

Changes to P802.3cc D3.2 for reflections

Pete Anslow, Ciena

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Introduction

A comment has been submitted against P802.3cc to change the way the reflections are specified:

Changes were made between D3.1 and D3.2 due to comments r01-9 and r01-10. Unfortunately, this has introduced several issues:

The normative requirements for discrete reflectances in the channel for 25GBASE-LR are in footnote c to Table 114-8 "25GBASE-LR and 25GBASE-ER illustrative link power budgets" rather than in the section of the draft that specifies the characteristics of the fiber optic cabling.

The requirements in footnote c to Table 114-8 limit the number of discrete reflectances ≤ -35 dB to 6 however small the reflectances are. This is not practical. The specifications for PAM4 PMDs (which are more sensitive to MPI than NRZ) being developed by the P802.3bs and P802.3cd projects allow any number of discrete reflectances ≤ -55 dB.

Table 114-12 (for 25GBASE-ER) characterises the discrete reflectances as having an "insertion loss contribution". This is not correct.

Table 114-12 also limits the number of discrete reflectances ≤ -35 dB to 6 however small the reflectances are.

This contribution shows the changes that are requested with revision marks compared to D3.2.

Table 114-8

Table 114-8—25GBASE-LR and 25GBASE-ER illustrative link power budgets

Parameter	25GBASE-LR	25GBASE-ER		Unit
Power budget (for maximum TDP)	9.7	20.7		dB
Operating distance	10	30	40 ^a	km
Channel insertion loss	6.3 ^b	15 ^b	18^a minus insertion loss values per Table 114-12 See 114.9^a	dB
Maximum discrete reflectance	See 114.10 -26^c	See 114.10 Table 114-12		dB
Allocation for penalties ^d (for maximum TDP)	3.4	20.7 minus maximum channel insertion loss per Table 114-12 2.7		dB
Additional insertion loss allowed	0	Maximum channel insertion loss per Table 114-12 minus 15.3 minus insertion loss values per Table 114-12	0	dB

^aLinks longer than 30 km are considered engineered links. Attenuation for such links needs to be less than the worst case for cables containing IEC 60793-2-50 type B1.1, type B1.3, or type B6_a single-mode cabled optical fiber.

^bThe channel insertion loss is calculated using the maximum distance specified in Table 114-5 ~~for 25GBASE-LR~~ and fiber attenuation of 0.43 dB/km at 1295 nm plus an allocation for connection and splice loss given in 88.11.2.1.

^c~~The number of discrete reflectances in the range > -35 dB and ≤ -26 dB is at most 3; the number of discrete reflectances ≤ -35 dB is at most 6; and the total number of discrete reflectances is at most 6.~~

^dLink penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

114.9 part 1

114.9 Fiber optic cabling model

The fiber optic cabling model for 25GBASE-LR and 25GBASE-ER is as specified for 100GBASE-LR4 and 100GBASE-ER4 in 88.10 with the exceptions that Table 88-14 is replaced by Table 114-11 and the [maximum channel](#) insertion loss ~~contribution of discrete reflectances~~ for 25GBASE-ER is specified by Table 114-12.

Table 114-11—Fiber optic cabling (channel) characteristics

Description	25GBASE-LR	25GBASE-ER		Unit
Operating distance (max)	10	30	40	km
Channel insertion loss ^{a, b} (max)	6.3	See Table 114-12 18		dB
Channel insertion loss (min)	0	10 ^c		dB
Positive dispersion ^b (max)	22.6	27.6	36.8	ps/nm
Negative dispersion ^b (min)	-27.9	-83.7	-111.6	ps/nm
DGD_max ^d	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

^aThese channel insertion loss values include cable, connectors, and splices.

^bOver the wavelength range 1295 nm to 1325 nm for 25GBASE-LR and 1295 nm to 1310 nm for 25GBASE-ER.

^cChannel insertion loss (min) may be implemented with an optical attenuator.

^dDGD_max is the maximum differential group delay that the system must tolerate.

