Interferometric Noise and Solution Paths for IEEE 802.3ae 10 Gb Links

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Outline

- What is interferometric noise
- Modeling interferometric noise
- Calculations
- Interferometric noise contributors
- Alternatives
- Conclusions

Interferometric noise

- optical interference of the desired signal and parasitic doubly reflected signal at the detector
  - ►need at least two reflection points
- present in practically all single mode optical communication links
- may cause BER floor if not controlled
- present in SMF systems with DFB lasers due to laser coherence
  - ►but strict coherence not required

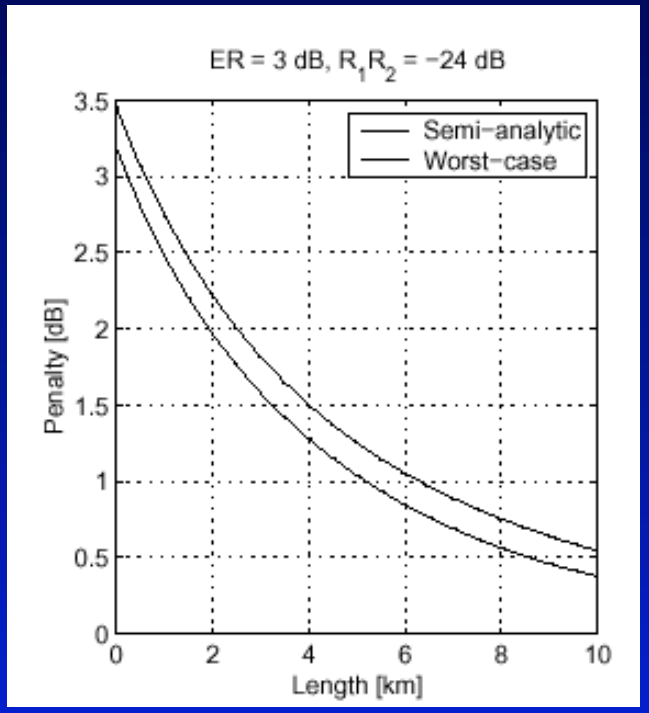
Interferometric noise: semi-analytical model

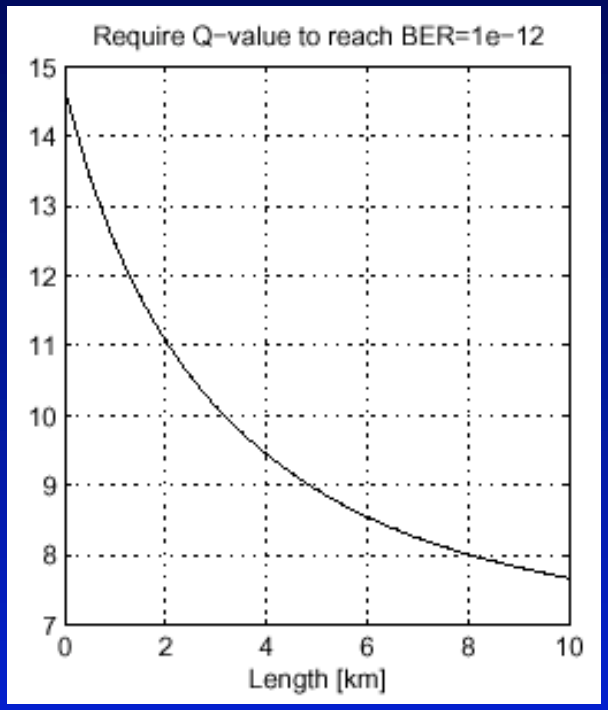
- Quasi-static conditions
  - signal levels given by the link model
  - laser phase noise assumed uniformly distributed
  - BER calculated by averaging over all phases
  - penalty calculated in the presence of ISI and thermal noise
  - possible to include signal dependent noise sources (RIN, baseline wander)

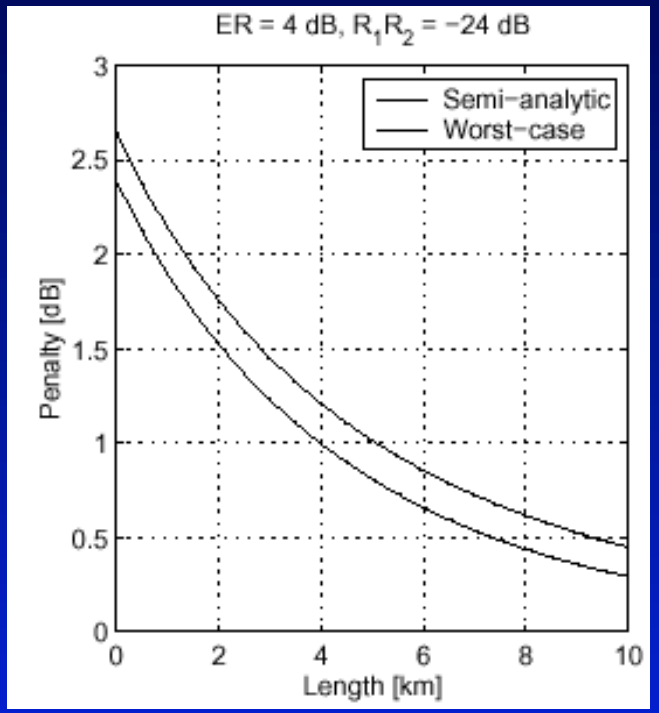
Calculation of Interferometric Noise Penalty

