100GBASE-DR
MPI vs ER

following P802.3cd connector RL matrix in Table 140-12

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100GBASE-DR, MPI penalty for 3.5, 4, 5 dB ER, following P802.3cd connector RL matrix in Table 140-12

- *king_02a_0116_smf* MPI model unrolled to 110k samples
- MPI penalty extrapolated to 10^{-6} probability

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]

MPI penalty matrix

45dB x	0			1			2			3			4			5			6			7			8		
ER	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5
0	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.07	0.06	0.07	0.10	0.07	0.09	0.11	0.08	0.11	0.13	0.09	0.13	0.15	0.10	0.13	0.18
1	0.06	0.07	0.09	0.08	0.09	0.12	0.09	0.12	0.14	0.10	0.14	0.16	0.13	0.15	0.19	0.14	0.19	0.22	0.14	0.19	0.23	0.17	0.21	0.24	0.18	0.24	0.27
2	0.12	0.17	0.19	0.14	0.18	0.22	0.16	0.21	0.24	0.17	0.23	0.28	0.20	0.25	0.30	0.22	0.27	0.34	0.22	0.28	0.35	0.24	0.31	0.37	0.27	0.34	0.41
3	0.21	0.27	0.33	0.22	0.32	0.35	0.24	0.34	0.36	0.26	0.35	0.43	0.27	0.37	0.44	0.29	0.39	0.48	0.31	0.43	0.50	0.32	0.44	0.53			
4	0.34	0.42	0.50	0.35	0.44	0.53	0.37	0.47	0.55	0.38	0.50	0.57	0.40	0.52	0.60	0.38	0.55	0.63	0.45	0.57	0.64						
5	0.44	0.57	0.65	0.47	0.64	0.71	0.47	0.60	0.76	0.50	0.65	0.78	0.53	0.64	0.80	0.49	0.73	0.84									
6	0.53	0.75	0.90	0.58	0.77	0.88																					

Penalty vs ER

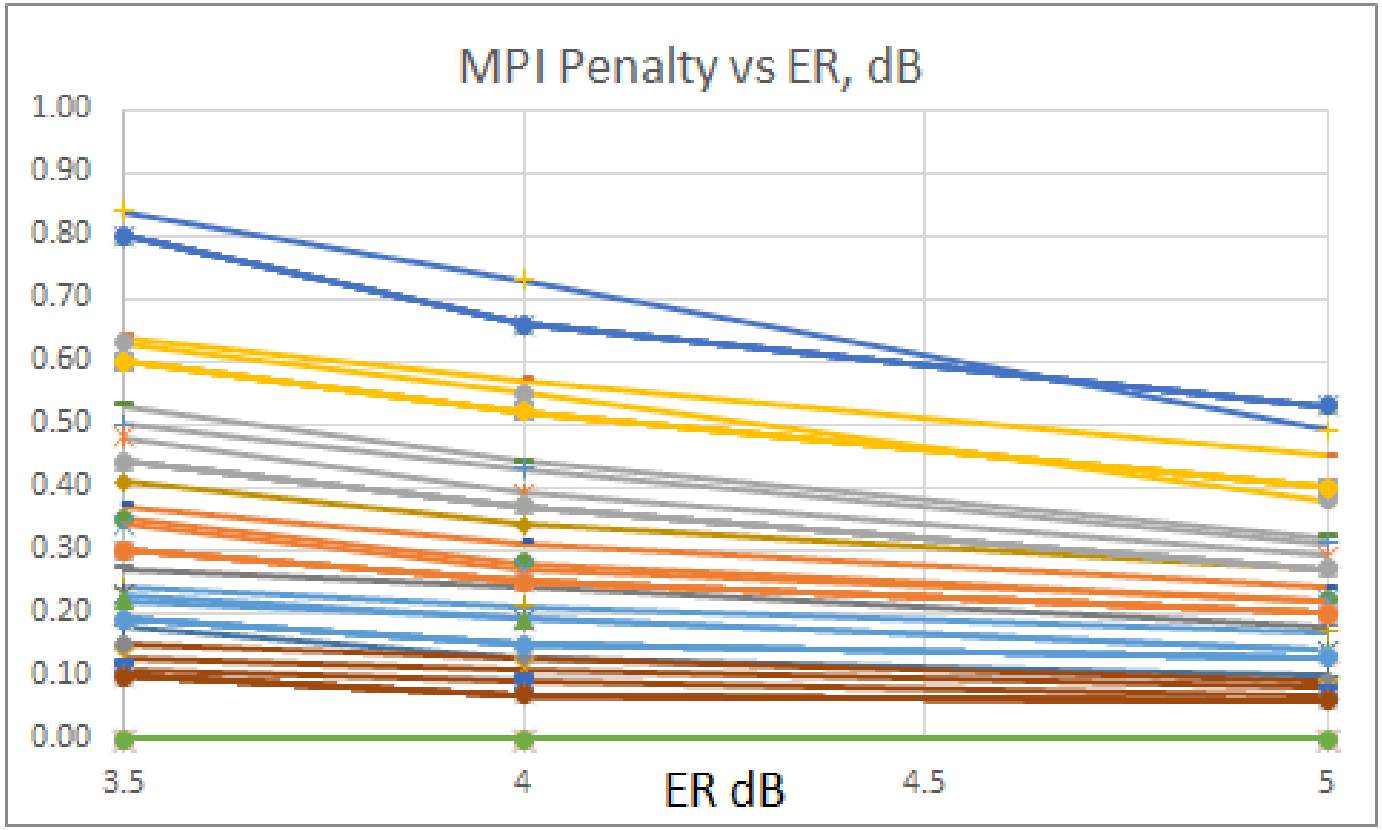
P2-P1	45dB x	0			1			2			3			4			5			6			7			8		
	ER	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5
35 dB x	0	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.01	0.04	0.00	0.02	0.04	0.00	0.03	0.05	0.00	0.04	0.06	0.00	0.03	0.08
	1	0.00	0.01	0.03	0.00	0.01	0.04	0.00	0.03	0.05	0.00	0.04	0.06	0.00	0.02	0.06	0.00	0.05	0.08	0.00	0.05	0.09	0.00	0.04	0.07	0.00	0.06	0.09
	2	0.00	0.05	0.07	0.00	0.04	0.08	0.00	0.05	0.08	0.00	0.06	0.11	0.00	0.05	0.10	0.00	0.05	0.12	0.00	0.06	0.13	0.00	0.07	0.13	0.00	0.07	0.14
	3	0.00	0.06	0.12	0.00	0.10	0.13	0.00	0.10	0.12	0.00	0.09	0.17	0.00	0.10	0.17	0.00	0.10	0.19	0.00	0.12	0.19	0.00	0.12	0.21			
	4	0.00	0.08	0.16	0.00	0.09	0.18	0.00	0.10	0.18	0.00	0.12	0.19	0.00	0.12	0.20	0.00	0.17	0.25	0.00	0.12	0.19						
	5	0.00	0.13	0.21	0.00	0.17	0.24	0.00	0.13	0.29	0.00	0.15	0.28	0.00	0.11	0.27	0.00	0.24	0.35									
	6	0.00	0.22	0.37	0.00	0.19	0.30																					

Penalty at ER – penalty at 5dB ER

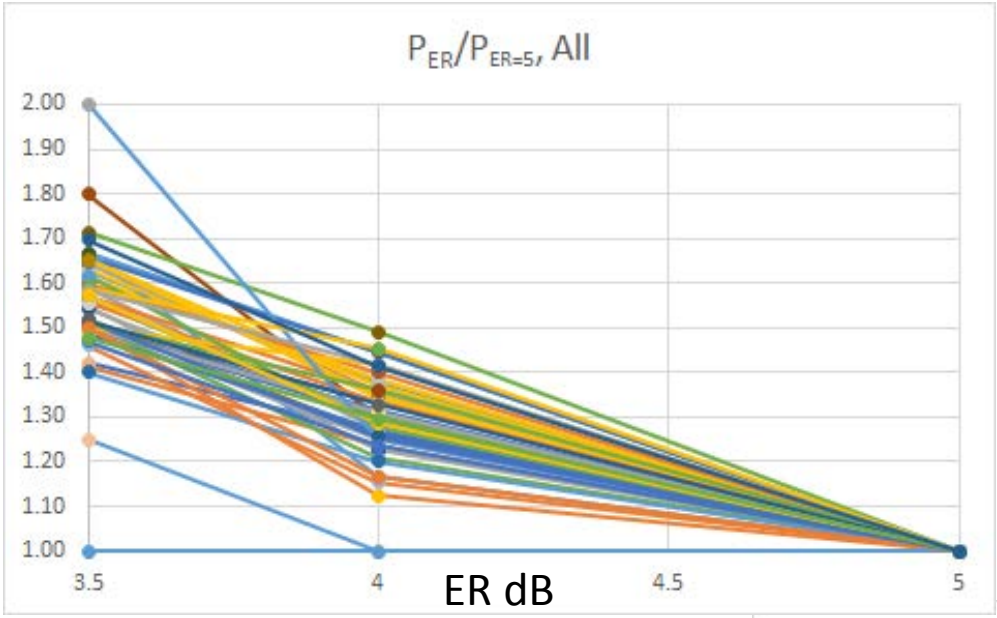
P2/P1	45dB x	0			1			2			3			4			5			6			7			8		
	ER	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5	5	4	3.5
35 dB x	0	1.00	1.00	1.00	1.00	1.25	2.00	1.00	1.00	1.25	1.00	1.20	1.40	1.00	1.17	1.67	1.00	1.29	1.57	1.00	1.38	1.63	1.00	1.44	1.67	1.00	1.30	1.80
	1	1.00	1.17	1.50	1.00	1.13	1.50	1.00	1.33	1.56	1.00	1.40	1.60	1.00	1.15	1.46	1.00	1.36	1.57	1.00	1.36	1.64	1.00	1.24	1.41	1.00	1.33	1.50
	2	1.00	1.42	1.58	1.00	1.29	1.57	1.00	1.31	1.50	1.00	1.35	1.65	1.00	1.25	1.50	1.00	1.23	1.55	1.00	1.27	1.59	1.00	1.29	1.54	1.00	1.26	1.52
	3	1.00	1.29	1.57	1.00	1.45	1.59	1.00	1.42	1.50	1.00	1.35	1.65	1.00	1.37	1.63	1.00	1.34	1.66	1.00	1.39	1.61	1.00	1.38	1.66			
	4	1.00	1.24	1.47	1.00	1.26	1.51	1.00	1.27	1.49	1.00	1.32	1.50	1.00	1.30	1.50	1.00	1.45	1.66	1.00	1.27	1.42						
	5	1.00	1.30	1.48	1.00	1.36	1.51	1.00	1.28	1.62	1.00	1.30	1.56	1.00	1.21	1.51	1.00	1.49	1.71									
	6	1.00	1.42	1.70	1.00	1.33	1.52																					