114.9 part 2

Table 114-12—~~Insertion loss contribution of discrete reflectances in 25GBASE-ER~~

Insertion loss contribution of discrete reflectances (dB)		Number of discrete reflectances ≤ -35 dB						
		0	1	2	3	4	5	6
Number of discrete reflectances > -35 dB and ≤ -26 dB	0	0	0	0	0.1	0.1	0.1	0.2
	1	0.1	0.1	0.1	0.2	0.2	0.3	^a
	2	0.2	0.2	0.3	0.3	0.4	^a	^a
	3	0.3	0.4	0.4	0.6	^a	^a	^a
	4	0.5	0.6	0.7	^a	^a	^a	^a
	≥ 4	^a	^a	^a	^a	^a	^a	^a

^aThe indicated combination of reflectances is not supported.

Table 114-12—Maximum channel insertion loss versus number of discrete reflectances for 25GBASE-ER

Maximum channel insertion loss (dB)		Number of discrete reflectances > -55 dB and ≤ -35 dB										
		0	1	2	3	4	5	6	7	8	9	10
Number of discrete reflectances > -35 dB and ≤ -26 dB	0	18	18	18	17.9	17.9	17.9	17.8	17.8	17.8	17.7	17.7
	1	17.9	17.9	17.9	17.8	17.8	17.7	17.7	17.6	17.6	17.5	^a
	2	17.8	17.8	17.7	17.7	17.6	17.6	17.5	17.4	17.4	^a	^a
	3	17.7	17.6	17.6	17.4	17.4	17.3	^a	^a	^a	^a	^a
	4	17.5	17.4	17.3	^a	^a	^a	^a	^a	^a	^a	^a
	≥ 4	^a	^a	^a	^a	^a	^a	^a	^a	^a	^a	^a

^aThe indicated combination of reflectances is not supported.

114.10

114.10 Characteristics of the fiber optic cabling (channel)

The characteristics of the fiber optic cabling (channel) for 25GBASE-LR and 25GBASE-ER are as specified for 100GBASE-LR4 and 100GBASE-ER4 in 88.11 with the following exceptions:

- ~~that~~ Table 88-14 is replaced by Table 114-11.
- For 25GBASE-LR, the maximum value for each discrete reflectance shall be less than or equal to the value shown in Table 114-13 corresponding to the number of discrete reflectances above -55 dB within the channel.
- For 25GBASE-ER, the maximum value of channel insertion loss is dependent on the number and maximum value of the discrete reflectances within the channel as given in Table 114-12. Discrete reflectances below -55 dB may be ignored when determining the supported channel insertion loss.

Table 114-13—Maximum value of each discrete reflectance for 25GBASE-LR

<u>Number of discrete reflectances above -55 dB^a</u>	<u>Maximum value for each discrete reflectance for 25GBASE-LR</u>
<u>1 to 4</u>	<u>-26 dB</u>
<u>6</u>	<u>-30 dB</u>
<u>8</u>	<u>-32 dB</u>
<u>10</u>	<u>-34 dB</u>

^aFor numbers of discrete reflectances in between two numbers shown in the table, the lower of the two corresponding maximum discrete reflectance values applies.

