1550 nm serial Back Reflection

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1550 nm serial Back Reflection Objective

- Objectives:
  - Create low cost 1550 nm Serial links
  - Create specifications which interoperate between vendors
  - Specifications which allow multiple technologies
  - Design a robust PMD link with low RIN and low jitter
- The history of the existing 12 dB spec stems from 1G links on 850nm MMF with simple FC connectors. These were immune to reflections and were designed without pigtail fibers for the connectors.
  - Pigtails with mating connectors are a requirement with SMF due to alignment tolerance of fiber
  - Mated connectors (SC or FC/PC) required at 10G rates; an air gap connector is unacceptable

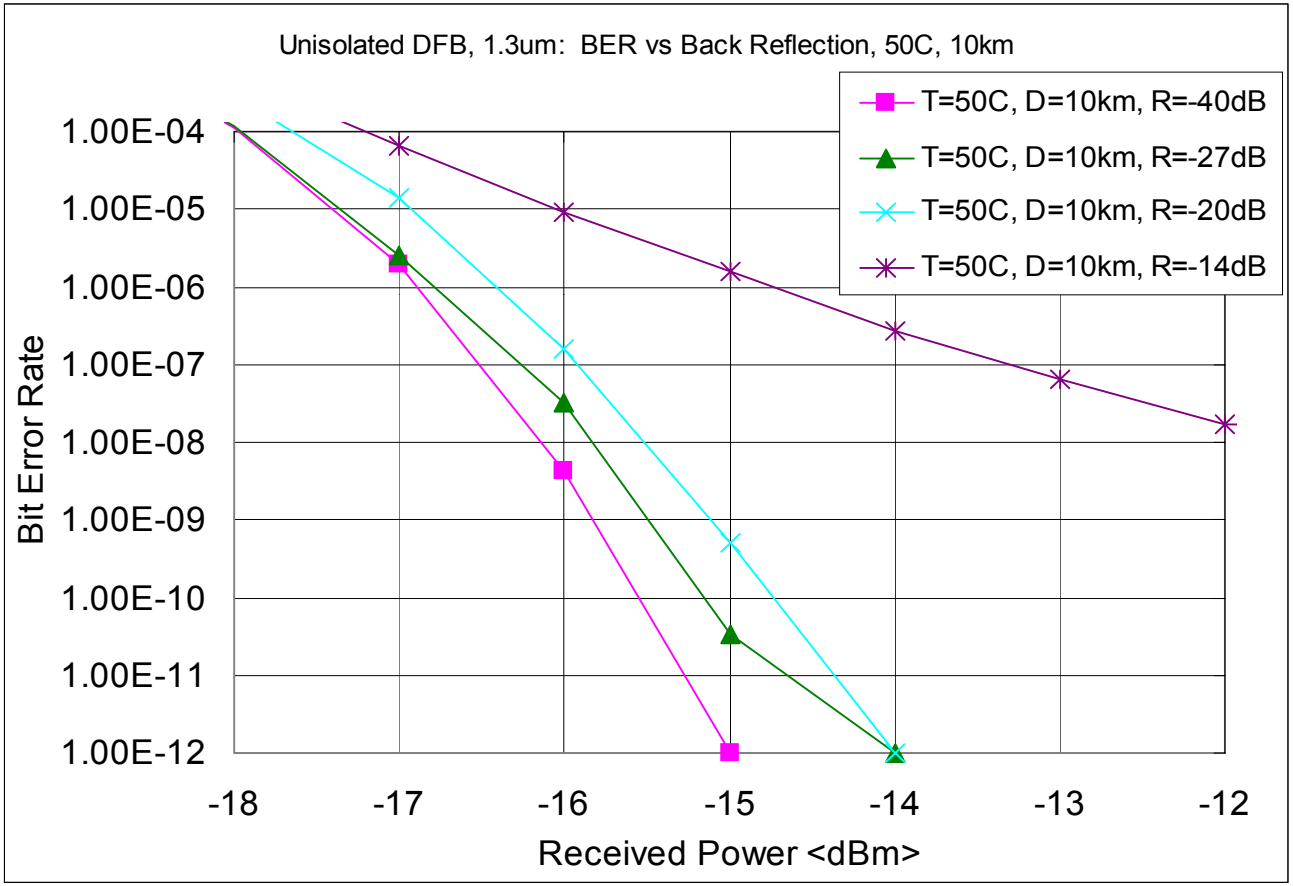
1550 nm serial Back Reflection Problem

- Reverse back reflection at the receiver
  - Measures the optical power reflected back from the input of a receiver
- Two types of noise are created by optical back reflections
  - Optical feedback into the laser results in increased Jitter and RIN

    (1G designs required an RIN –120 dB 10G require –140 dB)
  - Interferometric noise is caused by the conversion of laser phase noise into intensity noise by multiple reflections in the optical path
    - See “Effects of Phase-to-Intensity Noise Conversion by Multiple Reflections on Gigabit-per-Second DFB Laser Transmission Systems” by James Gimlett and Nim Cheung in Journal of Lightwave Technology Vol. 7 No. 6 June 1989
- Both types of noise can create BER penalties and BER floors
  - Addressed in “**Comments of serial PMD optical spec’s**”

    Mark Verdiell 9/00

1550 nm serial Back Reflection Objective



- Uncooled Unisolated DFB showing the effects of both types of reflective noise
- Graph from LightLogic 9/00

1550 nm serial Back Reflection Solutions for optical feedback noise

- Manufactures of transponders terminate receiver fiber to minimize reflected power
  - Very cost effective to produce (< 1% of total transponder costs)
  - Users will use standard fiber to connect to transponder. No special considerations required!
- Transmit optical isolator is typically required on 1550nm designs but will fix optical feedback into the laser only
- RIN may be compromised if isolator is not of high quality. This means $$ for the isolator
- Connector reflected power will cause additional noise. Isolator will help the laser, but noise is still present on the link

1550 nm serial Back Reflection Solutions for Interferometric noise

- Interferometric noise can not be fixed with an isolator
  - This will reduce the BER sensitivity on all levels of signals
  - The only way to reduce Interferometric noise is to reduce all reflections
  - Maintain the 26 dB return loss of the entire link including all connectors, attenuators, or any other device in the optical link
  - This is less severe than SONET, but should maintain a robust link
  - GR 1377 requires 27 dB at the receiver
  - GR 1377 asks for 40 dB for link reflections from connectors

1550 nm serial Back Reflection Conclusion

- 10 Gigabit Serial links have tight design margins due to higher bandwidth receivers than lower speed links. The resulting noise will reduce the usable power budget, reduce the link length, and increase the BER.
- For 40 km links, the optical link budget is very small. Any reduction in noise will help with receiver sensitivity
- If noise can be designed out by low cost techniques, a more robust link will result
- Change clause 52 to reflect a 26 dB return loss out of the receiver for 1550 nm serial PMD
- Maintain the 26 dB return loss of the entire link including all connectors, attenuators, or any other device in the optical link
- In section 52.12.2.2 link return loss is specified at 26 dB per connector
- **Motion: Move to change clause 52, table 52-13 "Return Loss" specification to 26 dB (min)**
- **Motion: Add to clause 52, table 52-14 "Return Loss for any device in the optical link" to 26 dB (min)**