Considerations for Link Loss

Vince Ferretti

Corning

IEEE P802.3cs Task Force, Vienna Austria, July 2019

Background

- Link loss design can be challenging over longer link lengths
- In determining link loss for a concatenated series of optical cables in a link, methods other than maximum attenuation coefficient can be used
- ITU-T G.652D appendix 1 provides guidance on using statistical modeling to develop economic design models
- Corning has also conducted further analysis

G.652 Appendix 1:

Information about cabled fibre link attributes used for system design

- The worst case design is a deterministic methodology utilizing minimum and maximum values and is useful for a transmission system with a small number of components and spliced factory lengths of optical fibre cables.
- On the other hand, for a concatenated link that includes a large number (>8) of spliced factory lengths of optical fibre cable, the transmission parameters for the concatenated link must take into account not only the performance of the deterministic attributes of individual cable lengths but also the statistics of concatenation.
- The transmission characteristics of the factory length optical fibre cables will have a certain probability distribution which can be taken into account if the most economic designs are to be obtained.

G.652 Appendix 1:

Information about cabled fibre link attributes used for system design

Table I.1 – Representative values of concatenated optical fibre links

Attenuation coefficient	Wavelength region	Typical link value
(Note)	1260 nm-1360 nm	0.5 dB/km
	1530 nm-1565 nm	0.275 dB/km
	1565 nm-1625 nm	0.35 dB/km
Chromatic dispersion parameter	D_{1550}	17 ps/(nm × km)
	S_{1550}	0.056 ps/(nm^2 × km)
NOTE – Typical link value corresponds to the link attenuation coefficient used in [b-ITU-T G.957] and [b-ITU-T G.691].		

Further Corning Study Analysis and Results

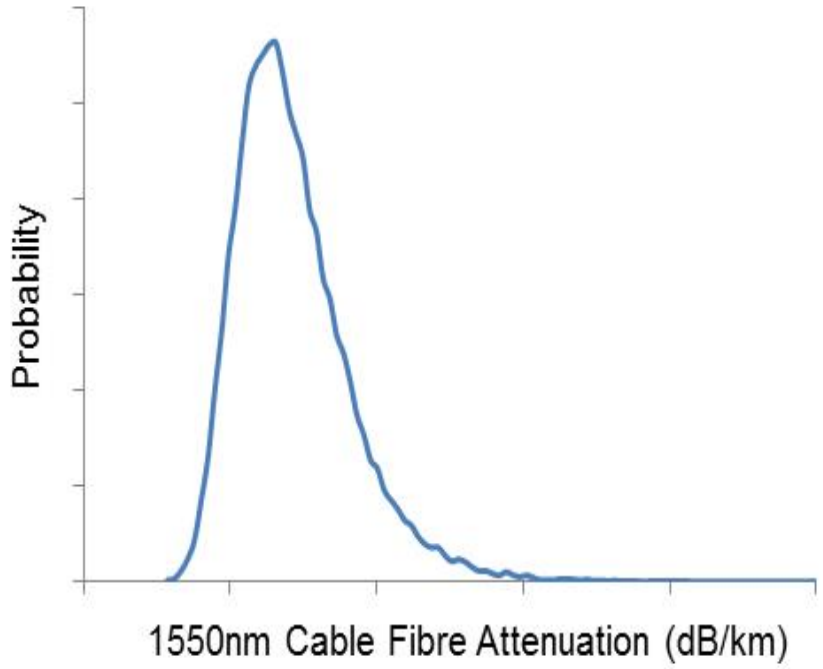
- Corning conducted further study to analyse the impact of a randomized link length distribution on the link design attenuation (LDA) specification.

- In addition, evaluation of ribbon cable corner fibres impact (worst case) on the LDA was also analysed.

