

SMF PMD MPI Penalty Investigation

400 Gb/s Ethernet Task Force
SMF Ad Hoc Conference Call
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Contributors and Participants

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- Peter Stassar, Huawei
- Steven Swanson, Corning
- Alan Tipper, SemTech

Introduction

- MPI Penalty does not have consensus in 802.3bs
- An informal group (listed on page 2) has been working to reach consensus on an MPI Penalty
- Consensus has not been reached
- The objective of this presentation is to introduce the investigation to 802.3bs
- Material brought into the investigation by Paul Kolesar and Vipul Bhatt is included as examples

Select Points from Introductory Email

- MPI penalty depends on the modulation format and the assumed Return Loss (RL).
- MPI penalty continues to be an open item in .bs TF. Values from few tenths of a dB to 1dB have been proposed, with suggestions that even higher values may be appropriate.
- Since PAM-4 is in multiple SMF baselines (50G and 100G per λ) it is critical to reach agreement on a MPI penalty that meets Ethernet application model, for example 99% of links.
- First step is to get an agreed set of assumptions; most important connector RL and corner cases of connector topologies. Both 26dB and 35dB have been proposed.
- 26dB has been used because it's in many existing installations. However, just like when MMF transitioned from OM1/2 to OM3/4, new SMF plant with better performance may be considered for new data rates.

Select References

- http://www.ieee802.org/3/bm/public/smfadhoc/meetings/oct_30_12/anslow_02_1012_smf.pdf
- http://www.ieee802.org/3/bs/public/14_11/nicholl_3bs_01_114.pdf
- http://www.ieee802.org/3/400GSG/public/13_07/bhatt_400_01a_0713.pdf
- http://www.ieee802.org/3/minutes/jul13/outgoing/IEEE_802_d3_to_TIA_TR-42d11_0713.pdf