Penalty ratio at ER ref 5 dB ER

MPI penalty vs ER, all cases

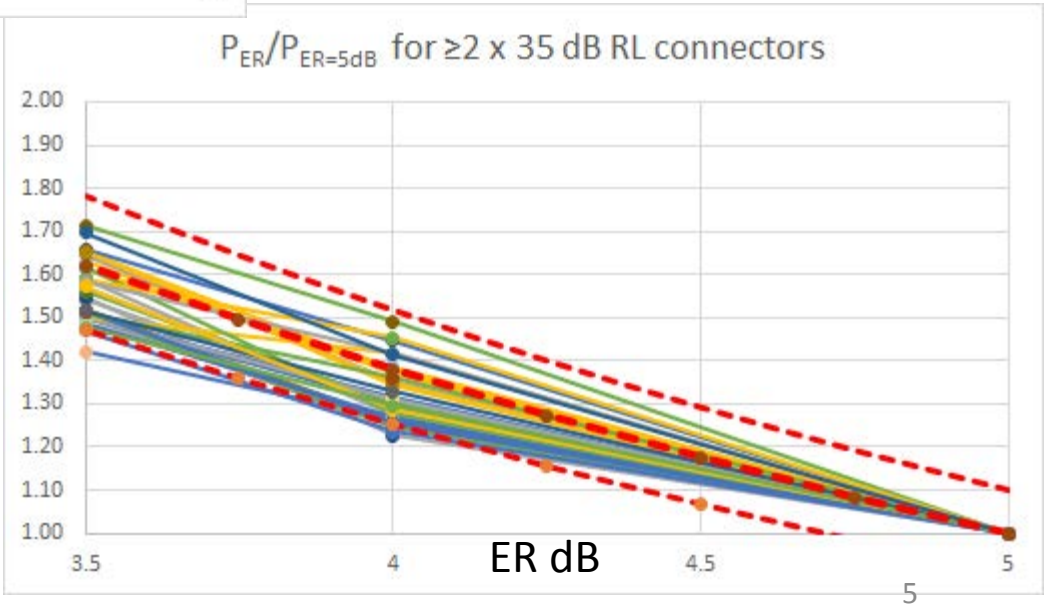


MPI penalty at ER=3.5 or 4 dB divided by penalty at 5 dB

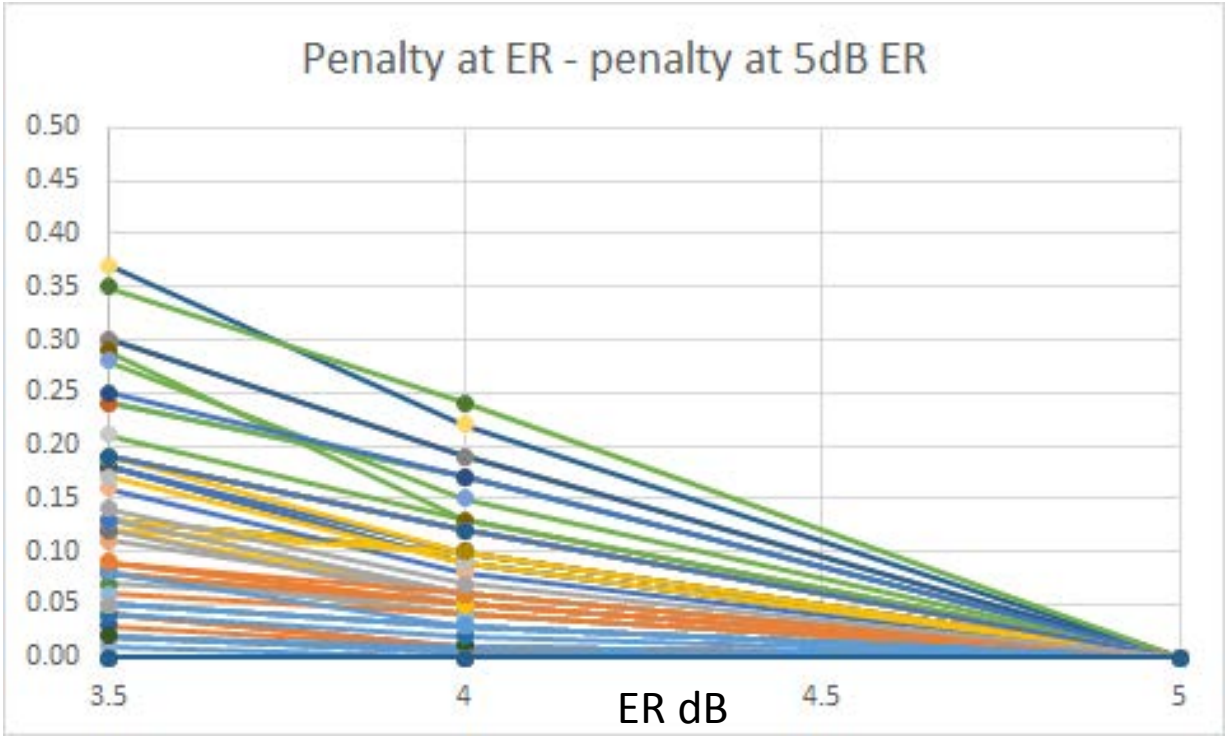


- Outliers are from scenarios with very low MPI at 5dB ER (all cases with < 2 x 35 dB RL connectors)

- Plot consistent with ~+/- 0.05 dB uncertainty



MPI penalty increase over the 5 dB ER penalty



Conclusions

- For all connector combinations in Table 140-12:
  - Maximum increase in MPI penalty for reducing ER from 5dB to 3.5 dB is 0.4 dB.
  - Maximum increase in MPI penalty for reducing ER from 5dB to 4 dB is 0.25 dB.

  - Over the ER range of 5 to 3.5 dB, the increase in MPI penalty for reduced ER is proportional to the penalty at 5dB, and increases inversely with ER (in dB), with close approximation to:

$$P_{ER} \sim P_{ER=5} \times 5^{\left(1-\frac{ER}{5}\right)}$$

Possible changes to 100GBASE-DR

- In Table 140-6:
- Decrease the extinction ratio (min) for 100GBASE-DR from 5 dB to 3.5 dB
- Replace “Launch power in OMAouter minus TDECQ (min)” with:

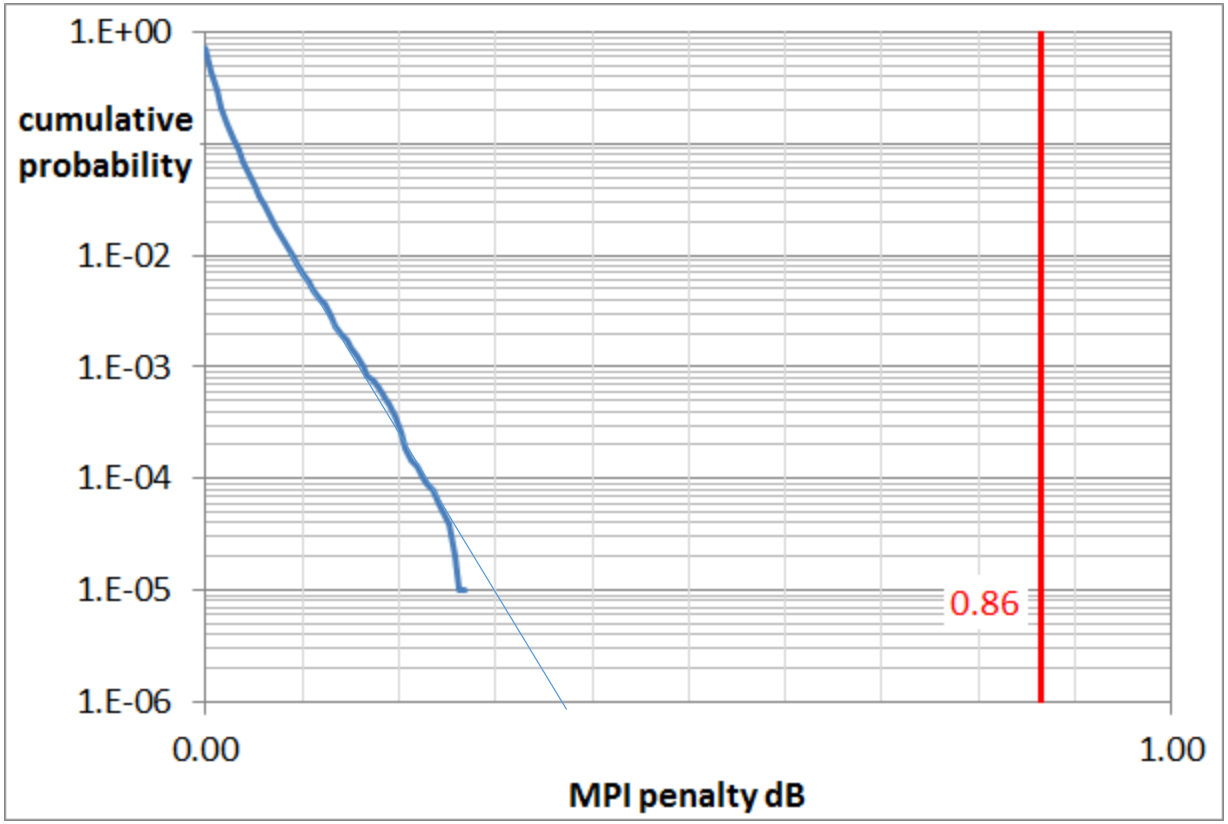
  “Launch power in OMA_{outer} minus TDECQ (min) for ER ≥ 5dB” (no change to value)
- Add a row

  “Launch power in OMA_{outer} minus TDECQ (min) for 5dB > ER ≥ 3.5dB” with value -0.9 dBm

  These changes have no detrimental impact on designs compliant to 802.3cd draft 1.3, but permit lower cost and lower power implementations.

