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COMPARISON AND CONTRAST OF 25GBE AND GEN6 FIBRE CHANNEL

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Fibre Channel and Ethernet

- Fibre Channel and Ethernet have had a long tradition of working with each other
  - GbE used many 1GFC techniques
  - 10GFC heavily followed 10GbE
  - 128GFC borrowed from 100GbE
  - 25GbE could borrow from 32GFC or 100GbE…
- Fibre Channel is a very different market than Ethernet
  - Fibre Channel links are >90% optical
  - Ethernet links are >90% copper
- I want to compare and contrast 25/100GbE and Gen6 FC
  - 128GFC came after 32GFC while 25GbE came after 100GbE

6 Generations of Fibre Channel

Doubling the Speed as Needed - before 2012...

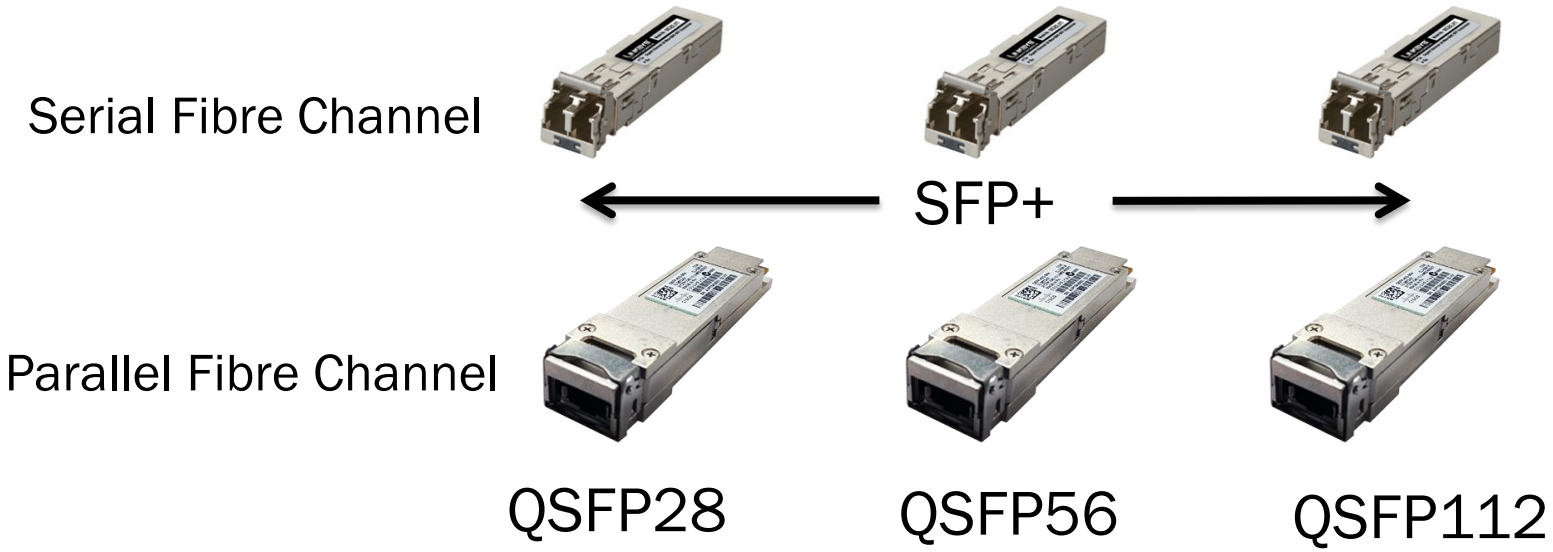
Generation	Gen1	Gen2	Gen3	Gen4	Gen5	Gen6
Electrical / Optical Module	1GFC / GBIC/ SFP	2GFC / SFP	4GFC / SFP	8GFC / SFP+	16GFC / SFP+	32GFC / SFP+
Electrical Speeds(Gbps)	1 lane at 1.0625	1 lane at 2.125	1 lane at 4.25	1 lane at 8.5	1 lane at 14.025	1 lane at 28.05
Encoding	8b/10b	8b/10b	8b/10b	8b/10b	64b/66b	64b/66b
Availability	1997	2001	2006	2008	2011	2016

GBIC ← SFP / SFP+ →

Future Generations of Fibre Channel

Serial and Parallel

Generation	Gen6	Gen7	Gen8
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



Relevant Generations of Ethernet

Serial and Parallel

	10/40GbE	25/100GbE
Electrical / Optical Module	SFI and XLAUI	XXVIAUI and CAUI-4
Electrical Speeds (Gbps)	1 lane of 10.3125 4 lanes at 10.3125	1 lanes of 25.7825 4 lanes at 25.

