

Optical Link over GI POF

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Multi-Gigabit Automotive Ethernet over Plastic Optical Fiber

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25G Link Objective

25G Link Objective in 802.3dh

12. Define the performance characteristics of an automotive link segment and an optical PHY to support 25 Gb/s point-to-point operation over this link segment supporting up to 2 inline connectors for at least 15 m using graded-index plastic optical fiber

Objectives for slower data rates are along similar lines.

802.3 Five criteria

One unique solution per problem – Don't reinvent the wheel

⇒ 25GBASE-SR (802.3bm-2015) defined how to make a 25G optical link over multimode fiber [Clause 95 and 112]

⇒ Don't change how millions of 25G optical links are made every year in a substantial way.

- 25GBASE-SR (and 100GBASE-SR4) uses a thoroughly debugged PCS/FEC/PMA
- Robust links: Specifications in Clause 112 (and 95) have stood the test of time with over 100 M installations and millions more added every year
- Established link test procedure – mask test, TDEC (link penalty)
 - Transceiver manufacturers are familiar
 - No new development for test equipment manufacturers
- 802.3cz has developed EEE and OAM that can be incorporated into .3dh PCS/PMA

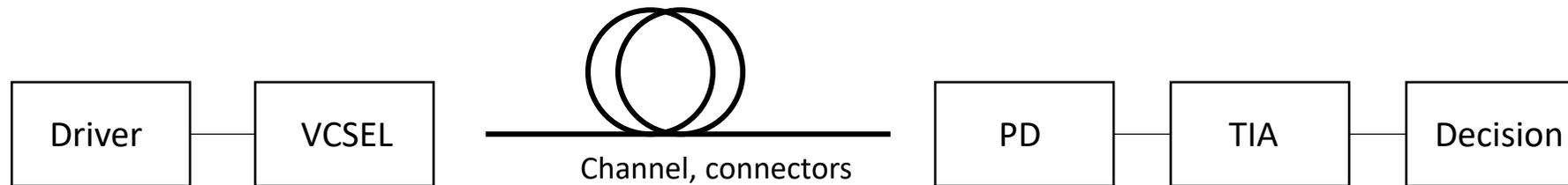
Link

Two 802.3 clauses define 25G multimode link

- 25GBASE-SR
 - Fewer elements than .3cz.
 - No equalization: VCSEL is not slow and channel BW is not low
 - includes RS (528, 512) FEC (max BER of 5E-5)
- Link defined in 802.3cz is heavy on signal processing

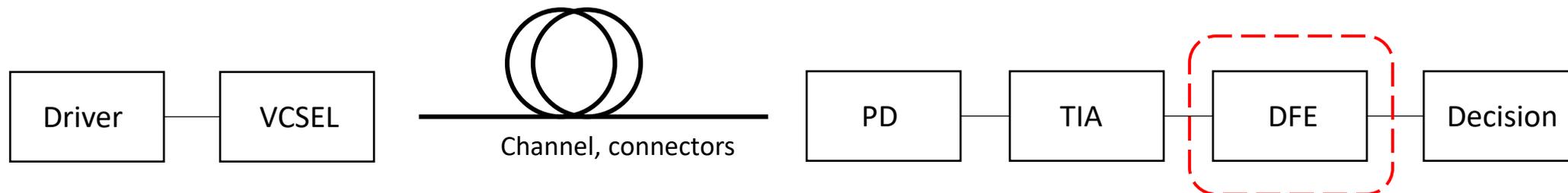
25GBASE-SR

Clause 112 (and 95)



802.3cz

Clause 166



25GBASE-SR Link Budget

Clause 112: 25GBASE-SR
Glass fiber

Launch OMA_{max} ————— +3 dBm

RS
SRS

Receiver sensitivity
Stressed receiver sensitivity

TDEC

Transmitter and dispersion eye closure penalty

Loss allocation

Includes fiber attenuation (0.4 dB), connector loss (1.5 dB), and power penalty (0.3 dB) for modal and mode partition noise