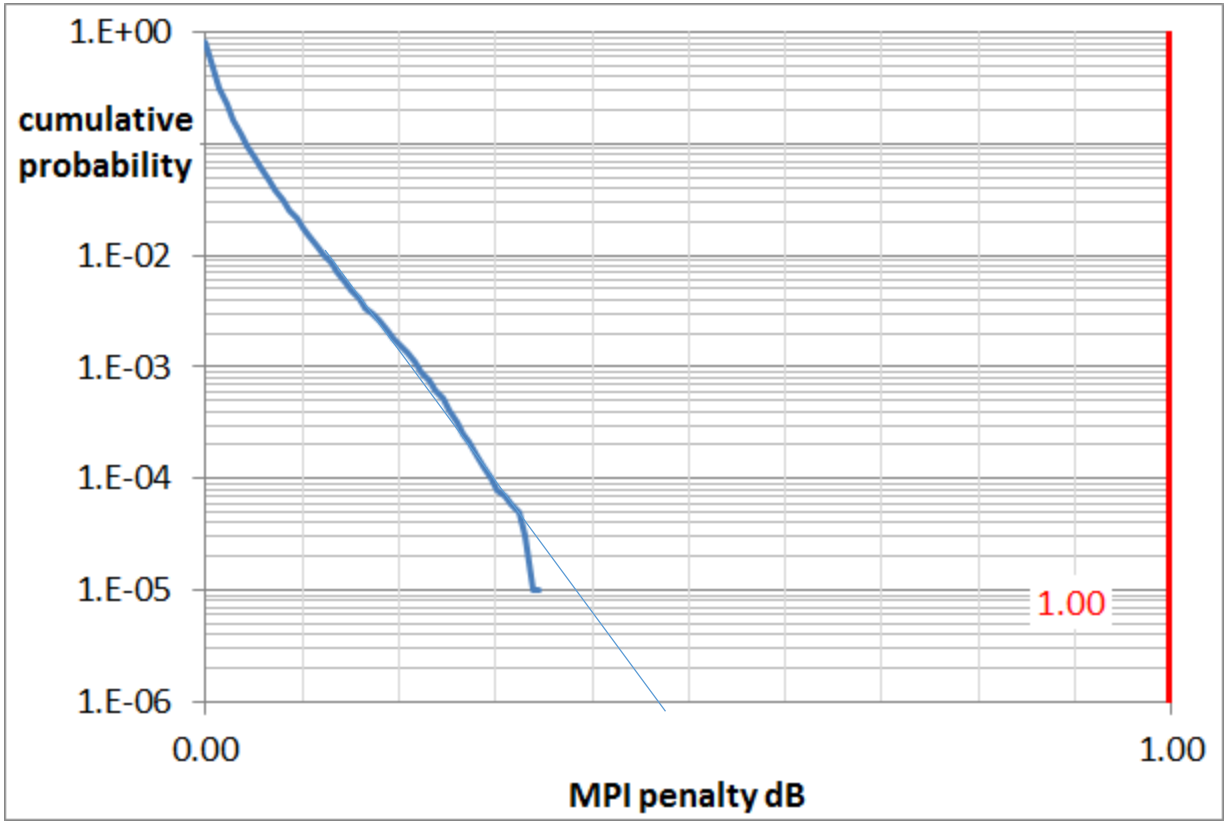
Back up - some MPI plots

100GBASE-DR, 5 dB ER



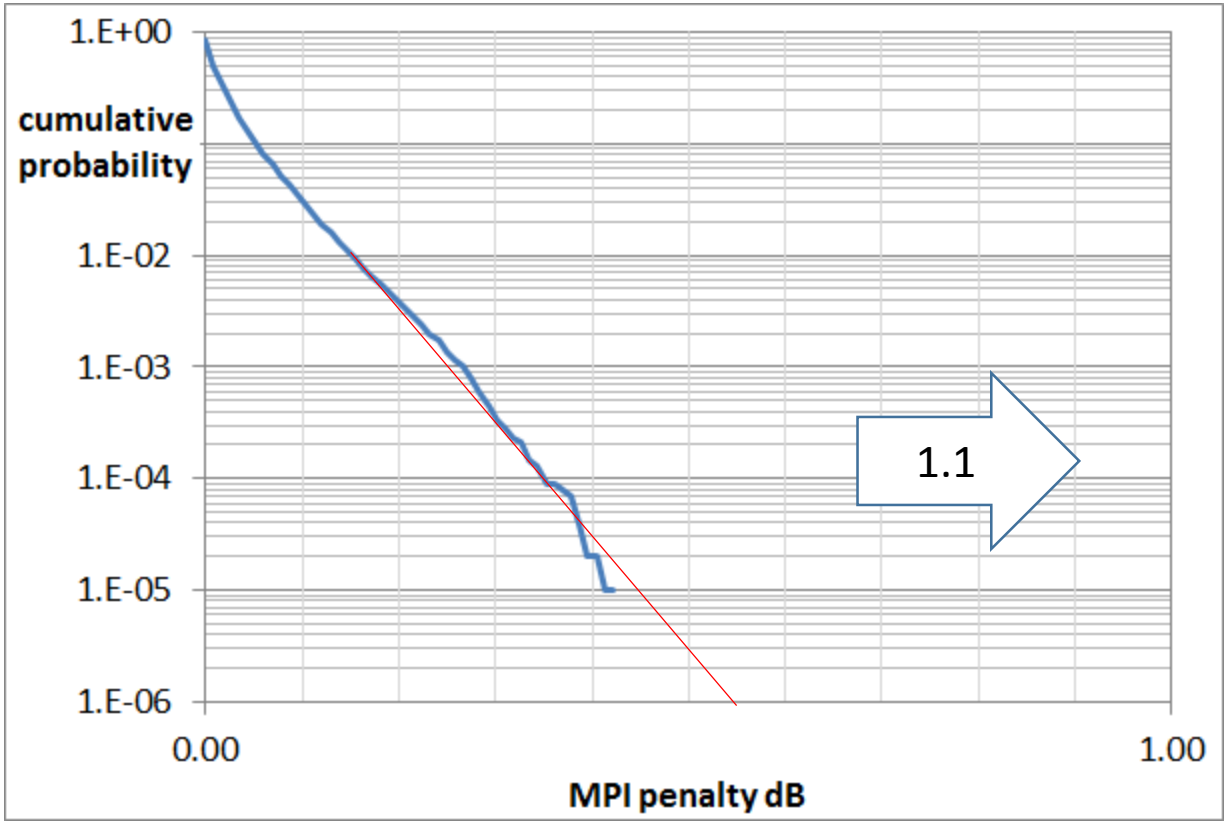
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.8, 4x35, 2x45

100GBASE-DR, 4 dB ER



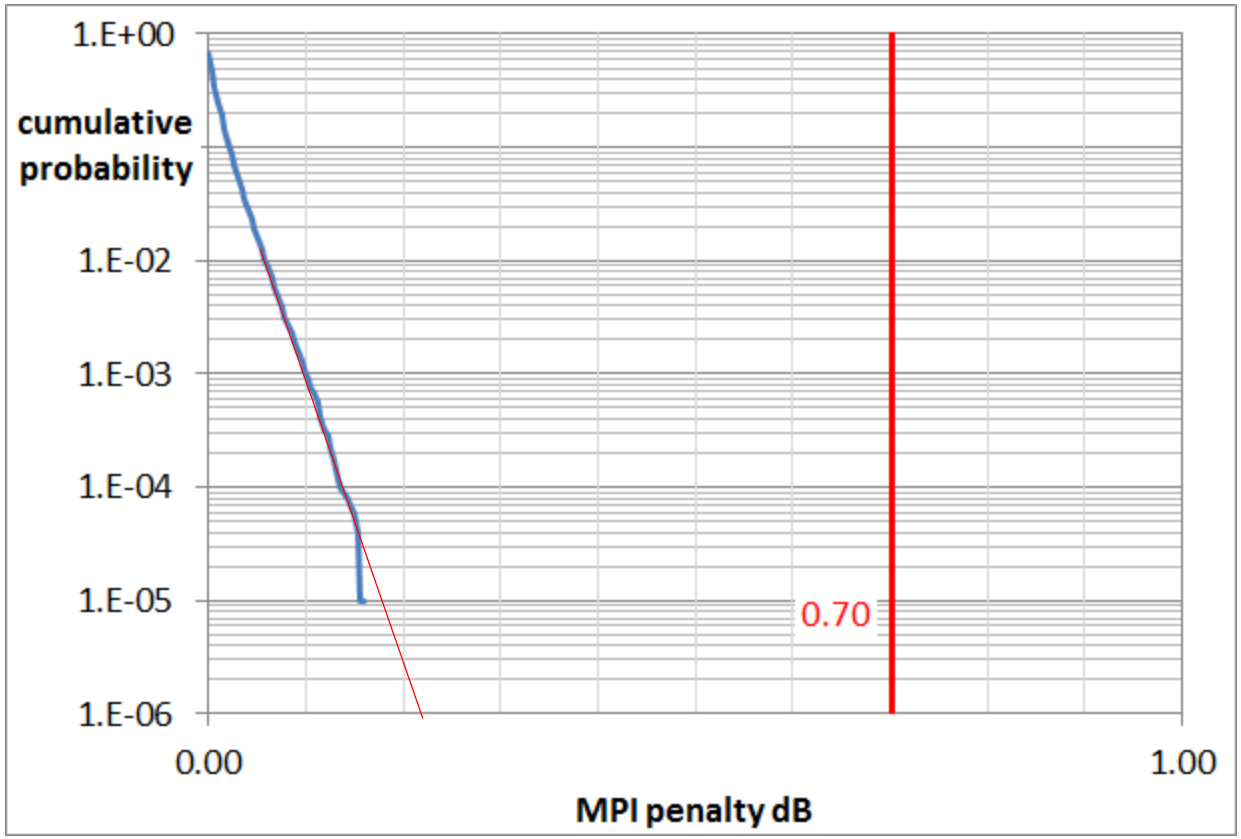
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.8, 4x35, 2x45

100GBASE-DR, 3.5 dB ER



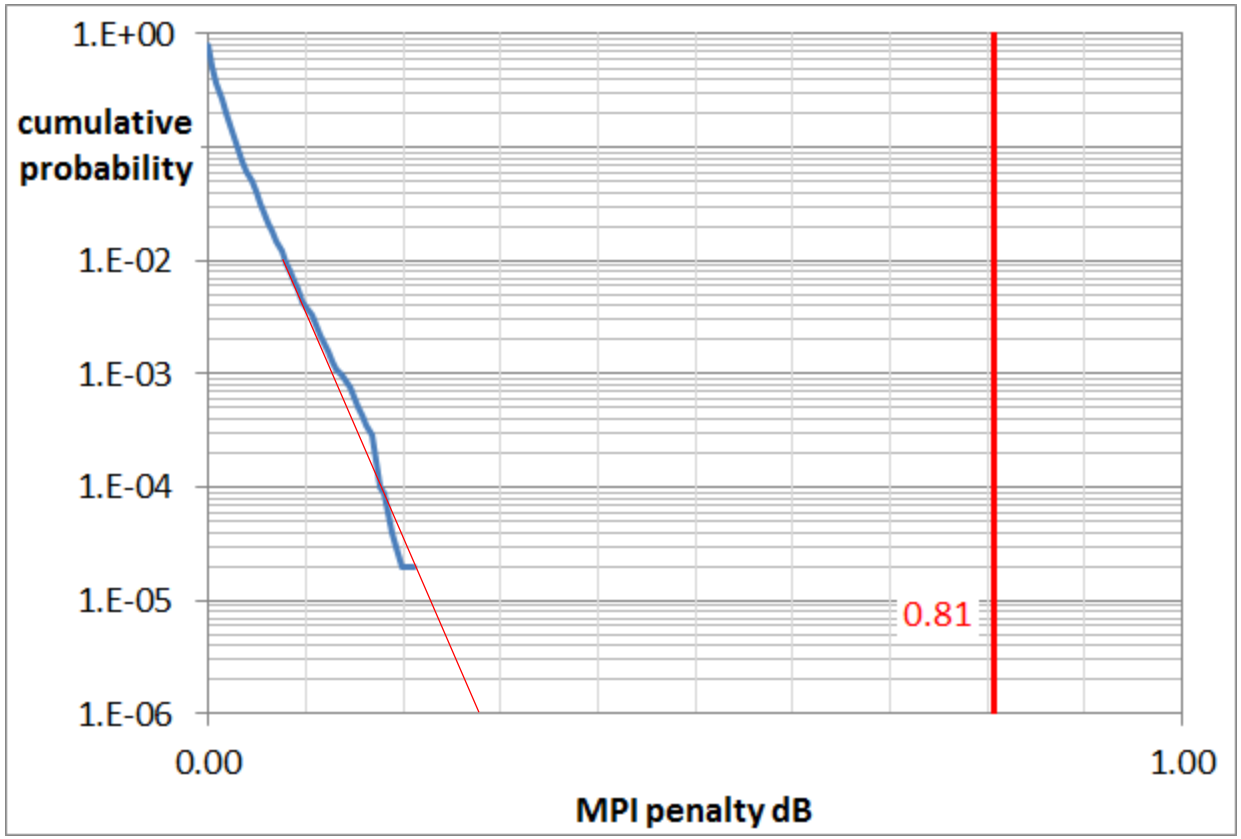
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.8, 4x35, 2x45

