

Finisar[®]

*Fiber Optic Solutions
for High-Speed Networks*

100Gb/s Clients

ECOC 100Gb/s Workshop 5

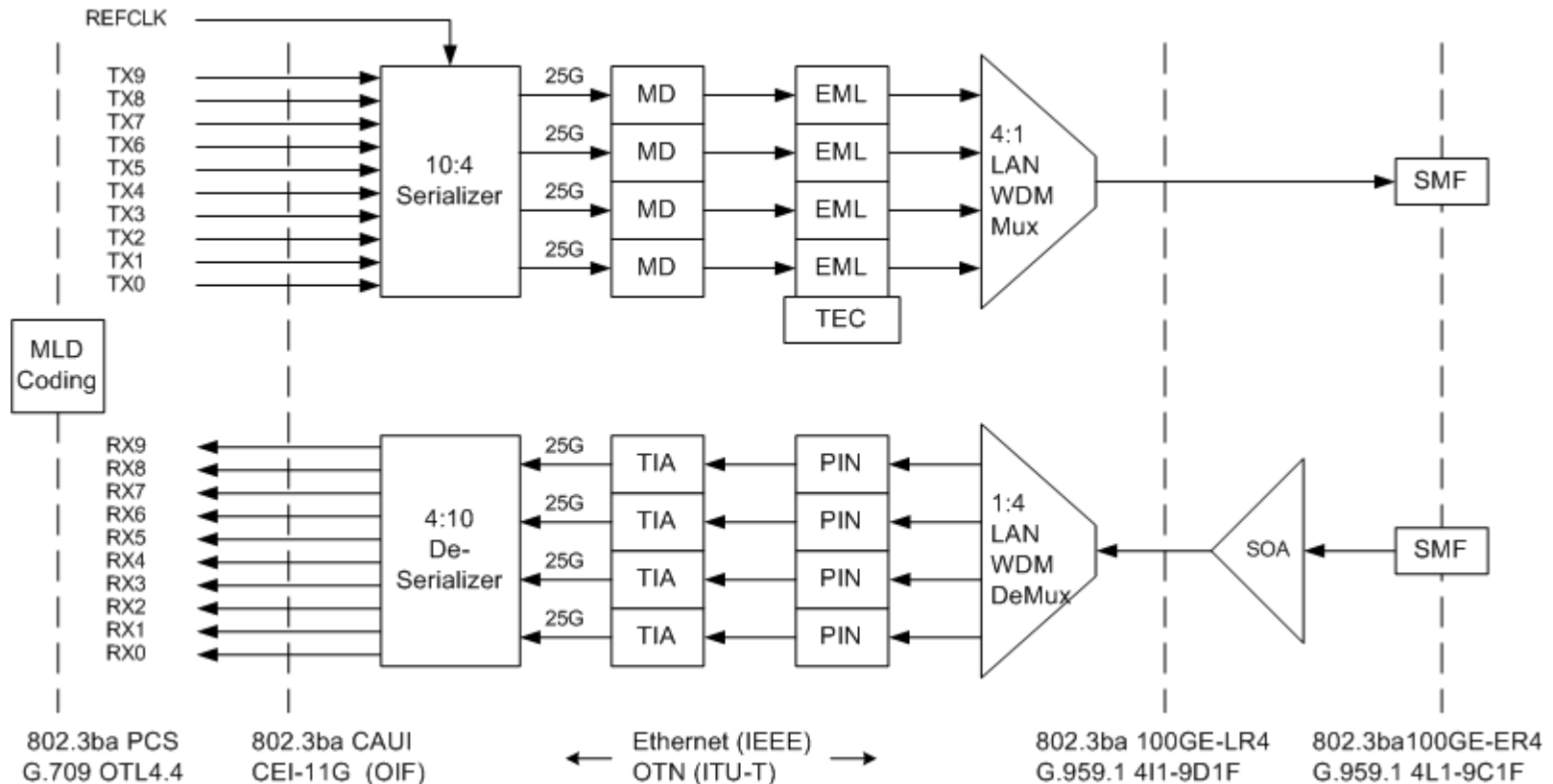
20 September 2009

Chris Cole

Outline

- ◆ 100Gb/s SMF Gen1 Client
- ◆ 100Gb/s SMF Gen2 Client
- ◆ 100Gb/s SMF Gen3 Client
- ◆ 400Gb/s SMF Client
- ◆ 100Gb/s Parallel MMF Gen2 Client
- ◆ Other Parallel MMF Clients
 - 100Gb/s MMF Gen1 Client (Obsolete)
 - 100Gb/s MMF Gen3 Client
 - 400Gb/s MMF Client