Backup

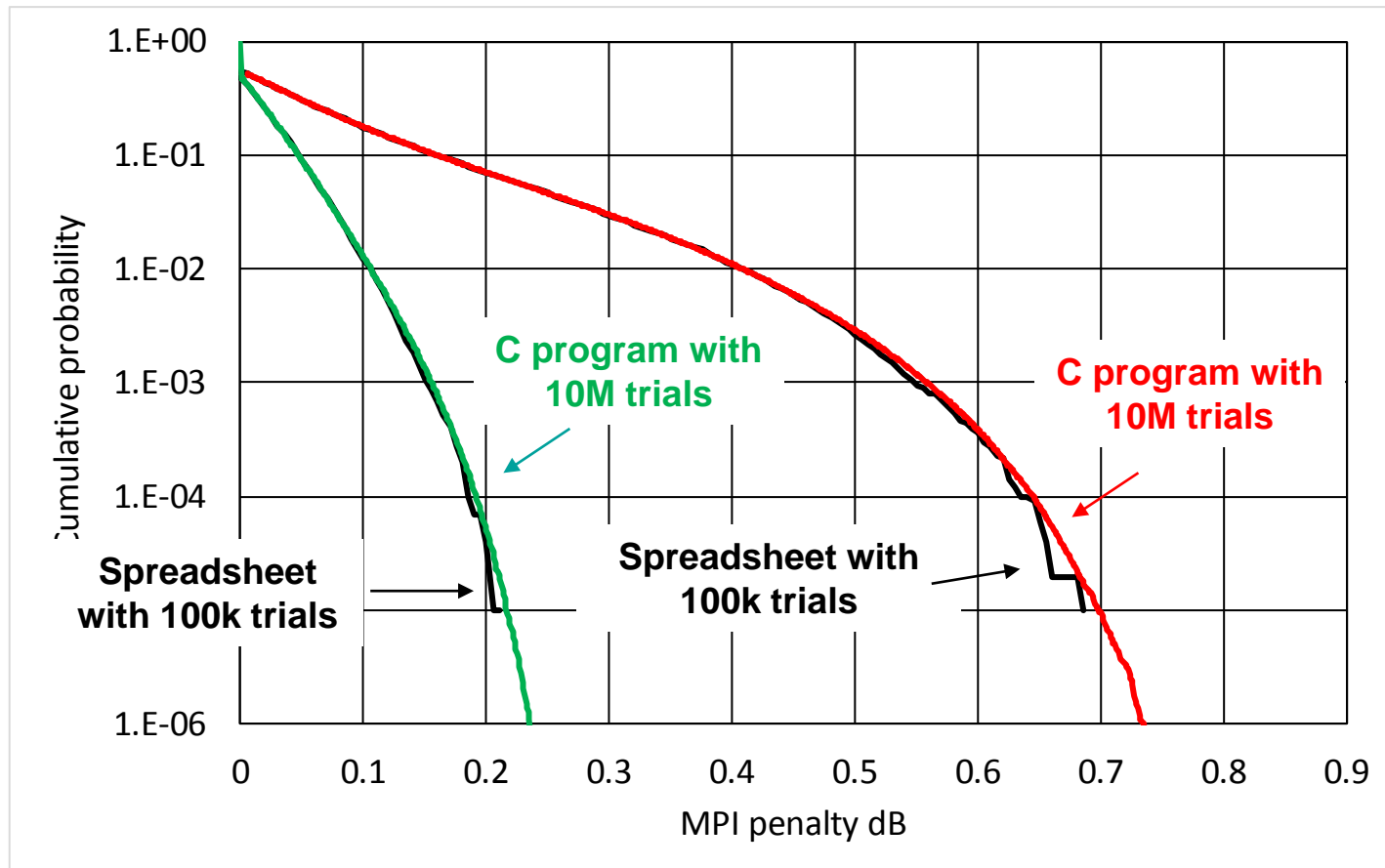
Calculations

The following slides look at the MPI penalty for various configurations using a C program based on the calculations in the spreadsheet in [king_3cc_01_0517_NRZ-MPIpen-0k7.xlsx](#) in order to extend the Monte Carlo analysis to a larger number of samples.

