800G Optics Options

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Summary

- Overview of optics options for 800GbE
- Proposal for 8x100G duplex singlemode fiber objective

Optics options for 800GbE

100G/lane

- 8x100G/lane parallel
  - Useful, but expected to be ~same as existing 2x400G DR4/8x100G DR1 and 2x400G DR4+/8x100G FR1 solutions in the market this year
- Run 800GbE over two duplex fiber pairs as “2x400G” optical interface
  - Twice fiber count, but possible; 400G FR4+LR4 interfaces already defined in MSA and 802.3cu
- 8x100G/lane duplex
  - **Does not exist**

200G/lane

- 4x200G/lane parallel (100-500m?)
- 4x200G/lane duplex (100-500m?)

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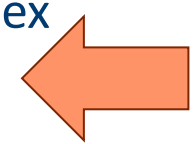
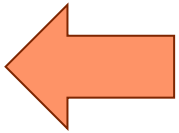


Gap in duplex-fiber support for 100G/lane networking equipment

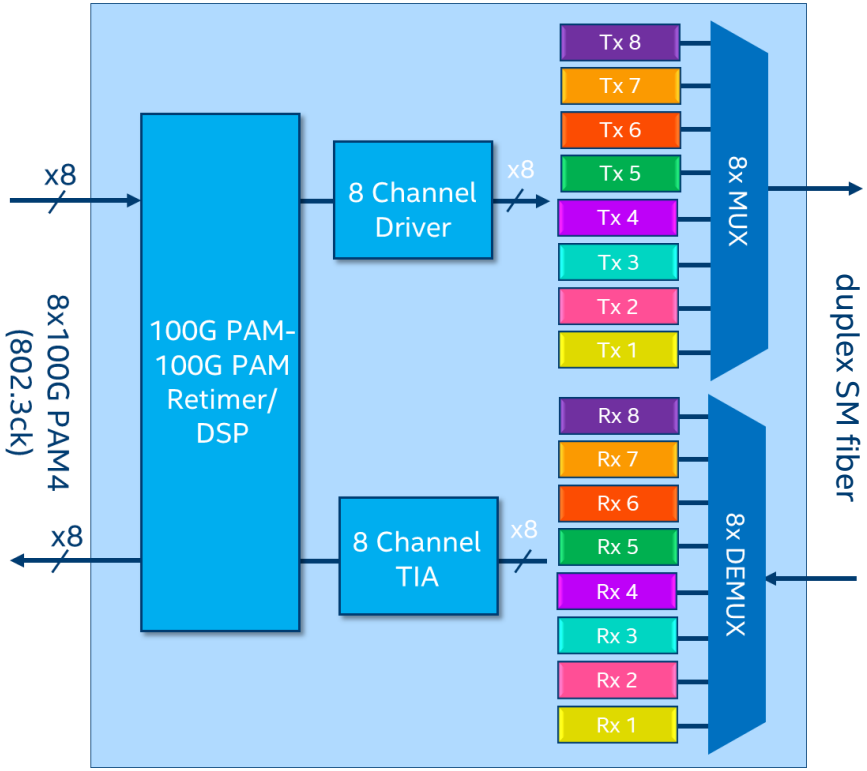
200G/lane

- 4x200G/lane parallel (100-500m?)
- 4x200G/lane duplex (100-500m?)