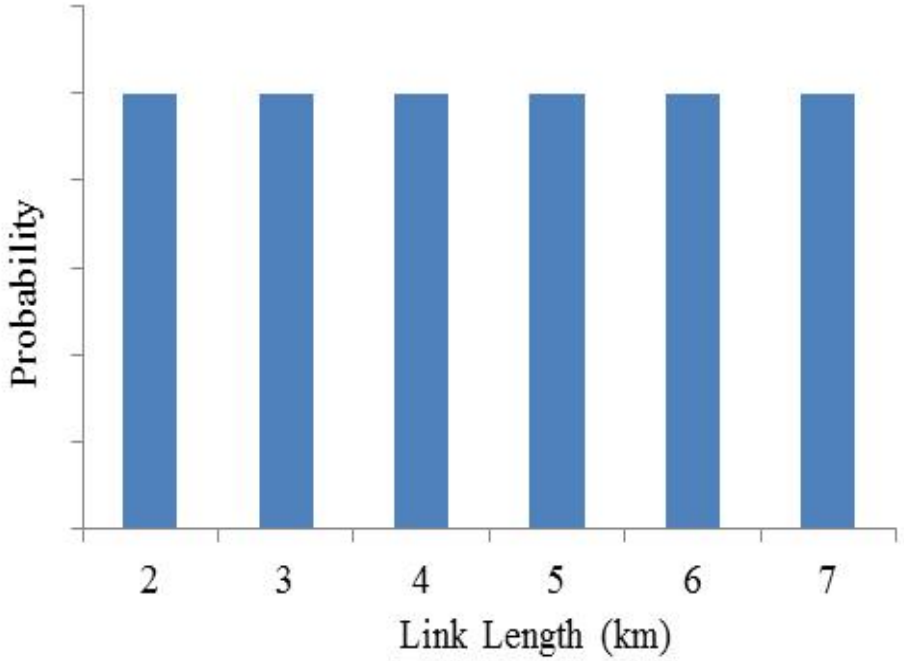
- To properly assess the impact of a randomized link length deployment for LDA a Monte Carlo analysis was performed with assumptions shown on following slides.

Randomized link length distribution impact to Link design attenuation (LDA) Assumptions

G.652 Cabled fibre attenuation data distribution

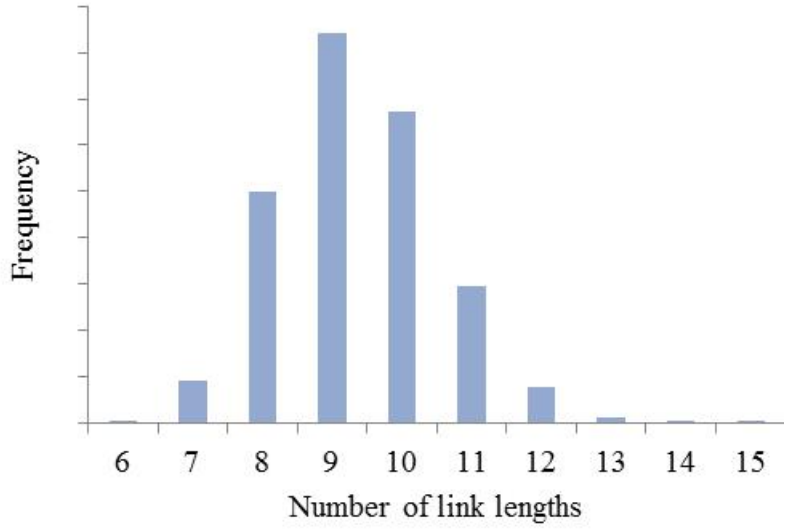


Conservative uniform distribution for links spanning from 2 km up to 7 km, each having an equal probability weighting of occurrence



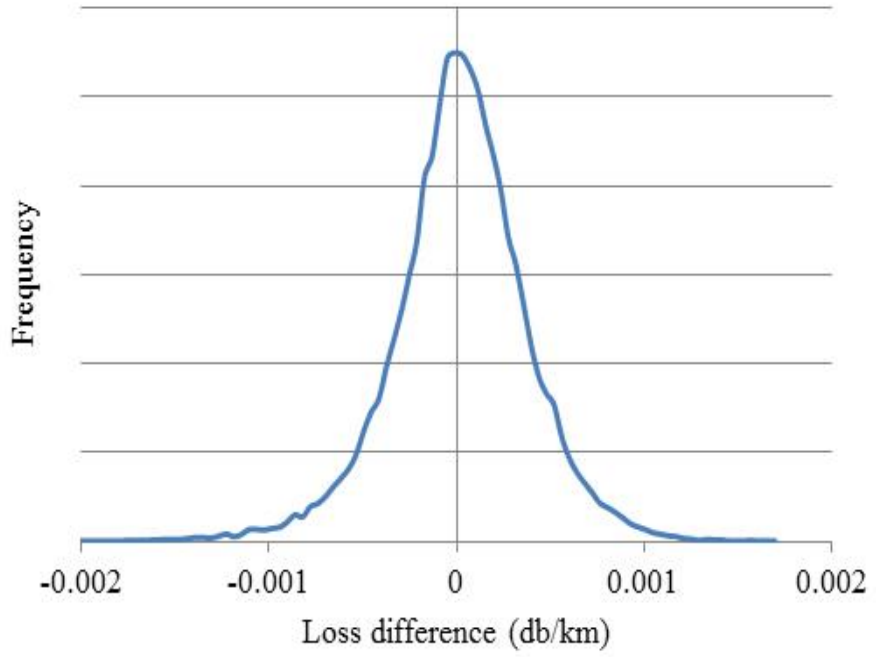
Randomized link length distribution impact to Link design attenuation (LDA) Assumptions

