Max DGD Penalty

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Background

- In recent 802.3 task force contributions, anslow_3cu_01_0519 and castro_3cu_adhoc_070319, new lower Max DGD penalties have been proposed and accepted
- These recommendations for lower values are based on deployment of primarily G.652.B and D fiber over the last 10-15 years.
- These fiber types have a lower PMD_Q specification value of 0.2 ps/√km as compared to earlier G.652.A and C fiber types with value of 0.5 ps/√km
- These proposals recommended lowering the max DGD penalty from 0.6dB to ~0.25dB over 10km
- These new values have been written into the 802.3cu draft

Data from anslow_3cu_01_0519

DGD_max 3

Vince Ferretti from Corning has helpfully pointed out a relevant publication:

JACOBS, S.A. et al., Statistical Estimation of PMD Coefficients for System Design. Electronics Letters, 1997, 33, pp. 619-621

This includes an analysis of 288 randomly selected scaled cabled fibers.

Equation 10 of this is:

$$X_Q = \frac{\left(2.004 + 0.975\sqrt{n \times 0.979}\right)}{\sqrt{n \times 48.6}}$$

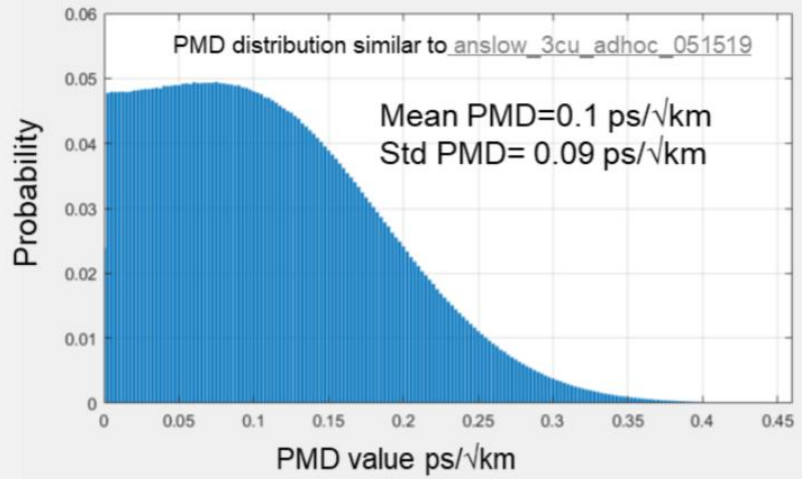
For n = 1 (one cable segment), this evaluates to X_Q = 0.426 ps/√km

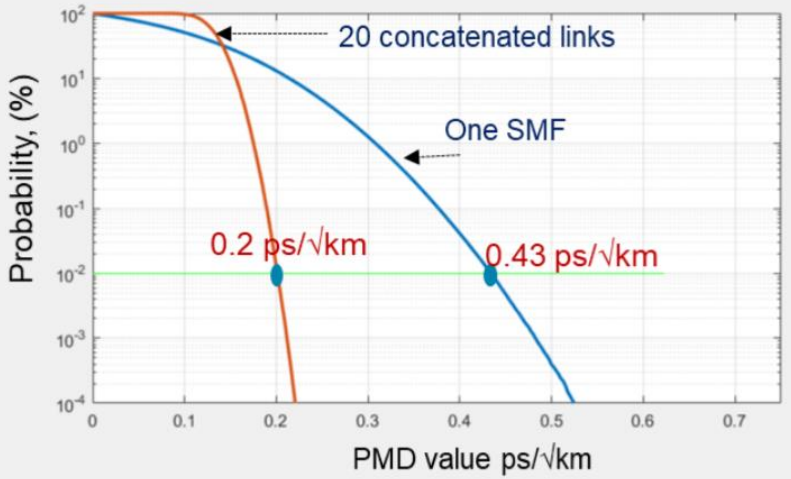
For a 10 km link and with a ratio of "Max" DGD to mean DGD of 3.75, this is also a DGD_max of 5 ps.

