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25GbE SMF 40km Technical Feasibility Review And Approach To Specification

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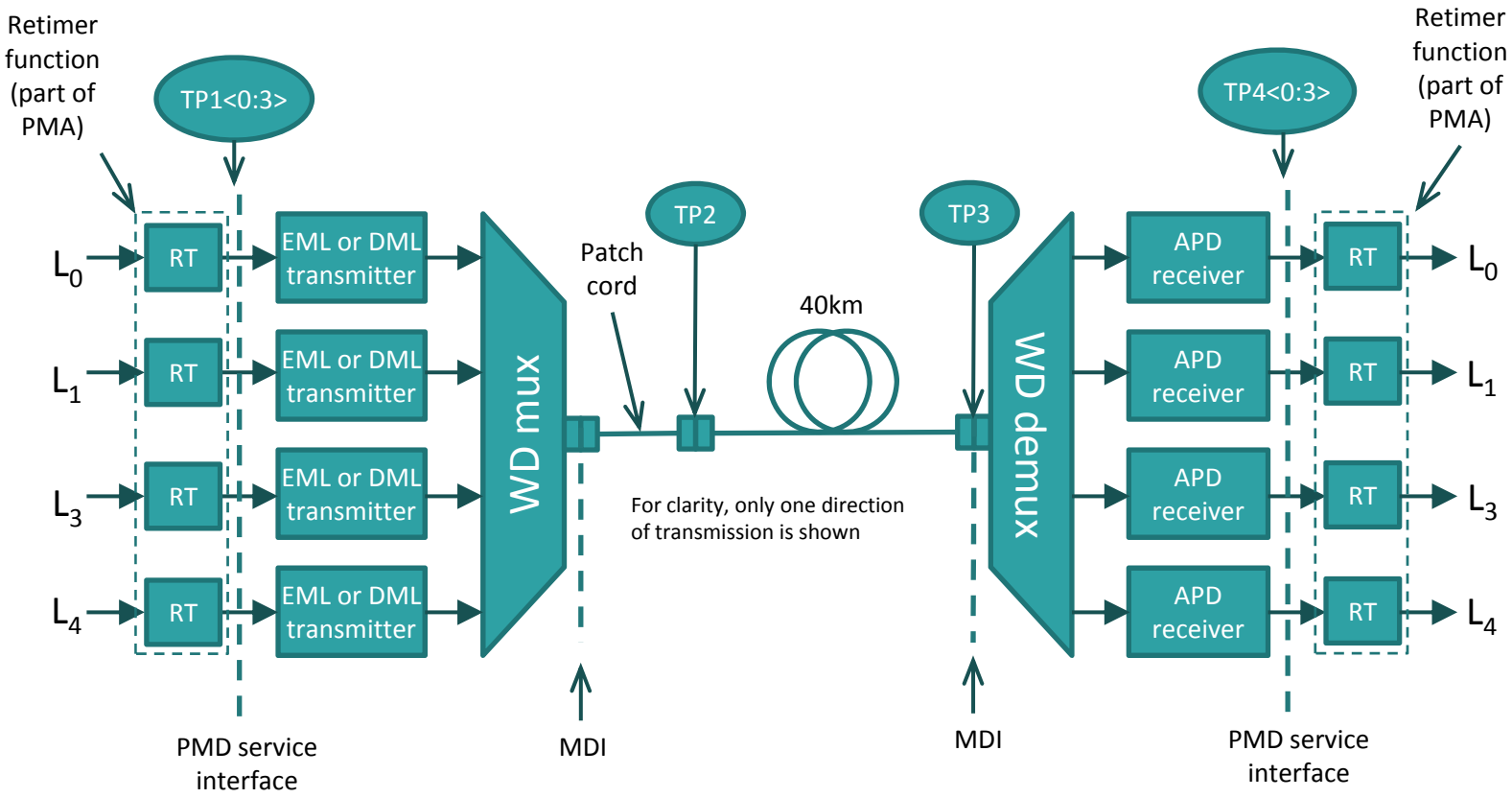
Outline

- Purpose:
  1. Review basics of 100G ER4-Lite (ER4f) and 100GBASE-ER4 optical specifications with goal to apply to 25GbE SMF 40km standard.
  2. Review technical feasibility data of 100G ER4-Lite, taken with EML transmitter and APD receiver.

