400GBASE-SR4.2 optical penalties

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Introduction

- 400GBASE-SR4.2 is proposed to go 50% further on OM5 than 50GBASE-SR / 100GBASE-SR2 / 200GBASE-SR4 / 400GBASE-SR8
  - 150 m vs. 100 m on OM5, 100 m vs. 100 m on OM4
- With more chromatic dispersion caused by the extra distance, we need to revisit the mode partition noise penalty
- When the combination of all the other impairments is too high, modal noise becomes significant too

Method of estimating penalties

- The next slide starts with the well-researched 10GBASE-SR specification and model
- Scales for spectral width, frequency, FEC, PAM4 and reach
- Recognises recent investigations into mode partition noise k factor
- Shows example ways of bringing the total penalties back to a very high but plausible level
- Unlike dawe_3cd_01b_0918 this calculation fully includes the Pcross effect
- It does not include recent small improvements in the fibre's specified chromatic dispersion
- Like the draft, it assumes faster lasers for > 100 m

Estimates of budget with minor noise penalties

		10GBASE-SR	50GBASE-SR			400G-4.2 D0.2		400G-4.2 better Tx		400G-4.2 125 m	
	Spread-sheet example		As in P802.3cd D3.5	Pessimistic	Optimistic	Pessimistic	Optimistic	Pessimistic	Optimistic	Pessimistic	Optimistic
PAM- (no. levels)		2	4								
No. eyes		1	3								
Qmin		7.0345	3.414								
TDP, TDEC or TDECQ	dBo	**3.9**	**4.5**	**4.5**		**4.5**		**3.31**	**3.68**	**3.70**	**3.96**
Total penalty	dBo	**4.2**	**4.60**	**5.15**	**4.91**	**6.73**	**5.74**	**4.50**	**4.50**	**4.50**	**4.50**
Signalling rate	GBd	**10.3125**	**26.5625**								
Reach	m	**300**	**100**			**150**		**150**		**125**	
Spectral width	nm	**0.29**	**0.6**	**0.6**		**0.6**		**0.6**		**0.6**	
MPN penalty	dBo	**0.1**	0.02	0.32	0.18	1.64	0.92	0.95	0.63	0.55	0.35
MN penalty	dBo	**0.3**	0.08	0.32	0.23	0.59	0.32	0.25	0.19	0.25	0.19
Combined	dBo	0.4	**0.10**	0.65	0.41	2.23	1.24	1.19	0.82	0.80	0.54
MPN k, also used for MN		**0.3**	**0.0270**	**0.1**	**0.075**	**0.1**	**0.075**	**0.1**	**0.075**	**0.1**	**0.075**
TDP, TDEC or TDECQ w/o Pmpn		3.8	4.5	4.5	4.5	4.5	4.5	3.31	3.68	3.70	3.96
Rate*reach*spectral width		897	1594	1594	1594	2391	2391	2391	2391	1992	1992
MPN noise	rel. OMA outer	**0.01247**	0.0035	0.0131	0.0098	0.0295	0.0221	0.0295	0.0221	0.0205	0.0154

Discussion

- These links are dispersion-limited not power-limited
- It's about the penalties, not so much about the budget
- Mode partition noise is a concern and modal noise is a contributor
- The classic theory of mode partition noise may not be accurate enough, and more information on modal noise would be helpful