100Gb/s Client Gen1 Architecture



- ◆ 10km (or 40km) reach
- ◆ CFP MSA module
- ◆ Discrete or photonic integration 1310nm EML optics

CFP MSA Module



- ◆ CFP MSA standard mechanical, electrical and firmware specifications
- ◆ Supports datacom and telecom applications
- ◆ Supports SMF & MMF with multiple optical connectors: SC, LC, MPO
- ◆ Supports multiple data rates: Nx10Gb/s, Nx40Gb/s and 100Gb/s

100Gb/s Client WDM Grid

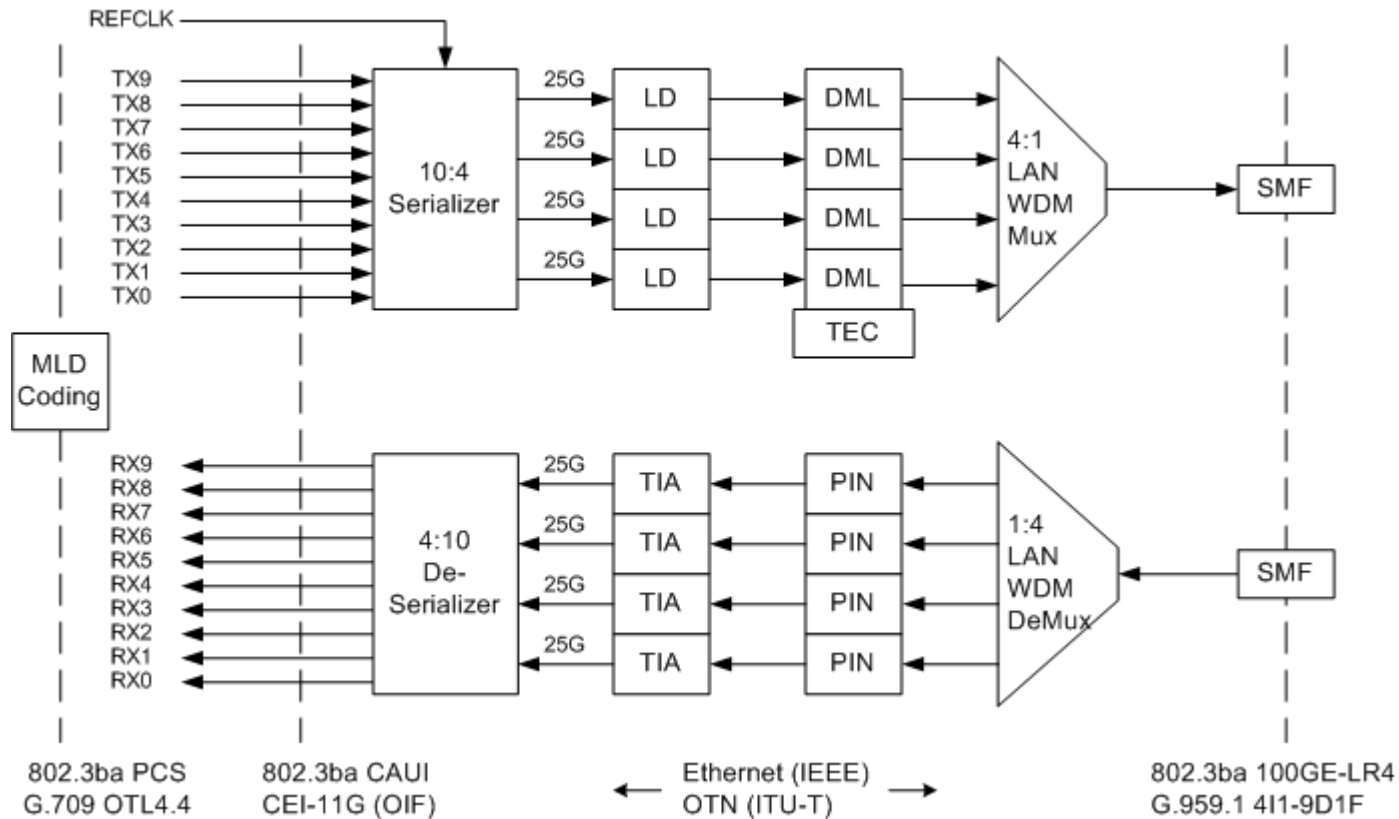
88.6 Wavelength-division-multiplexed lane assignments