Data from castro_3cu_adhoc_070319

PMD distribution used to estimate PMD penalty

If the PMD_Q (20 concatenated cables) is 0.2 ps/sqrt(km) what is the maximum PMD for one that occurs with probability of 0.01% ?





For this distribution the max PMD for one cable is 0.43 ps/sqrt(km)

From the distribution a DGD_max of 3.75x0.43x √10 =5.01 ps was obtained.

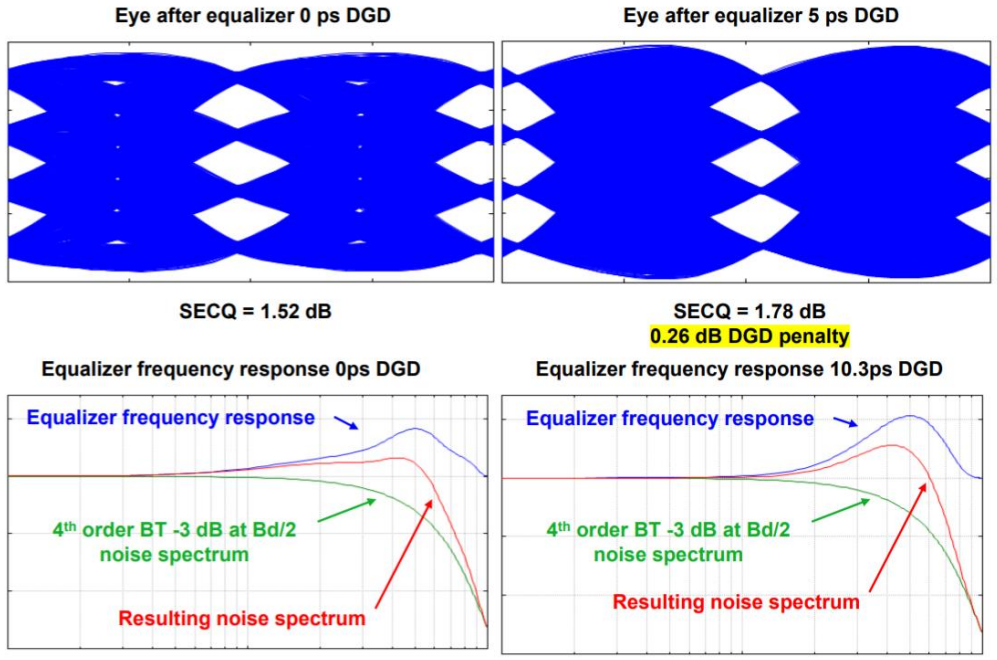
The correct parameters for the shown distribution are: MEAN= 0.1 ps/ √km STD i=0.074 ps/ √km

Proposed Max DGD values for 802.3cp

- For 10 km: 0.43 ps/√km x 3.75 x √10 km = 5 ps
- For 20 km: 0.43 ps/√km x 3.75 x √20 km = 7.2 ps
- Fo 40km: 0.43 ps/√km x 3.75 x √40km = 10.2ps

Data from anslow_3cu_01_0519

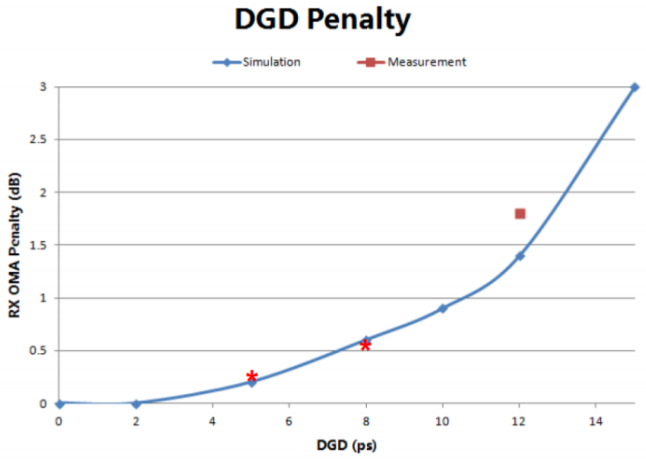
SECQ for ~26.56 GHz bandwidth Tx, 5 ps DGD