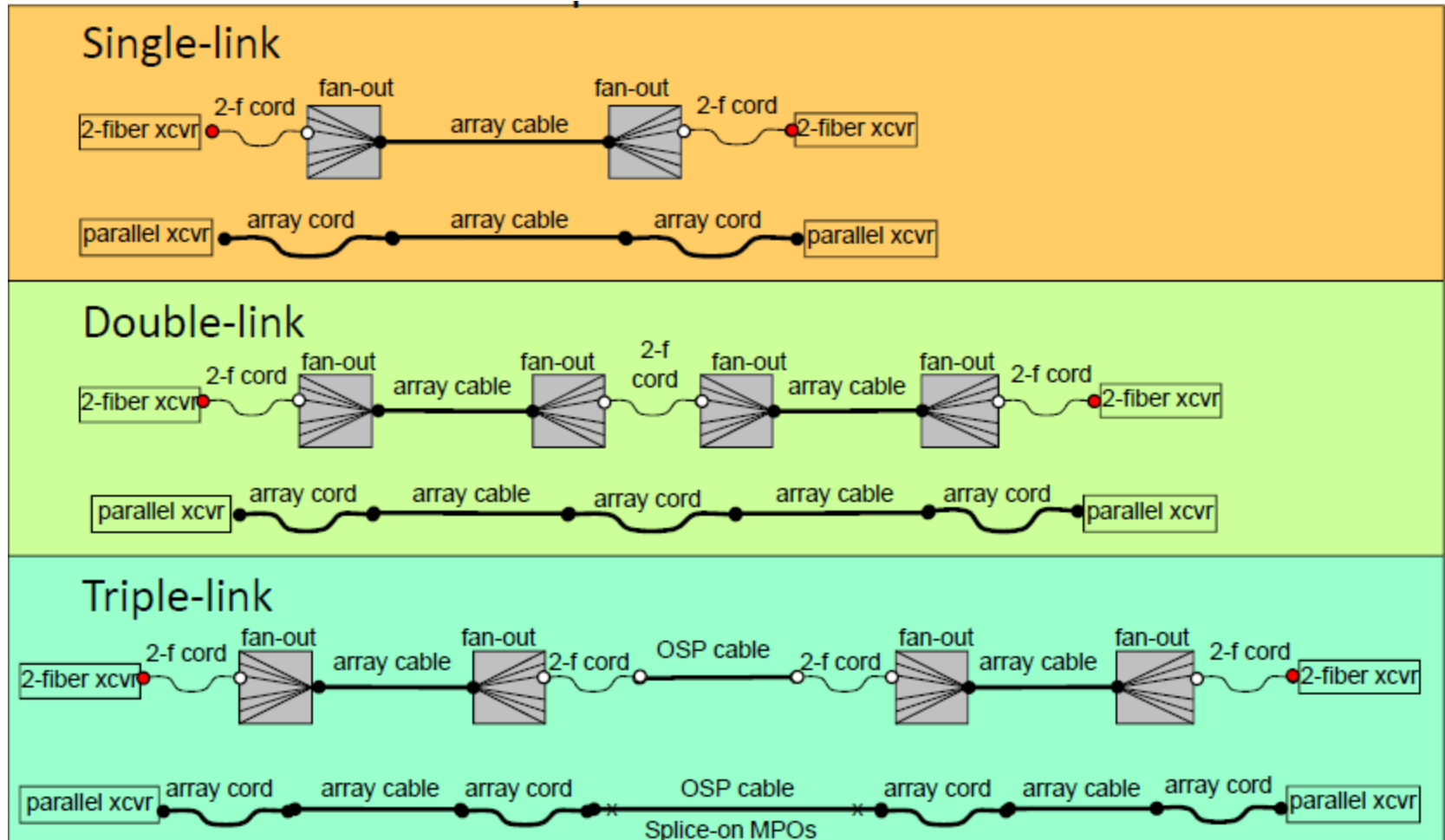
Select Investigation Questions

- What is a realistic worst case RL channel model?
- What is today's RL distribution in data centers?
- How does coherent addition of multiple reflections impact FEC frames?
- Which channel configuration is worse?
 - channel with few reflective events
 - channel with many reflective events

Example Material from Paul Kolesar

- Support of this material by Contributors and Participants is not implied.

