

25GBASE-LR ER, MPI

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Jonathan King, Finisar

MPI for 25GBASE-LR

- MPI penalty for 25GBASE-LR:
 - is negligible if just Tx and Rx return loss are considered
 - but becomes rapidly significant when more than one connector with return loss <35 dB is included
- MPI for various connector combinations have been calculated and are presented here

NRZ MPI calculations

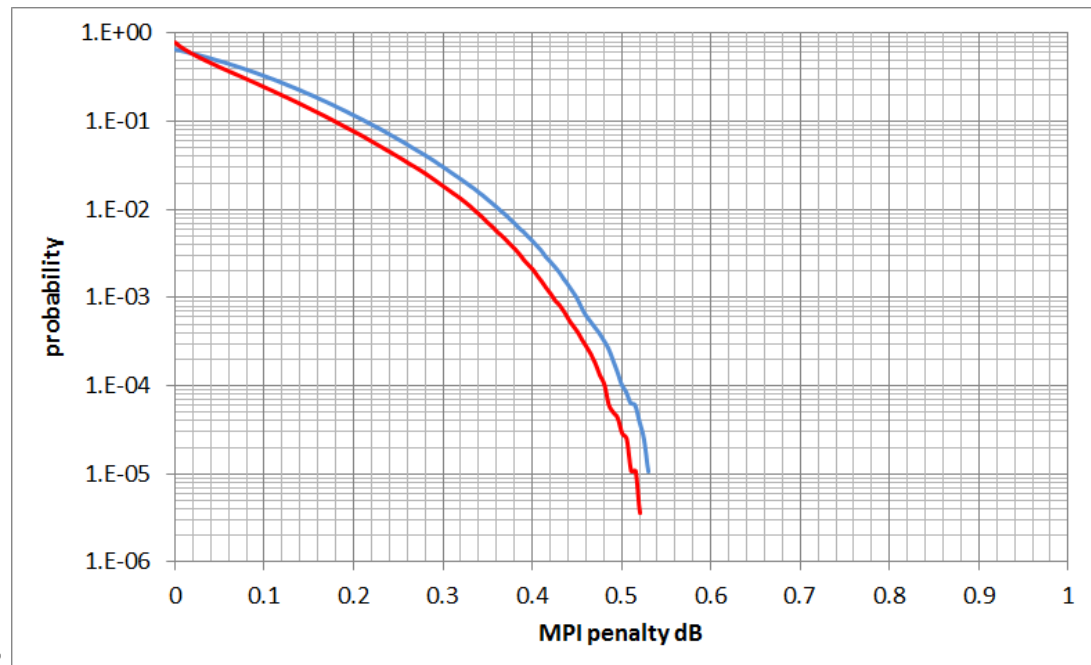
- Spreadsheet model
 - 8 reflections (Tx, Rx, and up to 6 connectors)
 - Random modulation levels at each reflector
 - Random phase between reflectors
 - Rx noise calculated for target BER without MPI
 - ER of transmitter used to calculate 0 and 1 levels
 - Insertion loss lumped just before the receiver
 - >250k samples
 - Error probability calculated for random phase between '1' and '0' modulation levels, error probabilities averaged, and effective Q penalty calculated
 - Equivalent to assuming optical phase of '1' and '0' levels are random (e.g. DML)
 - For comparison, error probability calculated for identical phase for '1' and '0' levels, error probabilities averaged, and effective Q penalty calculated
 - Equivalent to assuming optical phase of '1' and '0' levels are identical (e.g. a zero chirp M-Z)

25GBASE-LR

Example statistical MPI penalty for **random** vs **identical** optical phase for modulation level 'one' and 'zero'

MPI penalty for

- Tx RL = 12 dB
- Rx RL = 26 dB
- IL = 6.3 dB
 - (lumped just before Rx)
- 3 x 35dB RL connectors
- ~0.02 dB higher penalty for **random** optical phase between '1' and '0' levels



