800G-LR4 CD Specifications with Fiber Statistical Model Support

Rang-Chen Yu and Michael He, InnoLight
Frank Chang, Source Photonics

July 8, 2024

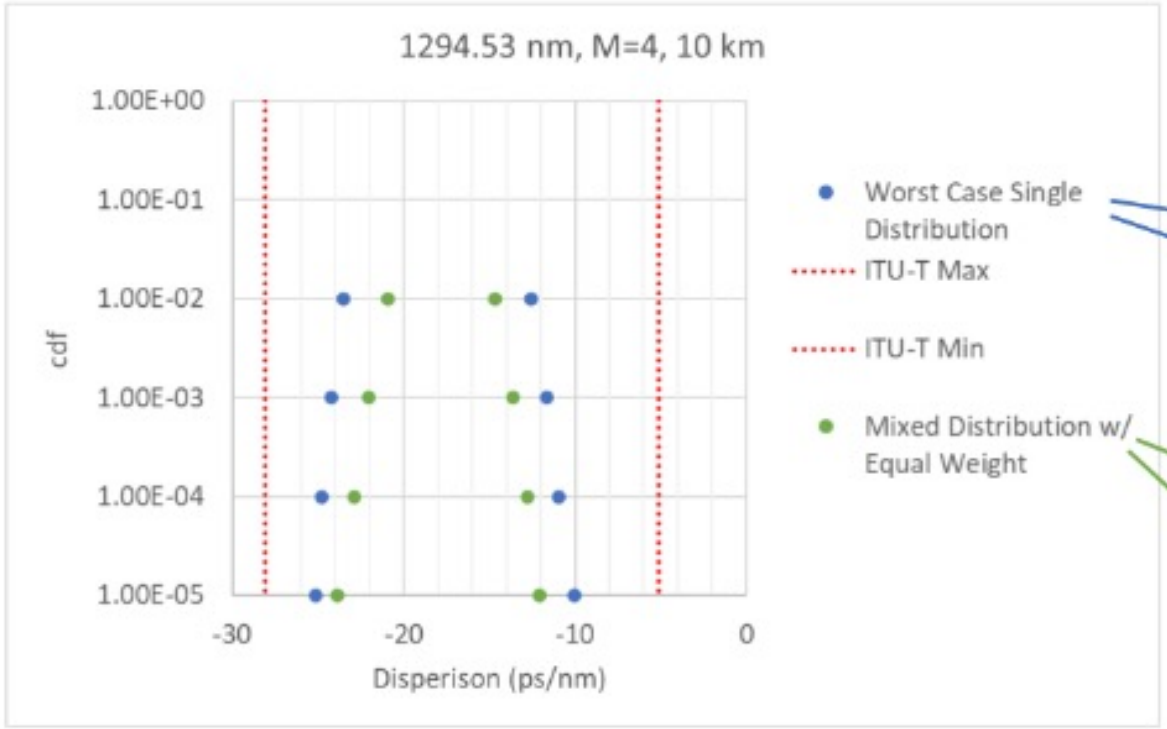
IEEE 802.3dj 2024 July Plenary

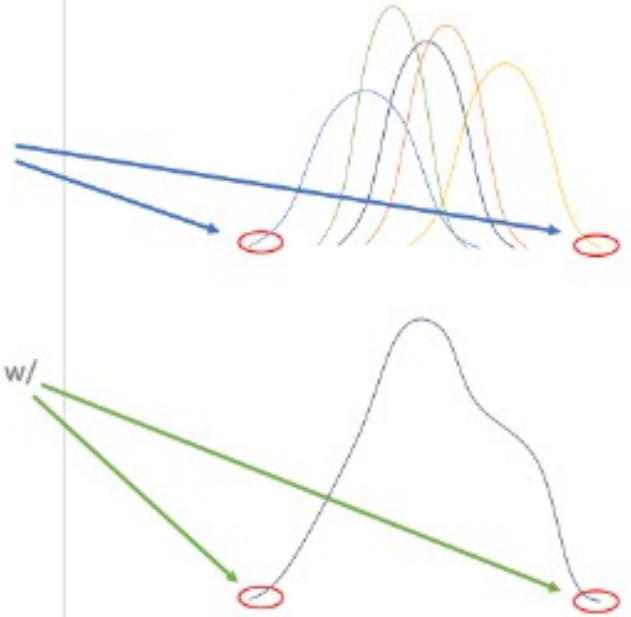
Supporters

- Roberto Rodes, Coherent
- Chris Cole, Coherent
- Earl Parsons, Comscope

Fiber Dispersion Model Options for 800G-LR4

- With 200G-PAM4 IMDD PMD, 802.3dj is moving to adopt fiber CD model with statistical distribution
- Most recent contribution by Parsons considers two distribution models (parsons_3dj_optx_01_240627.pdf)
  - Model #1: Worst case single distribution
  - Model #2: Mixed distribution with equal weight

