100G Link Infrastructure Requirements to Support Future 400G PMDs

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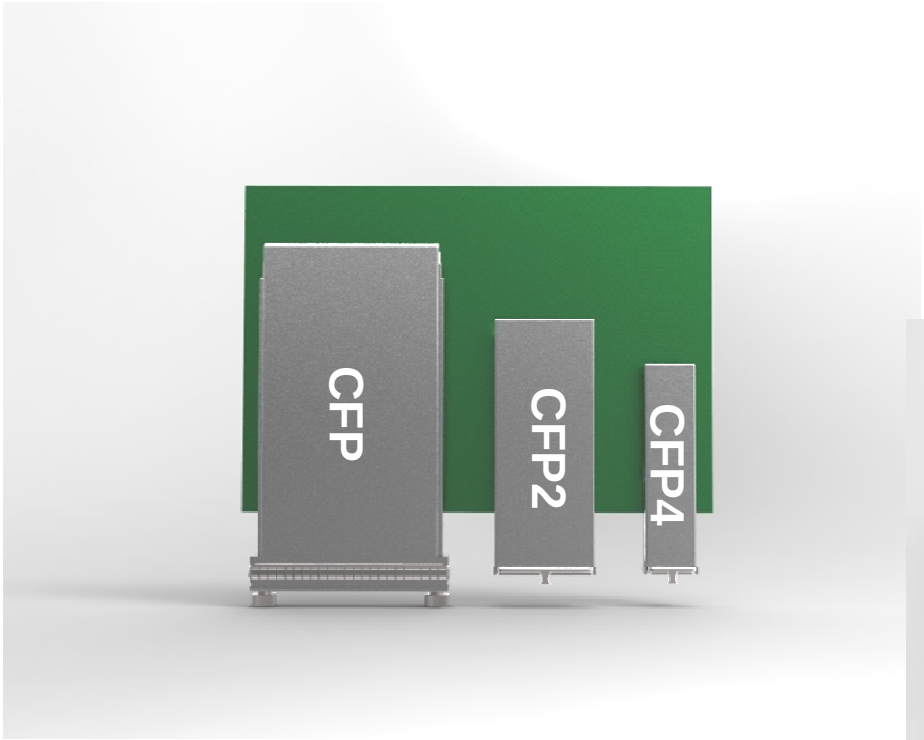
100GE

100G Ethernet Standard and Upcoming Standardization

PMD Support	**10G Media Lanes**	**25G Media Lanes**
Backplane	-none-	*100GBASE-KR4/KP4 (802.3bj-Draft Clause 93/94)*
Copper Cable Assembly	100GBASE-CR10 (802.3 Clause 85)	*100GBASE-CR4 (802.3bj-Draft Clause 92)*
MMF	100GBASE-SR10 (802.3 Clause 86)	*Two Objectives (NG 40G/100G SG)*
SMF (At least 500 meters)	-none-	*Objective (NG 40G/100G SG)*
SMF (At least 2 km)	-none-	-none-
SMF (At least 10 km)	-none-	100GBASE-LR4 (802.3 Clause 88)
SMF (At least 40 km)	-none-	100GBASE-ER4 (802.3 Clause 88)
SMF (At least 80 km)	-none-	-none-