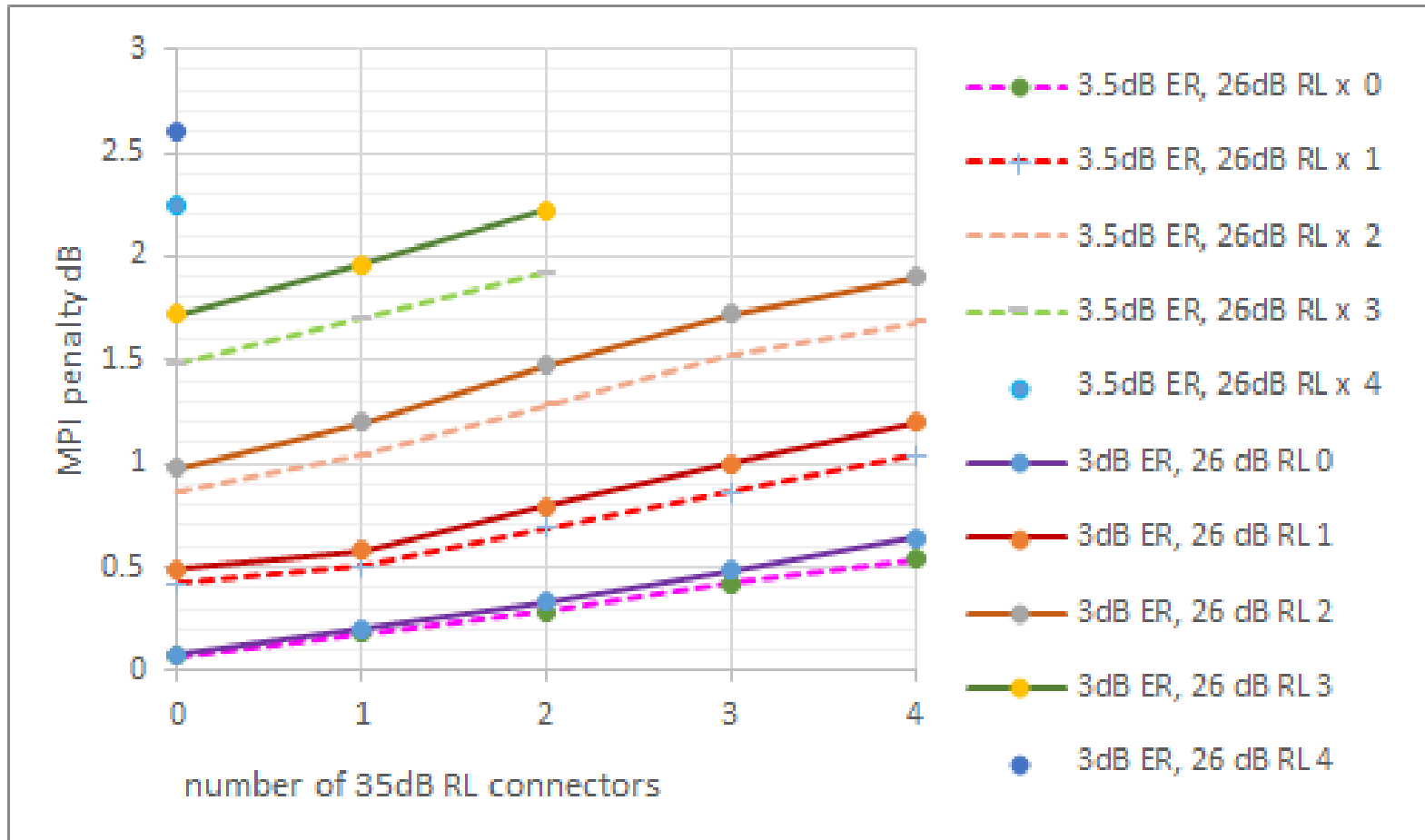
Tabulated MPI penalties

- 3.5 dB and 3 dB ER

3.5 dB ER		3.5dB ER, 26dB RL x				
		0	1	2	3	4
35 dB RL	0	0.07	0.42	0.86	1.48	2.24
	1	0.18	0.5	1.04	1.7	
	2	0.28	0.69	1.28	1.92	
	3	0.42	0.86	1.52		
	4	0.54	1.04	1.68		