Proposed MPI Channel Models



- Return Loss (RL) Legend (dB):
Red = 26, White = 26 → 35, Black = 55

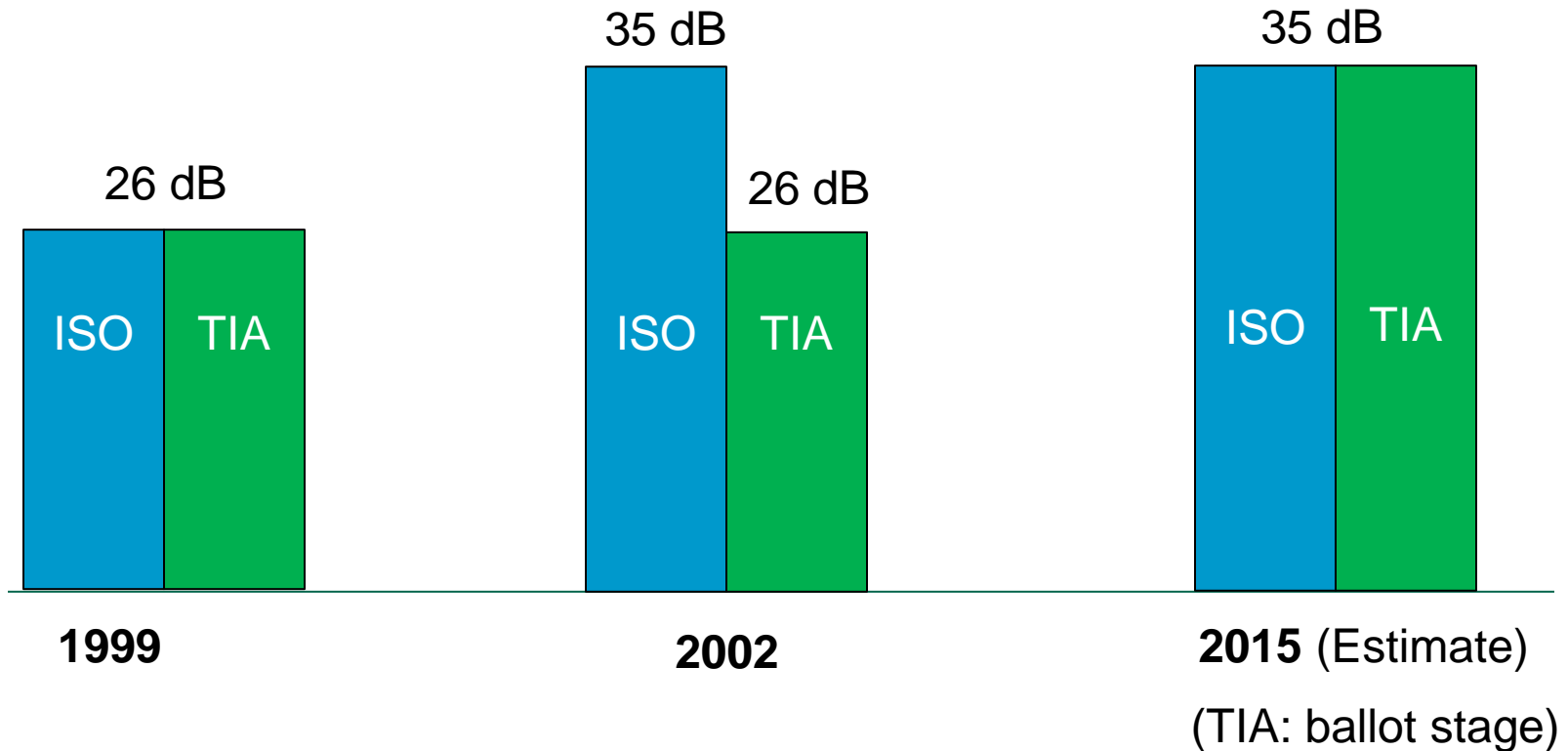
Discussion

- Coherent reflections can be both constructive and destructive. In addition, not only is there magnitude, there is duration. So while it is possible for a channel with a greater number of reflective events to produce a worse magnitude, it probably will be a less frequent event than the worst reflections within a channel with fewer reflective events.
- Present 99% criteria fails to address the duration aspect. MTTFPA is one way, which would also involve the effect of FEC. If it's more constraining than MTTFPA, such as assuring the channel actually passes correct data some high percentage of the time (rather than just knowing to throw away uncorrectable data, i.e. the MTTFPA criteria), then channel "reliability" limit is required, such as 99.99999% of the time.