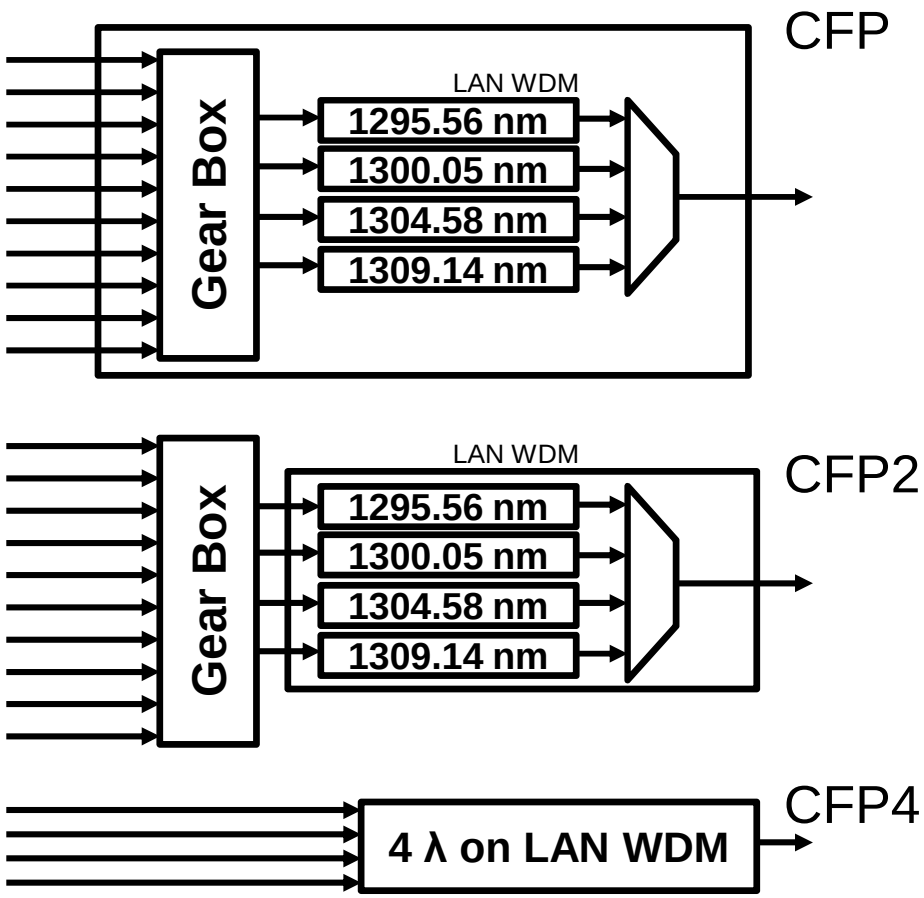
CFP(LC), CFP2(LC) and CFP4(LC) for SMF Applications



CFP MSA Form Factors:
http://www.cfp-msa.org/

Example: CFP, CFP2, and CFP4 for 100GBASE-LR4/ER4 SMF PMD

Transmit side only depicted.



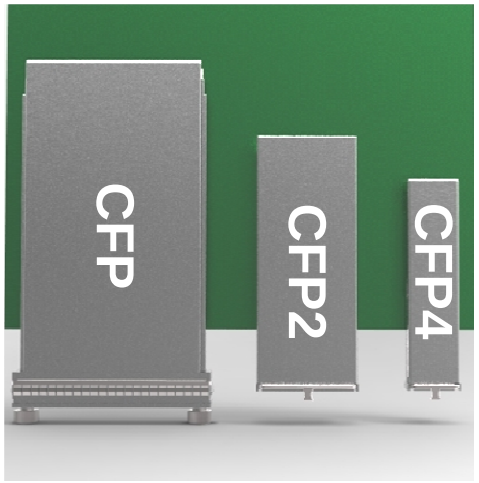
100GBASE-nR4

- A new **500-m** reach **SMF** PMD for 100GE is actively being considered in the 802.3 NG 40G/100G Optical Ethernet Study Group
- Character “n” is a place holder
- 100GBASE-LR4 is the current option