The wavelength range for each lane of the 100GBASE-LR4 and 100GBASE-ER4 PMDs is defined in Table 88–5. The center frequencies are members of the frequency grid for 100 GHz spacing and above defined in ITU-T G.694.1 and are spaced at 800 GHz.

Table 88–5—Wavelength-division-multiplexed lane assignments

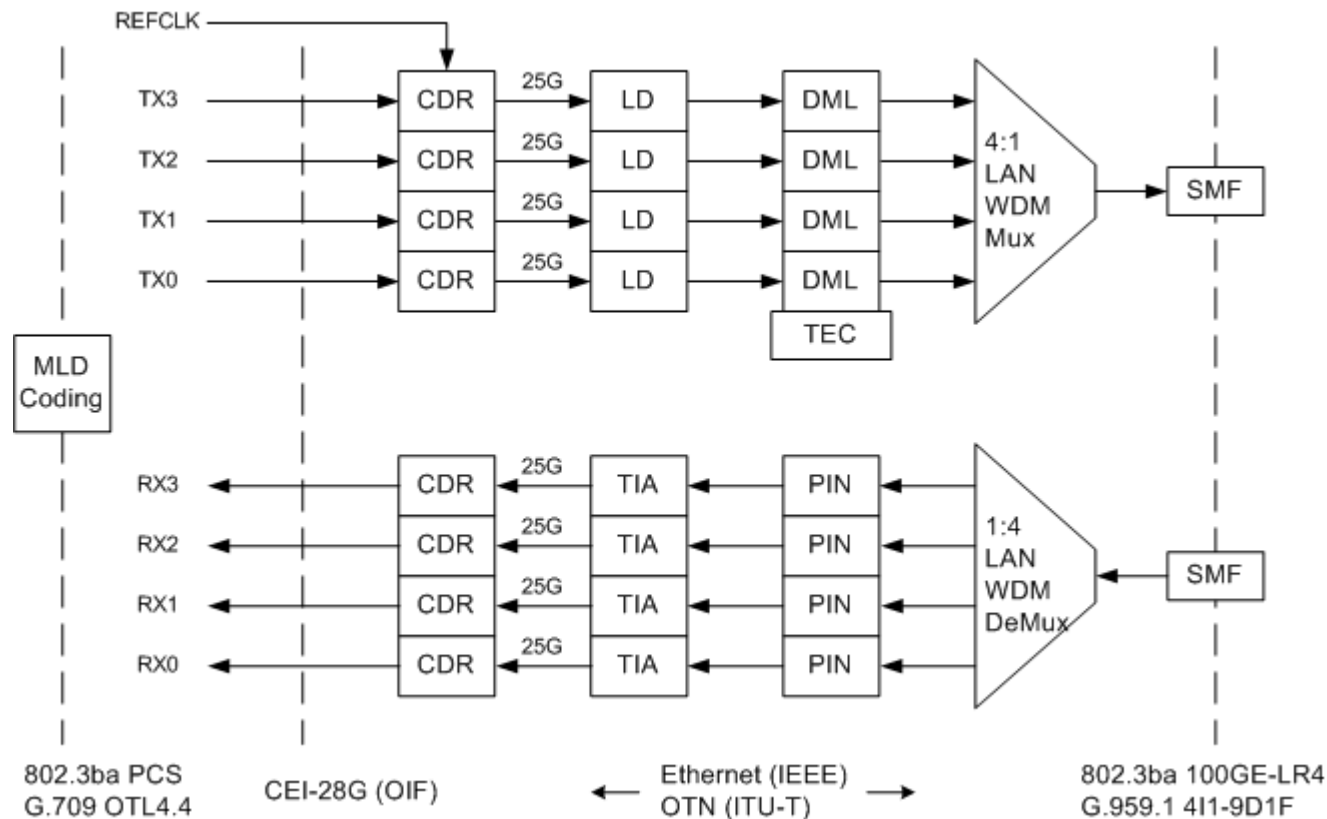
Lane	Center frequency	Center wavelength	Wavelength range
L ₀	231.4 THz	1295.56 nm	1294.53 to 1296.59 nm
L ₁	230.6 THz	1300.05 nm	1299.02 to 1301.09 nm
L ₂	229.8 THz	1304.58 nm	1303.54 to 1305.63 nm
L ₃	229 THz	1309.14 nm	1308.09 to 1310.19 nm