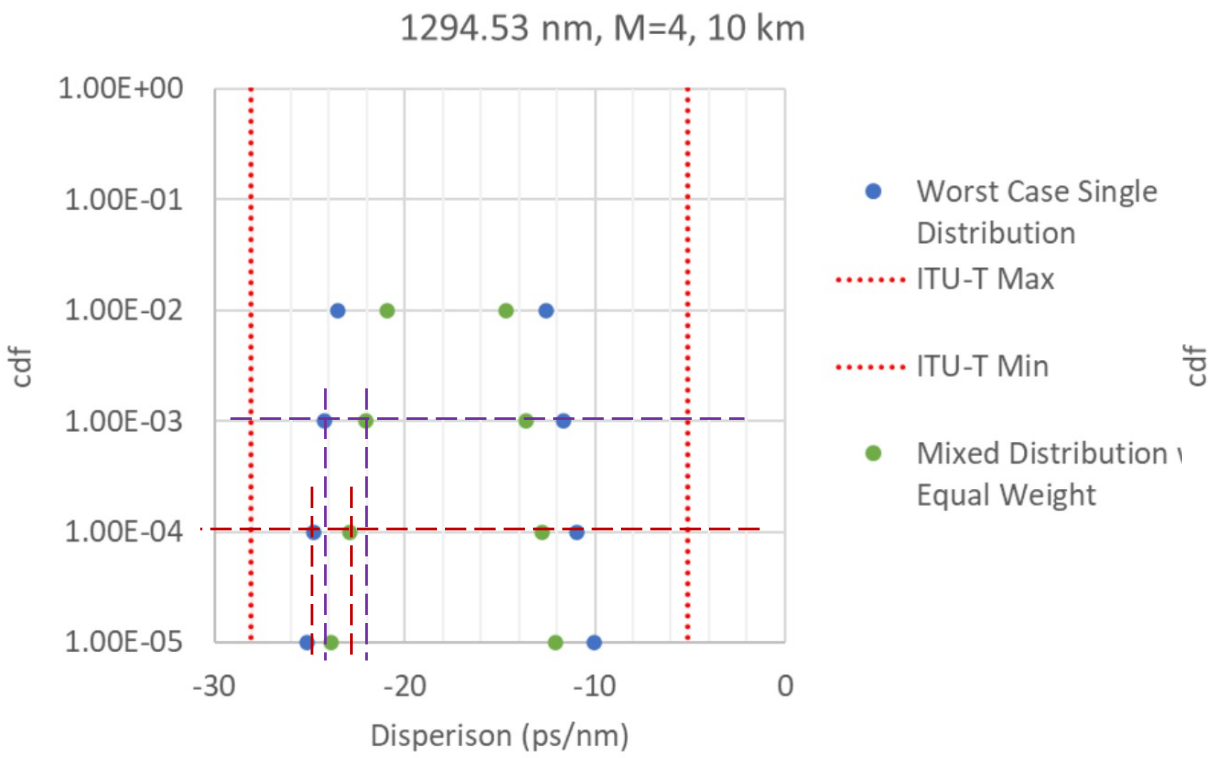


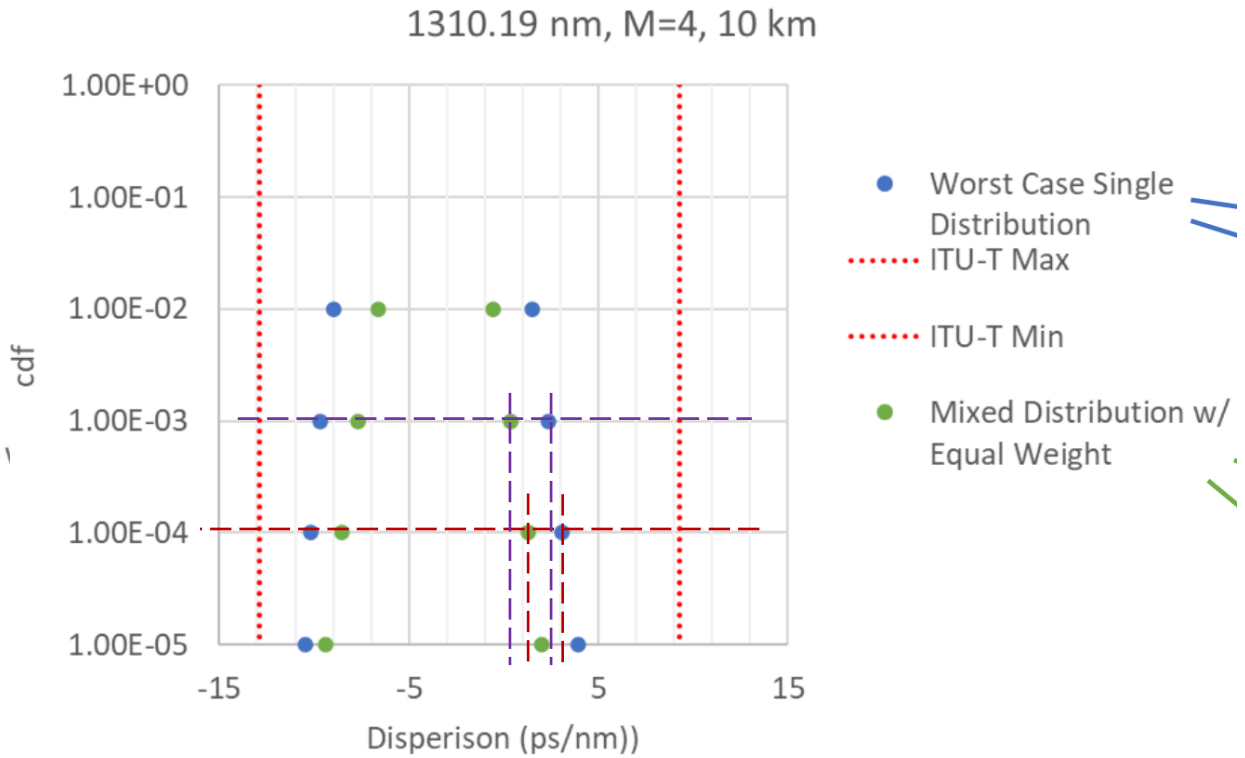


Cartoon for illustration purposes
Not representative of data

CD Limit for 800G-LR4 Wavelengths

We derive CD limit from parsons_3dj_optx_01_240627.pdf Corresponding to two different fiber CD models