Likely gap in longer reach support for 800GbE

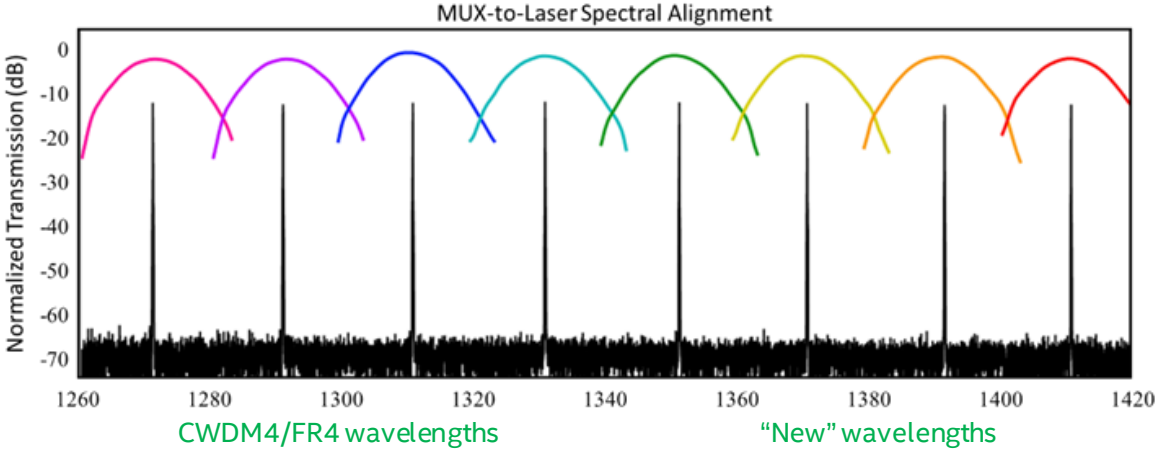
800GbE on duplex singlemode fiber: FR8

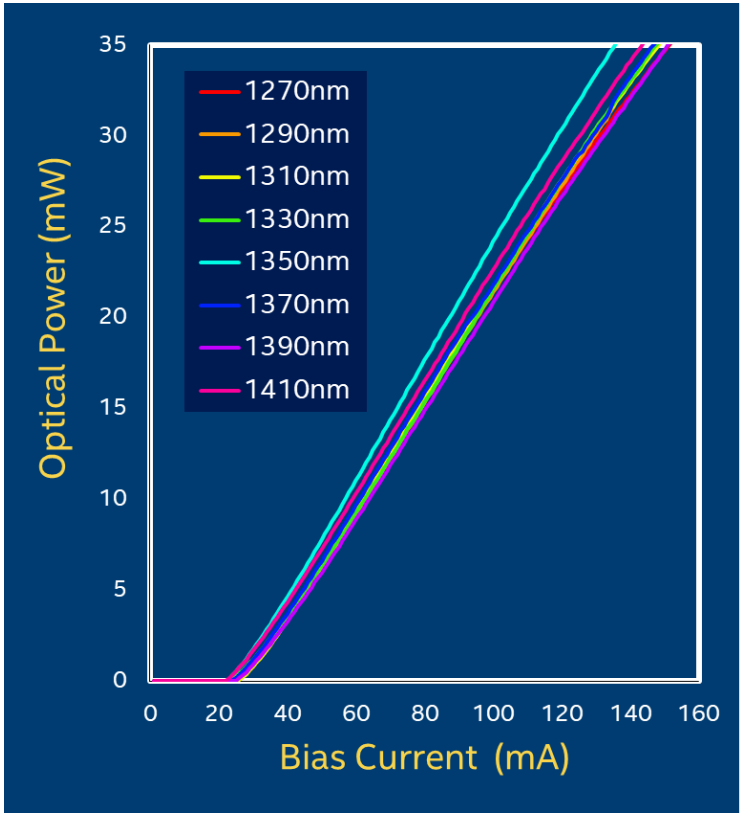


- 8λ x 100G PAM4 on one duplex SM fiber pair
  - Suggest CWDM wavelength grid, fully uncooled for lower power; other implementations possible
- Could leverage most design elements (form factor, ICs, packaging, etc.) from 400G FR4 and 2x400G FR4 optics shipping now and/or coming this year
- Same fiber plant and link budgets as 400G FR4. No new FEC, no gearboxes
- See further slides for more on technical feasibility