From the input parameter selected, a 40 km distance was found to be sufficient as a minimum distance for applying an LDA value



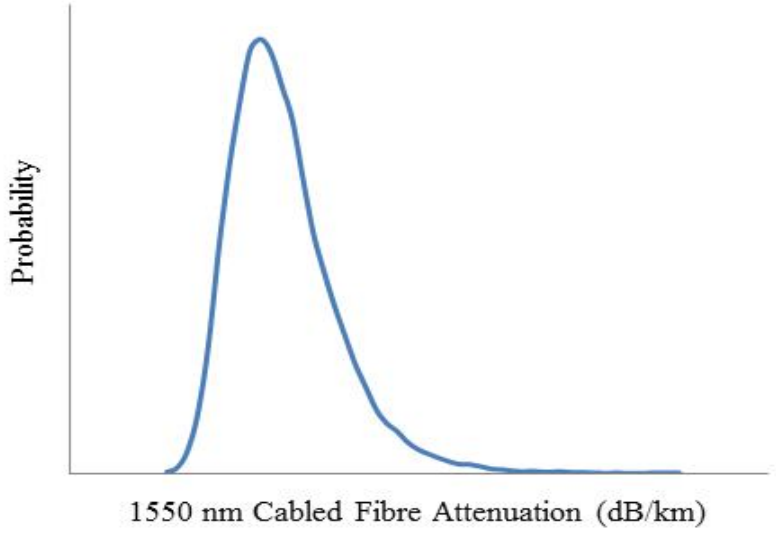
% of 40 km span that would be deployed using less 8 segments is calculated to be ~3.8%.

Loss difference of a 40 km span between randomized versus equally distributed links



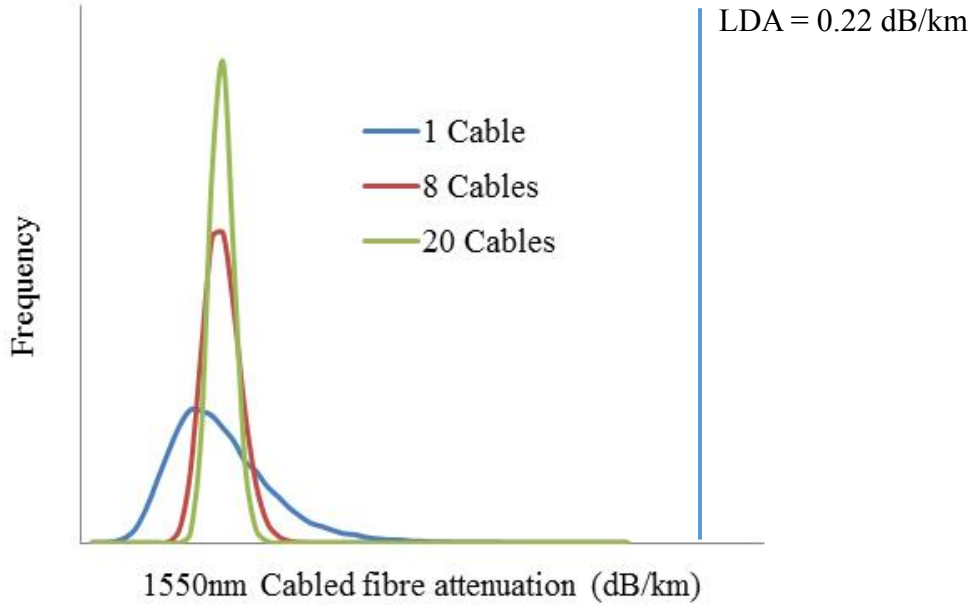
Randomized link length distribution impact to LDA Results

Ribbon cable corner case cabled fibre attenuation distribution



Ribbon corner fibre represent worst case attenuation

Loss difference of a 40 km span between randomized versus equally distributed links



Conclusions

- When optical links have multiple (>8) concatenated links, statistical modeling can be used to determine more economical design models
- G.652 Appendix 1 offers an informative very conservative approximation of this model
- Further Corning Study offers analysis that a lower attenuation can be calculated
- Recommend that 802.3cs choose one of these models when building informative models to describe the black link in the Super PON system

Thanks!