Serial Ethernet

10GbE
SFP+

25GbE
SFP+

Parallel Ethernet

40GbE
QSFP+

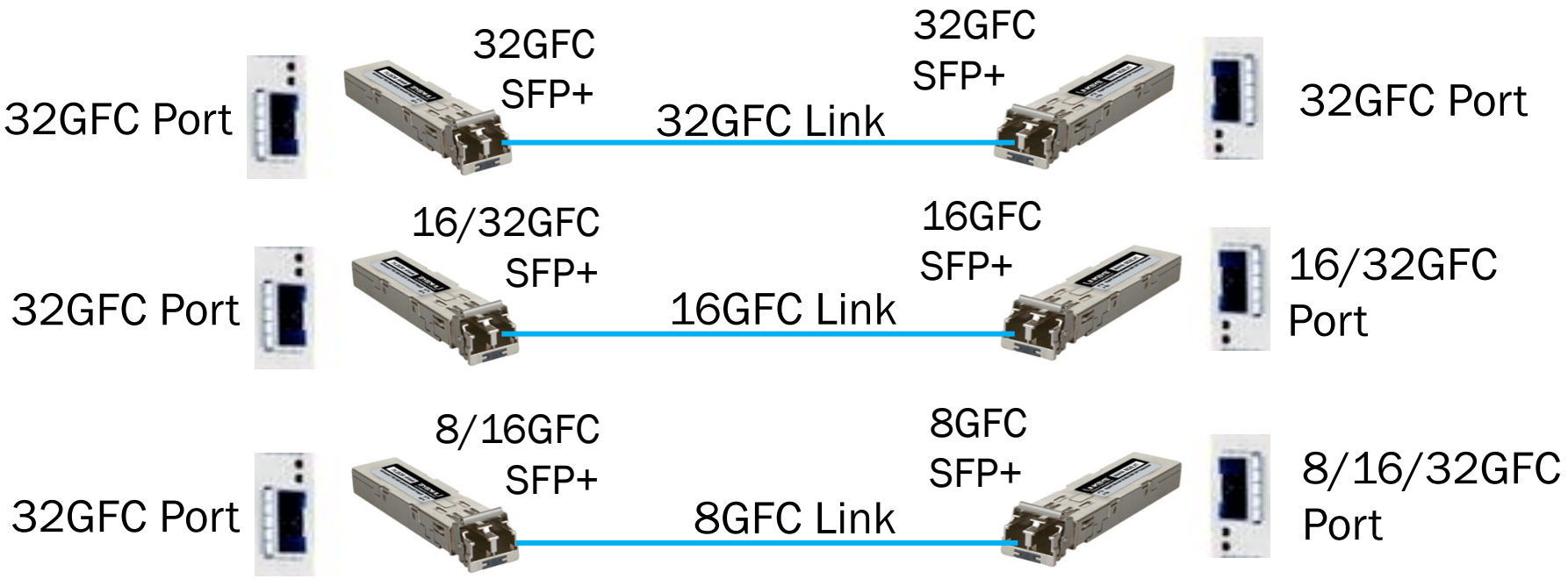
100GbE
QSFP28

Use Cases for Gen 6 Fibre Channel

- Fibre Channel tries to enable as many use cases as possible for a given technology
- FCIA Marketing Requirements Documents (MRD) call for backward compatibility to 2 generations with speed negotiation (11-380v0 and 12-515v0)
  - 32GFC backward compatible with 8GFC and 16GFC
  - 128GFC backward compatible with 32GFC and 16GFC
- T11 developed speed negotiation algorithms to support many scenarios