Worst Case Single Distribution

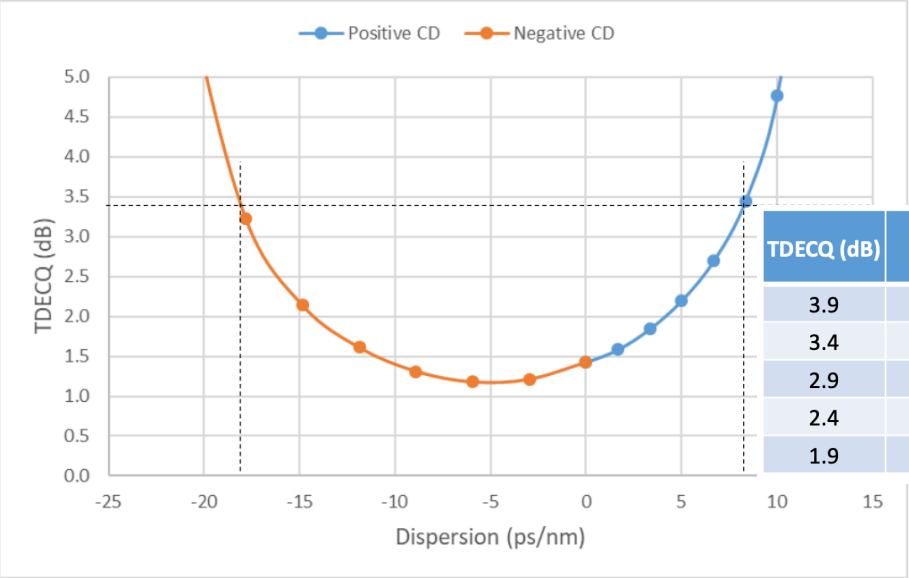
	Chan. 0	Chan. 1	Chan. 2	Chan. 3
	1294.53	1294.53	1310.19	1310.19
1.00E-02	-23.53	-12.6	-9	1.49
1.00E-03	-24.21	-11.67	-9.65	2.4
1.00E-04	-24.76	-10.95	-10.17	3.08
1.00E-05	-25.12	-10.07	-10.45	3.95