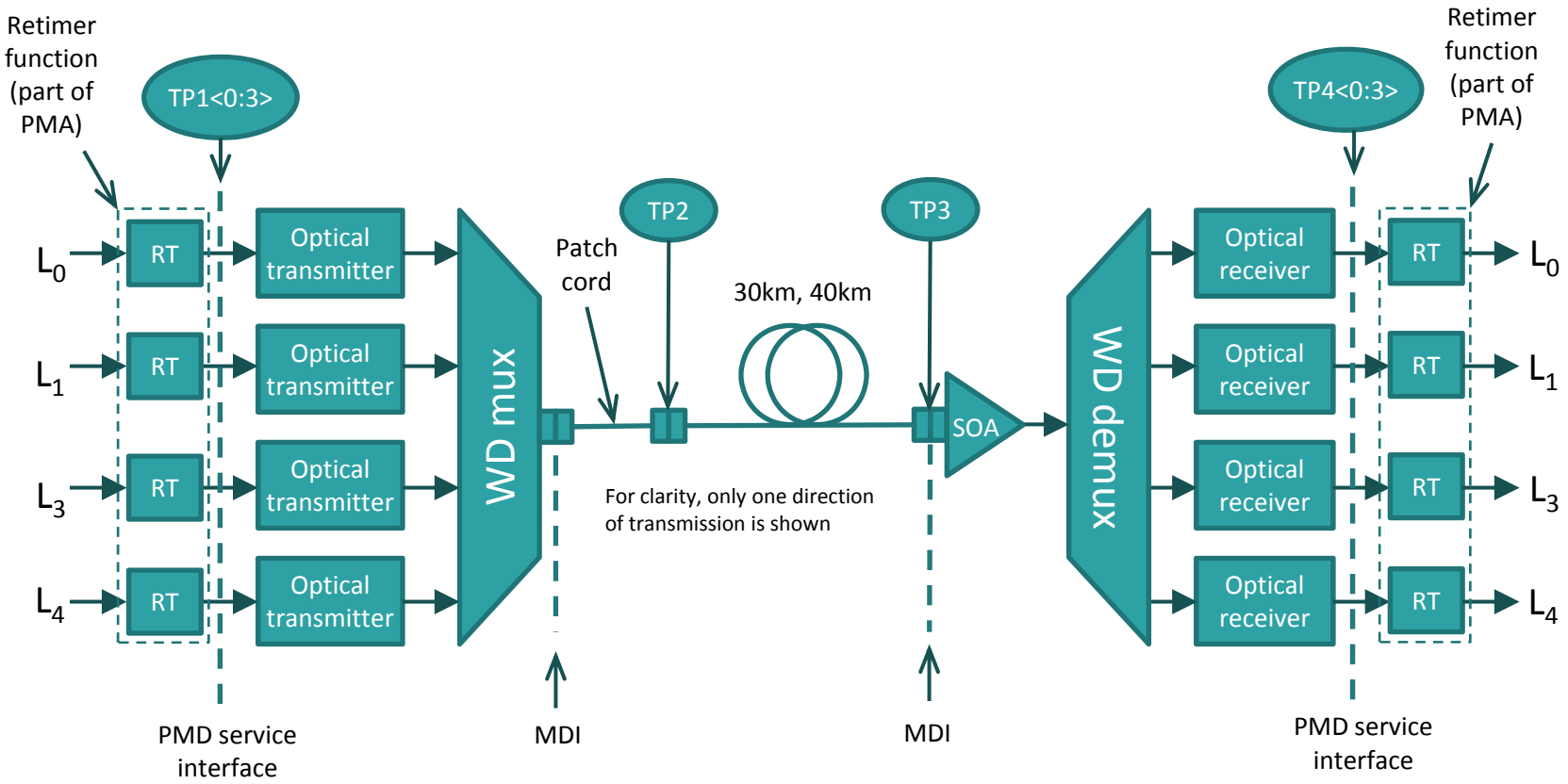
100G-ER4-Lite (ER4f) Block Diagram



Block diagram of transmit / receive paths assumed in specification

(modification of Figure 88-2 of IEEE Standard for Ethernet)

100GBASE-ER4 Block Diagram



Block diagram of transmit / receive paths assumed in specification

(modification of Figure 88-2 of IEEE Standard for Ethernet)

100G-ER4-Lite and -ER4 Basic Comparison

Parameters	Unit	ER4-Lite 4L1-9D1F 40km* (DML)	ER4-Lite 4L1-9D1F 40km* (EML)	100GBASE-ER4** (40km)
T_X OMA (min)	dBm	1.85	1.85	**0.1**
