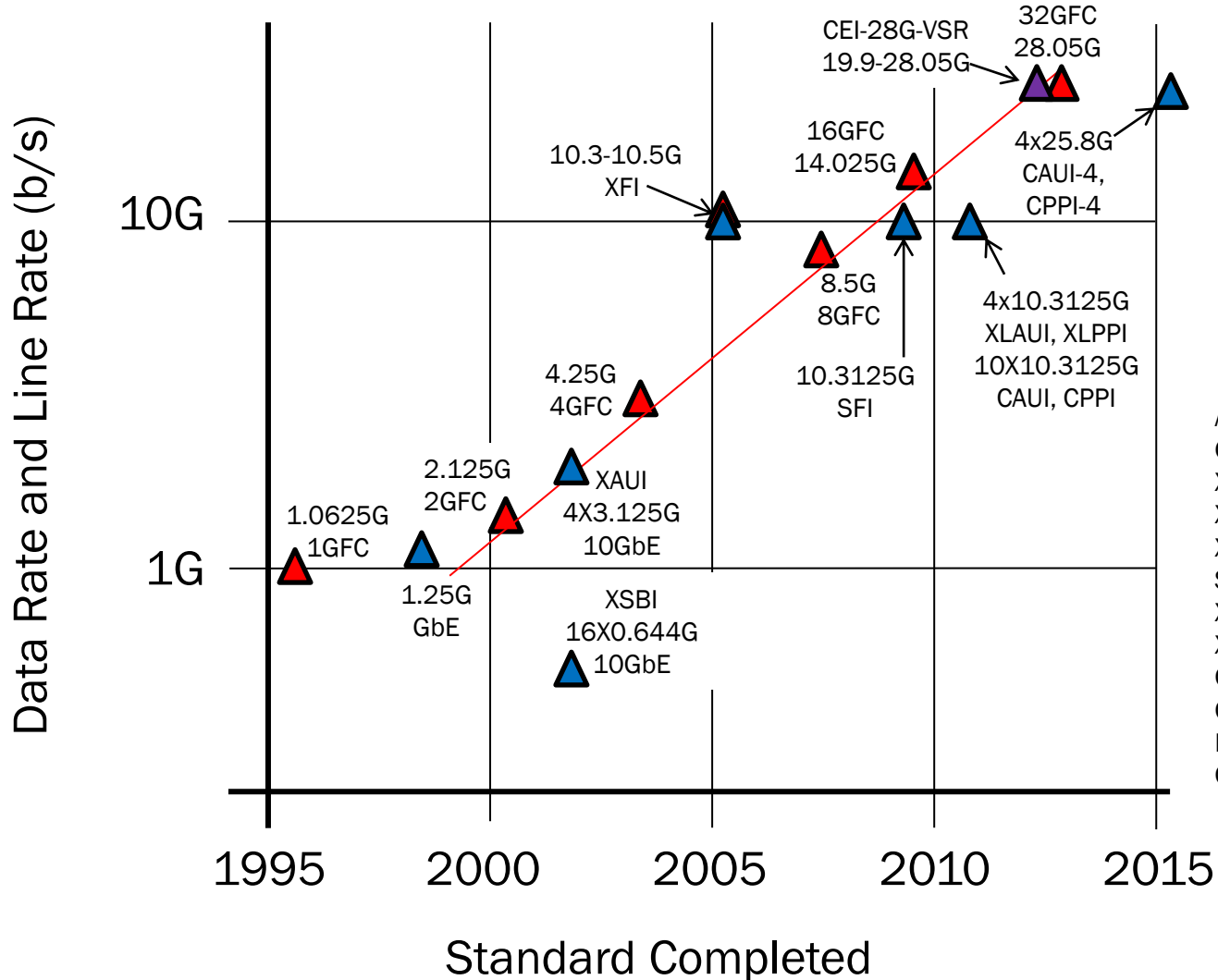
3-4 Years Between 2X Fibre Channel Electrical Interfaces and Speeds