OMA* ———— -3 dBm

2.2 dB Loss allocation

SRS ————— -5.2 dBm

OMA*

Minimum launch OMA to avail of the full 4.3 dB TDEC penalty

Launch OMA_{min} ————— -6.4 dBm

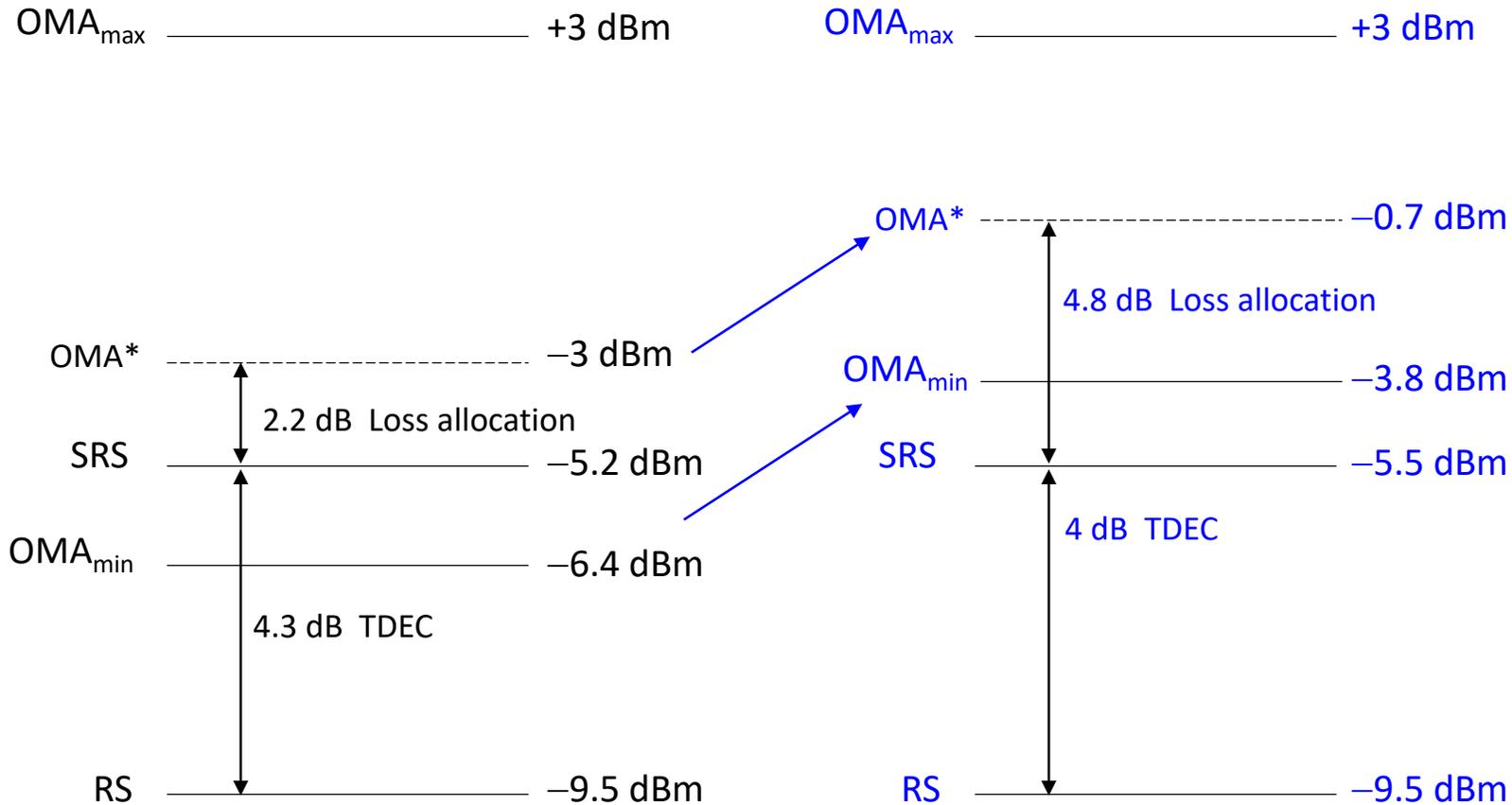
4.3 dB TDEC

RS ————— -9.5 dBm

802.3dh 25G Link

Clause 112: 25GBASE-SR

802.3dh Strawman



802.3dh Strawman

- Launch OMA from Tx raised to accommodate fiber attenuation and connector loss
- Worst case signal strength is similar to 25GBASE-SR
- No change to receiver sensitivity