400GE

Projection of Form Factor Evolution to 400G

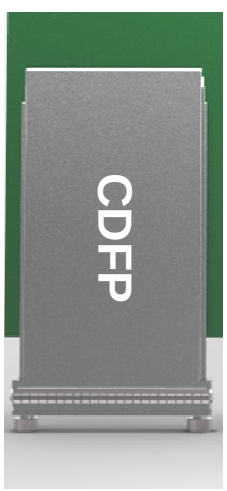
100G



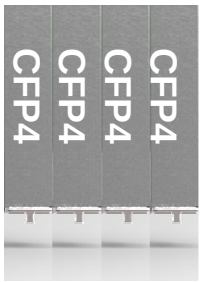
defensible

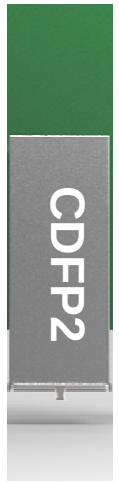
speculation

400G



16x25G electrical lanes





8x50G electrical lanes

4x100G electrical lanes

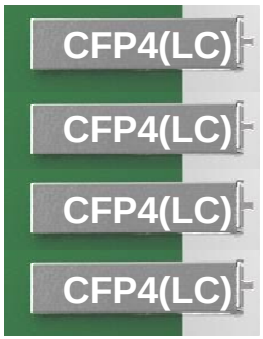
Roman Numerals
XL = 40
C = 100
CD = 400

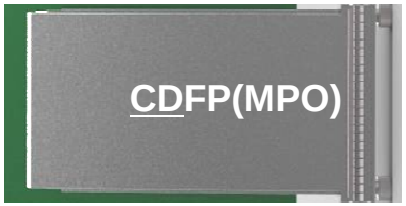
400G Optical Ethernet

- First-generation PMDs have to be implementable that meet and eventually do better than these requirements
  - Size (Width): ≤ 82 mm (CFP width, ~4 x CFP4)
  - Cost: ≤ 4 x CFP4
  - Power: ≤ 24 W (4 x 6 W power profile of CFP4)
- Improved bandwidth density PMDs will need higher rate optical and/or electrical lane technologies such as 50 to 56 Gbps

Possible SMF Road Map: 100G, 400G, 1.6T

Early Adopter 400G	Mature 400G	Early Adopter 1.6T
4 x 100GBASE-nR4 or 400GBASE-PSM4	400GBASE-???	4 x 400GBASE-??? or 1600GBASE-PSM4





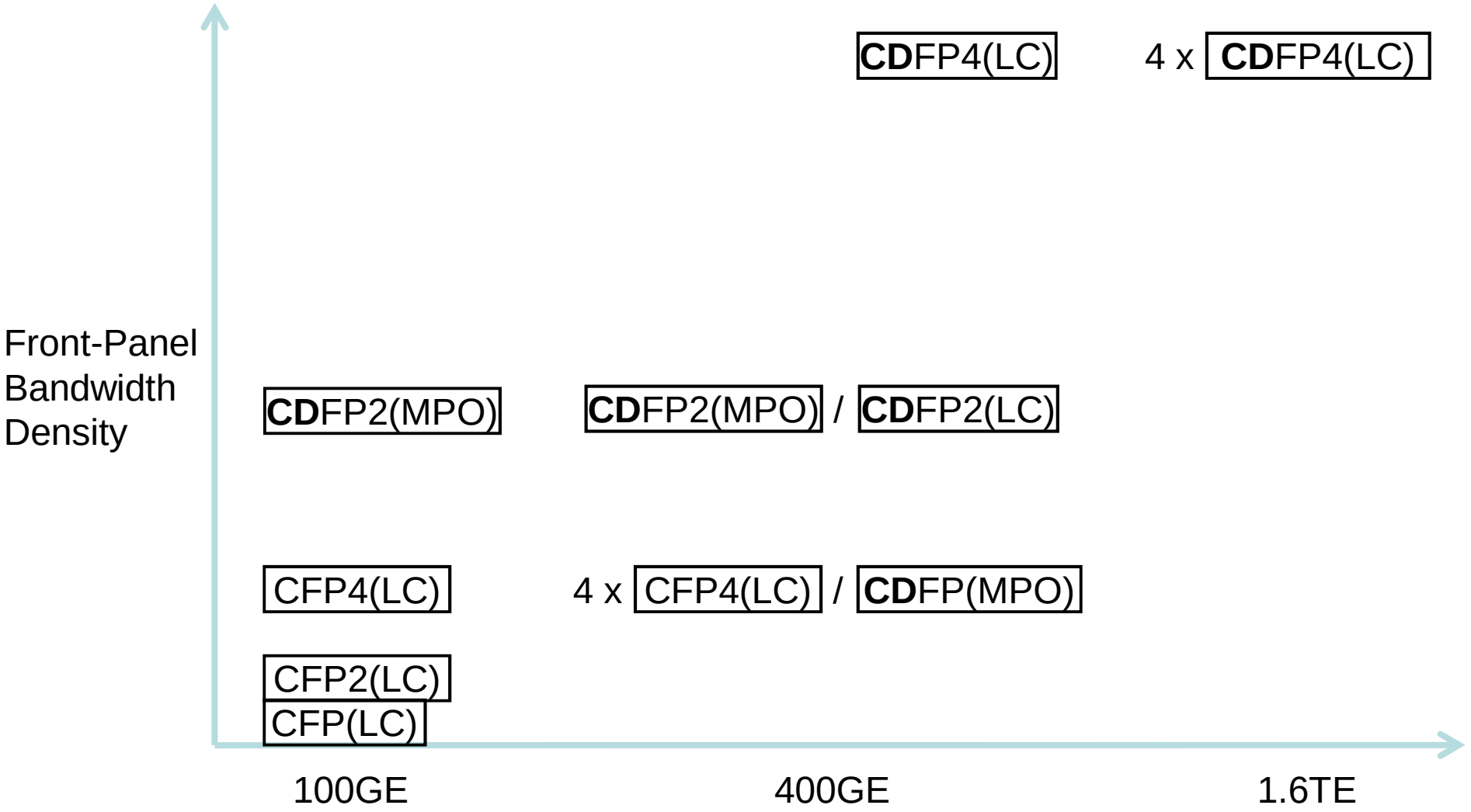
(High-Density 100GE)