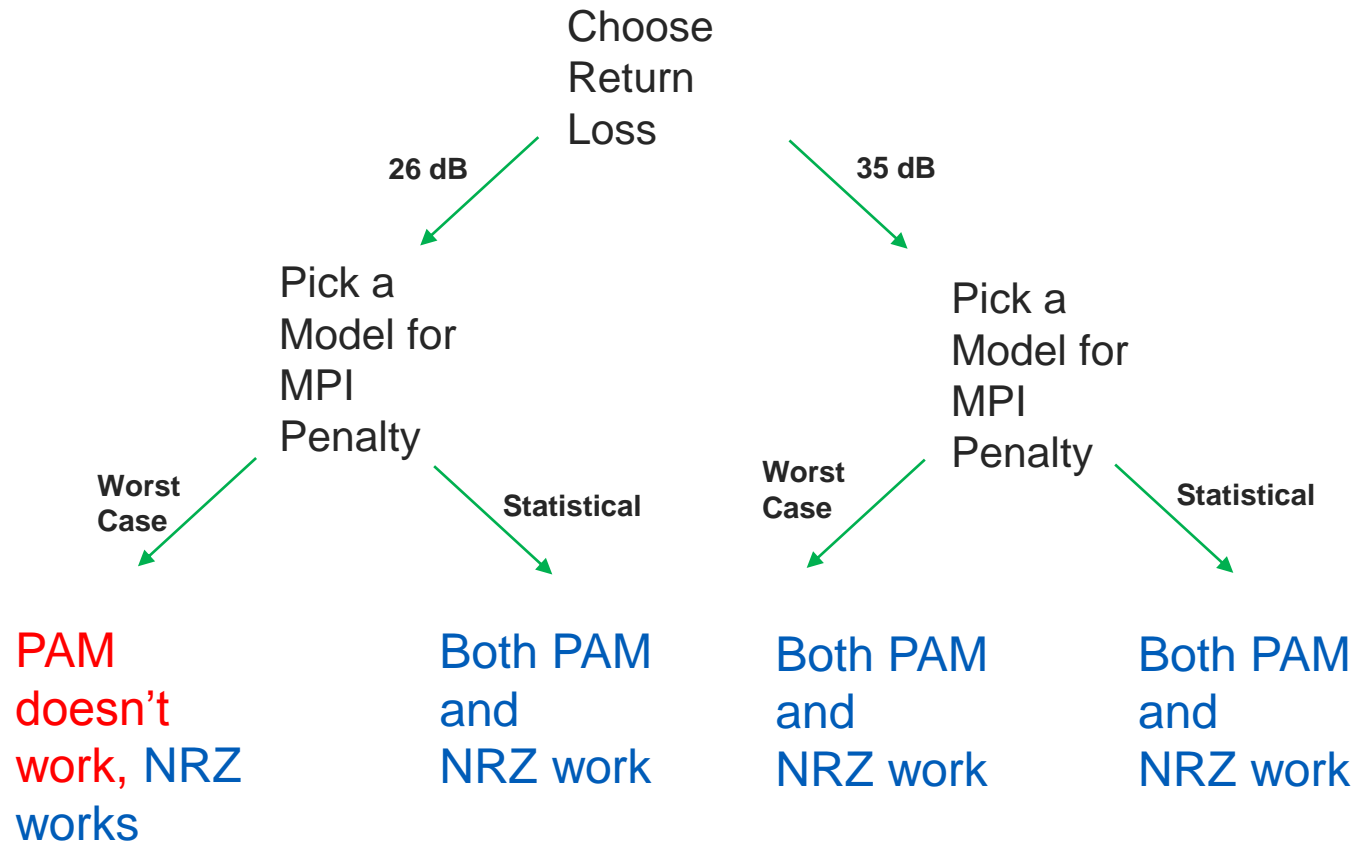
Example Material from Vipul Bhatt

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Status in ISO/IEC 11801 and TIA-568



MPI Decision Affects Choice of Modulation Scheme



Arguments for 26 dB vs. 35 dB

- Why 26 dB?
- Because it's the conservative and prudent approach.
- Why 35 dB?
- Because “day one” connector return loss has been steadily improving, providing greater margin for field degradation.

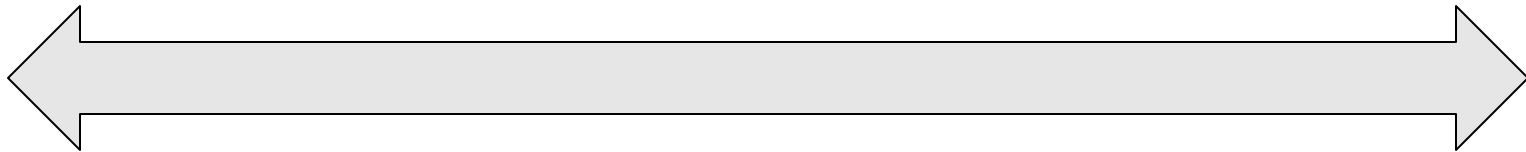
Question for 802.3bs participants: Is it acceptable to consider a compromise where channel characteristics are specified as follows?

- 35 dB for 2 km objective (data center oriented, more new fiber & connectors)
- 26 dB for 10 km objective (service provider oriented, high-longevity fiber & connectors)

MPI Penalty Estimate: A Continuum of Options

Worst Case

Best Case



- All variables are constant, worst case (amplitude, phase, polarization)

- Amplitude varies randomly per data pattern
- Polarization drifts quickly enough
- Phases: effective path lengths change quickly
- Laser output coherence is low

Discussion: The optimum answer is somewhere in between ... Can we reach early agreement on amplitude and polarization, and then focus on phase and duration statistics?

Thank you