T_X P_{avg} (min)	dBm	**2.5**	**0.6**	**-2.9**
T_X ER (min)	dB	**4**	**7**	**8**
R_X P_{avg} (max)	dBm	**-3**	**-4.1**	**4.5**
R_X OMA (min)	dBm	-16.1	-16.1	-17.9
R_X P_{avg} (min)	dBm	**-15.5**	**-17.4**	**-20.9**
R_X Sens OMA (max)	dBm	-17.6	-17.6	**-21.4**
R_X Sens P_{avg} (max)	dBm	**-17.0**	**-18.9**	-
Penalties	dB	**1.5**	**1.5**	**3.5**
Loss Budget	dB	**18**	**18**	**18**

Use for 25GbE SMF 40km ?

* With G.709 FEC
** BER of 10^{-12}

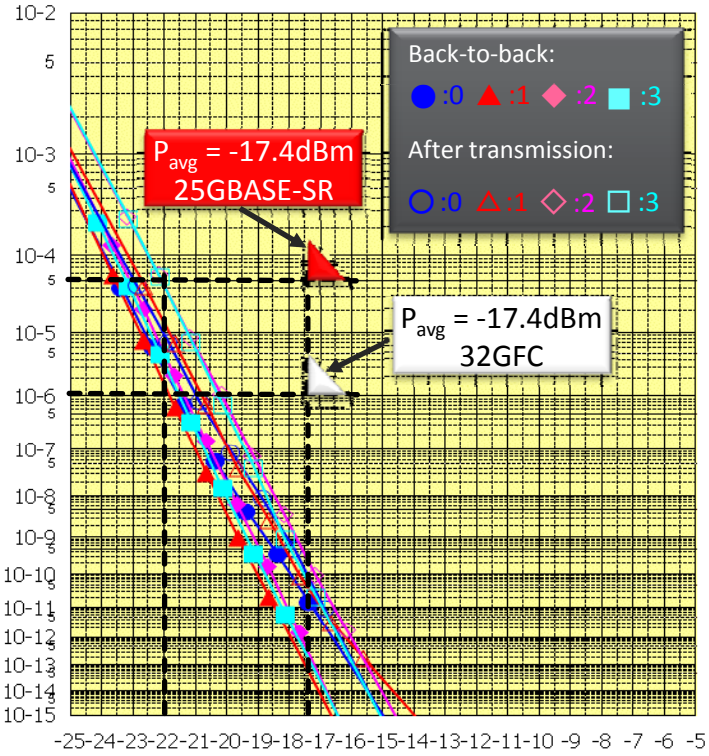
Red bold: Explicit spec.
Black: Inferred spec.
Note: ITU spec not finalized.