Generation	Product Naming	Throughput (MBps)	Line Rate (GBaud)	T11 Spec Technically Completed (Year)‡	Market Availability (Year)‡
1	1GFC	200	1.0625	1996	1997
2	2GFC	400	2.125	2000	2001
3	4GFC	800	4.25	2003	2005
4	8GFC	1600	8.5	2006	2008
5	16GFC	3200	14.025	2009	2011
6	32GFC	6400	28.05	2013	2014
7	64GFC	12800	TBD	2016	Market Demand
8	128GFC	25600	TBD	2019	Market Demand
9	256GFC	51200	TBD	2022	Market Demand
10	512GFC	102400	TBD	2025	Market Demand

Source: FCIA Roadmap v15

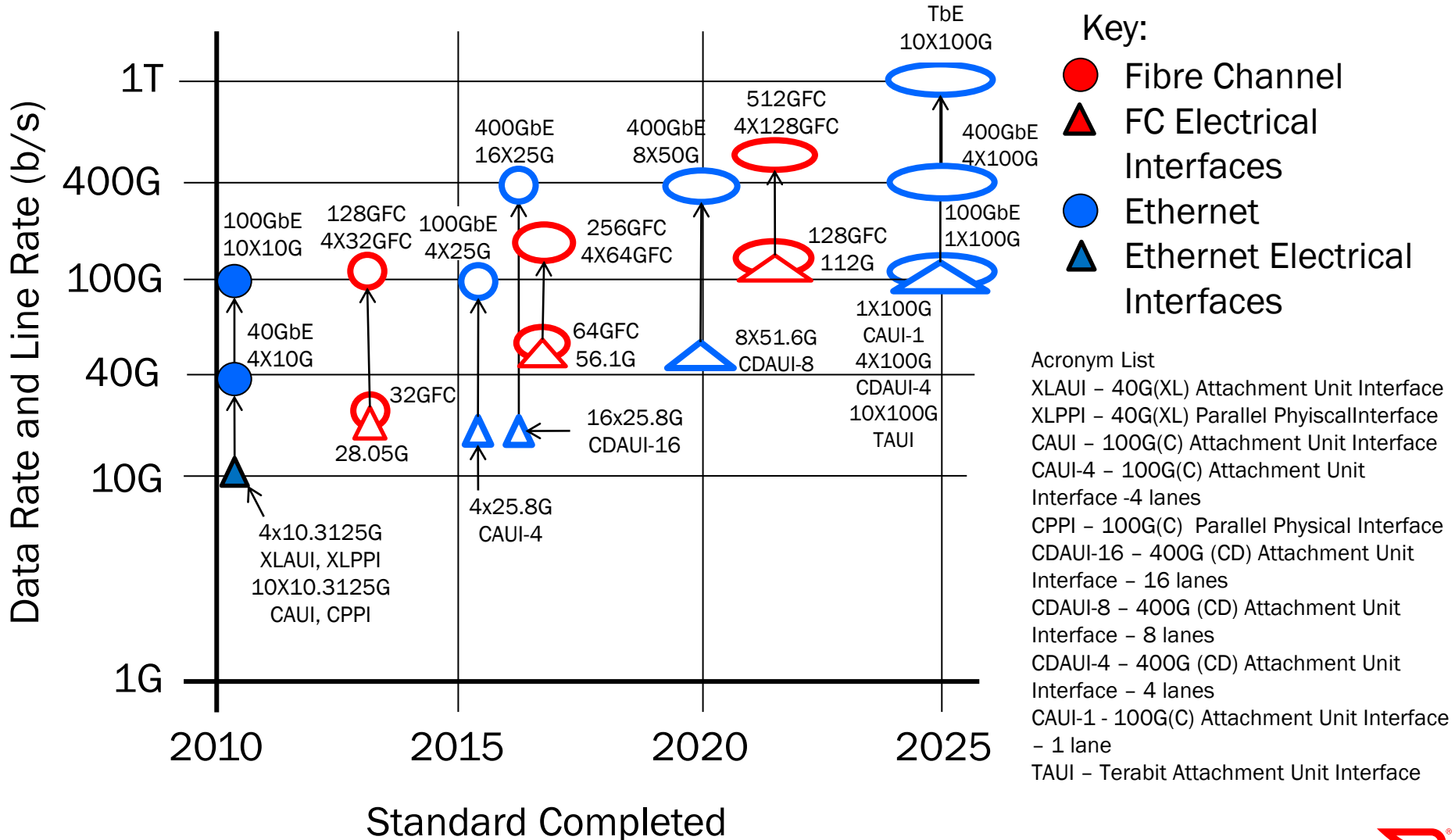


Electrical Interface Speeds 1995-2015



- Key:**
- ▲ FC Electrical Interfaces
 - ▲ Ethernet Electrical Interfaces
 - ▲ OIF Electrical Interfaces
- Acronym List**
- GFC = Gigabit Fibre Channel
 - XSBI - 10G (X) Sixteen Bit Interface
 - XAU1 - 10G (X) Attachment Unit Interface