100Gb/s Client Gen2 Architecture



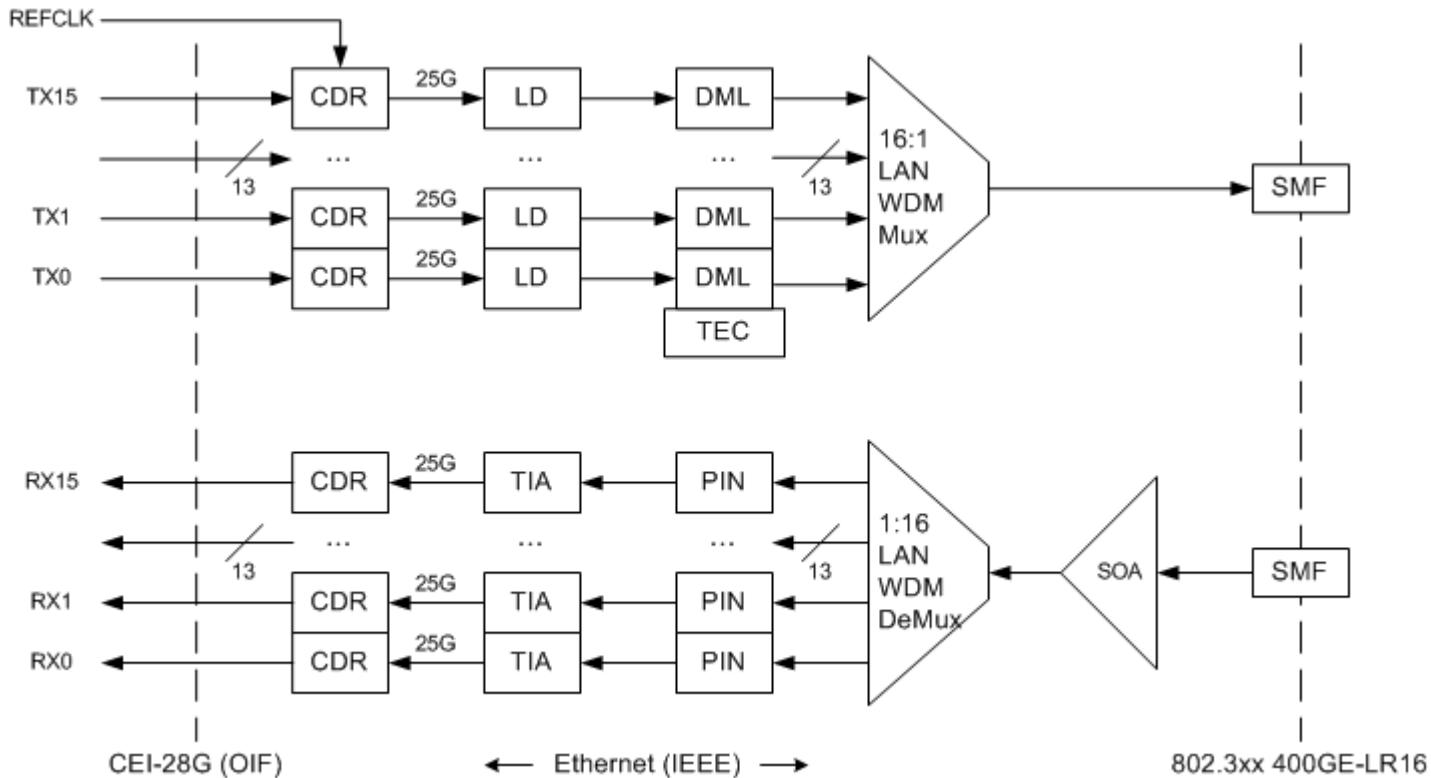
- ◆ 10km reach
- ◆ CFP MSA module
- ◆ Discrete or photonic integration 1310nm DML optics