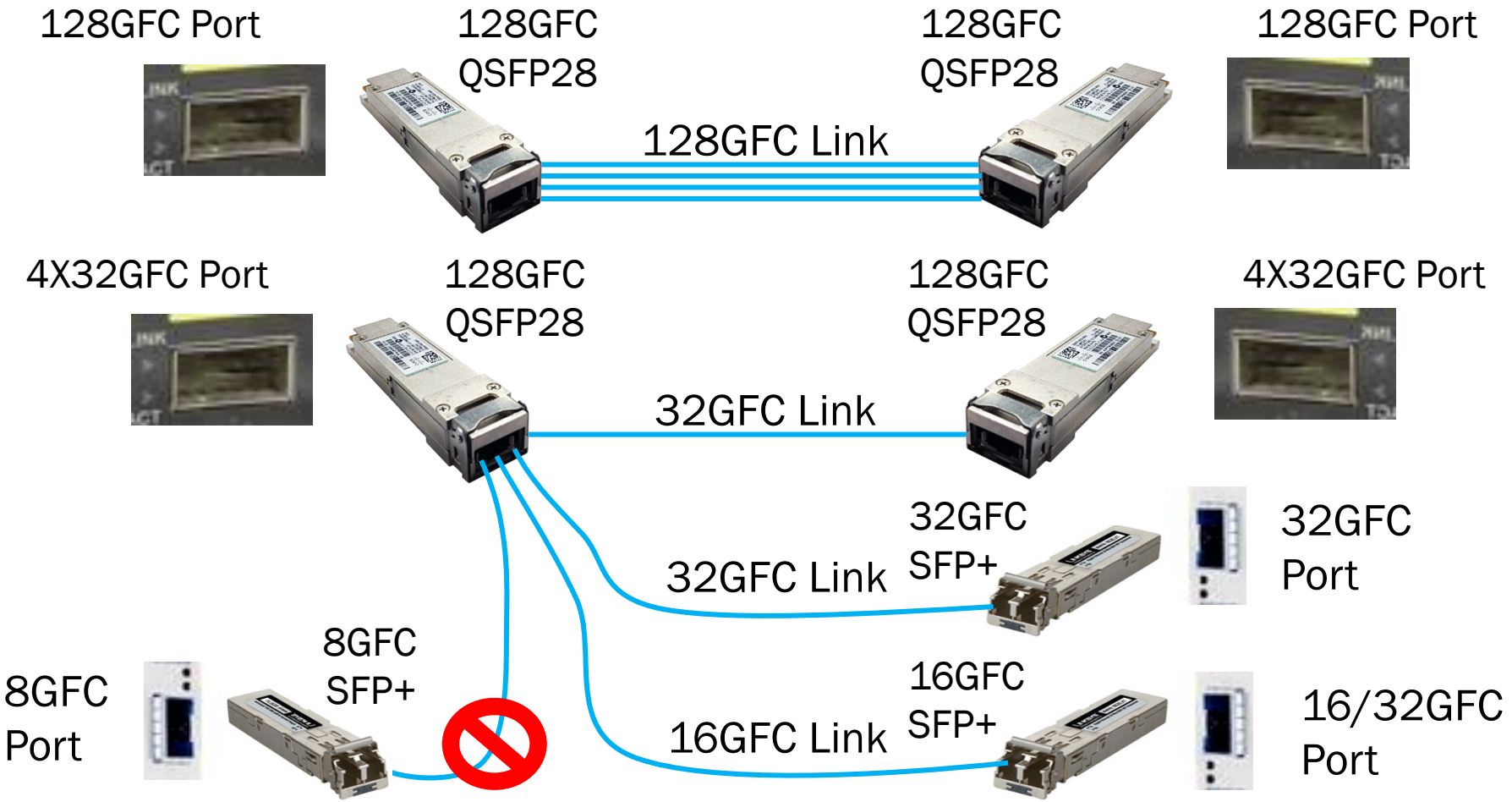
32GFC Use Cases

32GFC port must support 8GFC and 16GFC too



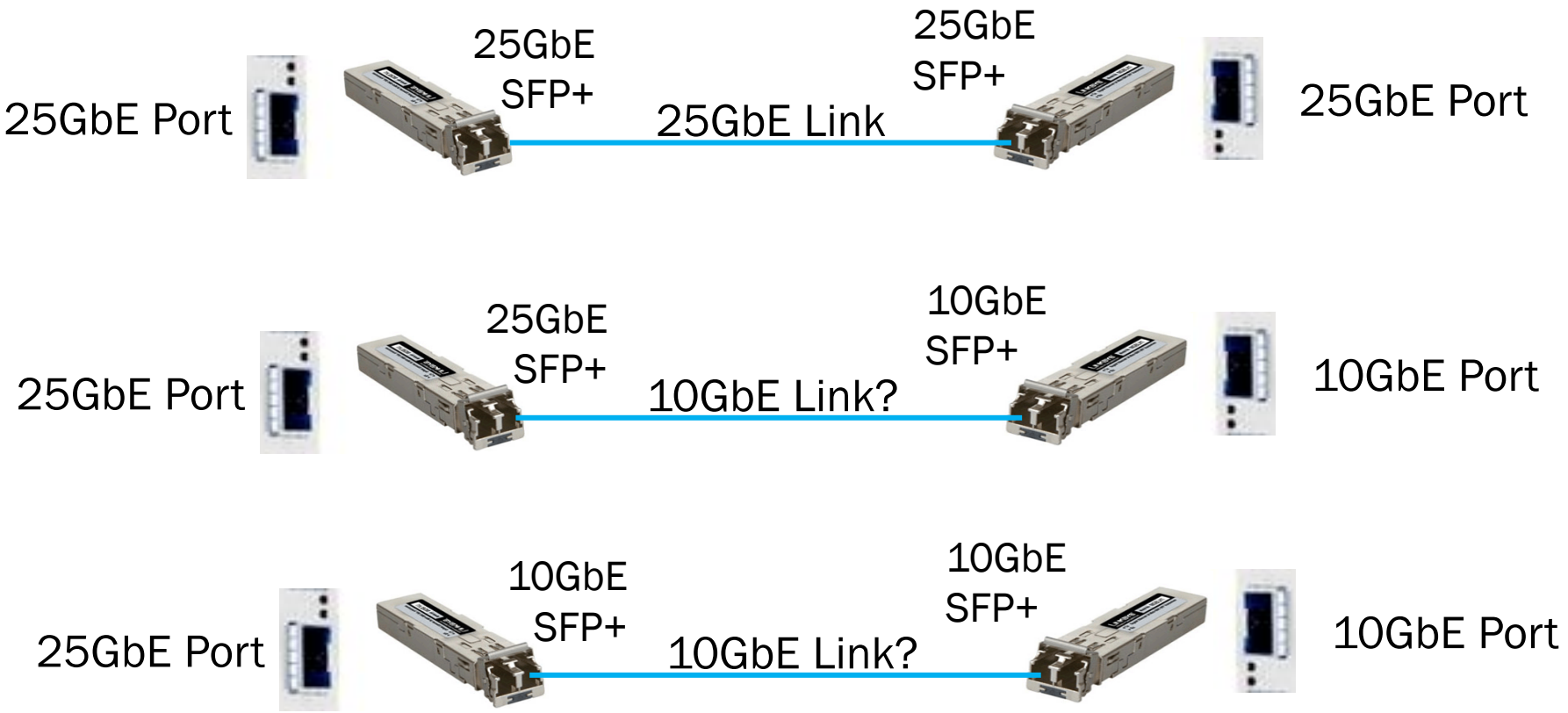