Technology Feasibility of 800G FR8

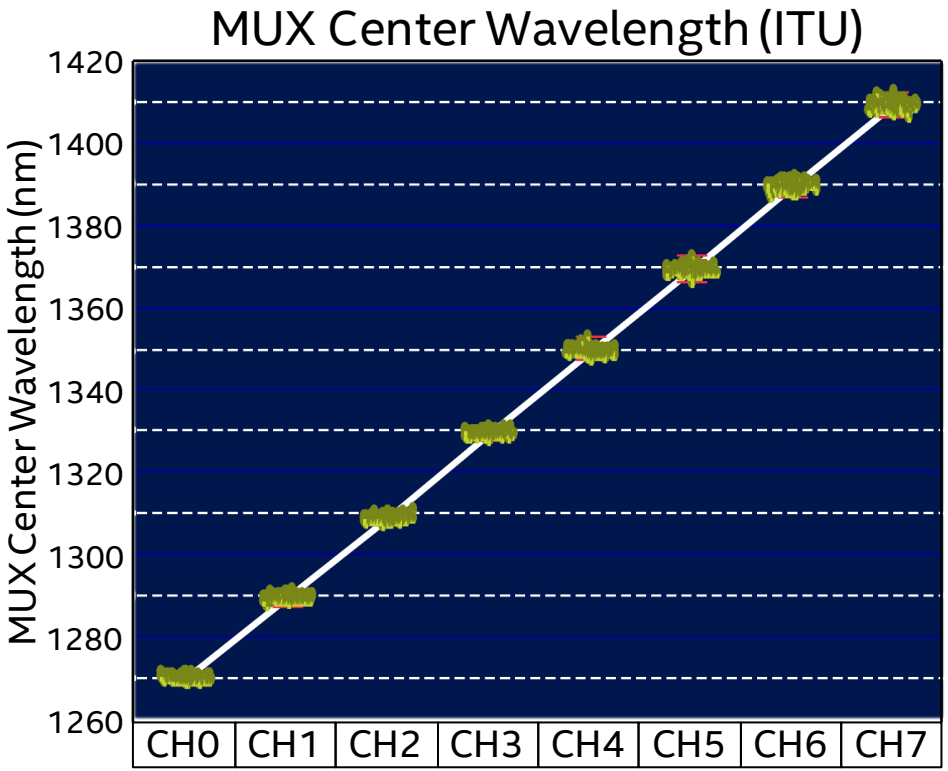
Prior Work: 8-Channel O+E Band Laser





- Integrated 8-channel laser on CWDM grid already demonstrated (in full PIC) with good performance (wavelength, efficiency / output power)
  - High-temp performance improves slightly at longer wavelengths
- Preliminary 2000 hour reliability testing also already completed on 8-channel lasers, showing slightly better results for longer wavelengths

Prior Work: 8-Channel Integrated Silicon Photonics Mux



Example: Integrated Silicon Mux

- Wafer-level (left) and module-level testing confirms good 8-channel CWDM mux performance
  - Good alignment between mux center-wavelength, ITU grid, and laser wavelength
  - Low insertion loss
  - Wide bandwidth, enables un-cooled laser operation over 0-80C

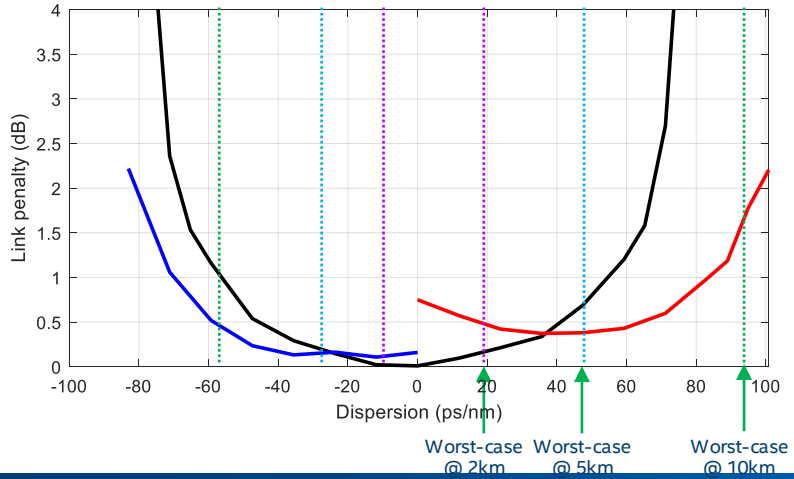
This is just an example, other implementations are possible

