Clarification of dispersion requirements for PAM-N 400Gb/s Ethernet SMF PMDs

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Introduction

- During the BS meeting in Atlanta, January 2015, confirmation by testing of the worst case chromatic dispersion penalty was identified as a big ticket item for all SMF PMDs.

- In this presentation the worst case dispersion requirements are clarified for each PAM-N PMD proposal

- Furthermore a justification is provided why this analysis is critical

- Q&A

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Wavelength dependence of chromatic dispersion for SMF

Dispersion characteristics for G.652 single-mode fiber (ps/nm.km)
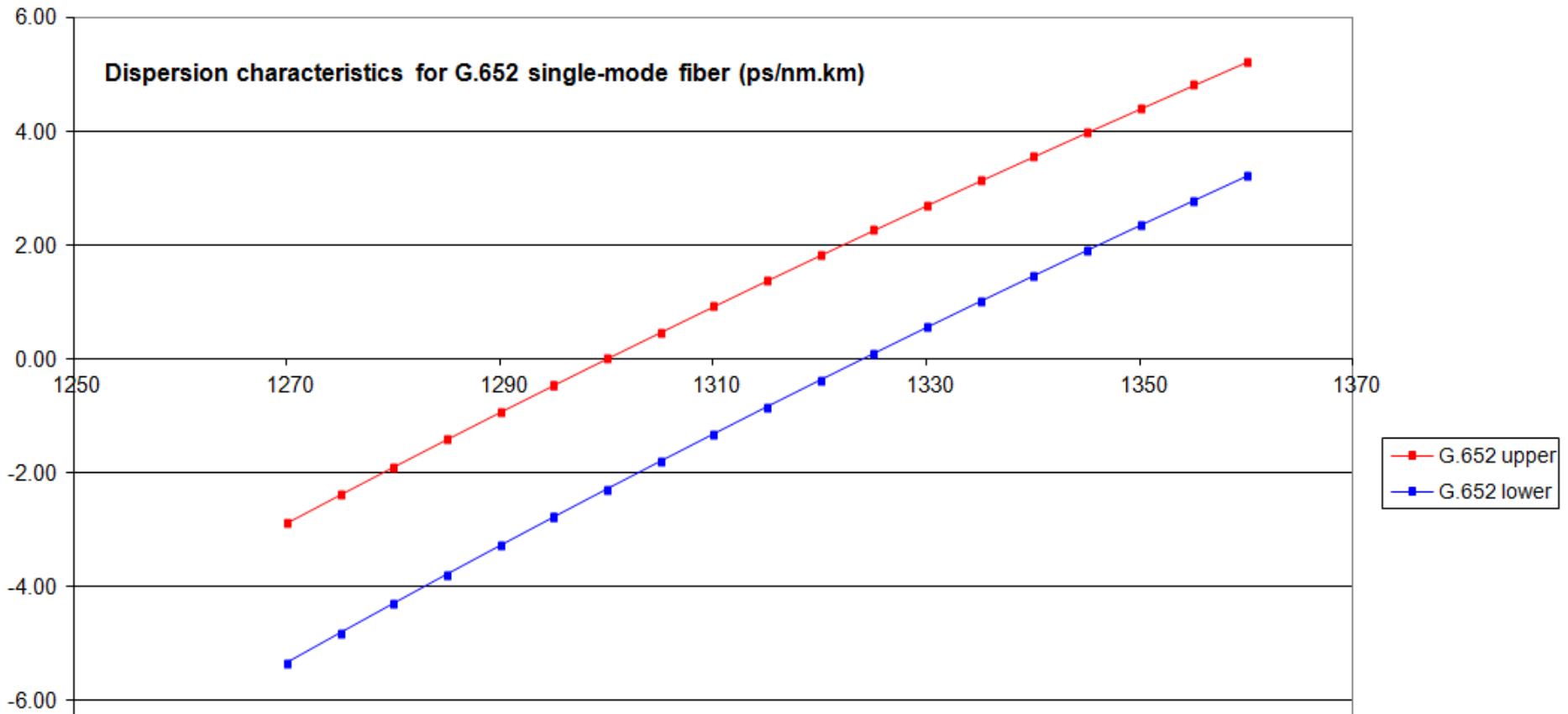
Courtesy Pete Anslow

Establishing chromatic dispersion requirements

Worst case chromatic dispersion requirements can be established for each SMF PMD proposal by taking the highest wavelength from the proposed wavelength range in combination with the red curve and the lowest wavelength in combination with the blue curve and multiply it by the maximum distance, either 500m, 2km or 10km.

Proposals for 8x50G PAM4&NRZ over 10km SMF

- Proposals:
    - Cole_3bs_01_0115 (NRZ) & Cole_3bs_02_0115 (PAM4)
    - Kojima_3bs_01a_0115
- Proposed range (DWDM): 1272.55 – 1310.19nm
- Worst case positive dispersion (1310.19nm): +0.94 ps/nm.km
    - **Worst case positive dispersion 10km (1310.19nm) nm: +9.4 ps/nm**
- Worst case negative dispersion (1272.55nm): -5.08 ps/nm.km
    - **Worst case negative dispersion 10km (1272.55nm): -50.8 ps/nm**
- These are significant dispersion levels
- Chromatic dispersion penalties for these 10km proposals need to be confirmed by testing with worst case dispersion

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Proposal for PSM4 100G PAM4 over 500m SMF

- Proposal: Welch_3bs_01a_0115

- Proposed wavelength range: 1297 – 1323 nm

- Worst case positive dispersion coefficient (1323nm): +2.08 ps/nm.km

  - **Worst case positive dispersion 500m (1323nm): +1.04 ps/nm**

- Worst case negative dispersion coefficient (1297nm): -2.59 ps/nm.km

  - **Worst case negative dispersion 500m (1297nm): -1.30 ps/nm**

- The worst case dispersion values over 1297 – 1323 nm are quite modest.