25G

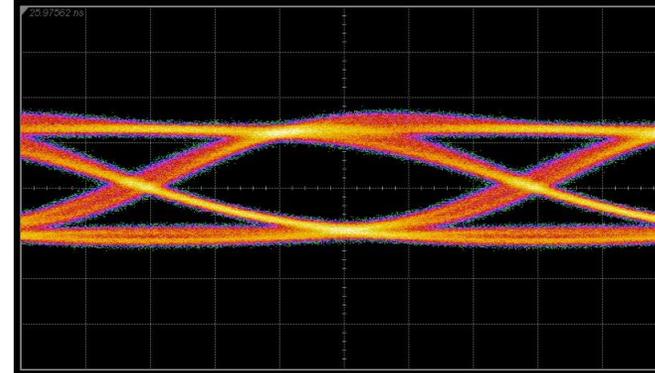
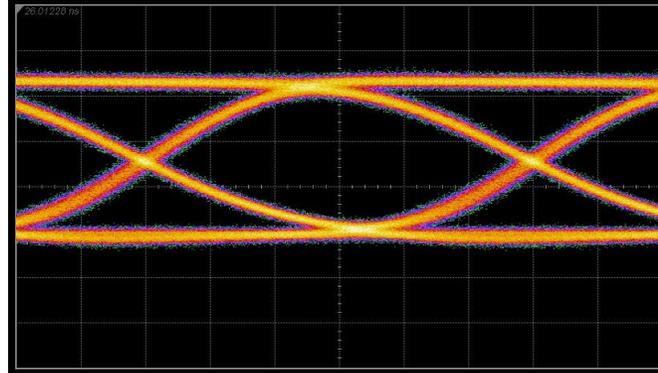
25G NRZ eyes: No Equalization

850 nm VCSEL

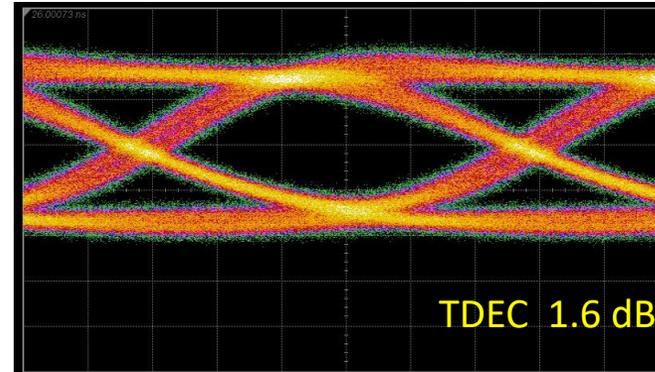
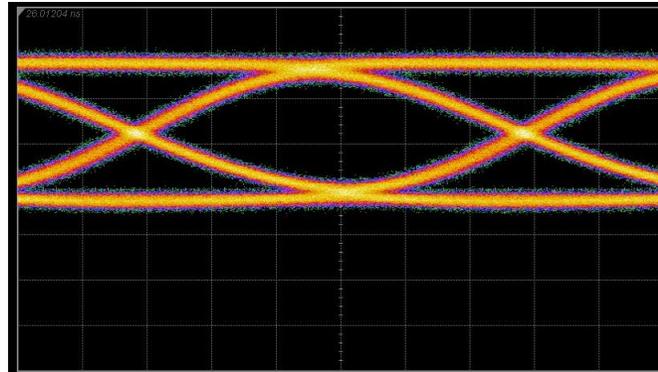
RT