Mix Distribution w/ Equal Weight

	Chan. 0	Chan. 1	Chan. 2	Chan. 3
Q Value	1294.53	1294.53	1310.19	1310.19
1.00E-02	-20.93	-14.64	-6.61	-0.54
1.00E-03	-22.05	-13.62	-7.68	0.4
1.00E-04	-22.88	-12.77	-8.51	1.28
1.00E-05	-23.9	-12.07	-9.41	1.99

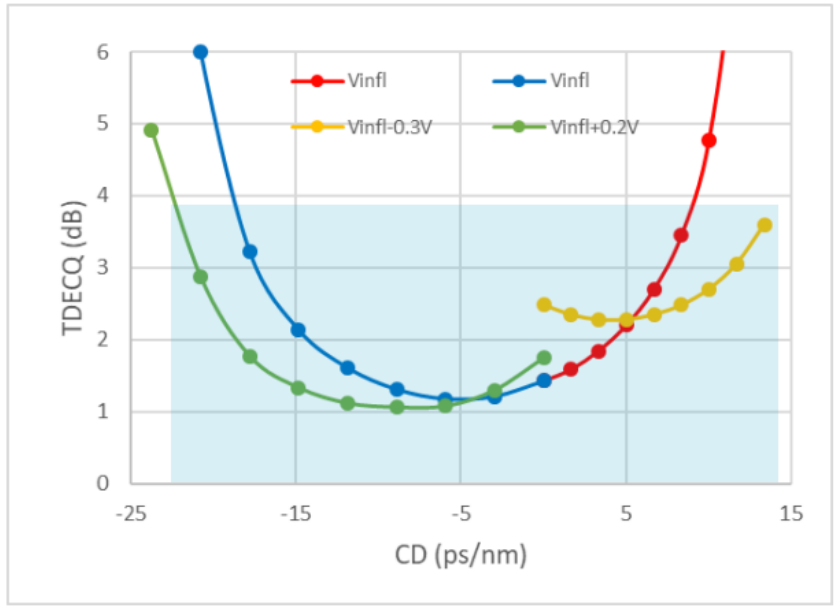
200G-PAM4 Transmitter Dispersion Performance

johnson_3dj_optx_01_240627.pdf



TDECQ (dB)	CD(min) (ps/nm)	CD(max) (ps/nm)
3.9	-19.3	9.2
3.4	-18.5	8.4
2.9	-17.6	7.4
2.4	-16.4	5.6
1.9	-14.5	3.4

johnson_3df_01a_221011.pdf



11 | Johnson_3df_1_221011

- John Johnson contributions discussed EML transmitter CD tolerance with simulations
- Negative dispersion limit is a key concern for high CD penalty
- With bias control for EML to enhance positive chirp, CD tolerance may be improved to ~ -22.2 ps/nm, from -19.3 ps/nm, with TDECQ 3.9dB as max.
- These analysis were based on certain ideal component parameters, actual component test data are needed to solidify performance boundaries

Fiber Dispersion Models Discussions

- Dis-advantage of Model#1 Worst case Single Distribution (WCSD):
  - Only consider two worst case fiber distributions, rest supplier data ignored
  - Unstable model if more suppliers come in with distribution worse than the current worst, do we have to re-consider?
  - Discouraging fiber suppliers to improve distribution towards ”sweet spot” centered distributions

- Advantage of Model #2 Mixed Distribution w/ Equal Weight (MDEW):
  - Fully consider all contributing fiber suppliers data
  - More stable model as there are already large number of data set
  - Encouraging fiber suppliers to improve fiber distribution to move to the center of total distribution
  - Leave more room for future 400G IMDD solutions with ~ 4x tighter CD tolerance levels

800G-LR4 CD Limit Spec. Proposal

- We propose 800G-LR4 CD specification as the following
  - Min. dispersion value of -22.9 ps/nm
  - Max. dispersion value of +1.3 ps/nm

- Proposed CD spec. supported by Parsons fiber model “Mixed Distribution with equal weight”, at Q=99.99%

- Rationale for adopting proposed 800G-LR4 CD Spec.:
  - Objective for IEEE 800G-LR4 PMD is to optimize economical solutions for 10km transmission, with reasonable fiber statistics for high probability of interoperability
  - In cases of extreme corner cases of higher CD value, customer may choose PMD options with higher level of CD tolerance, e.g., 800G-LR1. We should not burden 800G-LR4 for these extreme corner cases

Thank You!