128GFC Use Cases

Breakout and compatible back to 16GFC



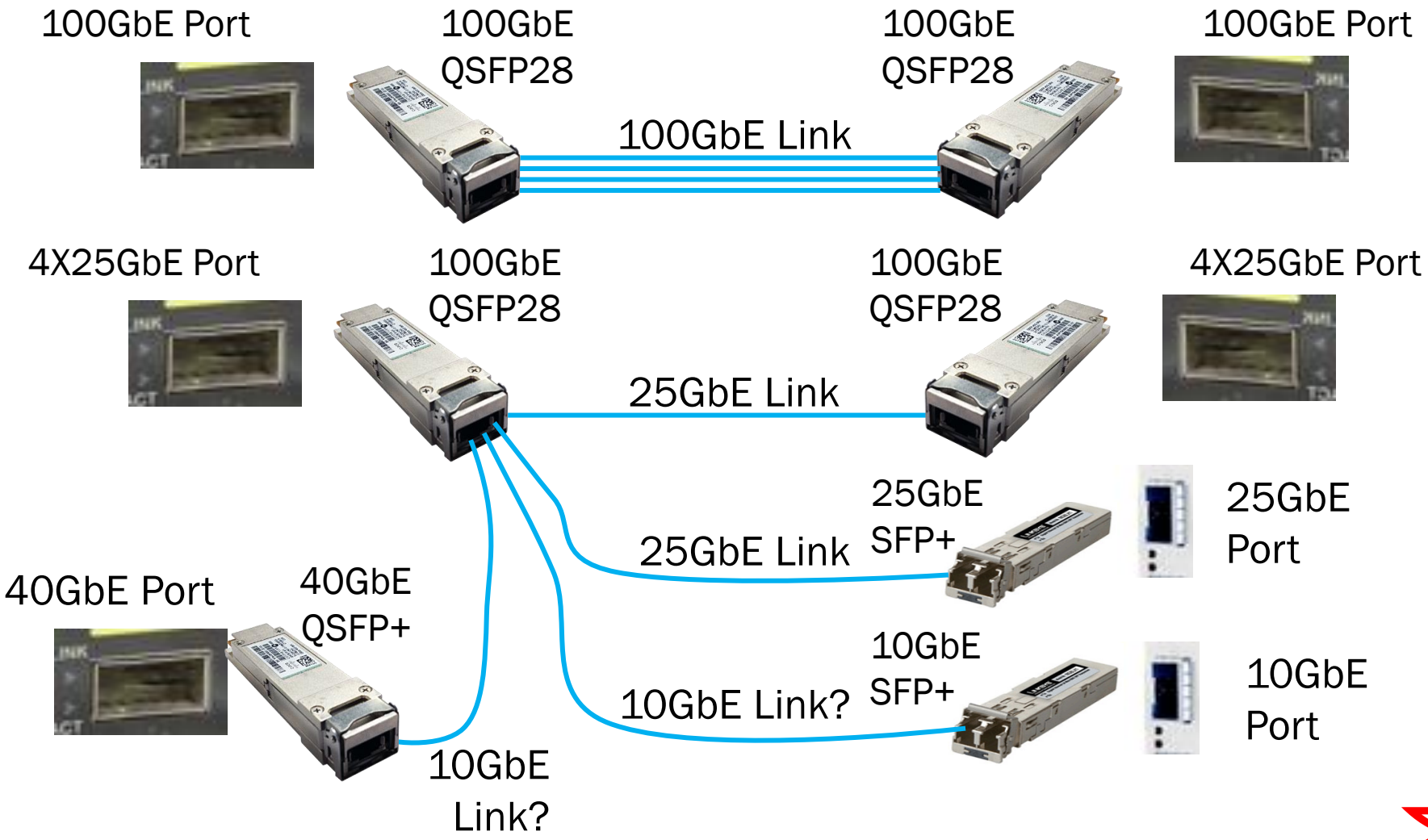
25GbE Use Cases (Copper or Optical)?