Parallel Single Mode, 4 Lanes (PSM4)
4, Tx and 4, Rx
1x12 MPO Connector

PMD Maturity & Obsolescence

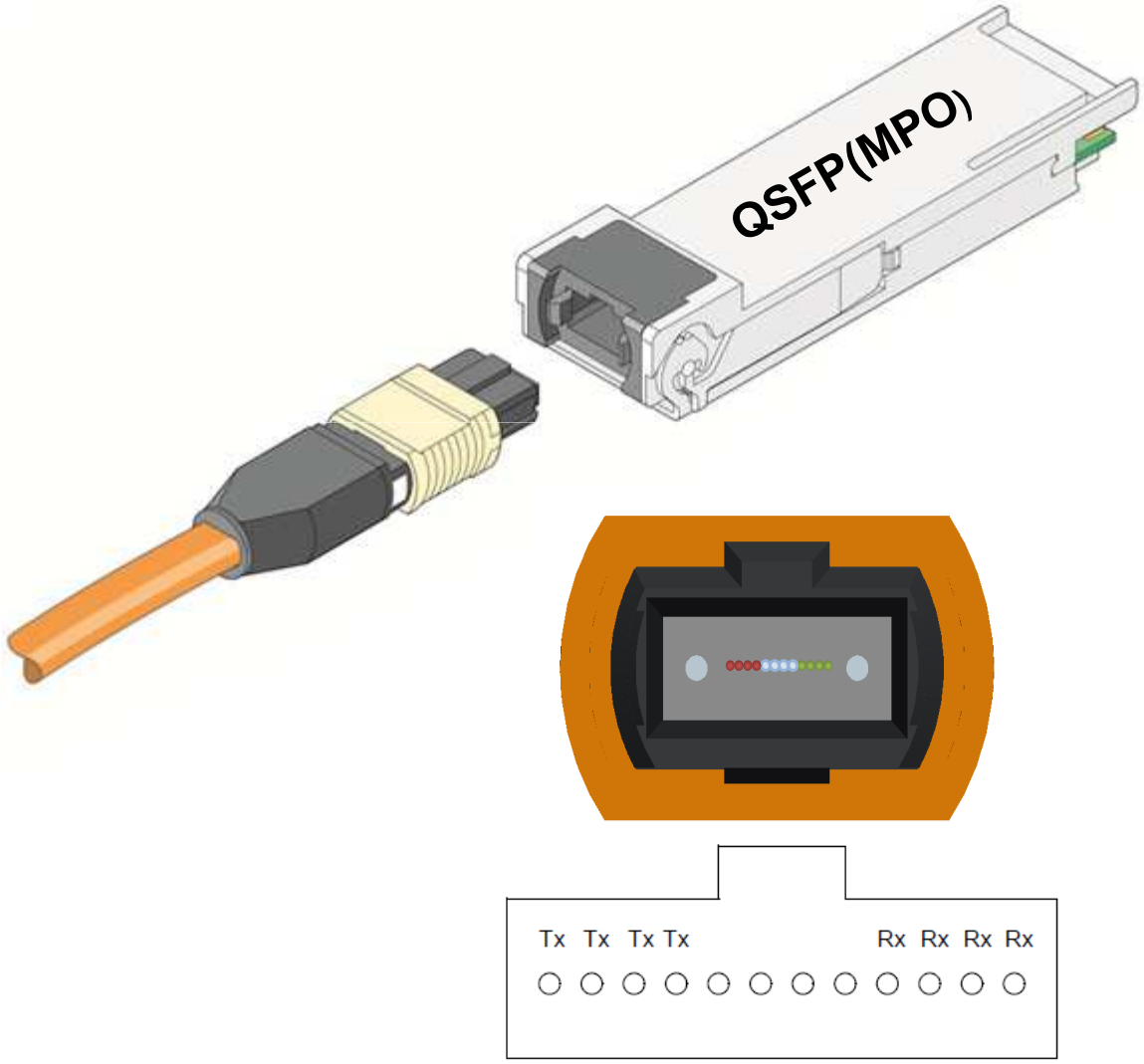
- Early Adopter PMD
  - Parallel Single Mode
  - Leverage of mature PMD from previous speed of Ethernet
  - Planned obsolescence
  - Implementation (with MPO connector) persists as high-density support of previous speed of Ethernet (e.g., 4 x 100GE)
- Mature PMD
  - Duplex SMF cabling (e.g., with LC duplex connector)
  - Note that 100GBASE-PSM4 as proposed for 100GBASE-nR4 would not be an example of a “mature PMD”