 - XFI - 10G (X) High Speed Interface
 - SFI - SFP+ High Speed Interface
 - XLAUI - 40G(XL) Attachment Unit Interface
 - XLPP1 - 40G(XL) Parallel Physical Interface
 - CAUI - 100G(C) Attachment Unit Interface
 - CAUI-4 - 100G(C) Attachment Unit Interface -4 lanes
 - CPPI - 100G(C) Parallel Physical Interface

Ethernet and Fibre Channel 2010-2025



Generations of Fibre Channel

Serial Fibre Channel

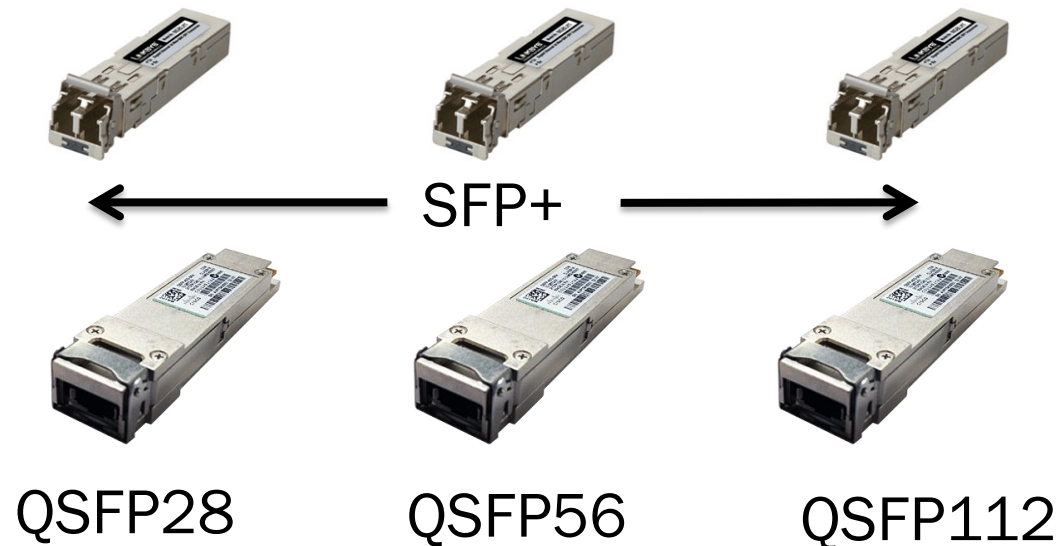
Generation	1 st Gen	2 nd Gen	3rd Gen	4th Gen	5th Gen	6 th Gen
Electrical / Optical Module	1GFC / GBIC/ SFP	2GFC / SFP	4GFC / SFP	8GFC / SFP+	16GFC / SFP+	32GFC / SFP+
Electrical Speeds(Gbps)	1 lane at 1.0625	1 lane at 2.125	1 lane at 4.25	1 lane at 8.5	1 lane at 14.025	1 lane at 28.05
Encoding	8b/10b	8b/10b	8b/10b	8b/10b	64b/66b	64b/66b
Availability	1997	2001	2006	2008	2011	2014