Will a 25GbE port support 10GbE?



100GbE Use Cases (Copper or Optical)?

Breakout and compatible back to 25GbE



PMD Comparison

	Passive Copper -5m	Active Copper -10m+	SR – 100m OM4	PSM – 500 m	CWDM – 2km	LR – 10km	ER – 40km
100GbE							
128GFC							
32GFC							
25GbE			?				

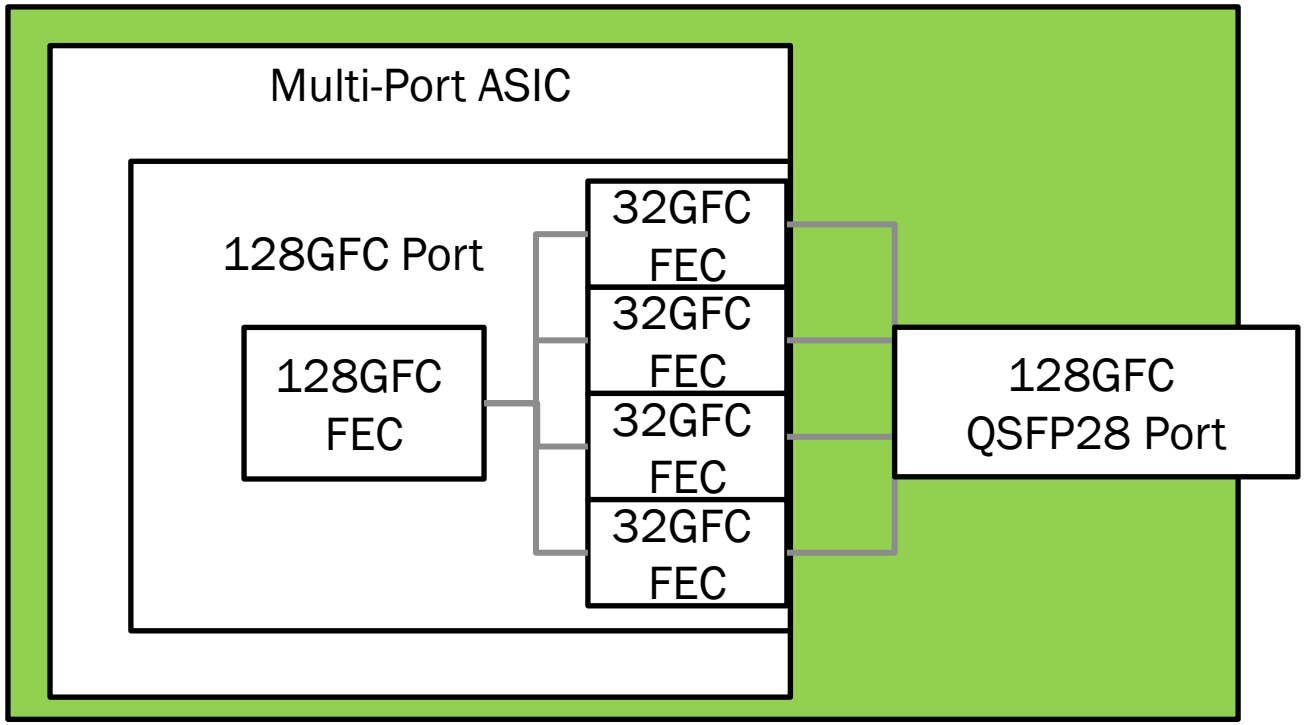
Support with standard
Support without standard or with MSA
No support

Challenges with 128GFC PMDs

- 128GFC was started when 32GFC was almost completed
- Impairments (mainly crosstalk) from 128GFC QSFP+ higher than 32GFC SFP+, so challenging for 128GFC to go 100 meters on OM4 like 32GFC
- Studies still underway to standardize distances for:
  - 128GFC QSFP28 to 128GFC QSFP28
  - 128GFC QSFP28 to 32GFC SFP+
  - 128GFC QSFP28 to 16GFC SFP+
- Each link needs to be studied in both directions because of different Tx and Rx conditions