125°C

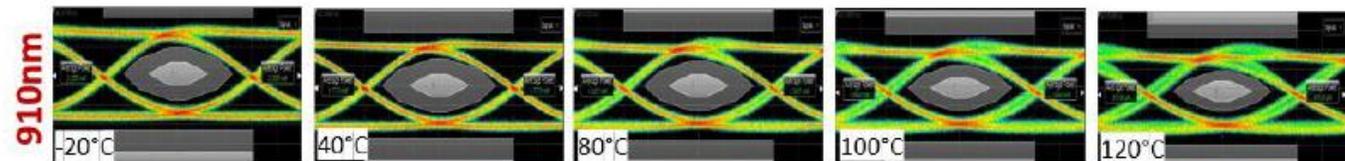
2 m glass fiber



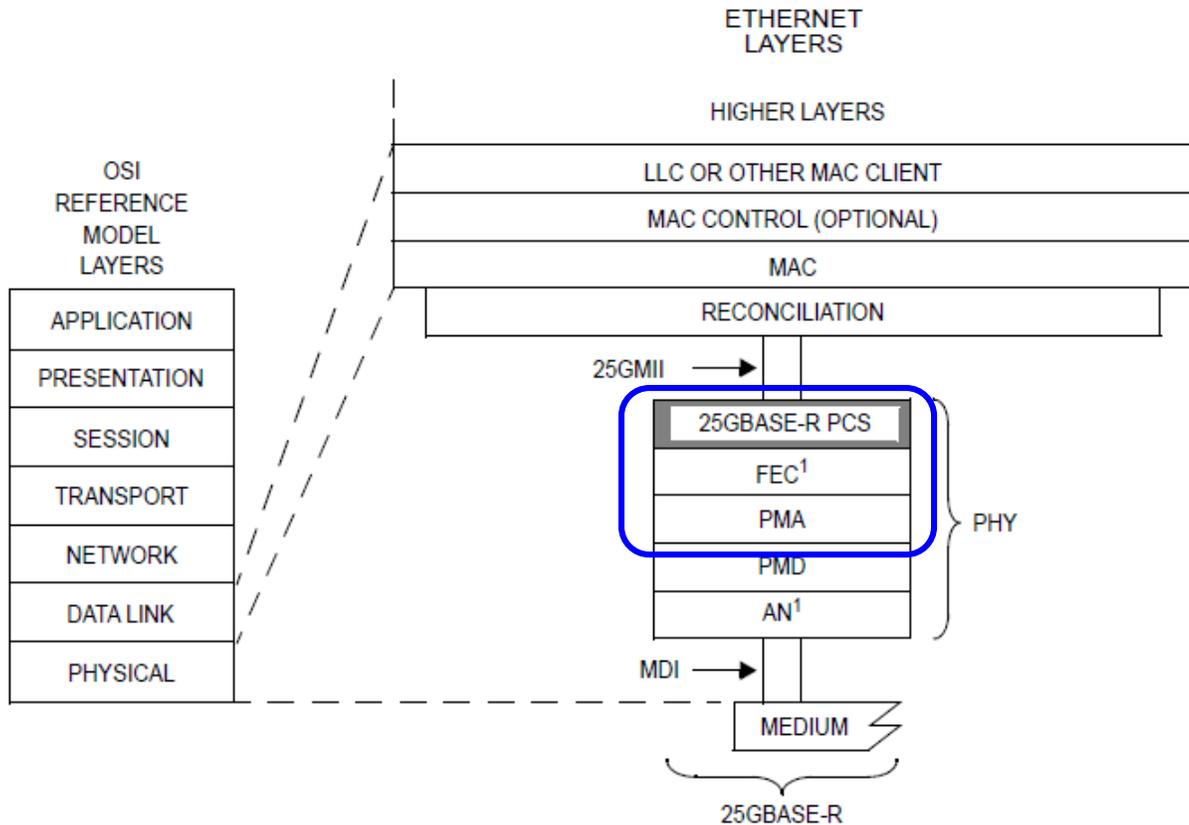
30 m GI POF (A4i)



* Mirko Hoser, [Hoser 3dh 220824.pdf](#).



PCS/FEC/PMA



25GMII = 25 GIGABIT MEDIA INDEPENDENT INTERFACE
 AN = AUTO-NEGOTIATION
 FEC = FORWARD ERROR CORRECTION
 LLC = LOGICAL LINK CONTROL
 MAC = MEDIA ACCESS CONTROL
 MDI = MEDIUM DEPENDENT INTERFACE
 PCS = PHYSICAL CODING SUBLAYER

PHY = PHYSICAL LAYER DEVICE
 PMA = PHYSICAL MEDIUM ATTACHMENT
 PMD = PHYSICAL MEDIUM DEPENDENT

NOTE 1—CONDITIONAL BASED ON PHY TYPE

25GBASE-SR uses RS (528, 512) FEC.

This FEC should work for 802.3dh too since the worst case signal strength can be made the same.

➤ 802.3cz has developed EEE and OAM that can be incorporated in this PCS/PMA.

OAM provides mechanisms for monitoring link operation such as remote fault indication and remote loopback control.

EEE The low power idle mode is enabled to save power during periods of low link utilization.

Figure 107-1—25GBASE-R PCS relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and IEEE 802.3 Ethernet model

25G Link Objective in 802.3dh

- 25GBASE-SR defined in Clause 112 (and 95) is a good starting point for 802.3dh
- Adopt developments in 802.3cz – EEE and OAM
- Accommodate the higher cable plant loss that includes fiber attenuation and connector loss, plus the modal noise penalty. The strawman link budget shows a way to accomplish this goal.
- Accommodate a wide range of source wavelengths (840 – 9xx nm) based on guidance on the fiber bandwidth.
- Use the same PCS and FEC as 25GBASE-SR because the worst case signal strength can be made the same in .3dh

Make the .3dh standard conservative and competitive. Past multimode standards from .3z (1G) to .3db (100G) have achieved this.