25GBASE-LR, -ER, MPI penalty vs connector matrix

extended to include up to 12 connectors

P802.3cc 25 Gb/s over SMF, ad hoc

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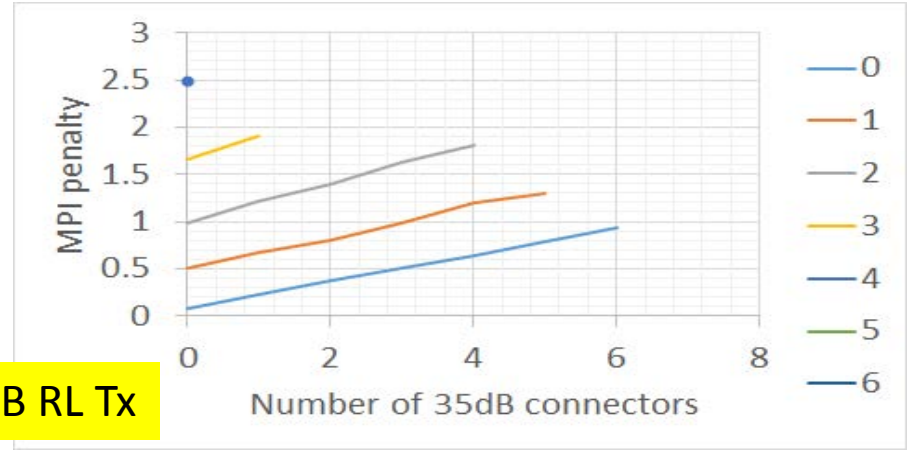
MPI penalty calculations for 25GBASE-LR and -ER

- 25GBASE-LR
  - Extinction ratio 3 dB
  - Transmitter reflectance -12 dB, -20 dB, -26 dB
  - Insertion loss 6.3 dB lumped in front of the receiver
- 25GBASE-ER
  - Extinction ratio 4 dB
  - Transmitter reflectance -12 dB, -20 dB, -26 dB
  - Insertion loss 10 dB lumped in front of the receiver
    - This is the minimum loss specified for interop with 25GBASE-LR
- Spreadsheet Model:
  - Extended from 8 to 12 reflections (Tx, Rx, 10 connectors) for 26dB Tx RL case only
    - Connector return losses of 26 dB or 35 dB
  - Statistical MPI penalty extrapolated (by ~ 1 decade) to 10^{-6} probability
    - Monte Carlo model with 400k samples
    - Random phases between connectors and Tx and Rx reflections
    - Random data for each reflector pair
      - Worst case penalties assume all optical phases aligned and ‘one’ level returned for each reflector pair

25GBASE-LR results

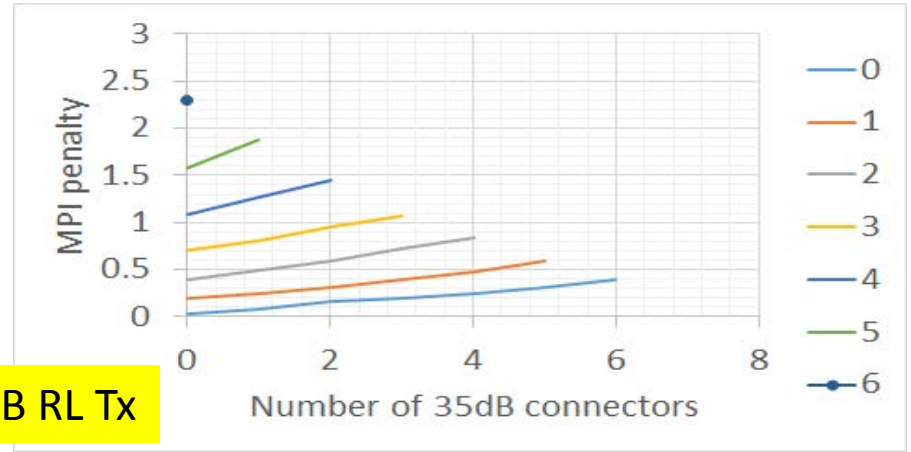
25G-LR	3	dB ER						
Tx :	12	dB RL						
	1E-06	35 dB RL						
		0	1	2	3	4	5	6
26 dB RL	0	0.08	0.23	0.38	0.5	0.64	0.78	0.94
	1	0.51	0.67	0.81	0.98	1.2	1.3	
	2	0.98	1.22	1.4	1.62	1.8		
	3	1.66	1.9					
	4	2.5						
	5							
	6							