Comparison of the two tools

BER 5E-5
ER 3 dB

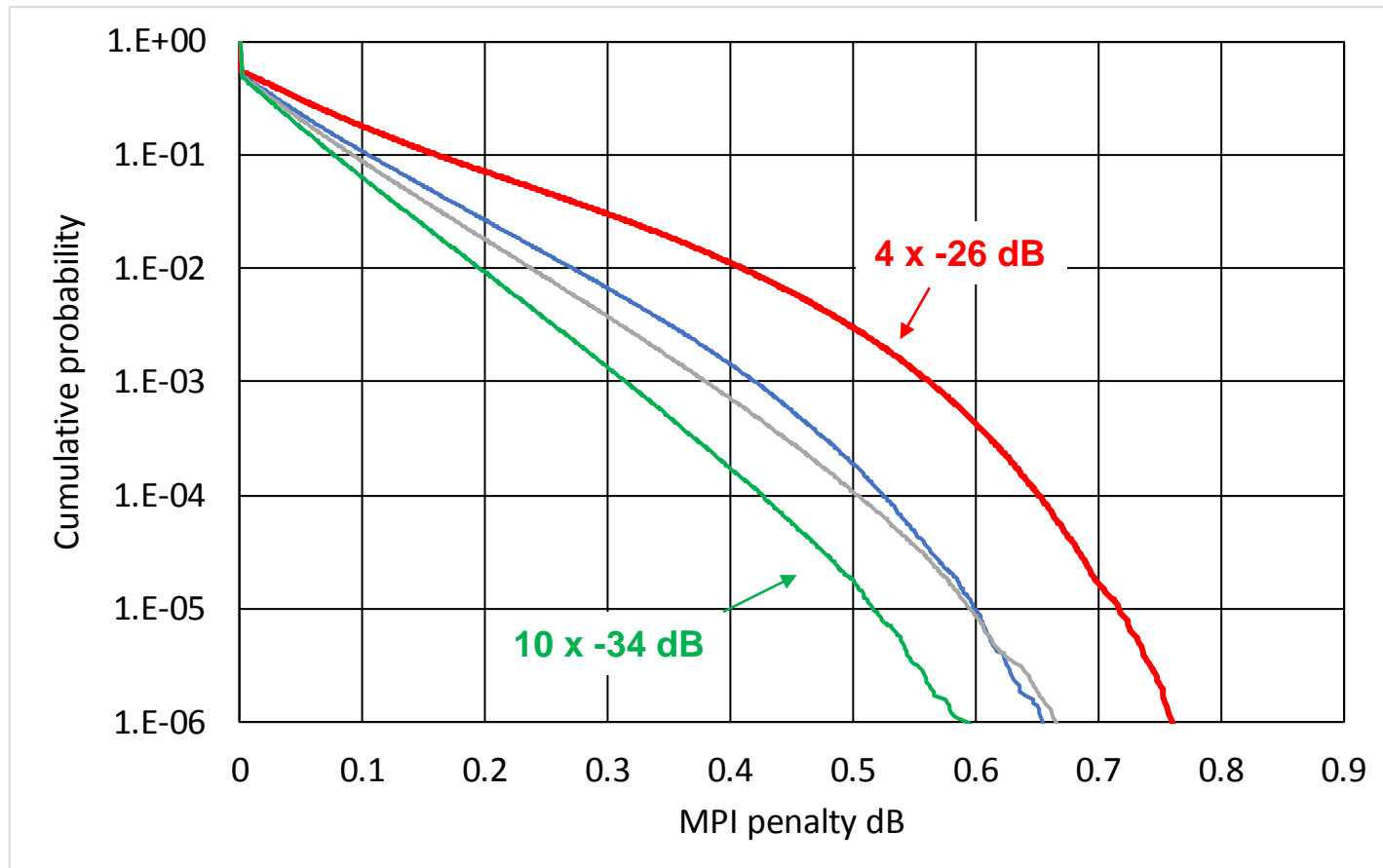
-26	-26	-100	-100	-100	-26	-26	-100	-100	-100	-26	6.3	-26
-26	-35	-100	-100	-35	-35	-35	-35	-100	-100	-35	6.3	-26