100GBASE-DR, 5 dB ER



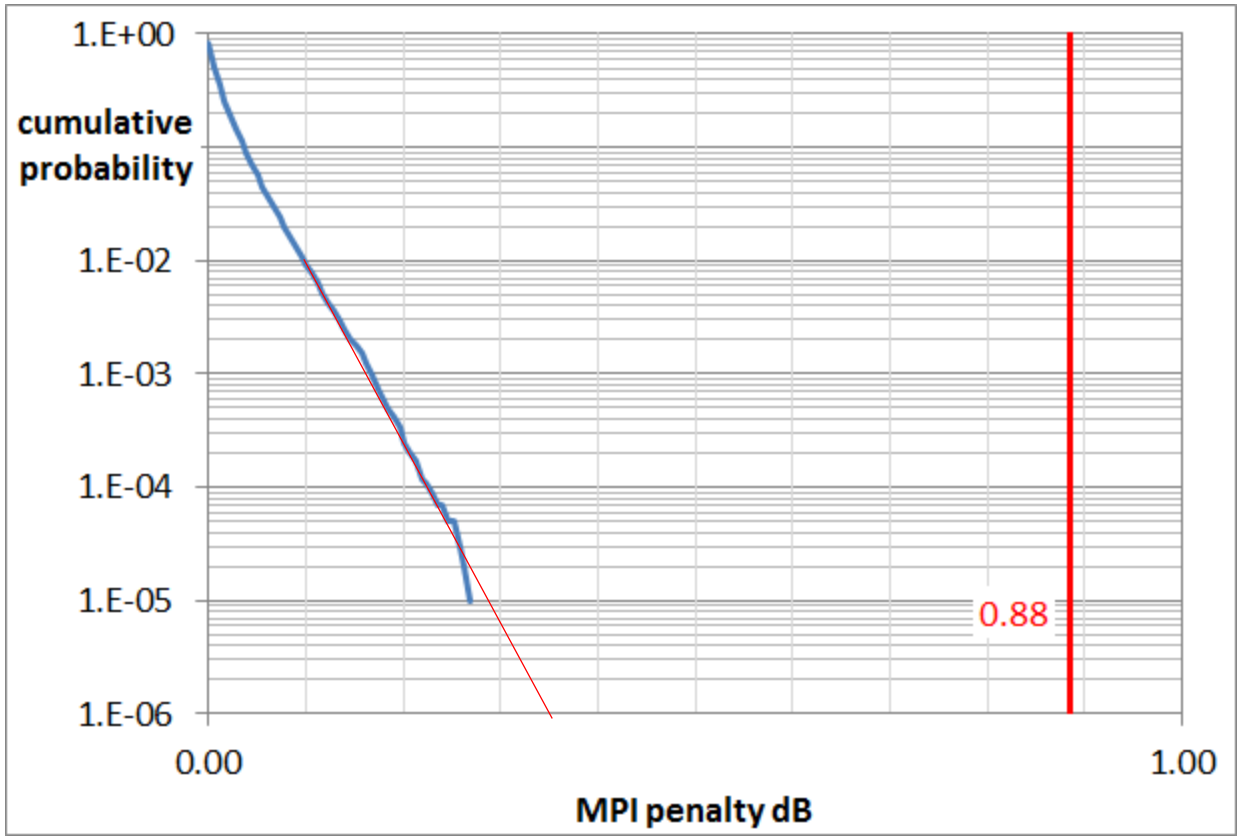
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.9, 2x35, 6x45

100GBASE-DR, 4 dB ER



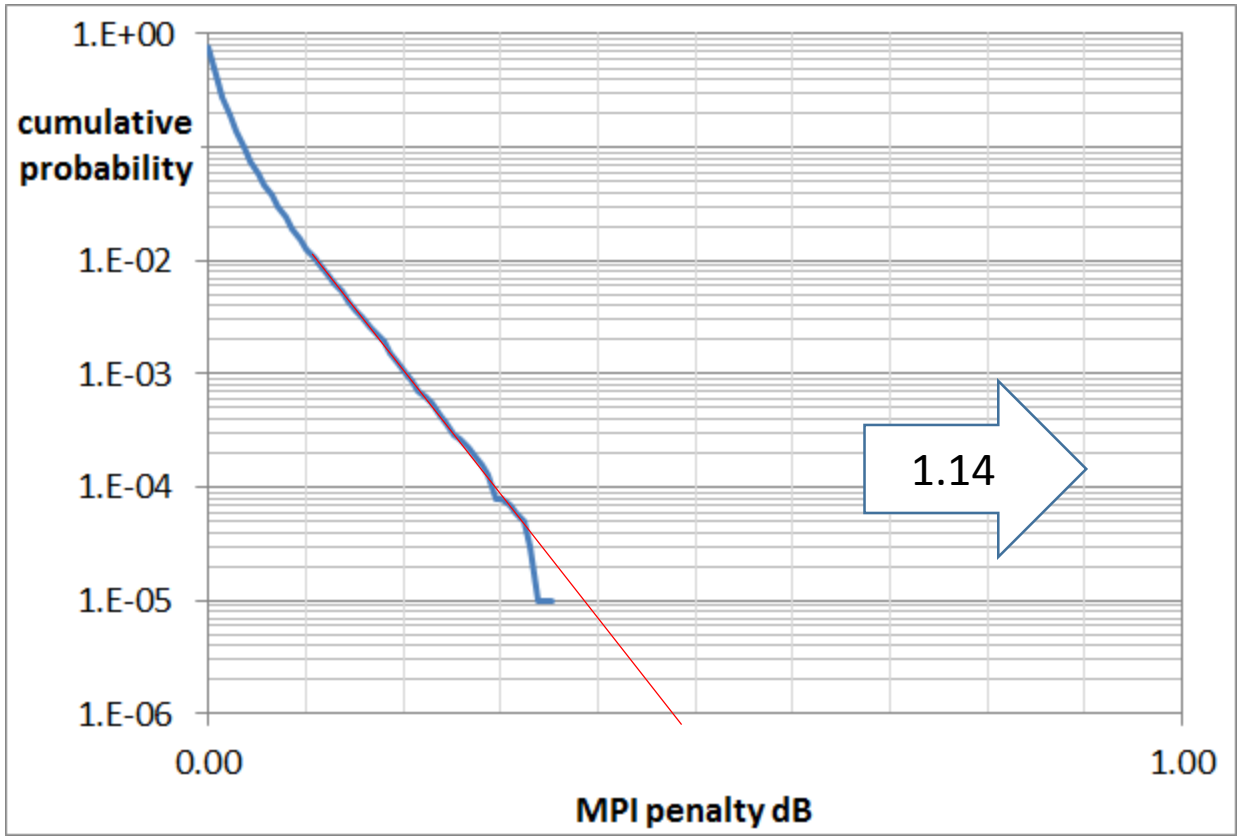
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.9, 2x35, 6x45

100GBASE-DR, 3.5 dB ER



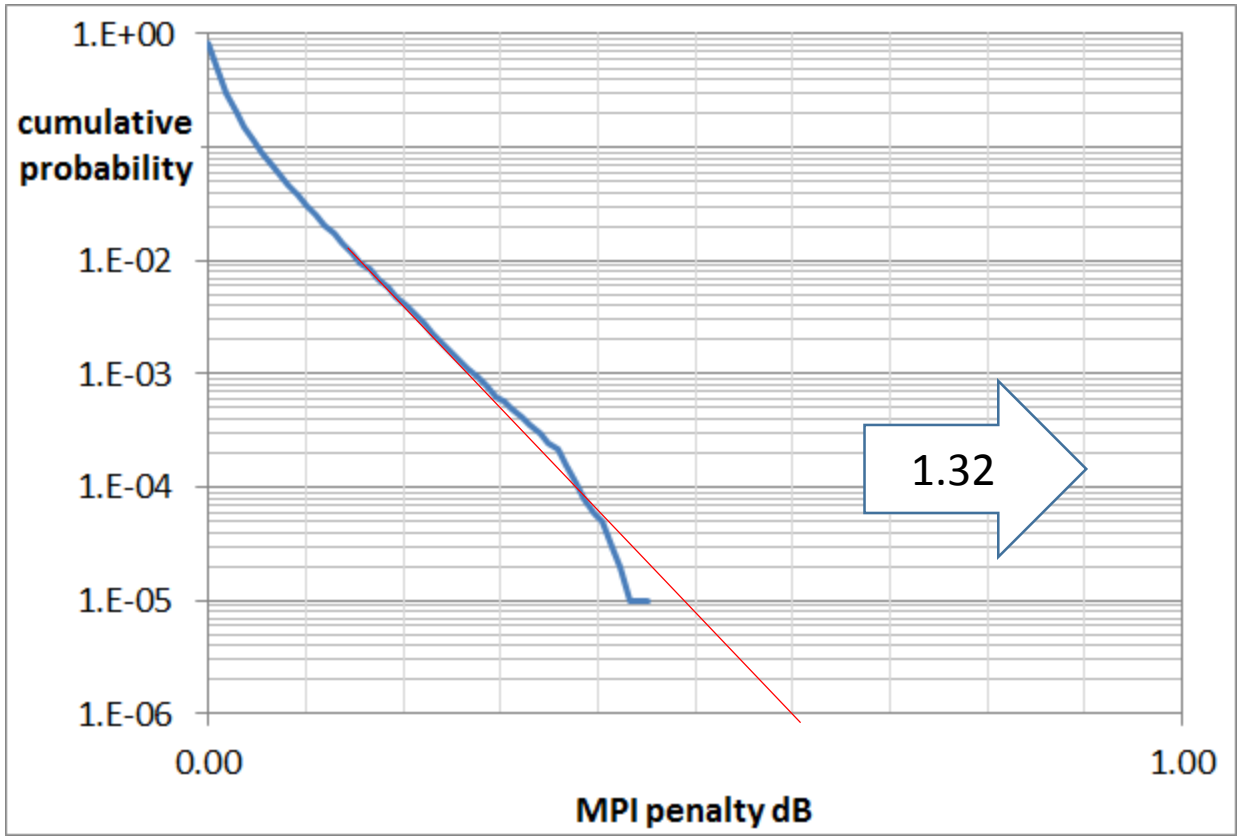
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.9, 2x35, 6x45