Generations of Fibre Channel

Serial and Parallel

Generation	6 th Gen	7 th Gen	8 th Gen
Electrical / Optical Module	32GFC and 128GFC /SFP+ and QSFP28	64GFC and 256GFC /SFP+ and QSFP56	128GFC and 512GFC /SFP+ and QSFP112
Electrical Speeds (Gbps)	1 lane of 28.05 4 lanes at 28.05	1 lanes of 56.1 4 lanes at 56.1	1 lane of 112.2 4 lanes at 112.2



High Level 128GFC Proposal

- 128GFC will be based on 4-lane modules
 - QSFP28 modules are preferred but larger modules like CFP2, CFP4 may be required for single-mode solutions
- For flexibility, the 4-lane port can use a breakout cable to adapt to 1 to 4 individual lanes in SFP+
 - Because of crosstalk and other challenges, parallel solutions will not be able to support the same optical requirements as SFP+ and will support less than 100 meters
 - 128GFC Optical parameters should be defined in a separate document than FC-P1-6
 - Individual lanes will only be backward compatible to one speed below the fastest speed due to module limitations



Block Spraying across 4 Lanes

- 128GFC will leverage the work of Ethernet as much as possible including:
 - 66-bit block striping across 4 lanes
 - Reed Solomon (528/514) Forward Error Correction at the 128GFC level instead of the 32GFC level