Specifications to allow both DML- and EML-based transmitters

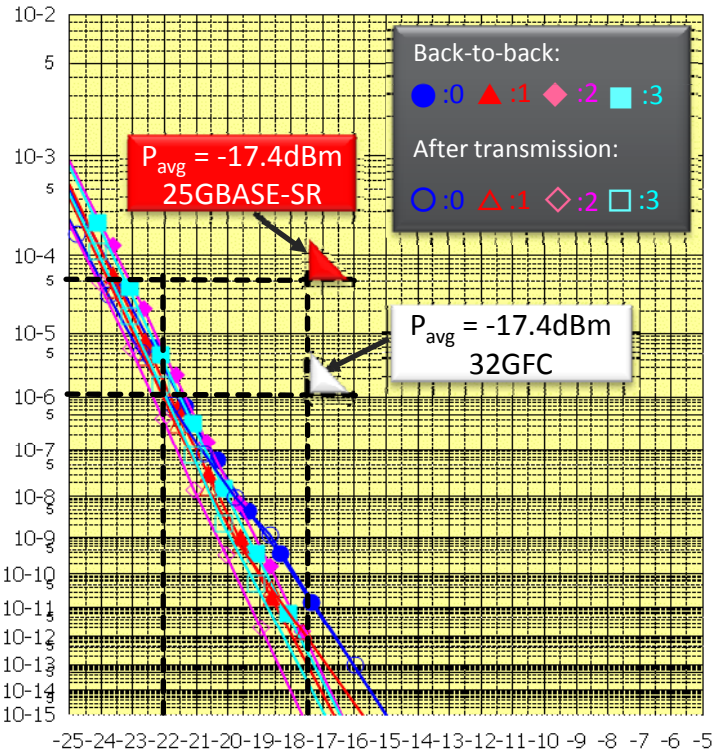
Technical Feasibility Of 40km With EML + APD (w/ FEC)

- Data under review in ITU-T SG15 for 4L1-9D1F in G.959.1
- Ratification schedule - February 2016 (target)

Positive Dispersion Limit



Negative Dispersion Limit



25GBASE-SR BER: 5×10^{-5}

32GFC BER: 1×10^{-6}

100GBASE-ER4 Channel Characteristics

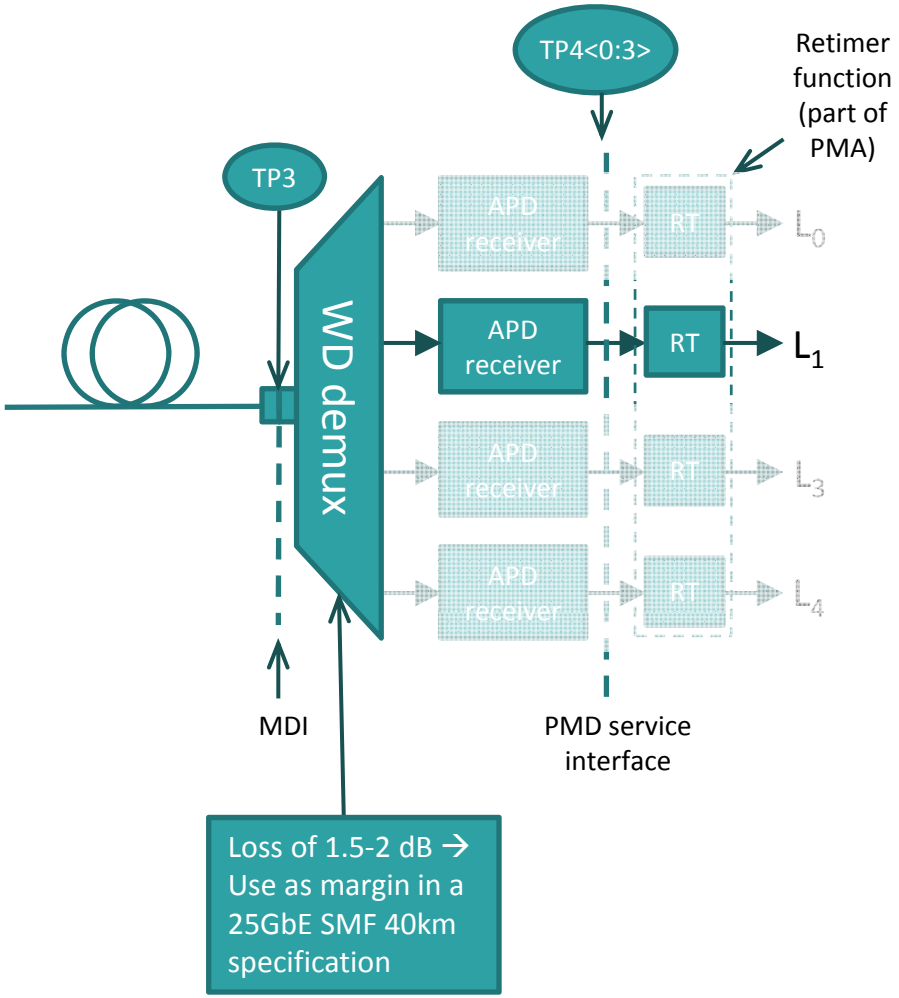
Description	100GBASE-ER4		Unit
Operating distance (max)	30	40	km
Channel insertion loss[a,b] (max)	18	18	dB
Channel insertion loss (min)	0		dB
Positive dispersion[b] (max)	28	36	ps/nm
Negative dispersion[b] (min)	-85	-114	ps/nm
DGD_max	10.3	10.3	ps
Optical return loss (min)	21	21	dB