DGD penalty for 5 ps

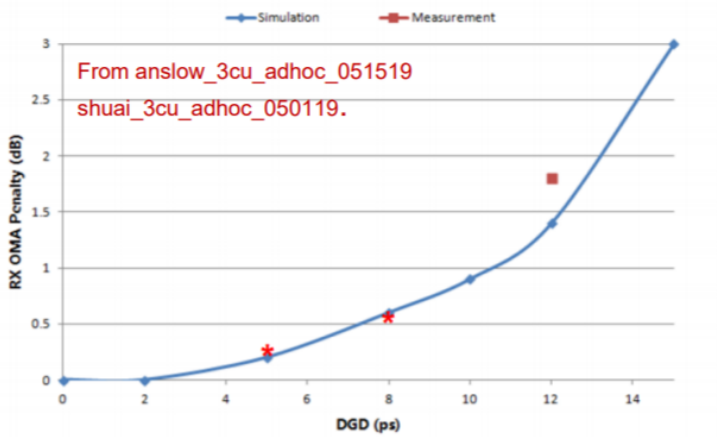
The value of 0.26 dB obtained on the previous page (second "*" right) agrees very closely with the predicted penalty for 5 ps of DGD in shuai_3cu_adhoc_050119.

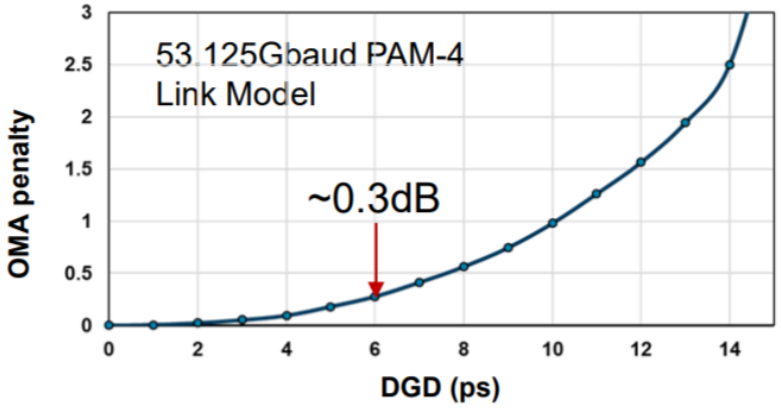
It would be more feasible to find an extra ~0.25 dB in the optical power budget for this.