100GBASE-DR, 5 dB ER



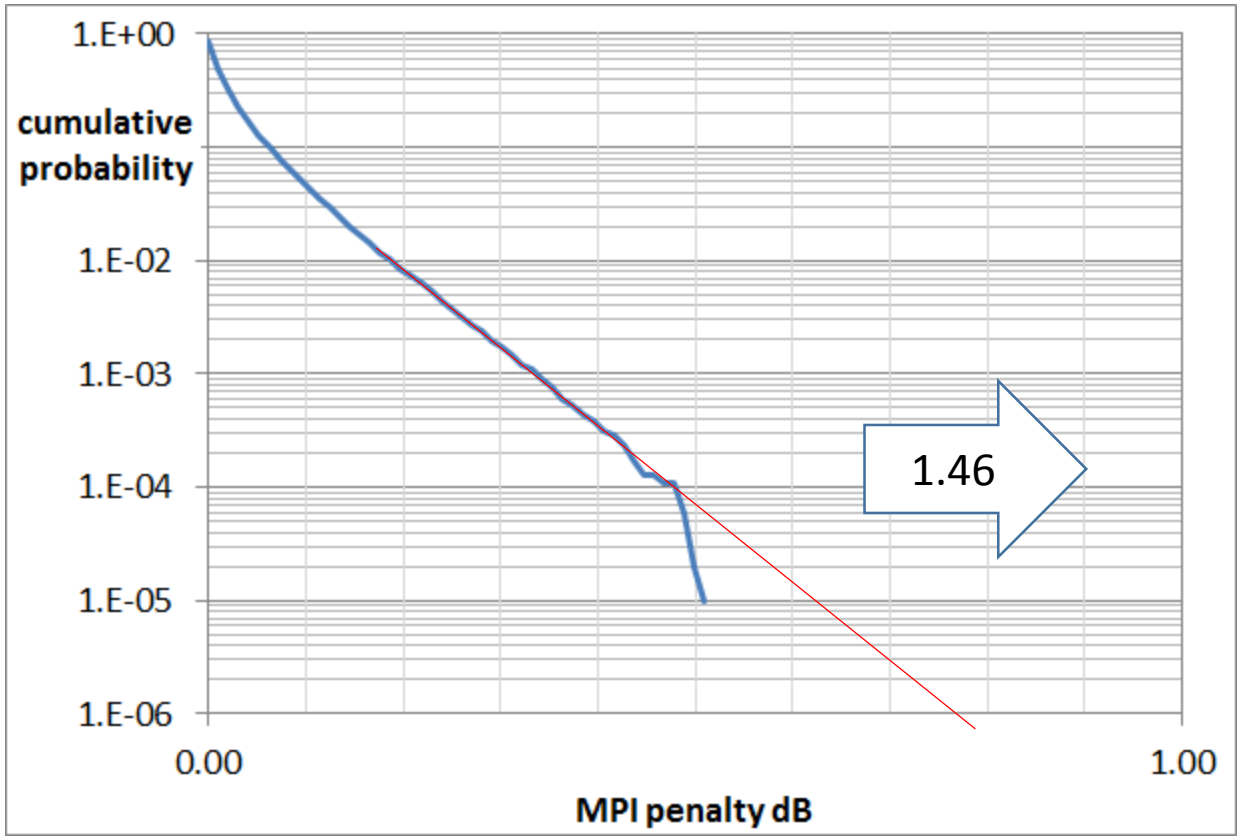
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 5x35, 2x45

100GBASE-DR, 4 dB ER



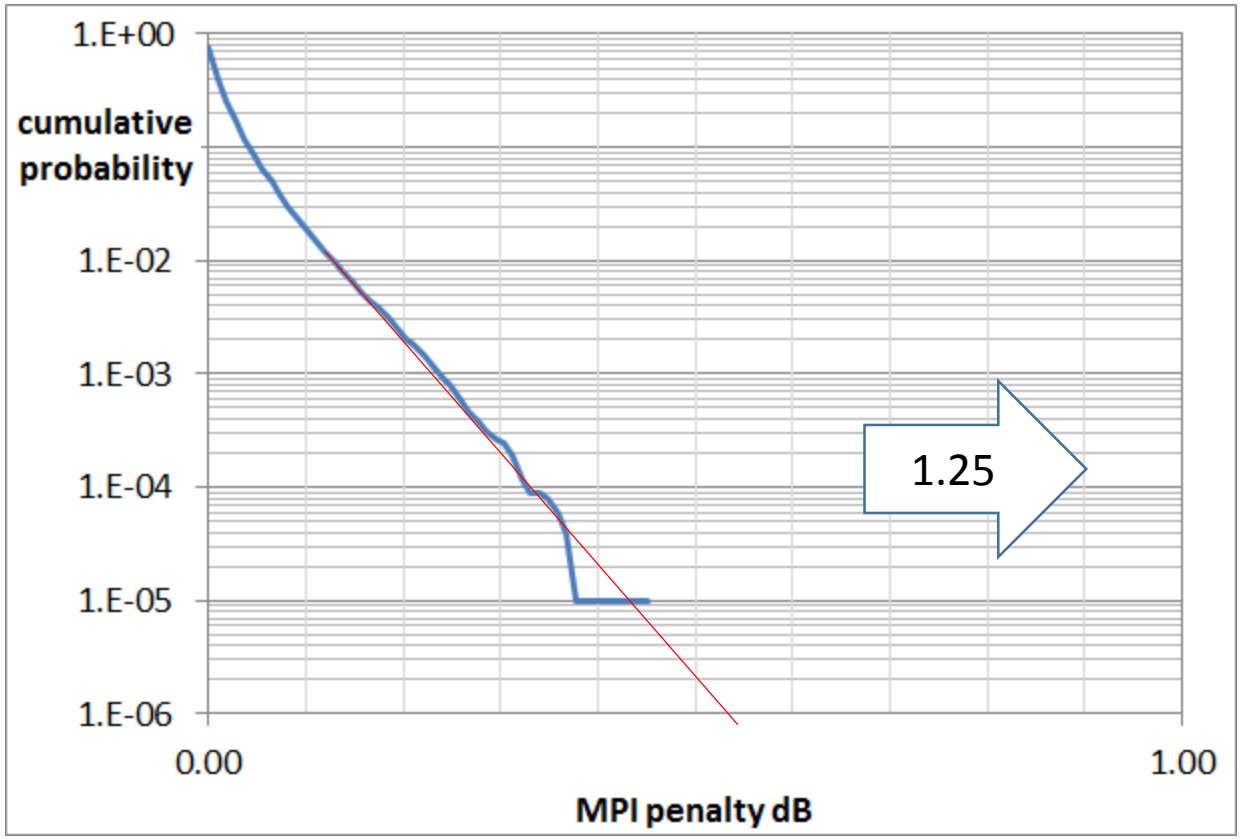
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 5x35, 2x45

100GBASE-DR, 3.5 dB ER



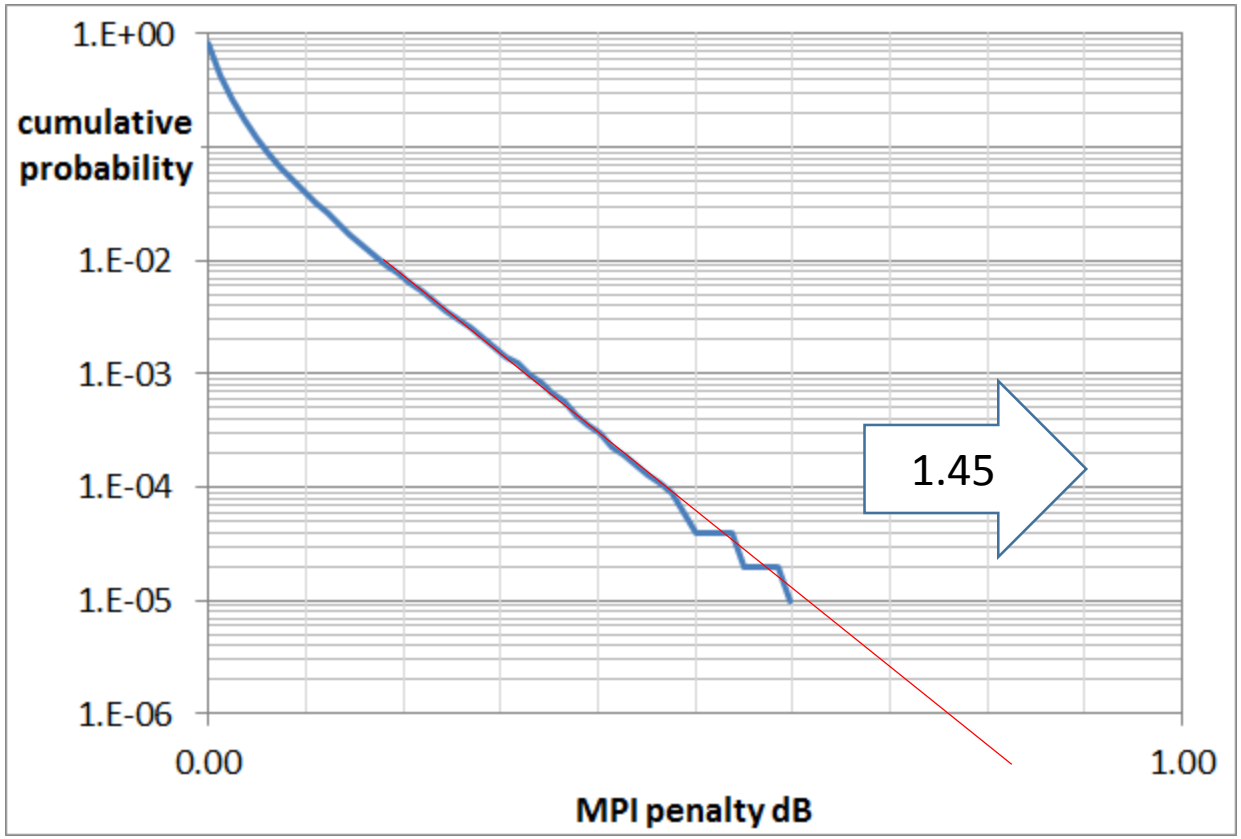
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 5x35, 2x45