[a]Channel insertion loss includes cables, connectors, and splices
[b]Over the wavelength range of 1294.53 nm to 1310.19 nm

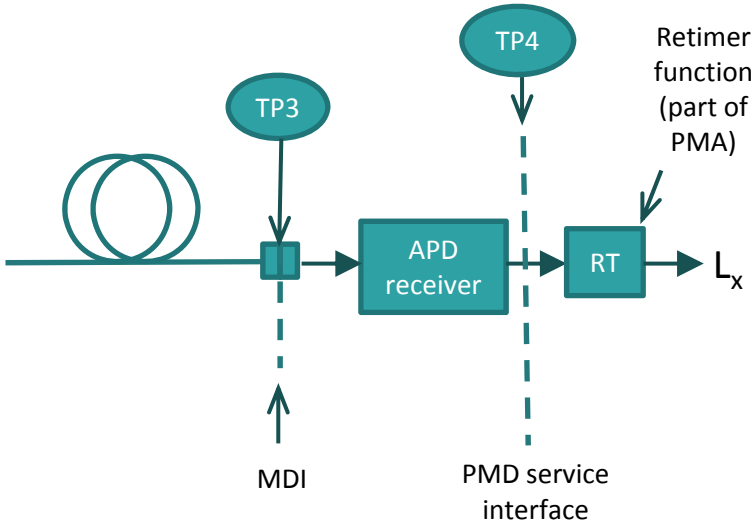
Channel insertion loss assumptions:
- Fiber loss: 0.43 dB/km at 1295nm
  - 0.43 dB/km x 30 km = 12.9 dB
  - 0.43 dB/km x 40 km = 17.2 dB
- Connector/splice loss: 2dB total (average of 0.5dB/connection)
- 40 km is engineered link i.e. same power budget as 30 km

100G ER4-Lite (ER4f) & 25GbE SMF 40km Receiver Comparison

100G ER4-Lite (ER4f)



25GbE SMF 40km



Summary / Conclusion

1. Reviewed basic optical specifications for 100G ER4-Lite (ER4f) and 100GBASE-ER4.
2. Reviewed technical feasibility data for 100G ER4-Lite (ER4f) based on EML transmitter and APD receiver.
3. Technical feasibility not a concern .
4. Could use DML variant of 100G ER4-Lite (ER4f) specification for 25GbE SMF 40km.