

Considerations on channel insertion loss for 10 km and 40 km 800G applications

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Introduction

- During the coming period we are expecting several baseline specification proposals for 10 km and 40 km objectives in the P802.3dj project.
- Therefore it is the right time to set the basis for channel insertion losses appropriate for these 10 km and 40 km applications in both O- and C-bands.
- The authors of this presentation are proposing to use established principles from both IEEE and ITU-T specifications as a basis for defining appropriate channel insertion losses.
- These can be used for baseline specification proposals for methodologies based on IMDD and coherent technologies.

Channel insertion loss for 10 km in the O-band

- For 10 km distances on SMF in the O-band IEEE 802.3 has previously defined channel insertion losses, evolving to a “fixed” value of 6.3 dB.

PMD	Clause	Channel Loss [dB]	Channel plan or wavelength range	Assumption fiber loss [dB/km]	Assumption patch panel connector losses [dB]
10GBASE-Lx	52	6.2	1260 – 1355 nm	0.42	2
40GBASE-LR4	87	6.7	CWDM O-band	0.47	2
100GBASE-LR4	88	6.3	LWDM O-band	0.43	2
25GBASE-LR	114	6.3	1295 – 1325 nm	0.43	2
50GBASE-LR	139	6.3	1304.5 – 1317.5 nm	0.43	2
100GBASE-LR1	140	6.3	1304.5 – 1317.5 nm	0.43	2
200GBASE-LR4	122	6.3	LWDM O-band	0.43	2
400GBASE-LR8	122	6.3	LWDM O-band	0.43	2
400GBASE_LR4-6	151	5	CWDM O-band	0.5	2

- Proposing to maintain 6.3 dB for 10 km in the O-band, mostly for backwards compatibility.
 - 6.3 dB channel insertion loss, covering up to 4.5 dB fiber loss and at least 1.8 dB for patch panel connectors, assuming a range of 0.365 – 0.447 dB/km for expected cabled fiber loss (1291 – 1311 nm applicable to LAN-WDM grid) according to Appendix I of Recommendation ITU-T G.695 (basic loss reference in IEEE 802.3).

Channel insertion loss for 10 km in the C-band

- So far IEEE 802.3 has not established precedent for a channel insertion loss value for 10 km in the C-band.
- Proposal to follow similar approach as for O-band, worst case expected fiber loss plus allocation for patch panel connector losses.
 - 0.209 – 0.278 dB/km, range expected cabled fiber loss (@ 1551 nm) according to Appendix I of Recommendation ITU-T G.695, would provide a worst case fiber loss of up to 2.8 dB for 10 km of fiber
 - Around 1.8 dB for patch panel connectors.
- Proposing to use around 4.6 dB for the basis channel insertion loss for operation over 10 km SMF in the C-band.
- In the case a higher loss would be desired for specific PMD cases, we would recommend to introduce a parameter “Additional insertion loss allowed” with a value of TBD, in a similar way as in Clauses 87, 88, 114, 122, 139, and 151.

Channel insertion loss for 40 km in the O-band

- For (up to) 40 km distances on SMF in the O-band IEEE 802.3 has previously defined some channel insertion loss numbers of up to 18.5 dB.
- Generally a statement has been included that “Links longer than 30 km are considered engineered links.”, suggesting that not every 40 km link meet the worst case loss (or alternatively the distance of 40 km may not be achieved).

PMD	Clause	Channel Loss [dB]	Channel plan or wavelength range	Assumption fiber loss [dB/km]	Assumption patch panel connector losses [dB]
40GBASE-ER4	87	18.5	CWDM O-band	≤ 0.4125	2
100GBASE-ER4	88	18	LWDM O-band	≤ 0.4	2
25GBASE-ER	114	18	1295 – 1325 nm	≤ 0.4	2
50GBASE-ER	139	18	1304.5 – 1317.5 nm	≤ 0.4	2
200GBASE-ER4	122	18	LWDM O-band	≤ 0.4	2
400GBASE-ER8	122	18	LWDM O-band	≤ 0.4	2

Channel insertion loss for 40 km in the O-band, continued

- ITU-T has established application codes for 40 km links operating in the O-band in Recommendation G.959.1, with a channel loss of 22 dB (as maximum link attenuation).
- With the assumption of a worst case loss of 0.447 dB/km as mentioned in G.695, a 40 km link would provide a maximum fiber loss of 17.9 dB. Adding 2 dB for patch panel losses would provide a worst case channel insertion loss of about 20 dB.
- So for O-band 40 km at 800G, we can
 - Either continue same approach as before with “Links longer than 30 km are considered engineered links.”, thus with a channel insertion loss of ~18 dB
 - Or start thinking about non-engineered links with a maximum channel insertion loss of around 20 dB.
- For the TF to decide, in the case base line specifications for 40 km links operating in the O-band are going to be proposed.

Channel insertion loss for 40 km in the C-band

- For (up to) 40 km distances on SMF in the C-band IEEE 802.3 has previously defined a channel insertion loss of 10.9 dB for 10GBASE-E (Clause 52), for a wavelength range of 1530 – 1565 nm, a fiber loss of 0.2725 dB/km and an allocation of 1 dB for patch panel connectors.
- ITU-T has established principles for specifying 40 km links operating in the C-band in Recommendation G.959.1 with a channel loss of 11 dB (as maximum link attenuation). By defining distances as target distances, ITU-T effectively also adopted the approach of defining the links to be “engineered”, thus with assuming an allocation of 2 dB for patch panel connectors, the fiber loss would need to be worst case 0.225 dB/km, whereas a worst case value of 0.278 dB/km has been mentioned in G.695.
- The losses of 10.9 dB in 10GBASE-E and 11 dB in G.959.1 are completely consistent.
- In [maniloff_3dj_01a_2303](#) and [williams_3dj_01a_2303](#) a value of 14 dB has been proposed.
- The authors recommend to use a channel insertion loss of 11 dB, maintaining the concept of an “engineered link” and introduce an additional parameter “Additional insertion loss allowed” with a value of TBD (up to 3 dB).
- For the TF to decide.

Thanks!