100Gb/s Client Gen3 Architecture



- ◆ New CFP2 form factor module with 4x25G I/O connector
- ◆ Approximate size: $\sim W_{\text{CFP}}/2 \times < L_{\text{CFP}} \times \sim H_{\text{CFP}}$
- ◆ Photonic integration optics required

400Gb/s Client Evolutionary Architecture



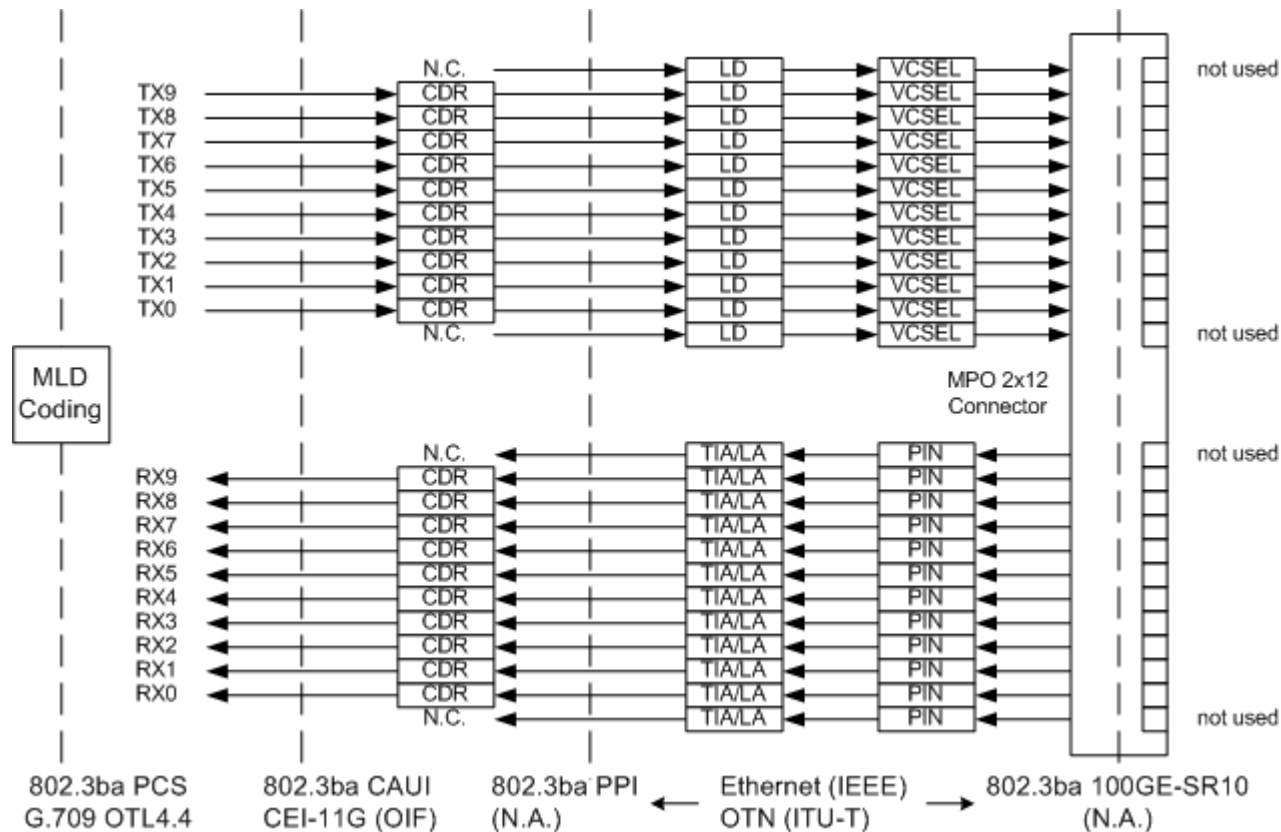
- ◆ New CDFP form factor module with 16x25G I/O connector
- ◆ Approximate size: $\sim 1.5W_{CFP} \times L_{CFP} \times \sim H_{CFP}$
- ◆ Photonic integration 1310nm optics required