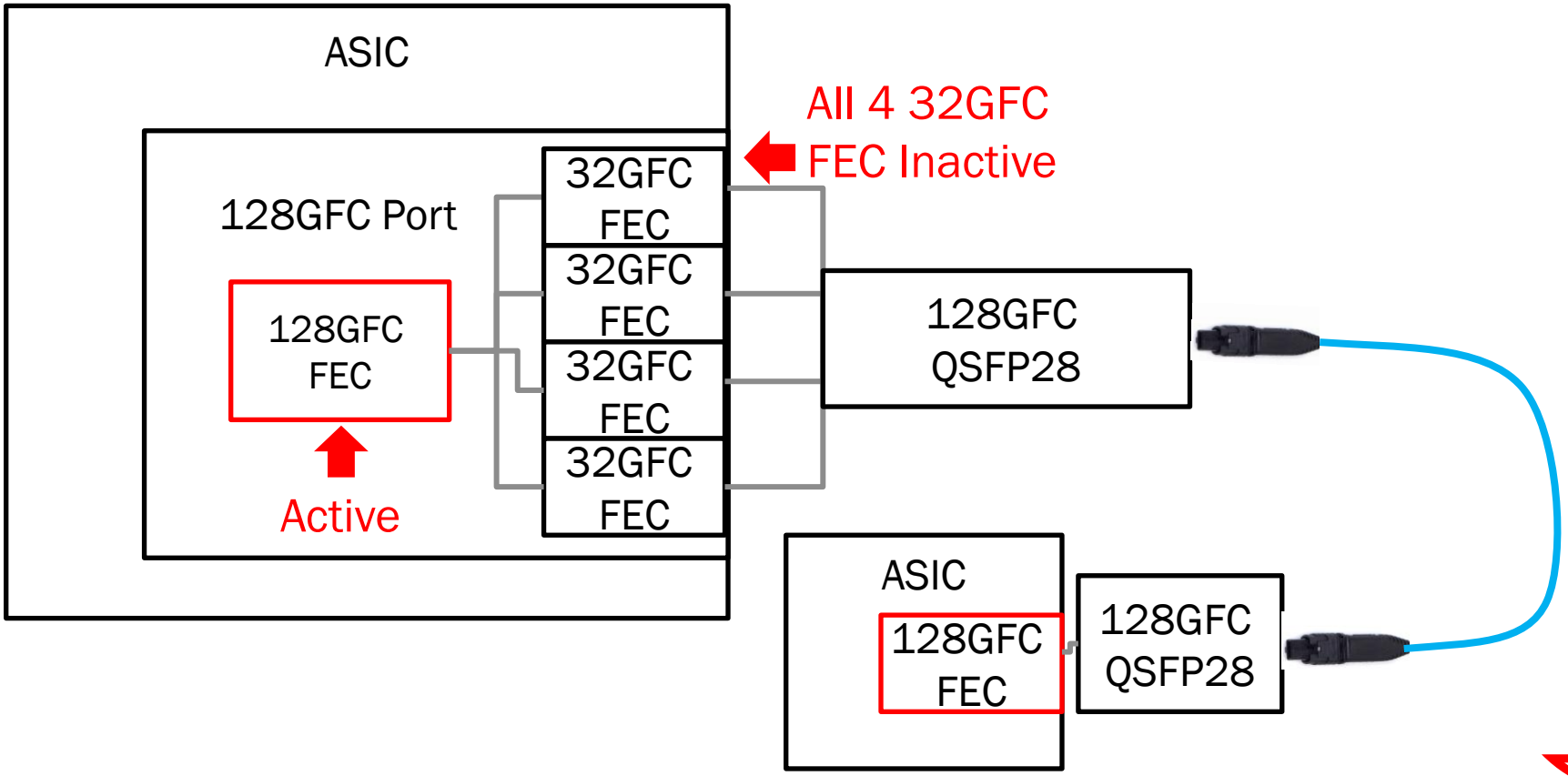
FEC in Gen 6 Fibre Channel

- Fibre Channel used RS-FEC similar to 802.3bj at the 128GFC and 32GFC levels to reduce cost



