100GBASE-DR optical reflection limits

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Introduction

Presentation [king_051017_3cd_adhoc_03](#) provided analysis of the MPI penalties that would be incurred if the ER for 100GBASE-DR was relaxed from 5 dB to 3.5 dB.

This presentation repeats some of this MPI penalty analysis using a C program based on the calculations in the spreadsheet in [king_02a_0116_smf.7z](#) in order to extend the Monte Carlo analysis to a larger number of samples.

Spreadsheet vs C program

5 x -35 dB + 5 x -45 dB, 5 dB ER
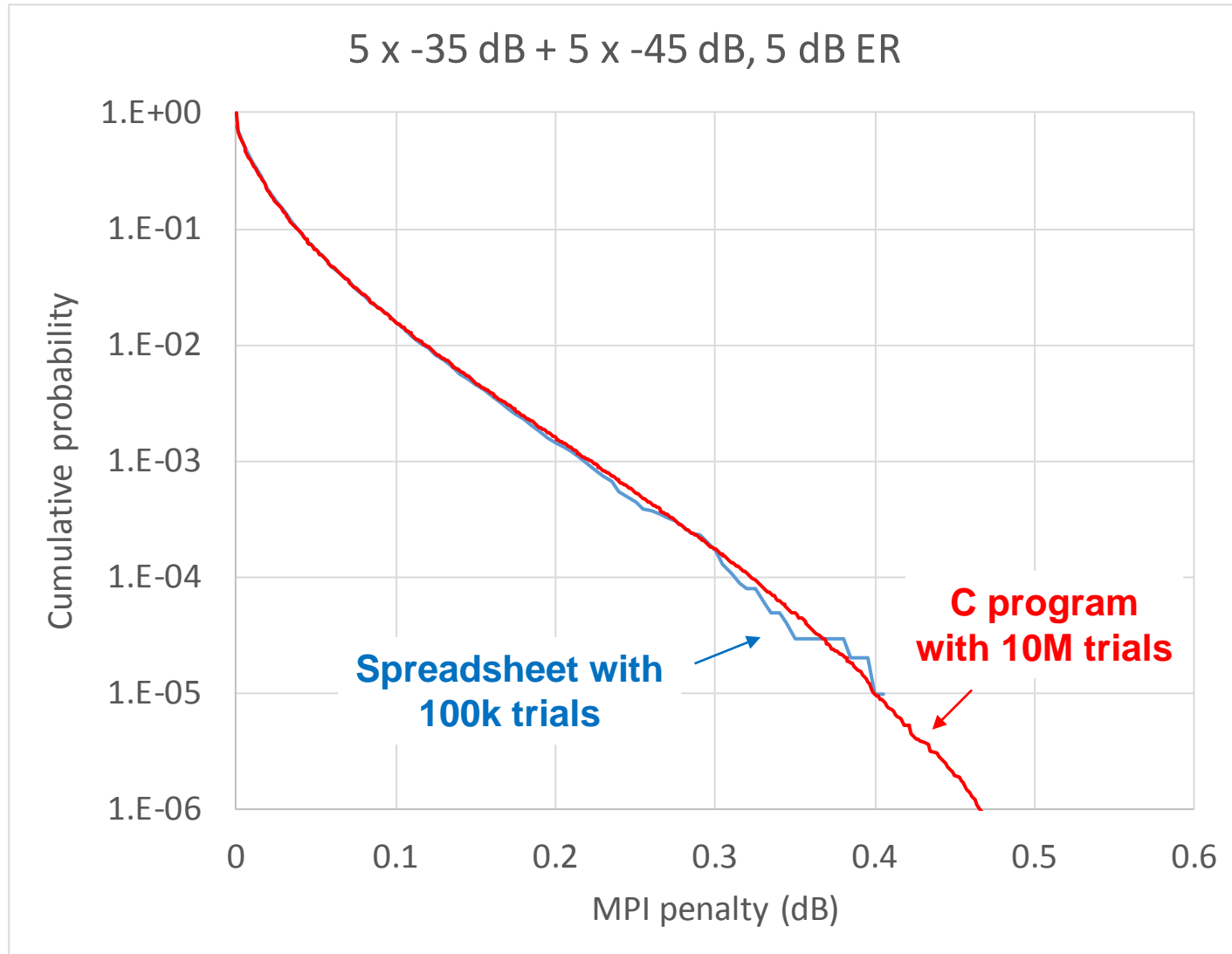
Penalties from king_051017_3cd_adhoc_03