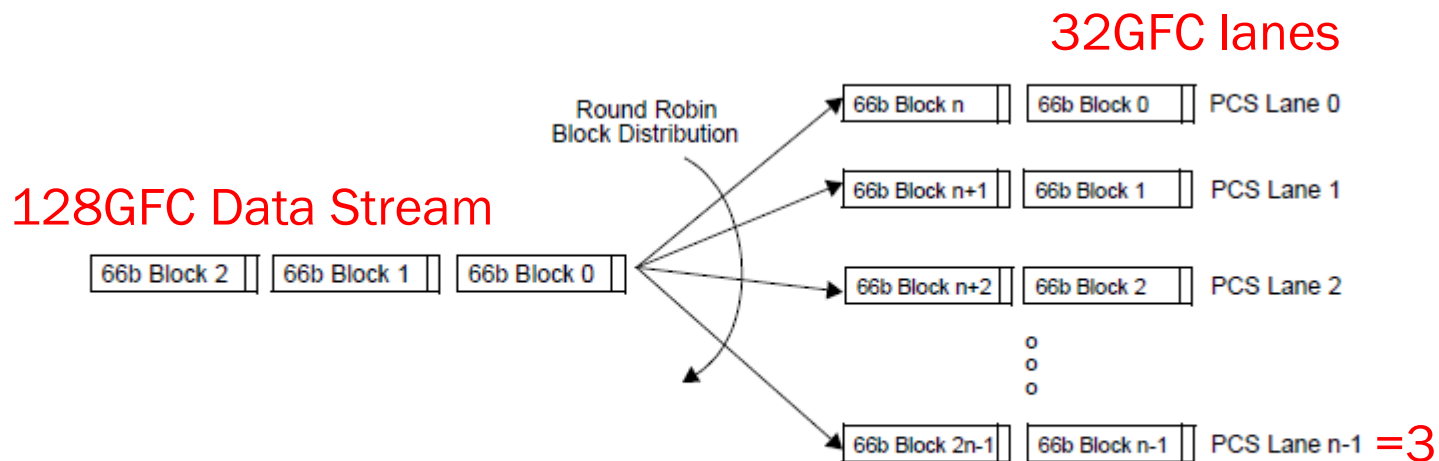
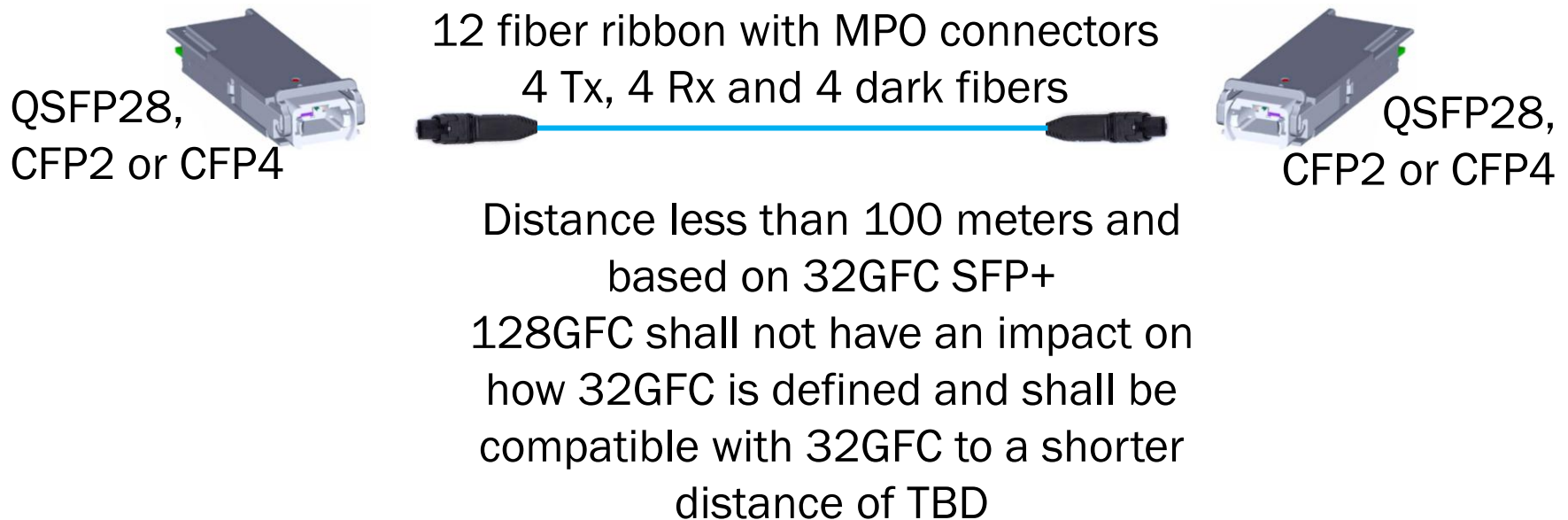


