

Overview of proposals and options for cd ranges for 800GBASE-FR4 and 800GBASE-LR4

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Introduction

For quite some time the P802.3dj Task Force has been discussing the maximum chromatic dispersion ranges for 800GBASE-FR4 and 800GBASE-LR4.

The P802.3dj TF received a detailed LS from ITU-T SG15 from their November 2023 meeting, enabling improved cd specifications for LR4 compared to the previously used worst case approach. Unfortunately for FR4, small to zero improvements were given.

Since the beginning of 2024 multiple proposals for improved cd modelling were provided and also a substantial effort was carried out by Earl Parsons,, affiliated with Commscope, to analyze the cd performance of fibers his company used in their cable designs. This information was shared with ITU-T.

At this meeting, the TF received an LS from the ITU-T SG15 Plenary Meeting, 1 – 12 July 2024, also in Montreal. That information is shown here as well.

Goals of this effort

As regularly emphasized by the P802.3df leadership, especially vice chairman Mark Nowell, the TF urgently needs to agree on appropriate chromatic dispersion ranges for 800GBASE-FR4 and 800GBASE-LR4 which currently are TBD in draft D1.1 of P802.3dj.

The arguments are being used in various debates in presentations and email threads, but in the end, **ONLY** the cd range will be specified and not aspects such as confidence levels. Additional aspects of why and how certain cd ranges, deviating from the previously used worst case approach, are specified may be clarified (to some extent) in an informative Annex to P802.3dj.

It is the authors' impression that there is a general feeling that referring to international standards, such as Recommendation ITU-T G.652, would be preferred, unless there are strong reasons to justify a different specification.

Available information on SMF cd ranges

- Statistical limits for relevant wavelengths from informative Appendix I to Recommendation ITU-T G.652:
 - Initial information in LS from ITU-T SG15 December 2023: [ITU-T LS](#)
 - Updated information in LS from ITU-T SG15 July 2024: [TBD](#) ([attachment1](#), [attachment2](#))
 - This data set is from 8 fiber manufacturers covering about 68% of the global market
- Statistical analysis of data sets from different fiber vendors by Earl Parsons, made available to the dj TF and ITU-T:
 - Most recent information at this meeting in [parsons_3dj_01_2407](#)
 - This data set is from 6 fiber manufacturers covering about 64% of the global market

800GBASE-LR4 proposal/options

Assumptions:

- Distance 10 km over G.652/657 fiber, 4 lambda's on 800 GHz grid (1294.53 - 1310.19 nm), 4 sections of 2.5 km (M=4).
- Only options mostly referred to are shown.

Option	potential range [ps/nm]	Source	Remarks
Previously used worst case	-28.05 to +9.27	ITU-T G.652	
ITU-T LS Nov '23	-26.3 to +4.57 ±0.8	ITU-T LS	99.99% confidence level
ITU-T LS Jul '24	-26.1 to +4.7	ITU-T LS	99.99% confidence level
	-24.6 to +2.8		99.9% confidence level
Rodes, et al	-24.6 to +2.8	rodes_3dj_01a_2407	Based upon ITU-T LS with 99.9% conf level, totally consistent with 99.99% data in Earl Parson's analysis for single extreme vendor distributions.
Yu (Ryan), et al	-22.9 to +1.3	yu_3dj_02_2407	Based upon 99.99% data for mixed vendor distributions with equal weight in Earl Parson's analysis .

Observations/comments on 800GBASE-LR4 proposal/options

- Significant reduction in positive dispersion, depending on assumptions.
- Key variable is not so much the actual cd level but rather the confidence level for covering the limits, ranging from 100% (worst case approach) to 99.99% to 99.9% to 99%.
- Also of relevance is how to treat the various distributions, either by single extreme vendor distributions or mixed vendor distributions with equal weight.
- If a majority feels that using single extreme vendor distributions is most appropriate for most networks then the proposal for -24.6 to +2.8 ps/nm in [rodes_3dj_01a_2407](#), consistent with 99.9% conf level & M=4 in Recommendation ITU-T G.652, may be agreeable to the dj TF.

800GBASE-FR4 proposal/options

Assumptions:

- Distance 2 km over G.652/657 fiber, 4 lambda's on CWDM grid (1264.5 - 1337.5 nm), 1 section of 2 km (M=1).
- Only options mostly referred to are shown.

Option	potential range [ps/nm]	Source	Remarks
Previously used worst case	-11.75 to +6.62	ITU-T G.652	
ITU-T LS Nov '23	-11.45 to +6.37 ±0.4	ITU-T LS	99.99% confidence level
ITU-T LS Jul '24	-11.74 to +6.48	ITU-T LS	99.99% confidence level
	-11.6 to +6.02		99.9% confidence level
Johnson, et al	-11.32 to +5.86	johnson_3dj_01a_2407	Based upon 99.99% data in Earl Parson's analysis for single extreme vendor distributions.

Observations/comments on 800GBASE-FR4 proposal/options

- Reductions from worst case for CDWM are pretty limited (compared to LR4) :
 - Negative dispersion: 1.3% for ITU-T 99.9% versus 3.7% for Johnson et al.
 - Positive dispersion: 9% for ITU-T 99.9% versus 11% for Johnson et al.
- Assuming the same level of support for 99.9% confidence level in G.652 versus 99.99% in [parsons 3dj 01 2407](#), there is still a small gap between the cd ranges potentially suitable for FR4. The biggest discrepancy is for negative dispersion. -11.32 to +5.86 ps/nm over 2000 m in [johnson 3dj 01a 2407](#) translates into 1951 m for -11.6 to +6.02 ps/nm in G.652.
- The proposal in [johnson 3dj 01a 2407](#) favors the most narrow range based upon [parsons 3dj 01 2407](#) but the actual benefit in optical performance may be relatively limited.
- It's up to the dj TF to choose between both ranges, picking the slightly more conservative range of -11.6 to +6.02 ps/nm in G.652 or the slightly more optimistic range of -11.32 to +5.86 ps/nm in [johnson 3dj 01a 2407](#)
- From an external reference point of view it would be so much more transparent to use G.652.

Thanks!