MPI penalty for 3.5 dB ER from king_051017_3cd_adhoc_03

-35 dB

	0	1	2	3	4	5	6	7	8	← -45 dB
0	0.02	0.04	0.05	0.07	0.1	0.11	0.13	0.15	0.18	
1	0.09	0.12	0.14	0.16	0.19	0.22	0.23	0.24	0.27	
2	0.19	0.22	0.24	0.28	0.3	0.34	0.35	0.37	0.41	
3	0.33	0.35	0.36	0.43	0.44	0.48	0.5	0.53	-	
4	0.5	0.53	0.55	0.57	0.6	0.63	0.64	-	-	
5	0.65	0.71	0.76	0.78	0.8	0.84	-	-	-	
6	0.9	0.88	-	-	-	-	-	-	-	

MPI allowance in P802.3cd D1.3

-35 dB

	0	1	2	3	4	5	6	7	8	← -45 dB
0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	
3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	-	
4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	-	-	
5	0.3	0.3	0.4	0.4	0.4	0.5	-	-	-	
6	0.4	0.5	-	-	-	-	-	-	-	

OMA$_{outer}$ increase required to accommodate MPI penalty

-35 dB

	0	1	2	3	4	5	6	7	8	← -45 dB
0						0.01	0.03	0.05	0.08	
1		0.02	0.04	0.06	0.09	0.12	0.13	0.14	0.17	
2	0.09	0.12	0.14	0.08	0.1	0.14	0.15	0.17	0.21	
3	0.13	0.15	0.16	0.23	0.24	0.18	0.2	0.23	-	
4	0.2	0.23	0.25	0.27	0.2	0.23	0.24	-	-	
5	0.35	0.41	0.36	0.38	0.4	0.34	-	-	-	
6	0.5	0.38	-	-	-	-	-	-	-	

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Penalties from C program

MPI penalty for 3.5 dB ER

-35 dB (row axis), ← -45 dB (column axis)

	0	1	2	3	4	5	6	7	8
0									
1									
2									
3									-
4							0.59	-	-
5	0.56	0.59	0.64	0.67	0.68	0.72	-	-	-
6	0.75	0.74	-	-	-	-	-	-	-

MPI allowance in P802.3cd D1.3

-35 dB (row axis), ← -45 dB (column axis)

	0	1	2	3	4	5	6	7	8
0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	-
4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	-	-
5	0.3	0.3	0.4	0.4	0.4	0.5	-	-	-
6	0.4	0.5	-	-	-	-	-	-	-

OMA$_{outer}$ increase required to accommodate MPI penalty

-35 dB (row axis), ← -45 dB (column axis)

	0	1	2	3	4	5	6	7	8
0									
1									
2									
3									-
4							0.19	-	-
5	0.26	0.29	0.24	0.27	0.28	0.22	-	-	-
6	0.35	0.24	-	-	-	-	-	-	-