100GBASE-DR, 5 dB ER



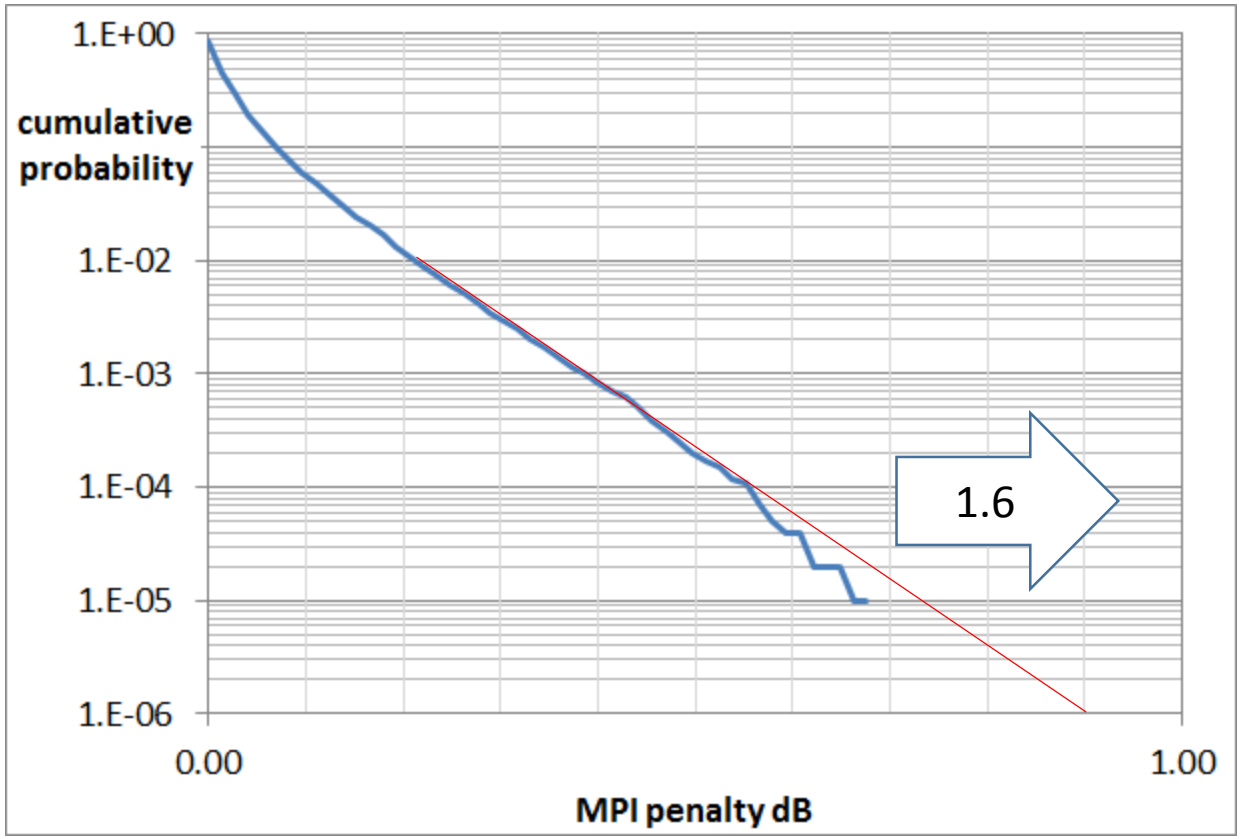
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 6x35, 0x45

100GBASE-DR, 4 dB ER



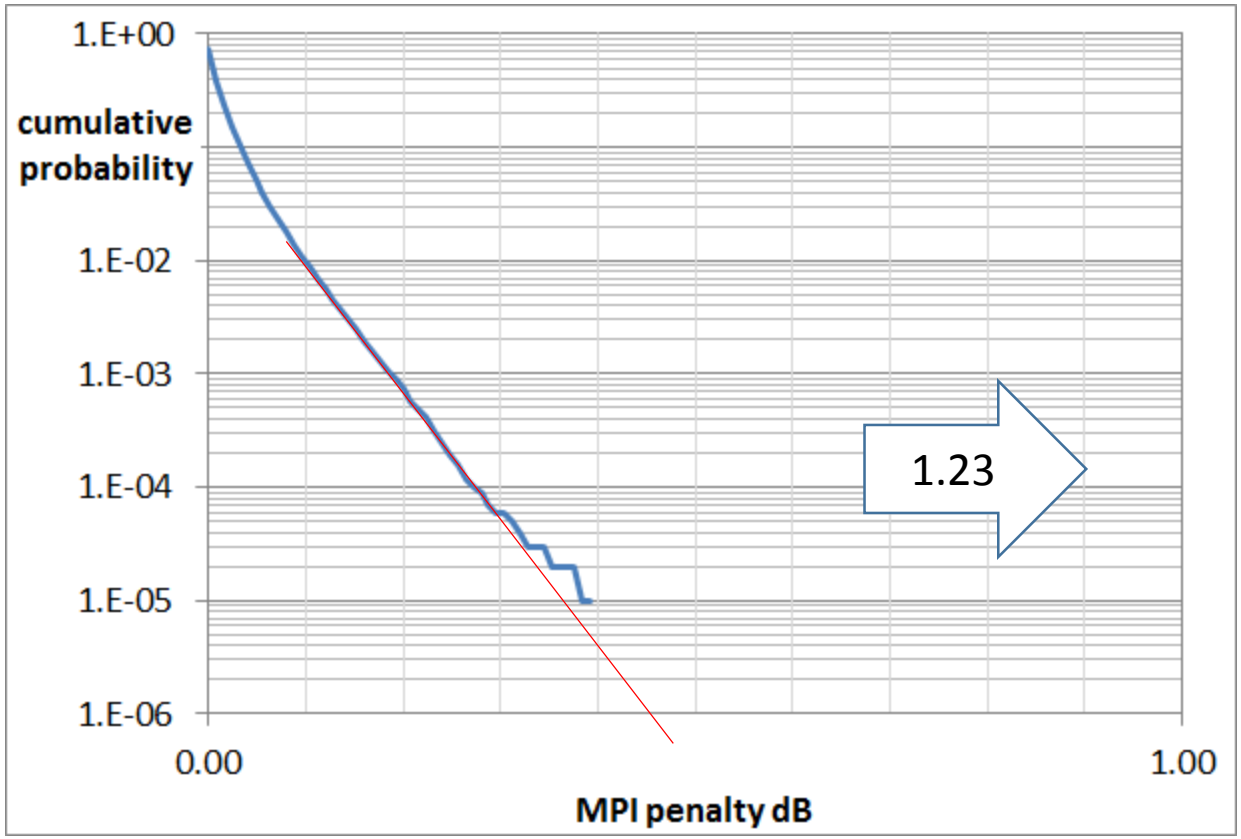
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 6x35, 0x45

100GBASE-DR, 3.5 dB ER



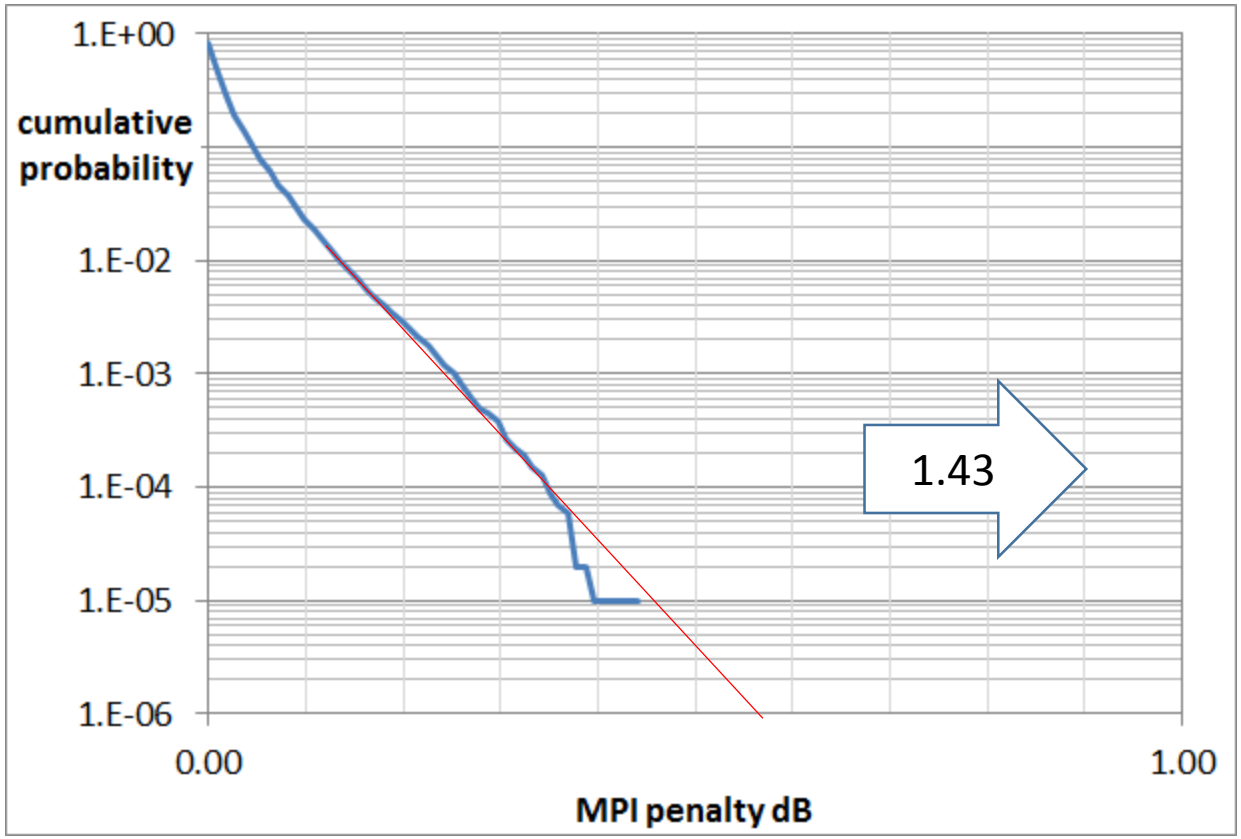
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 6x35, 0x45

100GBASE-DR, 5 dB ER



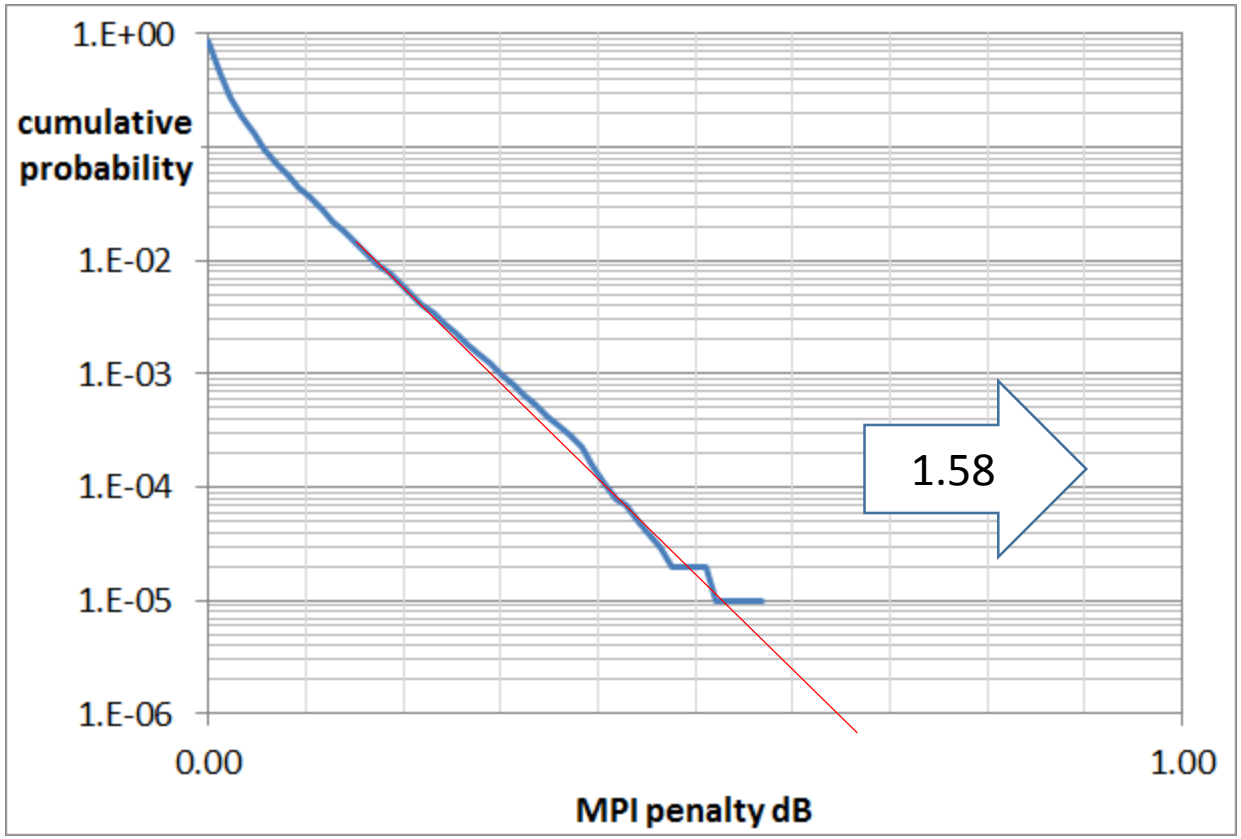
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 4x35, 6x45