For 128GFC, the 128GFC FEC is used

- The 32GFC FEC is disabled while the 128GFC FEC is used



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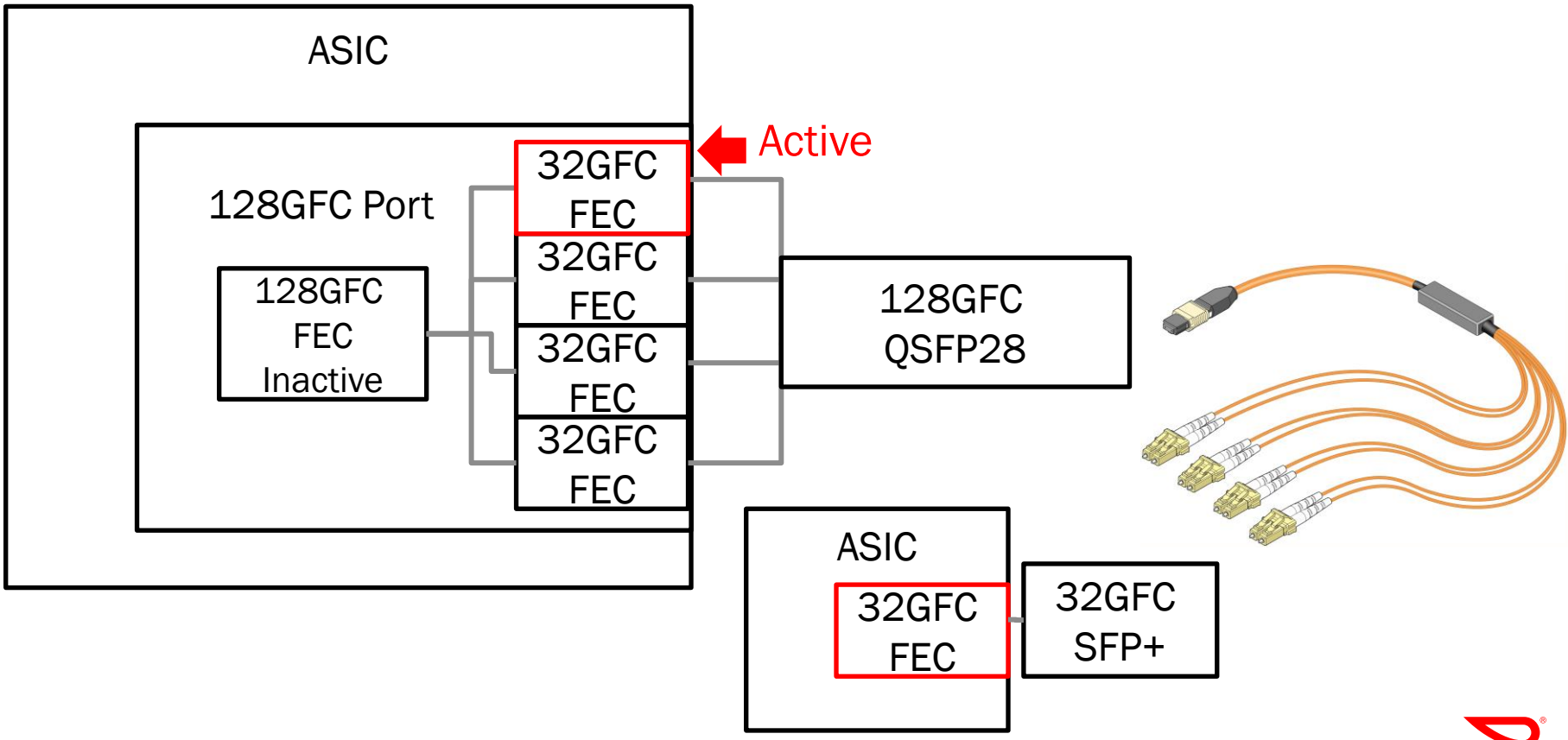


100GbE vs Gen6 Insertion Loss

Will 25GbE adopt the same channel?