Figure 82-6—PCS Block distribution

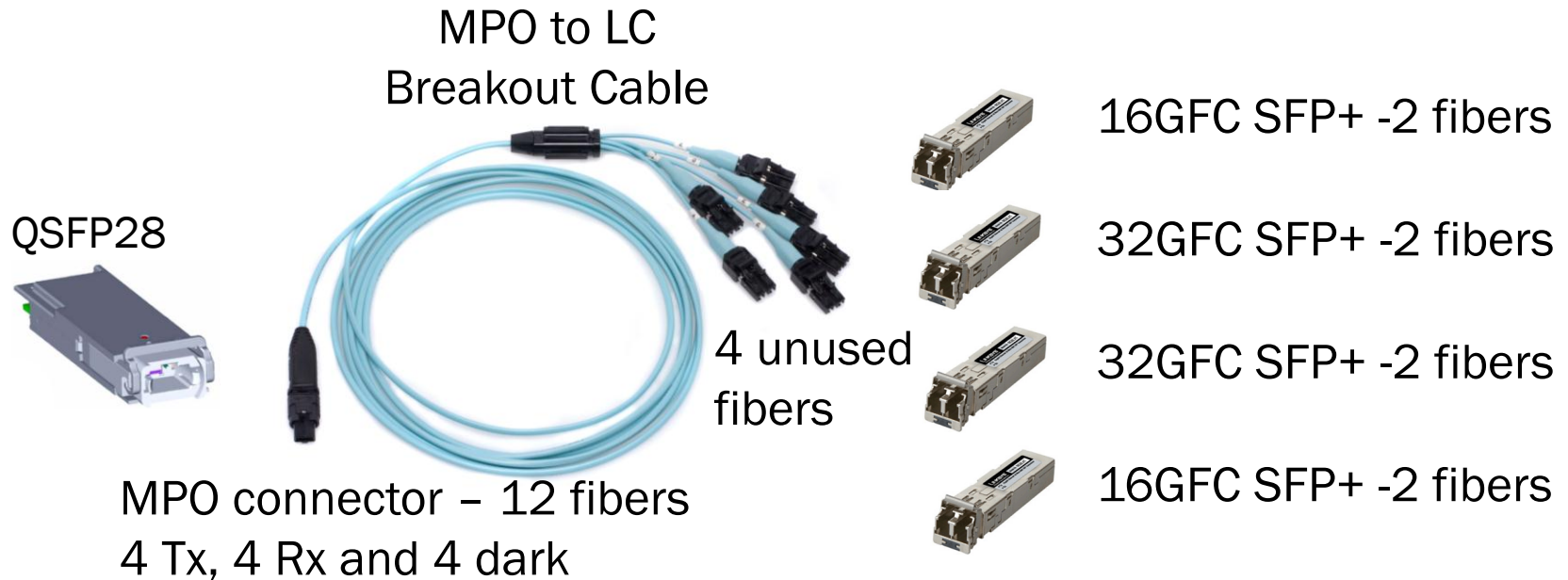
128GFC Cabling with 4-lane Modules

- 128GFC will require two 4-lane ports and modules
- The ports can be either QSFP28, CFP2, CFP4 or some future 4 lane optical module



Breakout Cabling and Modules

- 40GbE QSFPs have been very successfully deployed because they can break out into 4 lanes of 10GbE
- 128GFC port can be broken out to individual 16GFC and 32GFC lanes with a breakout cable