100GBASE-DR, 4 dB ER



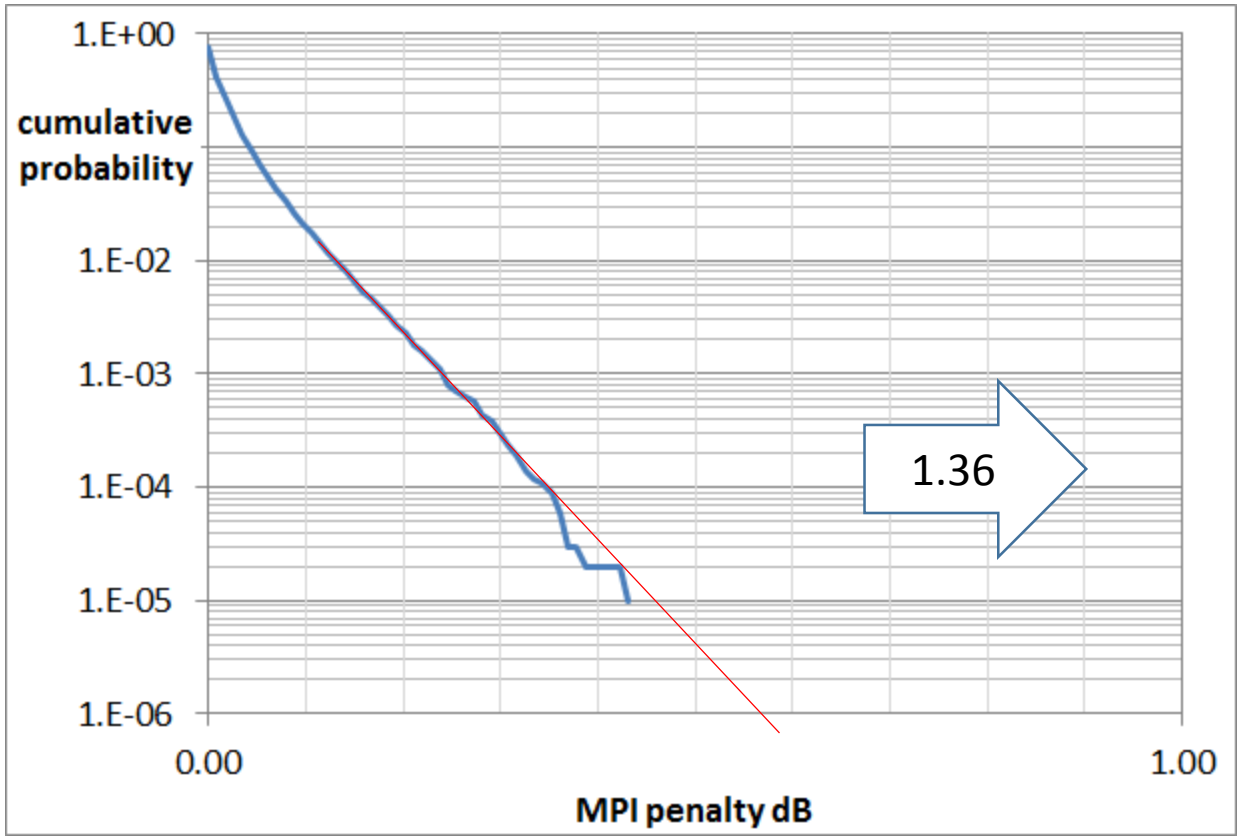
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 4x35, 6x45

100GBASE-DR, 3.5 dB ER



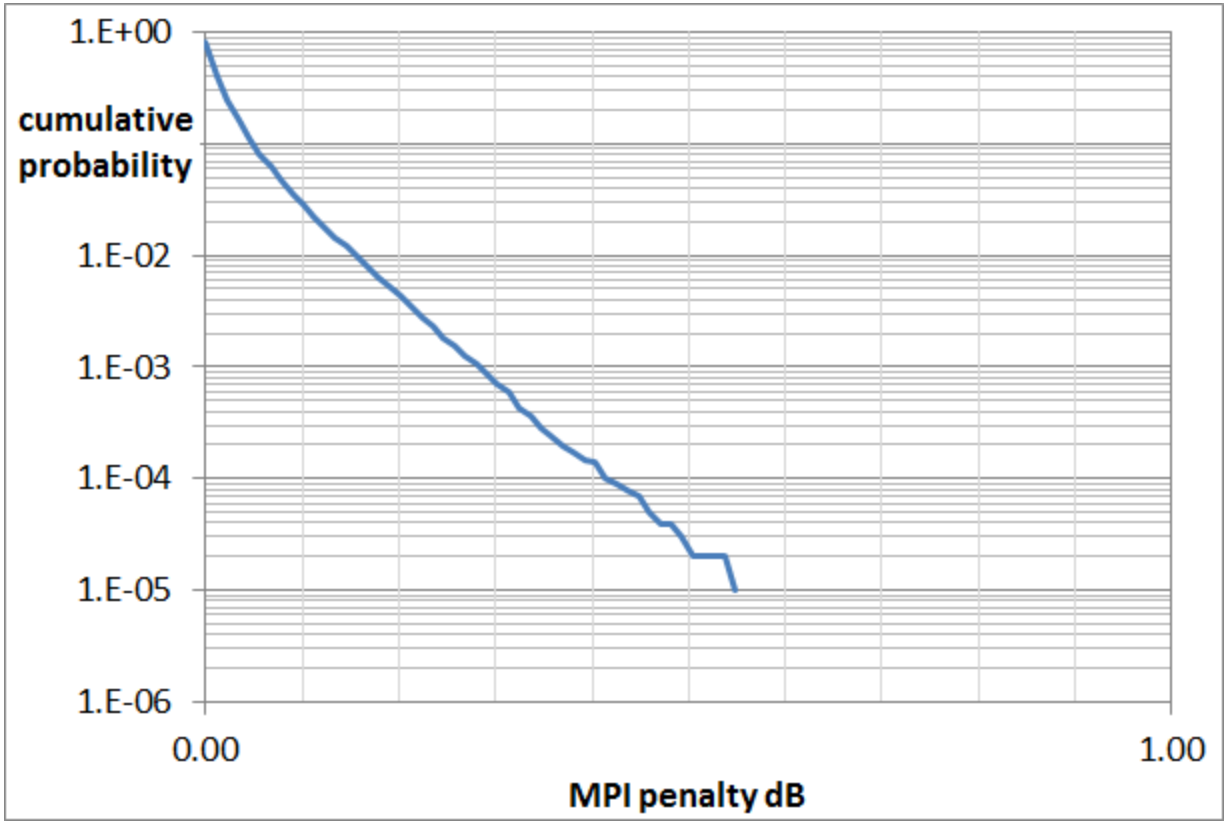
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.7, 4x35, 6x45

100GBASE-DR, 5 dB ER



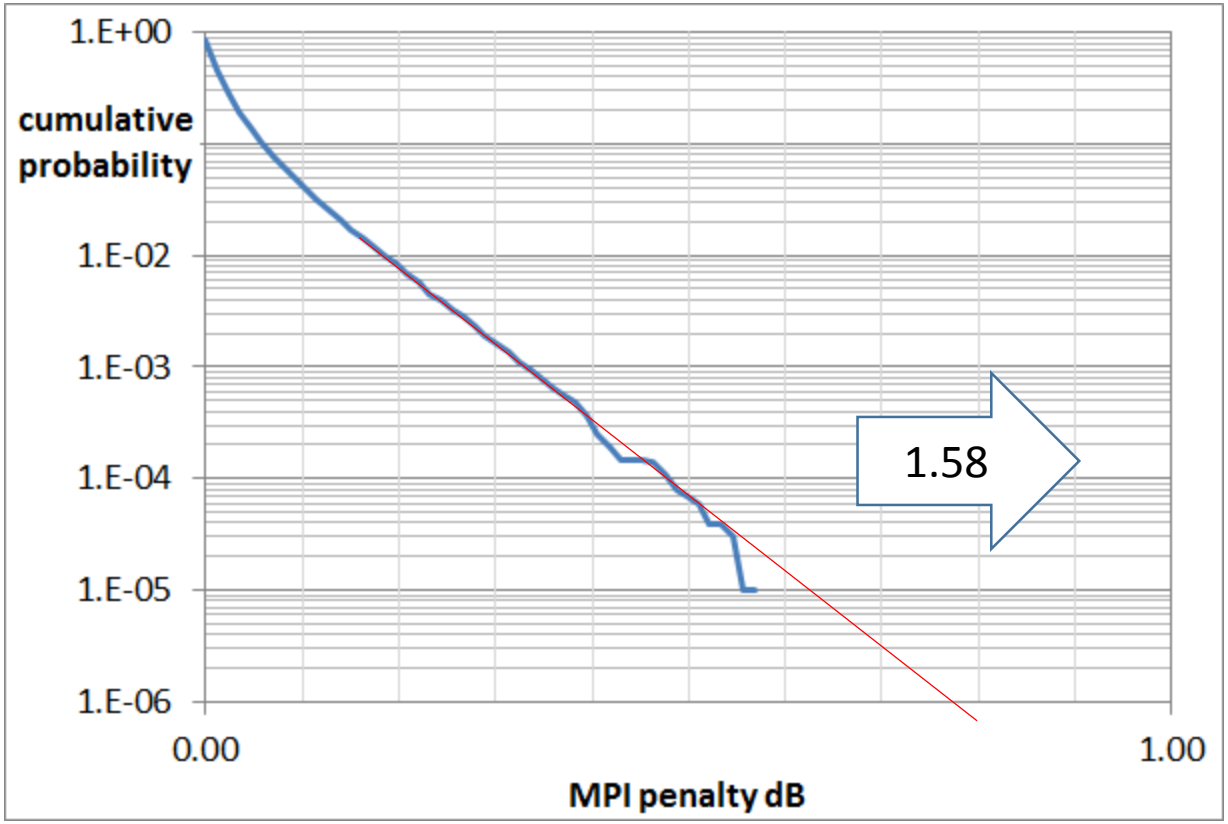
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 6x35, 1x45