Worst three curves with ER = 3.5 dB
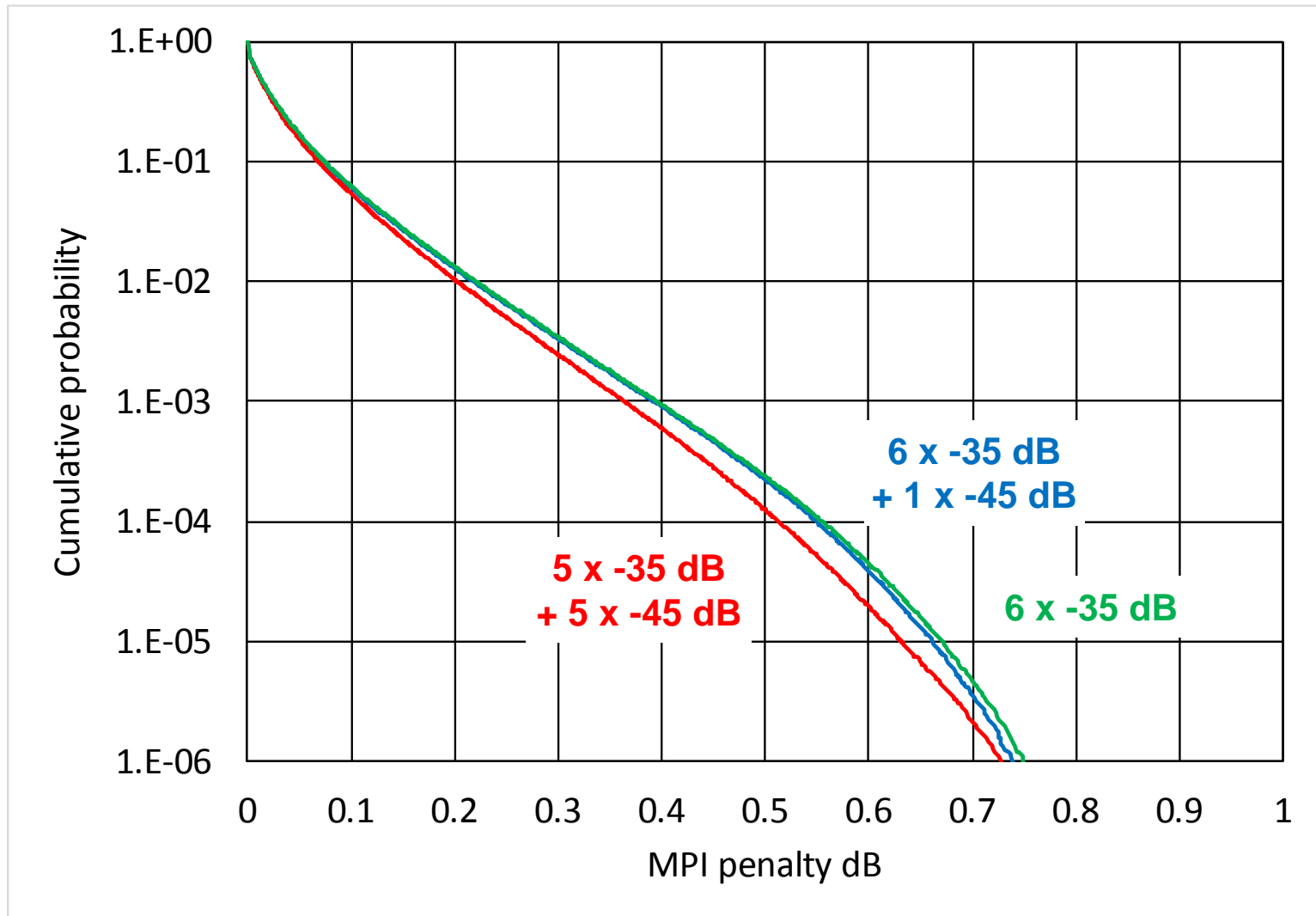
Changes needed

The increase in OMA$_{outer}$ needed to accommodate the increased MPI penalty if the ER is relaxed to 3.5 dB are all below 0.3 dB except for one case (6 x -35 dB reflections). This could be accommodated by changing Table 140-12 to have a maximum channel insertion loss of 2.6 dB for the 6 x -35 dB case.

Table 140–12—Maximum channel insertion loss versus number of discrete reflectances

Maximum channel insertion loss (dB)		Number of discrete reflectances > −55 dB and ≤ −45 dB								
		0	1	2	3	4	5	6	7	8
Number of discrete reflectances > −45 dB and ≤ −35 dB	0	3	3	3	3	3	3	3	3	3
	1	3	3	3	3	3	3	3	3	3
	2	3	3	3	2.9	2.9	2.9	2.9	2.9	2.9
	3	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	—[a]
	4	2.8	2.8	2.8	2.8	2.7	2.7	2.7	—[a]	—[a]
	5	2.8	2.8	2.7	2.7	2.7	2.6	—[a]	—[a]	—[a]
	6	2.7	2.6	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]

[a]The indicated combination of reflectances does not provide a supported maximum channel insertion loss.

Change to 2.6

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Penalty values

During the development of the P802.3bs draft, the agreement was made that, after some options that gave unacceptably large penalties had been eliminated, the MPI penalty allocation should be equal to the 1E-6 cumulative probability point on the chart in the Monte Carlo spreadsheet king_02a_0116_smf.7z. The largest MPI penalty allocation in the P802.3bs draft is currently 0.5 dB (with proposals to increase this to 0.6 dB for ER = 3.5 dB).

Relaxing the ER for 100GBASE-DR to 3.5 dB would increase the largest MPI penalty (for 6 x -35 dB reflectances) to 0.75 dB. The Task Force should consider whether this is acceptable or whether it is pushing the penalty too close to a "cliff edge".

Recommendations

If it is agreed to reduce the maximum ER for 100GBASE-DR from 5 dB to 3.5 dB then:

- Require an increase of 0.3 dB in OMA for transmitters with ER < 5 dB

- Change the maximum channel insertion loss for 6 x -35 dB reflectances in Table 140-12 from 2.7 to 2.6 dB

- Consider if an MPI penalty of 0.75 dB is acceptable

Thanks!