Multiple Physical Ports Behind a Multiplexer

Management Aspects of 128GFC and 4X32GFC need to be defined

- From FC-FS-3

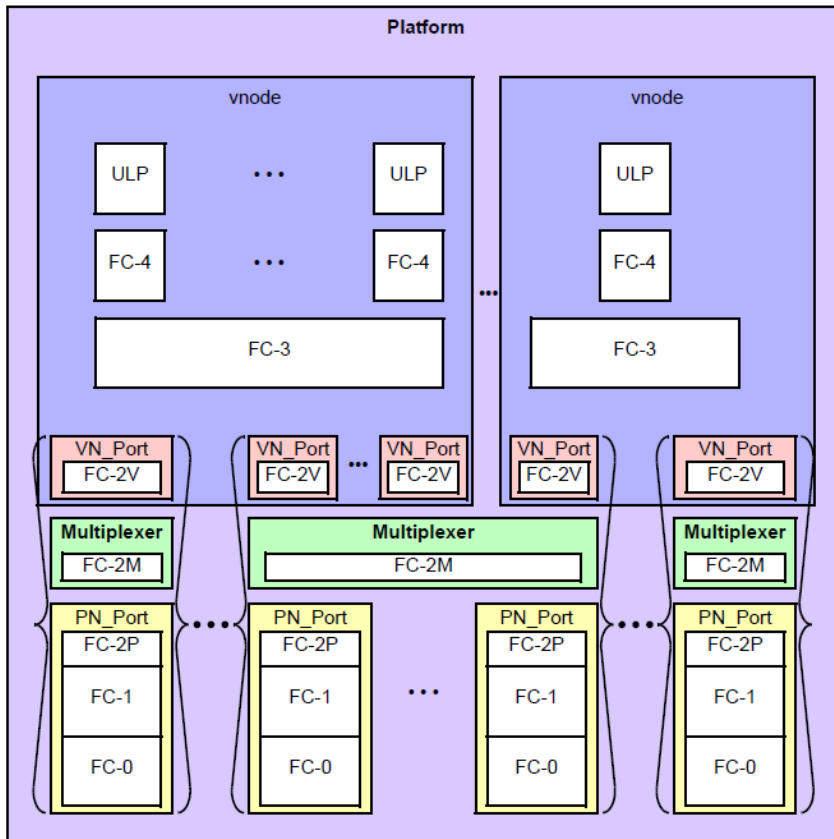
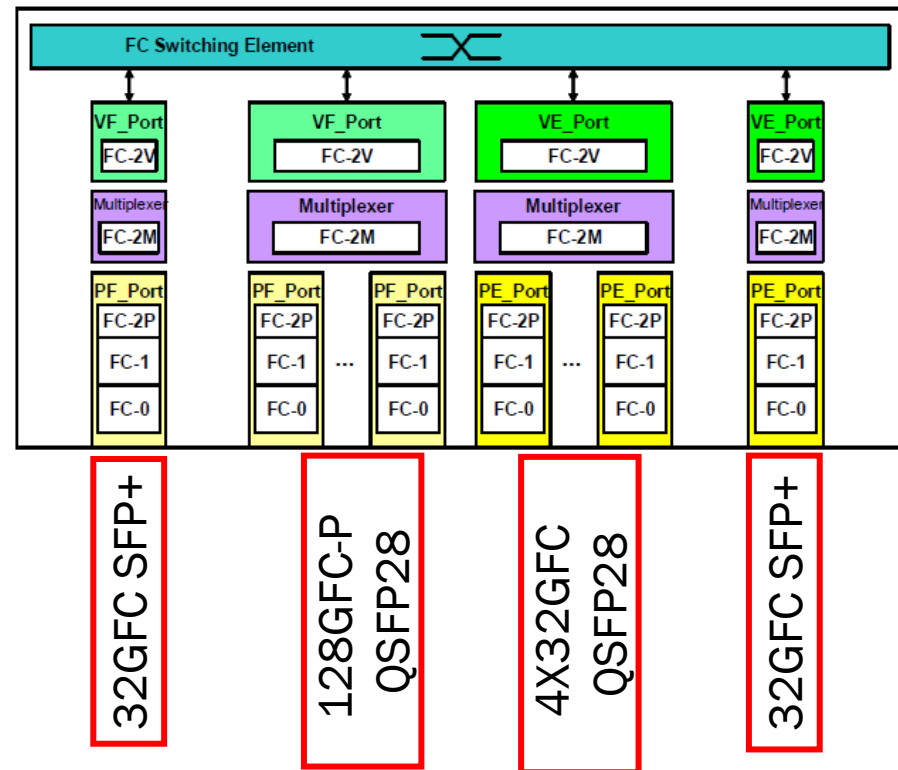


Figure 3 - Node components and functional levels model

- From FC-SW-5



Breakout cable
to individual
32GFC lanes₂



128GFC Conclusion

- With the ability to support 128GFC, Fibre Channel will be able to compete effectively with competing technologies
- 128GFC Multimode solutions will not be able to go 100 meters because of the limitations of crosstalk
- Speed Negotiation will need to be modified to support 128GFC - See 13-062v0
- 128GFC will need to be standardized in a separate document (suggest FC-PI-7) and be compatible with 32GFC SFP+ as defined in FC-PI-6





THANK YOU