Density Road Map



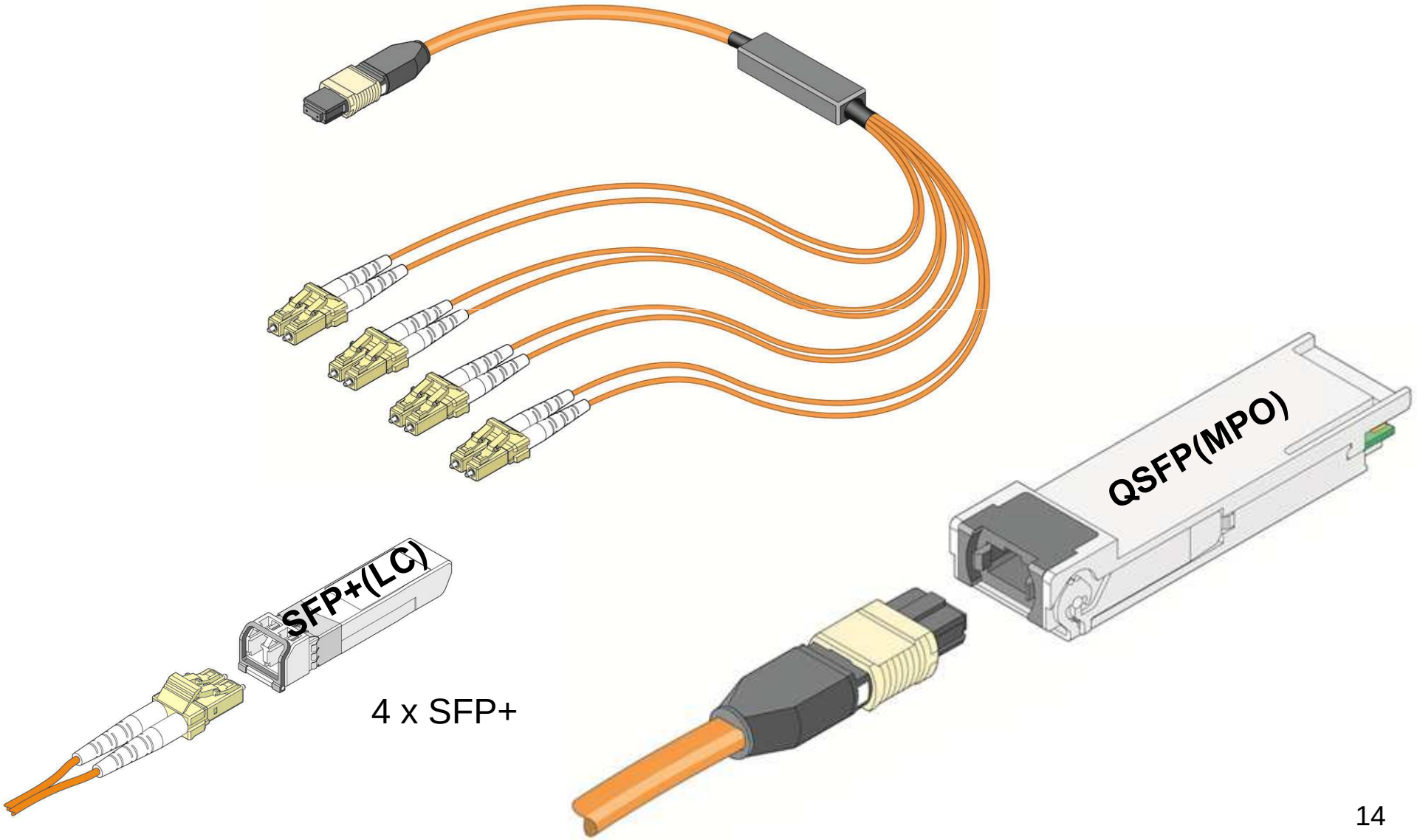
PARALLEL FIBER INFRASTRUCTURE

Paradigm Example: QSFP(MPO) for Parallel Fiber Applications



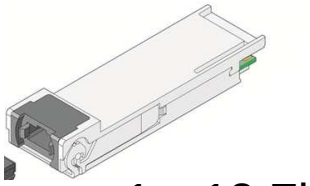
40GBASE-SR4

High-Density 10GE Based on QSFP(MPO): 4 x 10GBASE-SR



Example: Structured Cabling for 10G/40G

QSFP(1x12 MPO)

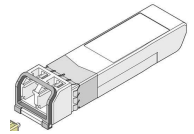