800G FR8 Reach and Dispersion Penalty

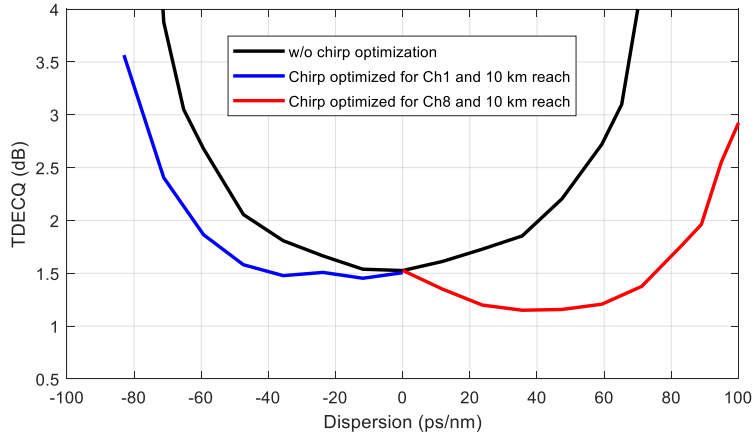
Simulated 800G FR8 Performance vs. Dispersion

- Simulated link penalty and TDECQ vs. dispersion are shown below
- The modulator chirp can be optimized for each channel and for a given maximum reach. Below, the black curve shows baseline performance, and the blue and red curves show optimization for Ch1 and Ch8 with up to 10 km reach, as an example
- 800G FR8 expected to comfortably support ~5km reach without chirp optimization, and potentially up to 10km with chirp optimization

Link penalty vs. dispersion

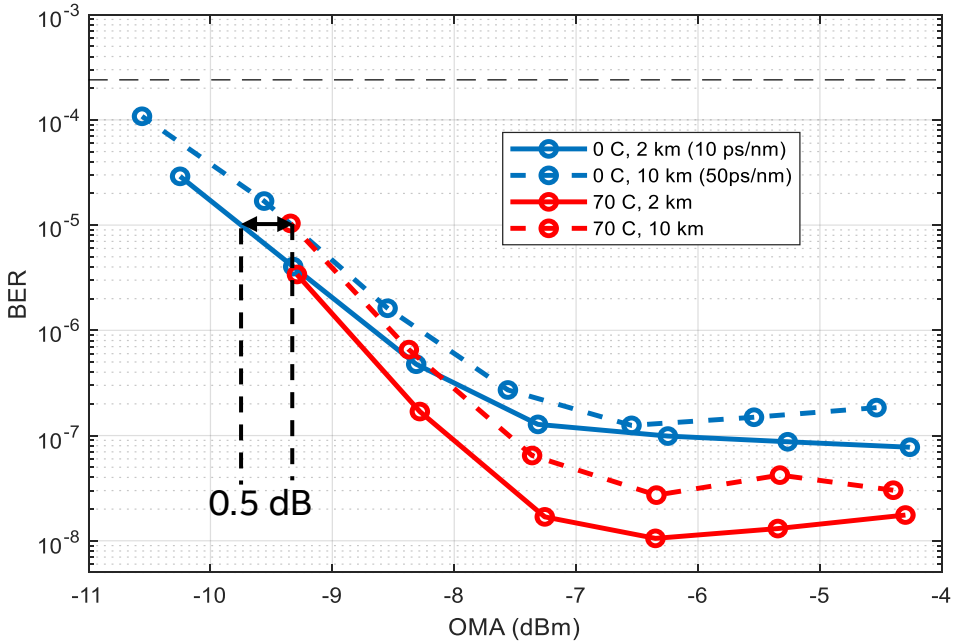


TDECQ vs. dispersion



Measured 100G/λ Performance vs. Dispersion

- Module BER measurements (without chirp optimization) show 0.5 dB penalty for 50 ps/nm vs 10 ps/nm, equivalent to 800G FR8 ~5 km reach on worst case fiber – in alignment with simulation