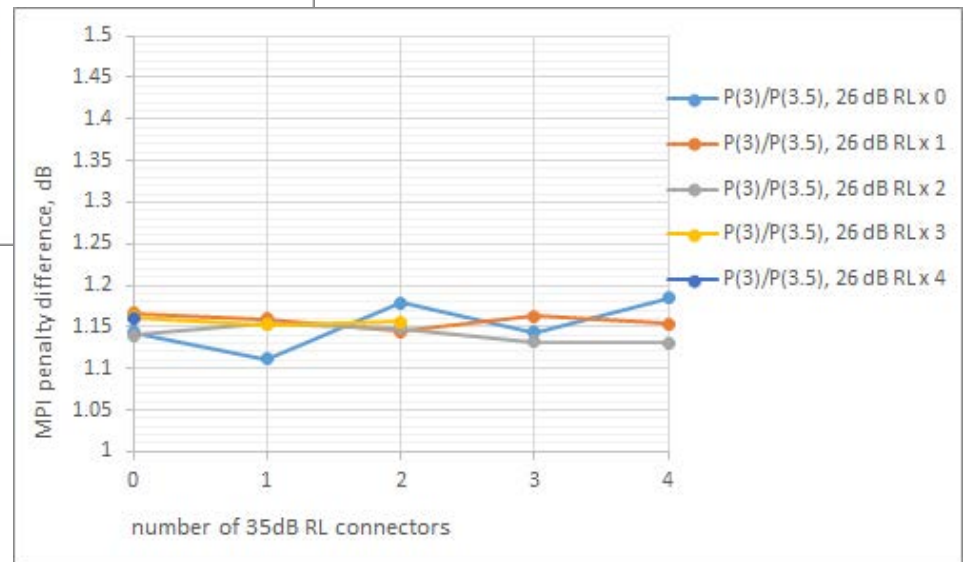
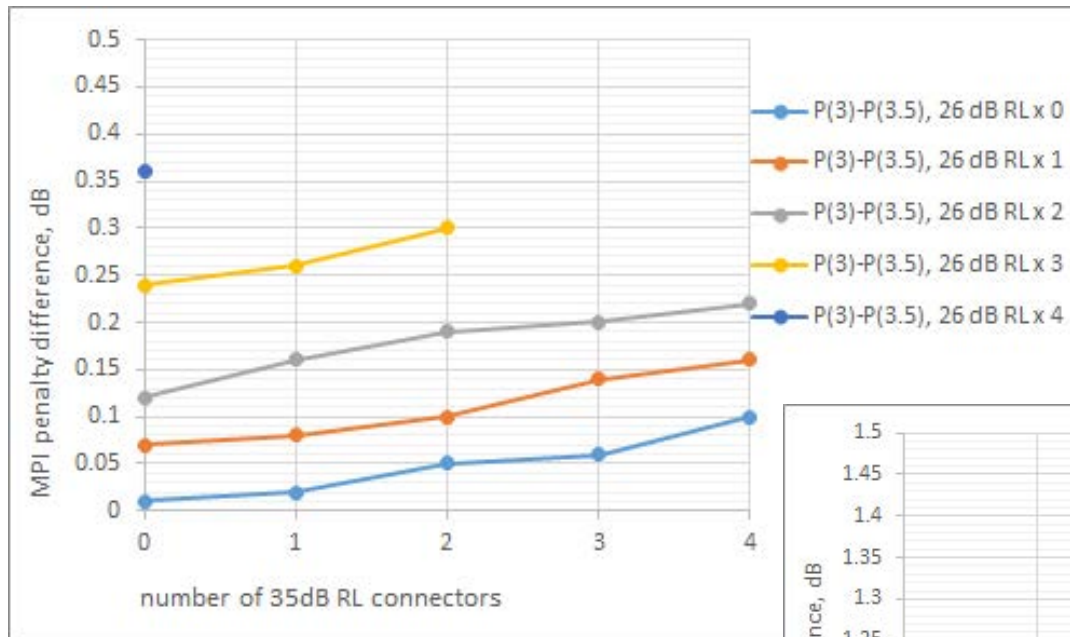
3 dB ER		3dB ER, 26 dB RL				
		0	1	2	3	4
35 dB RL	0	0.08	0.49	0.98	1.72	2.6
	1	0.2	0.58	1.2	1.96	
	2	0.33	0.79	1.47	2.22	
	3	0.48	1	1.72		
	4	0.64	1.2	1.9		

MPI penalty vs number of 35 dB and 26 dB RL connectors



25GBASE-LR MPI penalty

Difference between MPI penalties for 3 dB vs 3.5 dB ER



Ratio of dB MPI penalties for 3 dB vs 3.5 dB ER

Summary

- MPI penalty for 25GBASE-LR:
 - is negligible if just Tx and Rx return loss are considered
 - but becomes rapidly significant when more than one connector with return loss <35 dB is included
- The increase in MPI penalty for lowering ER from 3.5 dB to 3 dB is ~about a 20% increase in the dB MPI penalty (e.g. an MPI penalty would increase from 0.5 dB to 0.6 dB for four 35 dB RL connectors)