IEEE803.3aq 10GBase-LRM Overview

Goal

- Operate 10.3 Gbps Ethernet over FDDI grade Multimode Fiber (MMF)

- Fiber lengths up to 300 meters

- Support transition of core enterprise switching from 1GbE to 10GbE

- Note: 10GbE on 62.5um MMF without equalization the maximum operation length is 26 meters

  - 10G-Base –SR

Technical Challenge

- Modal Dispersion induced Inter-Symbol Interference (ISI) dominant issue

- Must operate on legacy fiber (~68% installed fiber base is MMF)

  - Fiber from early years of production

  - Fiber defects cause modal dispersion

  - Fiber variations from lot-to-lot and manufacture-to-manufacture

- Fiber must be modeled with statistics of defects
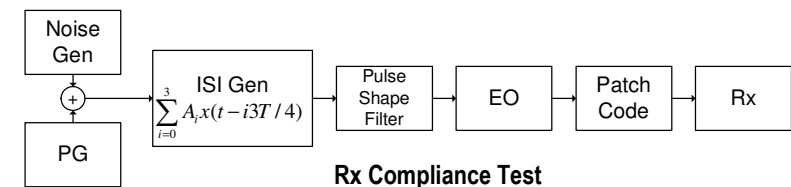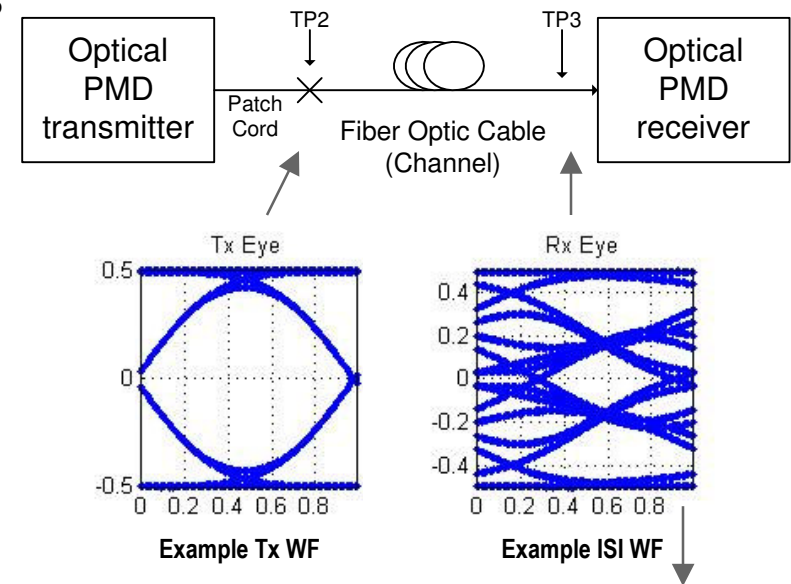
Techniques Considered

- Optical Mode Filtering
  - Excite a reduced number of optical modes, limit spread of modal dispersion
  - Rejected because mode coupling in optical connectors reduced effectiveness
- Pulse Amplitude Modulation (PAM-4)
  - Rejected because it lacked industrial support and noise levels differences at each modulation level reduces benefit.
- NRZ w/ Linear Equalizers Feed Forward Equalizers / Decision Feedback Equalizers (FFE/DFE)

Technique Chosen

- NRZ w/ Center and Offset launch
- No Training sequences (blind equalization)
- Equalizer implementation is vendor specific

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📚 Salient Specification Features

- Channels supported
  - Fiber Diameter/ Length/ Modal Bandwidth/ Insertion loss
- Transmit Specification & Compliance Test
  - Launch power, RIN, Eye Mask, TWDP,…
  - Transmit Waveform Dispersion Penalty test (TP2)
- Receiver Characteristics & Compliance Test
  - Bandwidth, Stressed receiver sensitivity,…
  - Rx Compliance test (TP3)
    - ISI Generator Architecture
    - Parameters of ISI generator chosen to represent channel model
      - Pre-curser, split and post cursor channel response
      - Additive noise
    - Note: Eye is closed in RX Stress test at Rx
    - Test is to run with BER < 1e-12 at specified SNR with ISI

Example Tx WF   **Example ISI WF**

$$\sum_{i=0}^{3} A_i x(t - i3T/4)$$

Rx Compliance Test

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VITESSE

- What Could Apply to SAS-2
  - Tx/Rx Compliance testing?

- Status
  - In Draft circulation and comment cycle

- See Web Page for more information
  - http://www.ieee802.org/3/aq/index.html