1 x 12 Fiber Patch Cable

40G

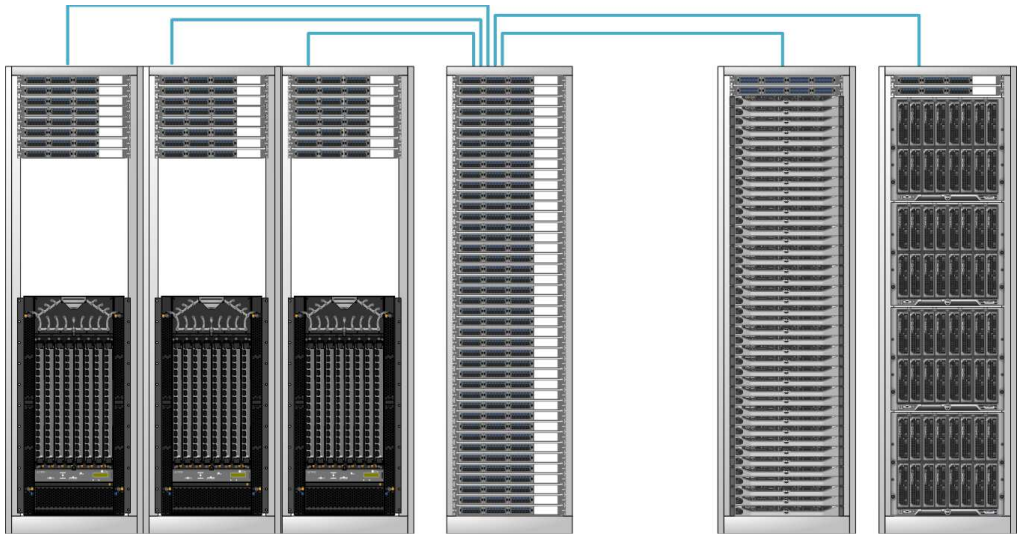
2 x 12 Fiber Trunk Cable

SFP+(LC Duplex)



10G

LC-Duplex Patch Cable



Use SMF for 100G/400G

Summary

- Form factor road map for bandwidth evolution
- Early adopter 400GE using 100GE module and parallel SMF cabling infrastructure
- Possible common module for 400GE and high-density (i.e., 4-port) 100GE

Thank You