100GBASE-DR, 4.5 dB ER



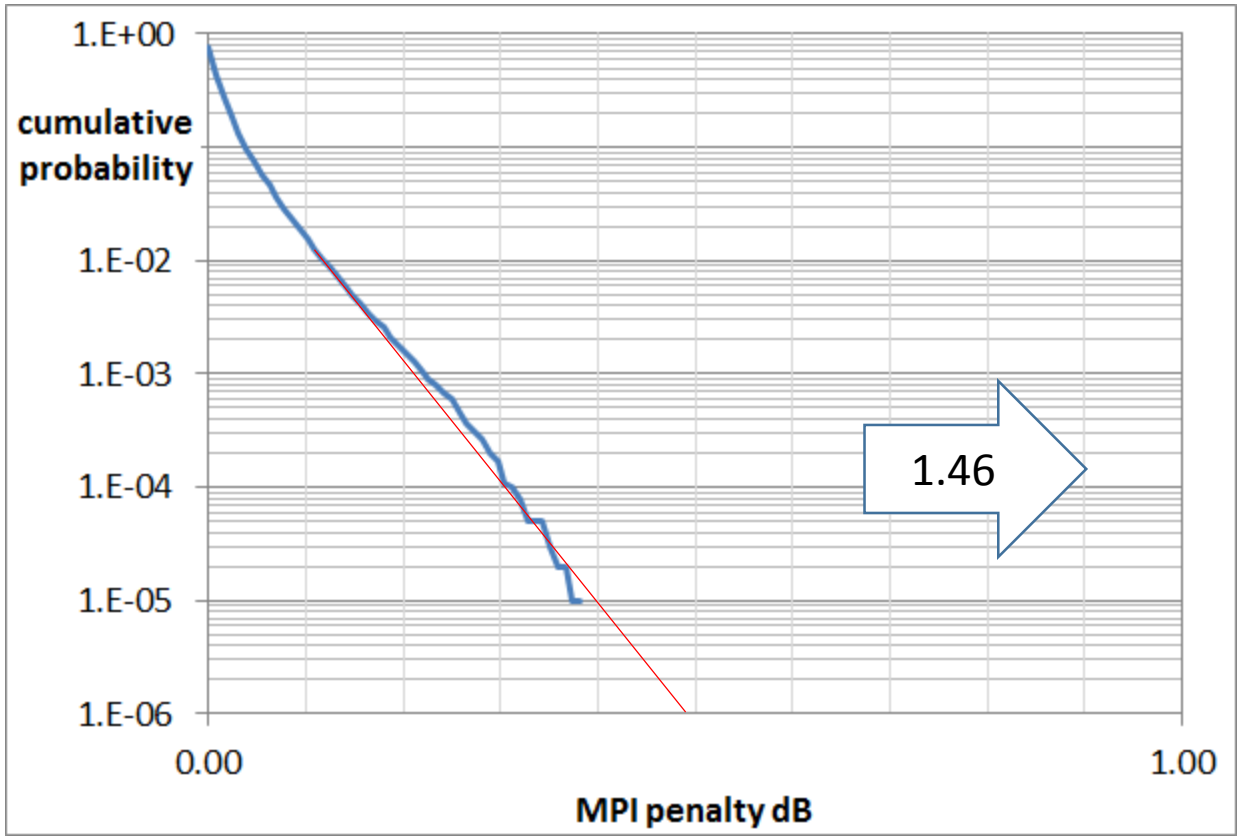
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 6x35, 1x45

100GBASE-DR, 4 dB ER



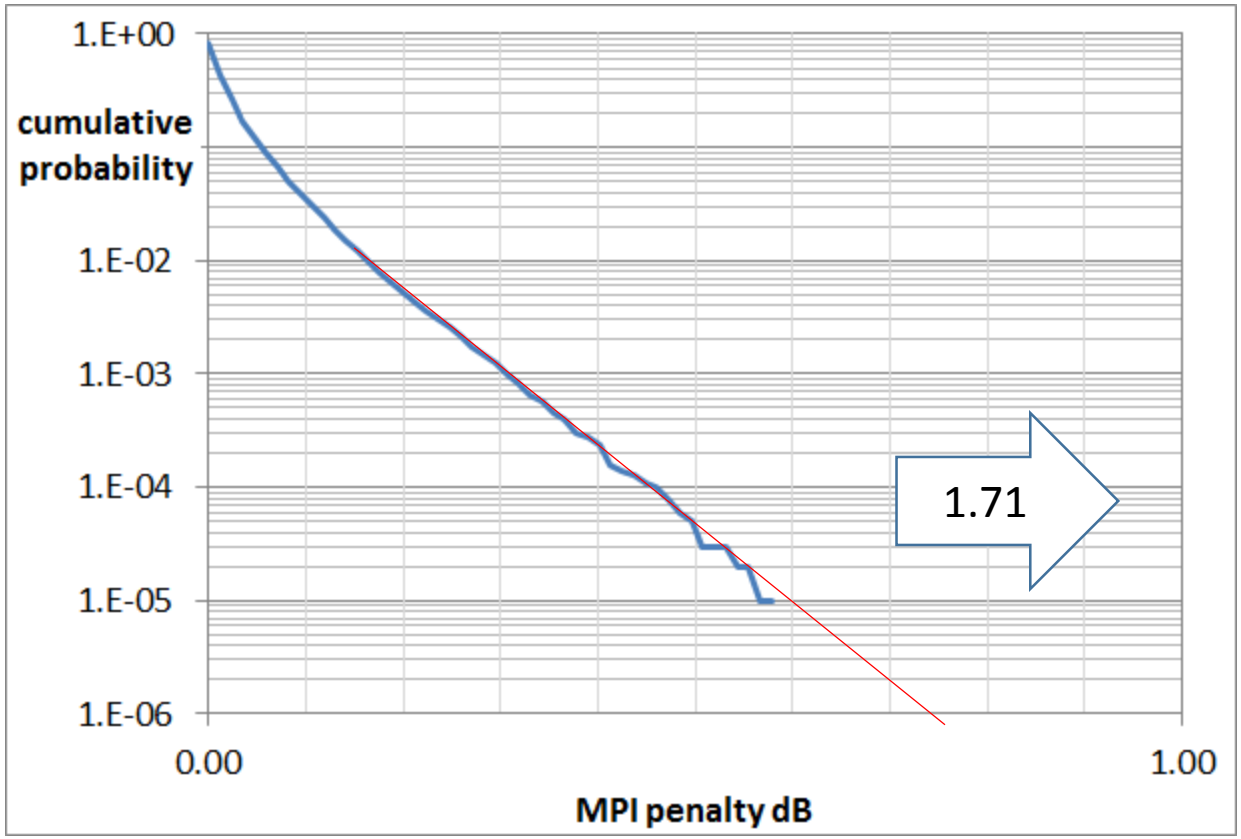
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 6x35, 1x45

100GBASE-DR, 5 dB ER



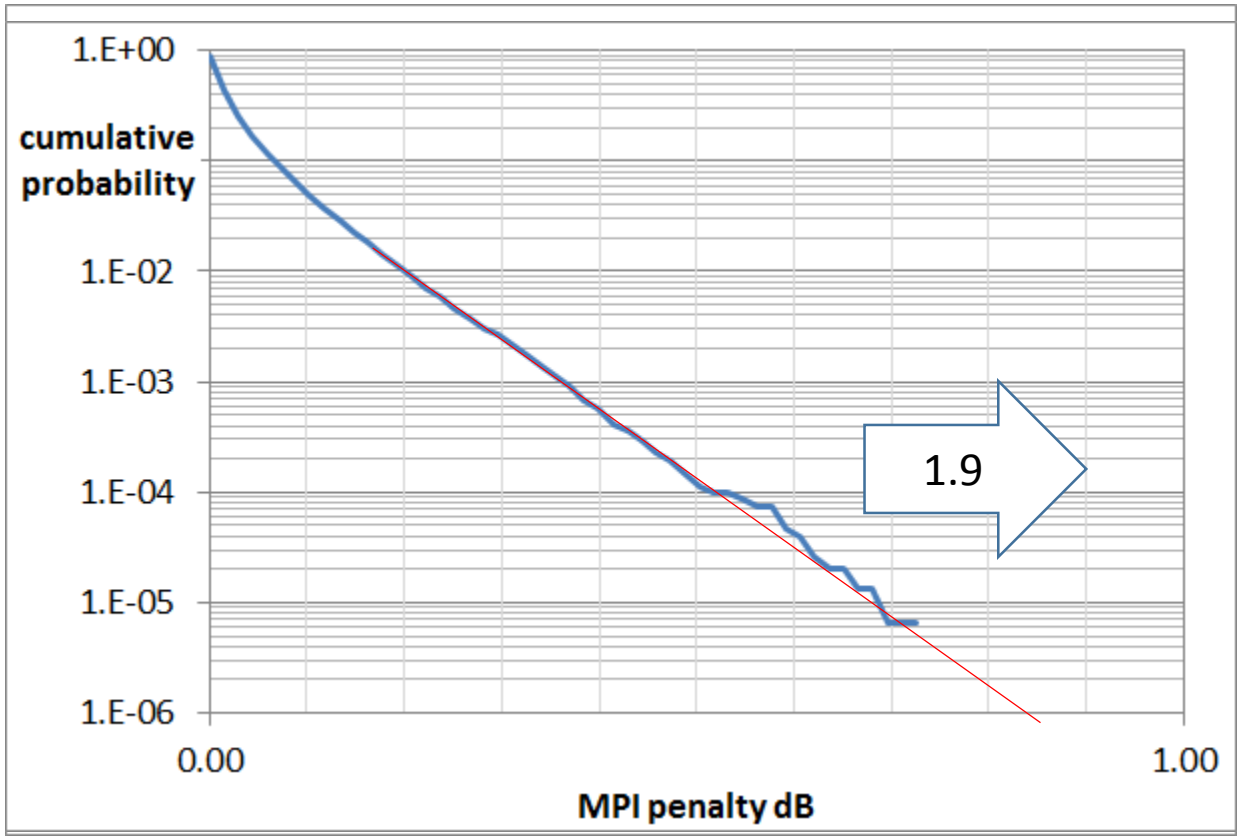
- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 5x35, 5x45

100GBASE-DR, 4 dB ER



- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 5x35, 5x45

100GBASE-DR, 3.5 dB ER



- Tx, Rx, IL, PCs, APCs
- 26, 26, 2.6, 5x35, 5x45