LR 0.7 dB penalty as proposed worst case

BER 5E-5
ER 3 dB

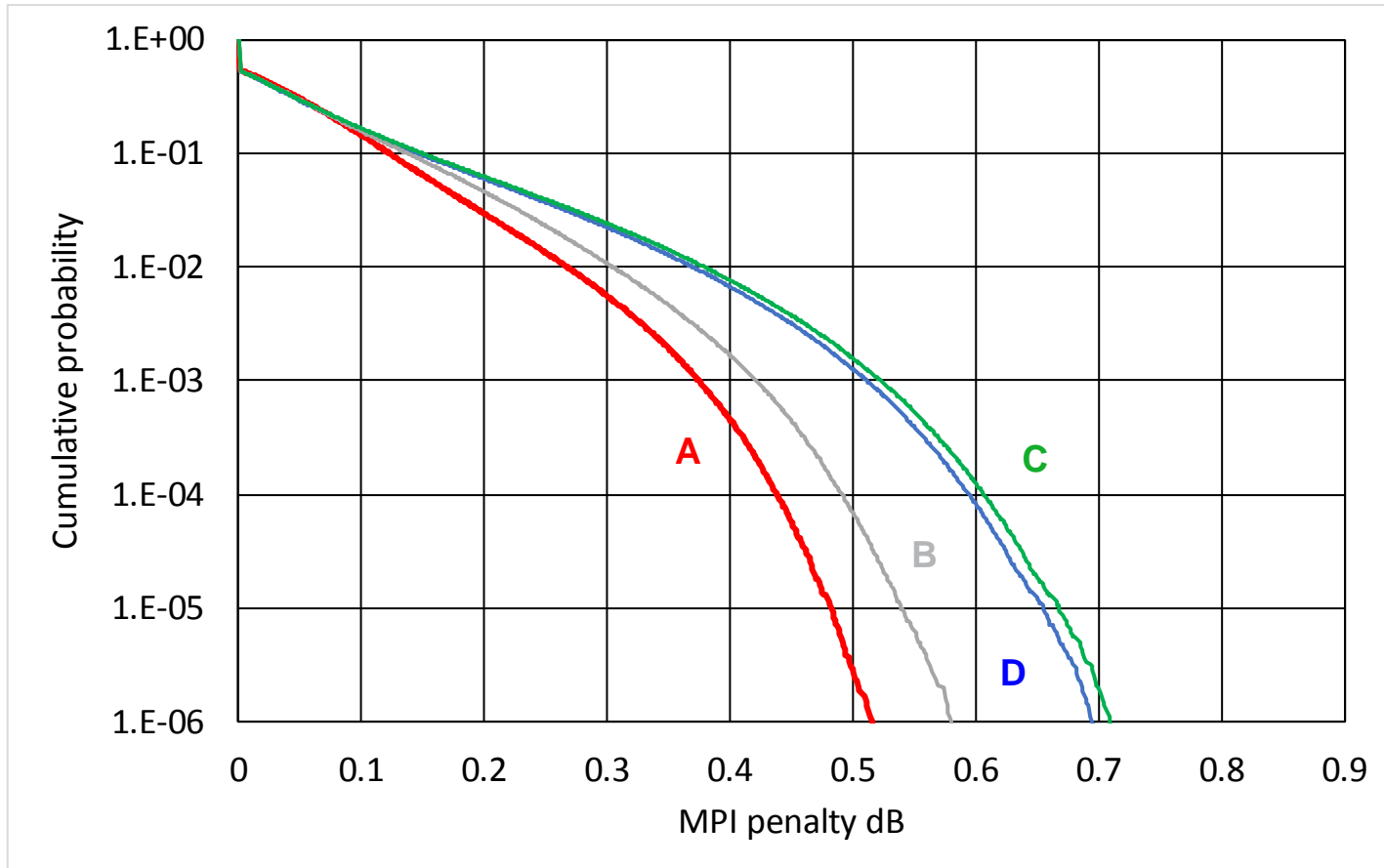
-26	-34	-34	-34	-34	-34	-34	-34	-34	-34	-34	6.3	-26
-26	-32	-32	-55	-32	-32	-32	-32	-55	-32	-32	6.3	-26
-26	-30	-55	-55	-30	-30	-30	-30	-55	-55	-30	6.3	-26
-26	-26	-55	-55	-55	-26	-26	-55	-55	-55	-26	6.3	-26