- -12 dB reflection at both the transmitter and the receiver
- Link (length dependent) parameters used in the calculation
  - ISI varied from 0.56 to 1.06 dB
  - loss between reflection points length dependent (0 - 7 dB)
- signal dependent noise sources neglected, but simple to include
  - RIN and baseline wander

1300 nm results, R_1R_2 = -24 dB





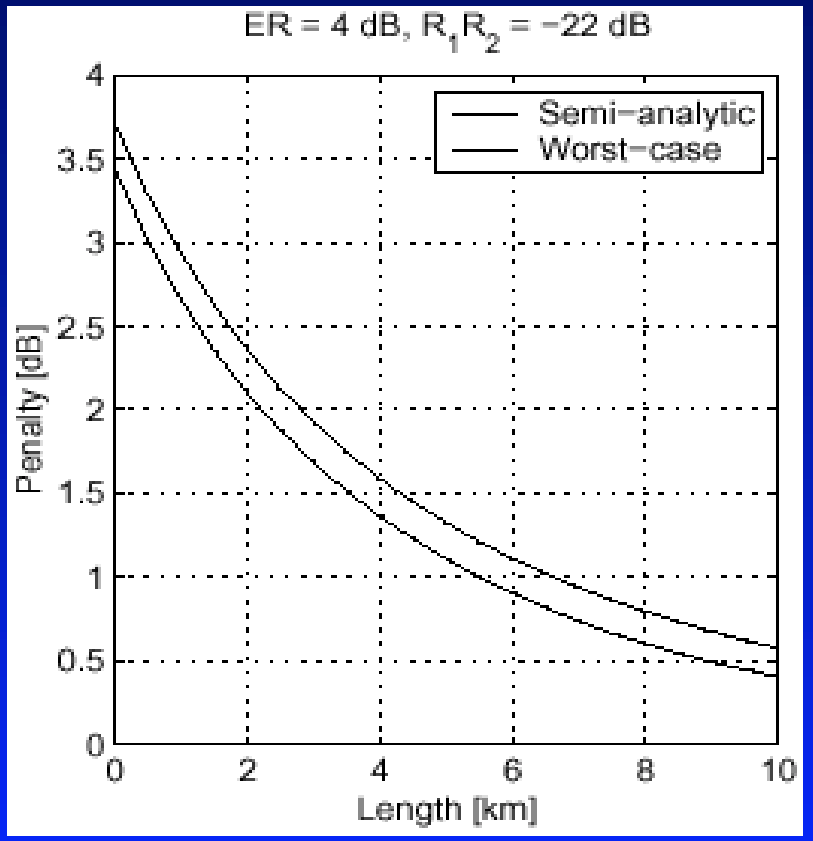


ER=3 dB

ER=4 dB

1300 nm results (2)

- results for extra connector



To find really worst case

- Return loss of transmitter allowed to be worse than 12 dB
- Include connector reflections
  - 12 dB and 26 dB together can decrease return loss to 10.4 dB due to interference
- Overshoot in signal possible

Air gaps in connectors

- Connectors are standardized for physical contact
- Inspite of this, people have expressed desire to be able to handle "accidental" air gaps that may happen in practice
- We need to make up our mind whether we will allow them or not
- Need clear statement because it affects the entire link budget and component specs

Areas of Agreement

- interferometric noise analytical model
  - ►agree in all areas
- interferometric noise magnitude
  - ►agree on the magnitude of the noise
- accidental air gaps
  - ►should not be considered (or allowed) in the link
    - –link will be out of spec anyway

Proposed solution - areas of agreement

- Connectors should not be allowed or considered to have "accidental" air gaps
- include interferometric noise penalty in the power budget

Areas of disagreement

- disagree on results interpretation and solution to the interferometric noise penalty

Proposed Solution by P. Ohlen

- Change the return loss at the receiver to 20 dB
- set minimum extinction ratio to 3 dB (already adopted) or alternatively to 4 dB for more robust link

Proposed solution by P. Pepeljugoski

- set minimum extinction ratio to 3 dB (already adopted) or alternatively to 4 dB for more robust link
- this proposal does NOT require redesign of any component in the link