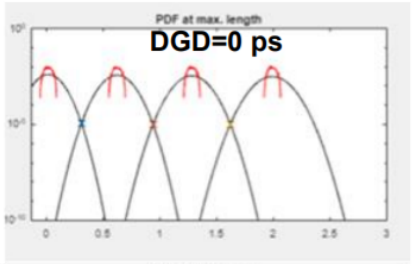


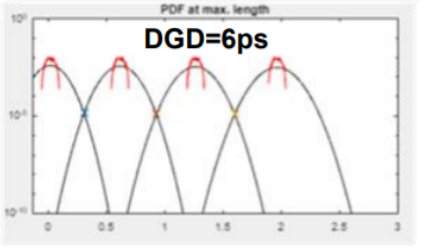
Data from castro_3cu_adhoc_070319

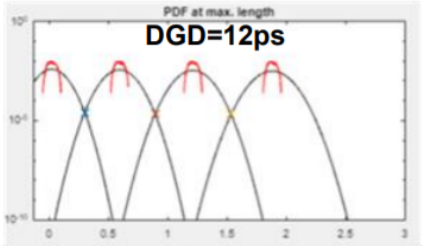
DGD Penalties

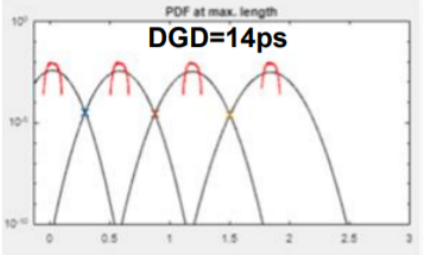




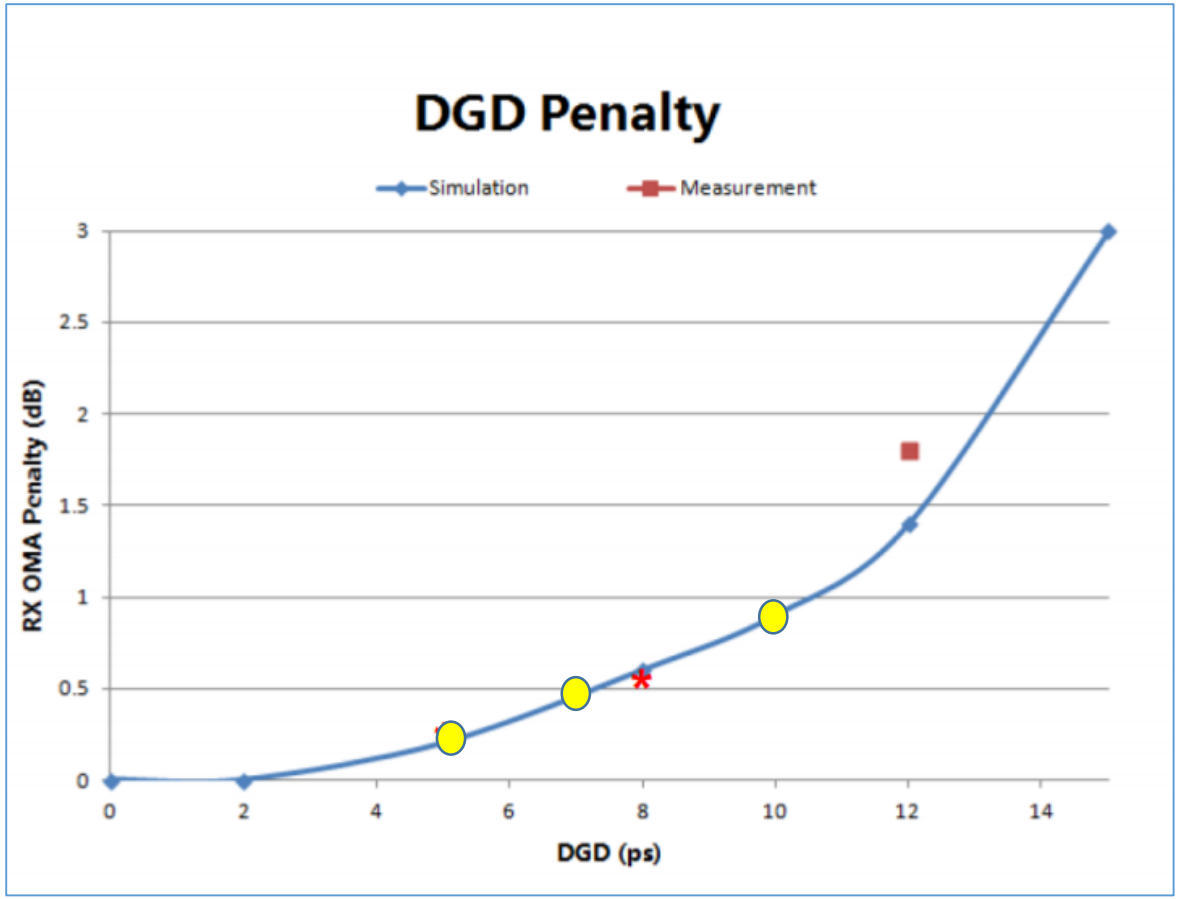








DGD Penalty Proposals for 802.3cp



- For 10 km (5ps), 0.25dB
- For 20 km (7ps), 0.5dB
- For 40 km (10ps), 0.9dB

Conclusions

- 802.3cu has provided updated max DGD values to be considered for 802.3 projects
- These updates are based on considering that most if not all of the fiber that has been deployed over the last 10-15 years has been G.652.B or D fiber, both of which have a lower PMD_Q specification
- Recommend that 802.3cp adopt this same methodology

Thanks!