400Gb/s Client WDM Grid

Lane	Center Frequency THz	Center Wavelength nm	Approximate Wavelength @nm
1330 band			
L33	225.8	1327.69	1328
L32	226.6	1323	1323
L31	227.4	1318.35	1318
L30	228.2	1313.73	1313
1310 band			
L23	229	1309.14	1310
L22	229.8	1304.58	1305
L21	230.6	1300.05	1300
L20	231.4	1295.56	1295
1290 band			
L13	232.2	1291.1	1292
L12	233	1286.66	1287
L11	233.8	1282.26	1282
L10	234.6	1277.89	1277
1270 band			
L03	235.4	1273.55	1275
L02	236.2	1269.23	1270
L01	237	1264.95	1265
L00	237.8	1260.69	1260

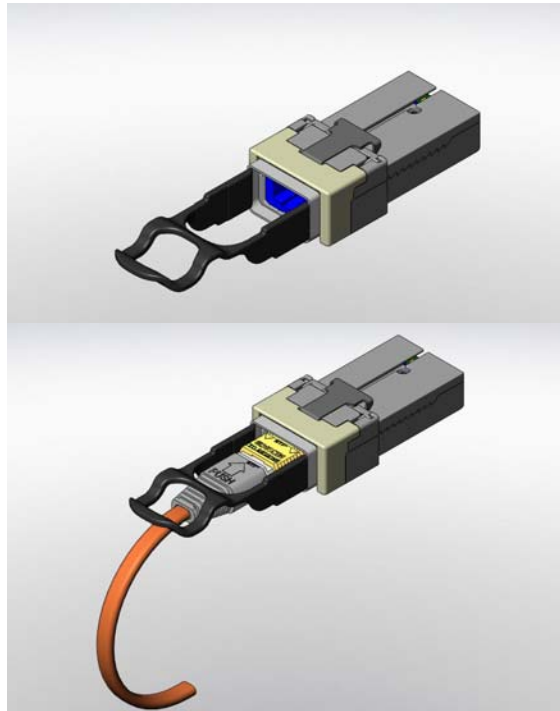
- ◆ On ITU G.694.1 DWDM grid
- ◆ 800GHz LAN WDM spacing and 1310nm band same as 100Gb/s IEEE and ITU-T specifications
- ◆ SOA closes 10km link budget (400Gb/s vs. 100Gb/s), because of additional fiber loss and dispersion penalty (70nm span vs. 15nm) and higher Mux and DeMux loss, (16:1 vs. 4:1).
- ◆ Complex Modulation Alternatives:
 - Electrical I/O remains at 16x25G
 - Ex1: QPSK uses 8 λ in 1310 & 1290 bands at 50Gb/s per λ
 - Ex2: DP-QPSK uses 4 λ in 1310 band at 100Gb/s per λ
- ◆ Selection will be based on state of photonic integration technology

100Gb/s Parallel MMF Client Gen2 Architecture



- ◆ 100m reach with PPI (un-retimed electrical I/O)
- ◆ CXP MSA connector/module (CFP module with CAUI optional)
- ◆ VCSEL Array 850nm Optics
- ◆ Highest density, lowest cost and power 100Gb/s optical interconnect

CXP Module and CXP Active Cable



- ◆ CXP connector standard mechanical and electrical specifications
- ◆ Supports datacom and telecom applications
- ◆ 2x12 MPO parallel fiber cable based
- ◆ Supports 10x10G and 12x12.5G applications with PPI electrical I/O

Other Parallel MMF Client Architectures

- ◆ 100Gb/s Parallel MMF Client Gen1 Architecture
 - 2xSNAP12 separate TX and RX MSA modules (~1/2 CXP density)
 - 2.5G MegArray connector retrofitted for 10G use
 - VCSEL Array 850nm Optics
 - Obsolete architecture; not recommended for product design!
- ◆ 100Gb/s Parallel MMF Client Gen3 Architecture
 - 100GE-SR4: 4x25G 850nm VCSEL array based
 - 1x12 MPO connector parallel cable
 - Un-retimed electrical I/O may not be feasible
 - Will require a new module form factor
- ◆ 400Gb/s Parallel MMF Client Gen1 Architecture
 - 400GE-SR16: 16x25G 850nm VCSEL array based
 - 3x12 MPO connector parallel cable
 - Un-retimed electrical I/O may not be feasible
 - Will require a new module form factor