- A low chromatic dispersion penalty for 4x100G PAM4 over 500m needs to be confirmed by testing with worst case dispersion

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Proposals for PSM4 2x50G PAM4&NRZ over 500m SMF

- Proposals: Cole_3bs_03a_1114 (NRZ) & Cole_3bs_04a_1114 (PAM4)

- Proposed range: 1277.89 – 1286.66 nm and 1300.05 – 1309.14 nm

- Worst case positive dispersion (1309.14nm): +0.84 ps/nm.km

  - **Worst case positive dispersion 500m (1309.14nm): +0.42 ps/nm**

    - This is a quite modest dispersion level

- Worst case negative dispersion (1277.89nm): -4.53 ps/nm.km

  - **Worst case negative dispersion 500m (1277.89nm): -2.27 ps/nm**

    - This is a non-negligible dispersion level

- Chromatic dispersion penalties for these 500m proposals need to be confirmed by testing with worst case dispersion

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Proposals for 8x50G PAM4&NRZ over 2km SMF

- Proposals:
  - Cole_3bs_01_0115 (NRZ) & Cole_3bs_02_0115 (PAM4)
  - Kojima_3bs_01a_0115
- Proposed range (DWDM): 1272.55 – 1310.19nm
- Worst case positive dispersion (1310.19nm): +0.94 ps/nm.km
  - **Worst case positive dispersion 2km (1310.19nm) nm: +1.88 ps/nm**
- Worst case negative dispersion (1272.55nm): -5.08 ps/nm.km
  - **Worst case negative dispersion 2km (1272.55nm): -10.16 ps/nm**
- These are non-negligible dispersion levels
- Chromatic dispersion penalties for these 2km proposals need to be confirmed by testing with worst case dispersion

Proposals for 4x100G PAM4 over 2km SMF

- Proposal: Lewis_3bs_01a_0115 (NRZ)

- Proposed range (CWDM): 1264.5 – 1337.5nm

- Worst case positive dispersion (1337.5nm): +3.34 ps/nm.km

  - **Worst case positive dispersion 2km (1337.5nm) nm: +6.68 ps/nm**

  - This is quite a significant amount of dispersion, relatively higher than 9.5ps/nm for 100GBASE-LR4

- Worst case negative dispersion (1264.5nm): -5.94 ps/nm.km

  - **Worst case negative dispersion 2km (1264.5nm): -11.88 ps/nm**

- These are non-negligible dispersion levels

- Chromatic dispersion penalties for these 2km proposals need to be confirmed by testing with worst case dispersion

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What do we need to avoid?

- We need to avoid a condition where small variations in the level of chromatic dispersion cause significant variations in the chromatic dispersion penalty.

- Such a condition would cause significant variations of the system's BER performance.
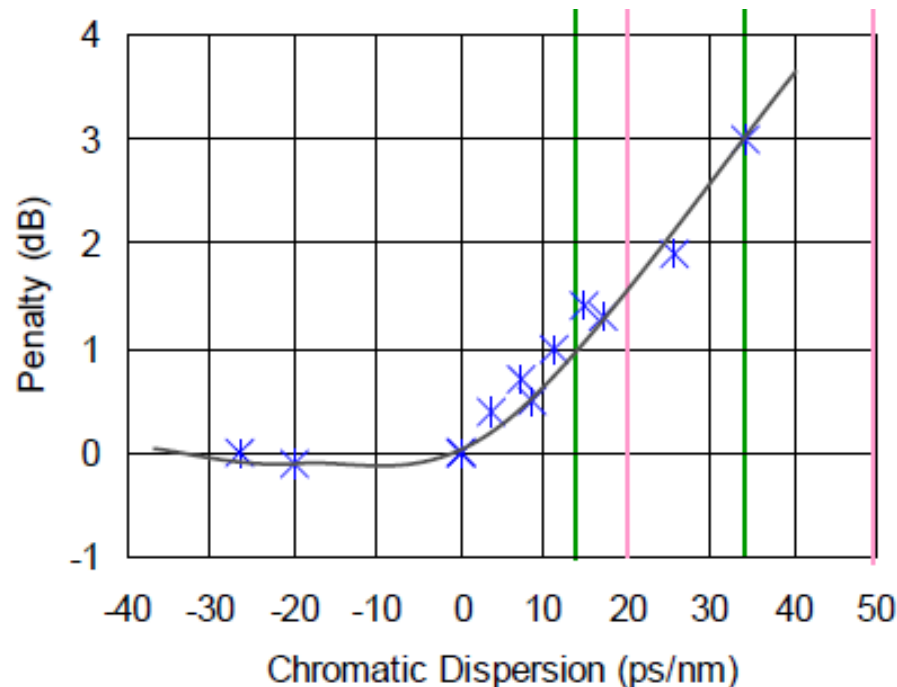
Example for 25G NRZ
isono_01_1107

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Q & A

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Thank you