LR 0.7 dB penalty 4 x -26 more realistic versions

BER 5E-5
ER 3 dB

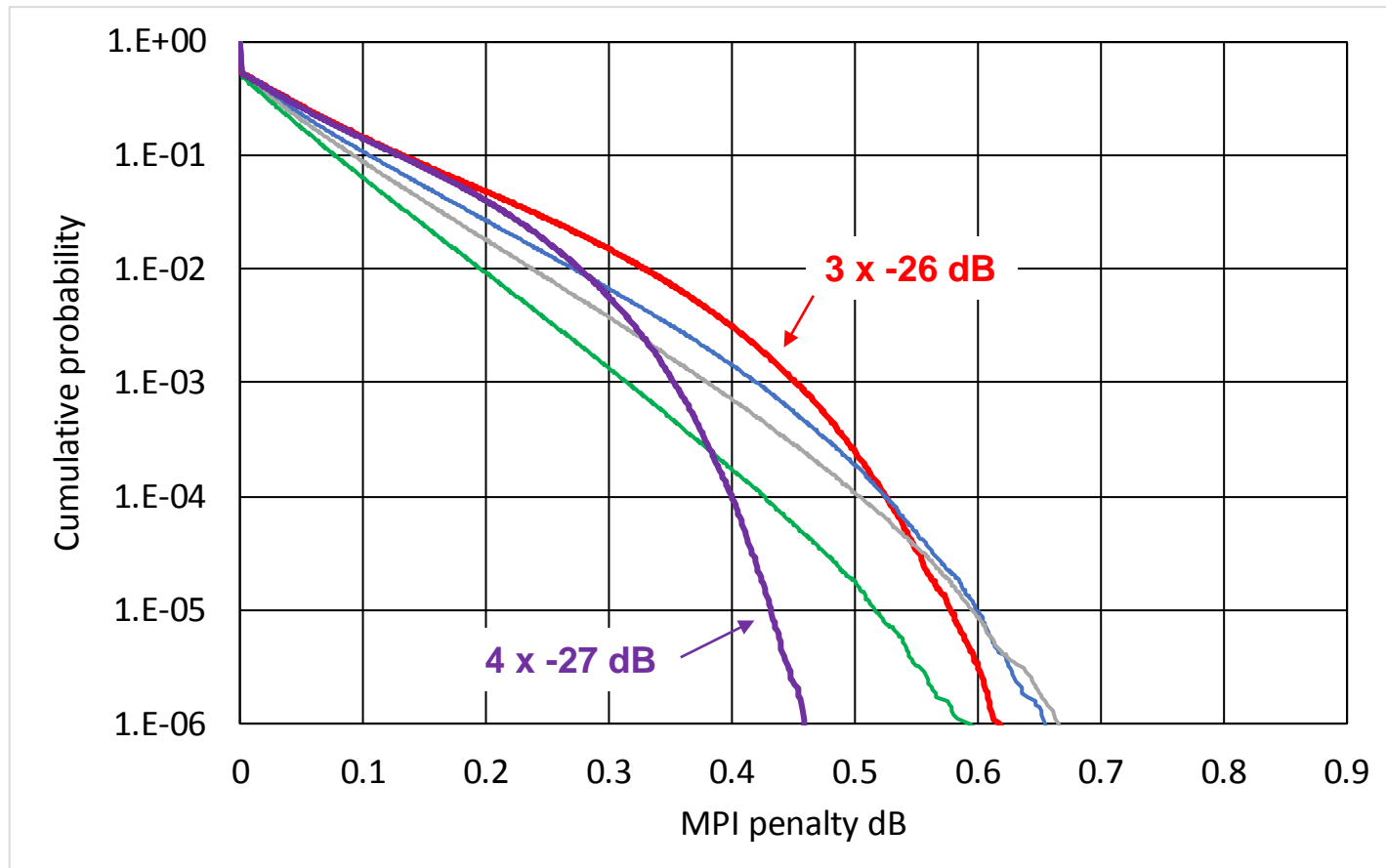
A	-26	-26	-55	-55	-55	-26	6.3	-26	-55	-55	-55	-26	-26				
B	-26	-26	-55	-55	-55	-26	-26	-55	-55	-55	6.3	-26	-26				
C	-26	-26	-55	-55	-55	-26	0.5	-26	-55	-55	-55	-26	5.8	-26			
D	-26	0.2	-26	-55	-55	-55	0.2	-26	0.2	-26	-55	-55	-55	0.2	-26	5.5	-26



LR 0.7 dB penalty conservative option

BER 5E-5
ER 3 dB

-26	-34	-34	-34	-34	-34	-34	-34	-34	-34	-34	6.3	-26
-26	-32	-32	-55	-32	-32	-32	-32	-55	-32	-32	6.3	-26
-26	-30	-55	-55	-30	-30	-30	-30	-55	-55	-30	6.3	-26
-26	-27	-55	-55	-55	-27	-27	-55	-55	-55	-27	6.3	-26
-26	-26	-55	-55	-55	-55	-26	-55	-55	-55	-26	6.3	-26



LR 4 x -26 dB conclusion

While the 4 x -26 dB + 6 x -55 dB case with all of the 6.3 dB of loss just before the receiver shows an MPI penalty at a probability of 1E-6 slightly above the 0.7 dB allocated in the budget, this scenario is very unrealistic as some portion of the 6.3 dB loss is bound to occur due to the 10 connectors in the link.

As shown on slide 11, if the lumped loss is nearer the middle of the link, or a small amount of the total loss is associated with each connector, the calculated MPI penalty comes within the 0.7 dB budget.

It is therefore proposed to set the maximum number of -26 dB reflectances in Table 114-13 on slide 6 to four.

Thanks!