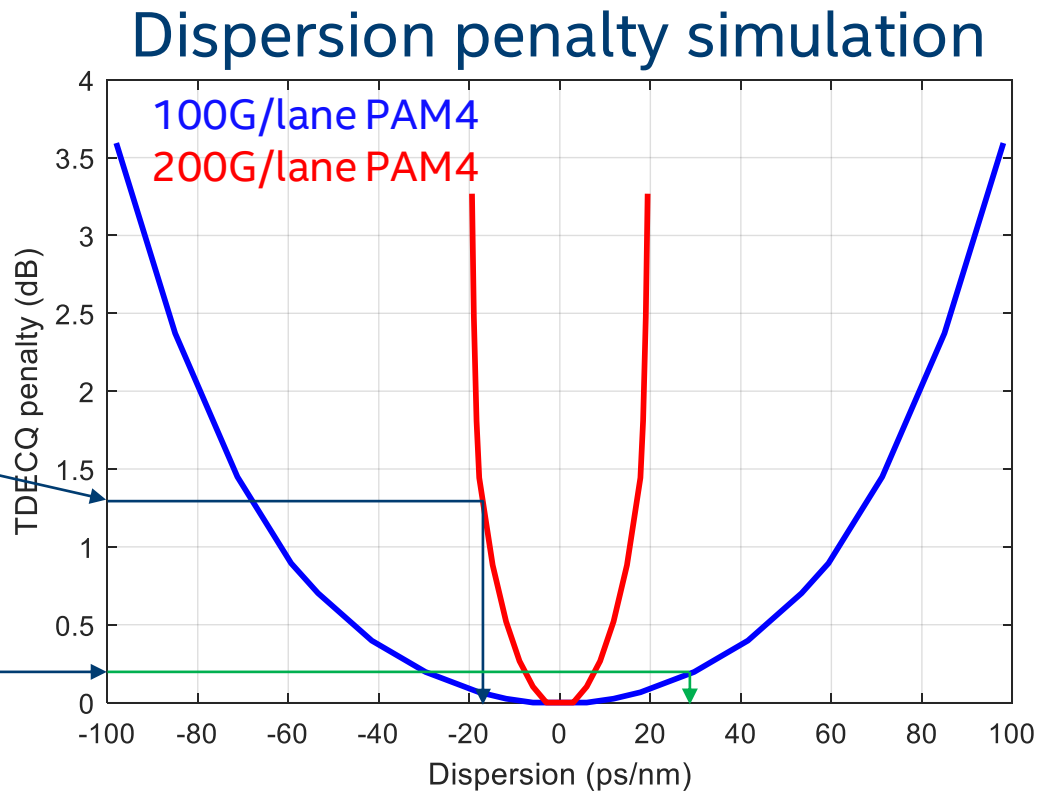


8x100G Dispersion Penalty Compared with 4x200G

- 800G (8x100G/lane) FR8 on CWDM grid a good solution for longer reach on single mode fiber

FR4 @ 200G/lane:
> 1 dB dispersion penalty at 2km, and close to “the cliff”

FR8 @ 100G/lane:
~0.2 dB dispersion penalty at 2km



Summary

- In addition to 200G/lane objectives, suggest adding an objective or objectives for 8x100G optical interface(s) on one duplex single mode fiber pair
  - ✓ Supports duplex-fiber 800G optical interfaces with 100G/lane networking equipment
  - ✓ Supports longer reaches than 200G/lane
    - 500m, 2km, 5km, and 10km all feasible objectives

Thank you

Questions? Email me at scott.schube@intel.com

Backup

Worst-case fiber dispersion values for CWDM-spaced 8-channel wavelength grid

			Dispersion (ps/nm)					
			L=2km		L=5km		L=10km	
CWDM8 CH#	LAM_MIN (nm, 0C-2.5nm)	LAM_MAX (nm, 80C+2.5nm)	Min	Max	Min	Max	Min	Max
0	1264.5	1276.6	-11.32	-4.81	-28.31	-12.04	-56.62	-24.07
1	1284.5	1296.6	-7.21	-1.00	-18.02	-2.50	-36.04	-5.00
2	1304.5	1316.6	-3.29	2.64	-8.21	6.61	-16.43	13.21
3	1324.5	1336.6	0.46	6.12	1.15	15.31	2.29	30.62
4	1344.5	1356.6	4.04	9.46	10.09	23.64	20.19	47.28
5	1364.5	1376.6	7.46	12.65	18.66	31.63	37.31	63.25
6	1384.5	1396.6	10.74	15.72	26.86	39.29	53.72	78.58
7	1404.5	1416.6	13.89	18.66	34.74	46.66	69.47	93.31