100GbE = 10 dB

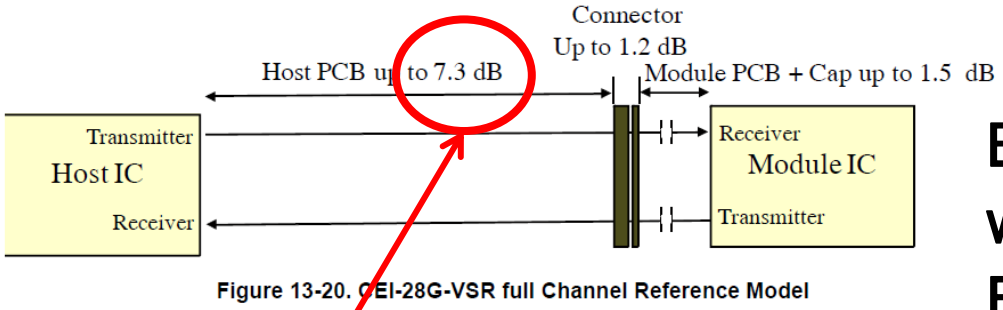


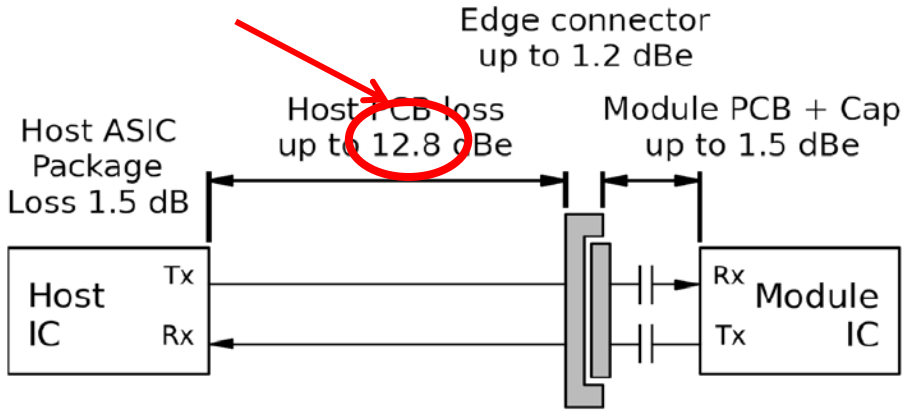
Figure 13-20. CEI-28G-VSR full Channel Reference Model

BER = 1E-15 without FEC, so no FEC gain allocated to correct errors from PCB

32GFC has 5.5dB more PCB trace loss than VSR, so passive copper is not possible

A billion times more errors…

32GFC = 15.5dB

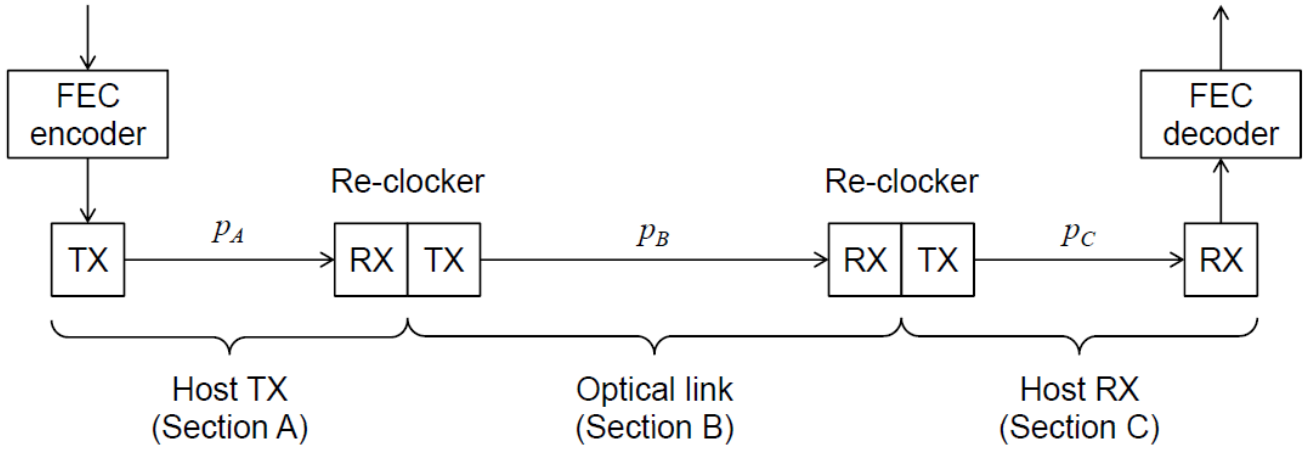


BER = 1E-6, so FEC gain allocated to correct errors from PCB

128GFC vs 100GbE FEC Allocation

Will 25GbE adopt the same FEC as 100GbE?

- Very different channels, BER and allocation of FEC



All FEC allocated to optical link in SR4

	p_A	p_B	p_C	p_{Total}
100GBASE-SR4	1E-15	5E-5	1E-15	5E-5
128GFC MMF	1E-6	1E-6	1E-6	3E-6

FEC allocated equally to all three sections in 32GFC

FEC Latency

- The latency for RS-FEC is dependent on the data rate and if the uncorrected errors are marked

	Line Rate (Gb/s)	Block time for 5,280 bits (nS)	Error Correction (nS)	Marking Uncorrected Errors (nS)	Total FEC Latency without Marking (nS)
100GbE	103.125	51	90	50	141
128GFC	112.2	47	90	50	137
25GbE	25.7825	205	90	50	295
32GFC	28.05	188	90	50	278

Source: T11/13-216v1 and ran_3bj_01a_0113.pdf

Questions for 25GbE Study Group

- Will XXVAUI (25GbE Electrical Interface) adopt a similar channel to 100GbE?
- What BER will segments of 25GbE links require?
- Will 25GbE use no FEC, KR FEC and RS-FEC?
- Will 25GbE be able to support backward compatibility to 10GbE?

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THANK YOU