12 dB RL Tx



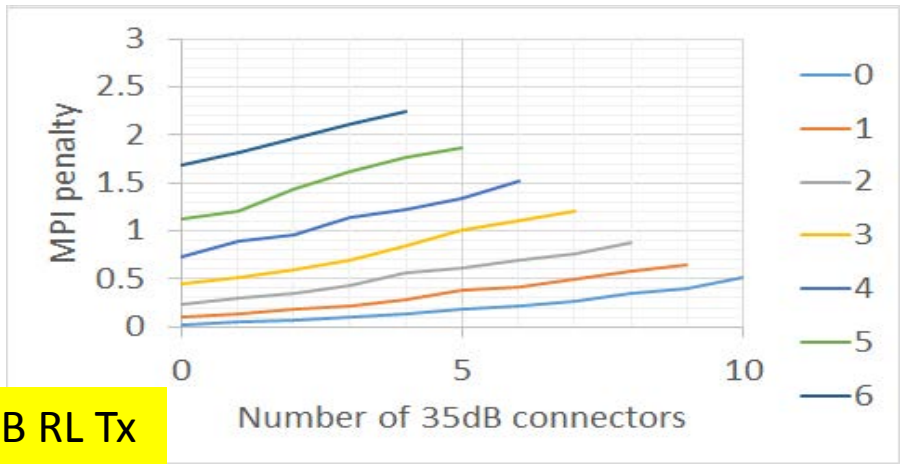
25G-LR	3	dB ER						
Tx RL	20	dB RL						
	1E-06	35						
		0	1	2	3	4	5	6
26	0	0.03	0.089	0.16	0.19	0.24	0.32	0.39
	1	0.19	0.25	0.32	0.4	0.48	0.6	
	2	0.4	0.5	0.6	0.72	0.84		
	3	0.7	0.8	0.95	1.07			
	4	1.08	1.26	1.45				
	5	1.58	1.87					
	6	2.3						

20 dB RL Tx



LR	3	dB ER										
Tx RL	26	dB RL										
	1E-06	35										
		0	1	2	3	4	5	6	7	8	9	10
26 dB RL	0	0.018	0.045	0.07	0.1	0.14	0.18	0.22	0.27	0.35	0.4	0.52
	1	0.1	0.14	0.18	0.22	0.28	0.38	0.42	0.49	0.58	0.64	
	2	0.23	0.3	0.35	0.43	0.56	0.62	0.7	0.76	0.88		
	3	0.44	0.52	0.6	0.7	0.85	1	1.1	1.2			
	4	0.72	0.9	0.96	1.14	1.22	1.34	1.52				
	5	1.12	1.2	1.44	1.62	1.76	1.86					
	6	1.68	1.82	1.96	2.12	2.24						

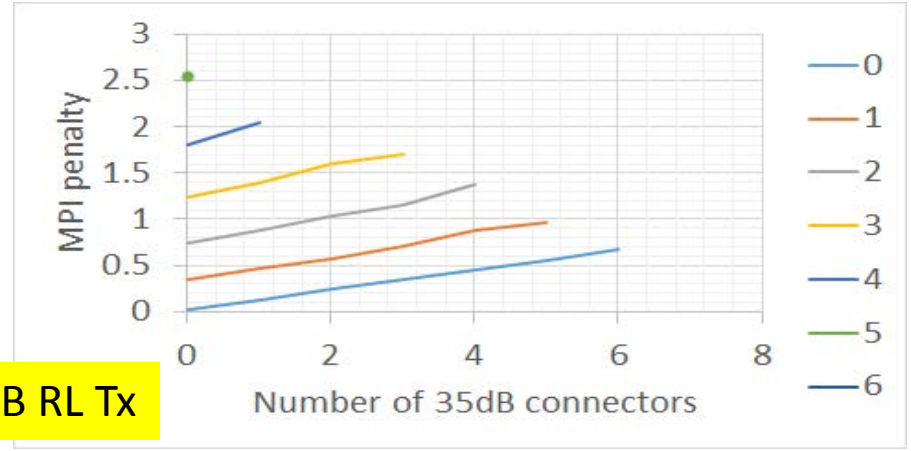
26 dB RL Tx



25GBASE-ER results

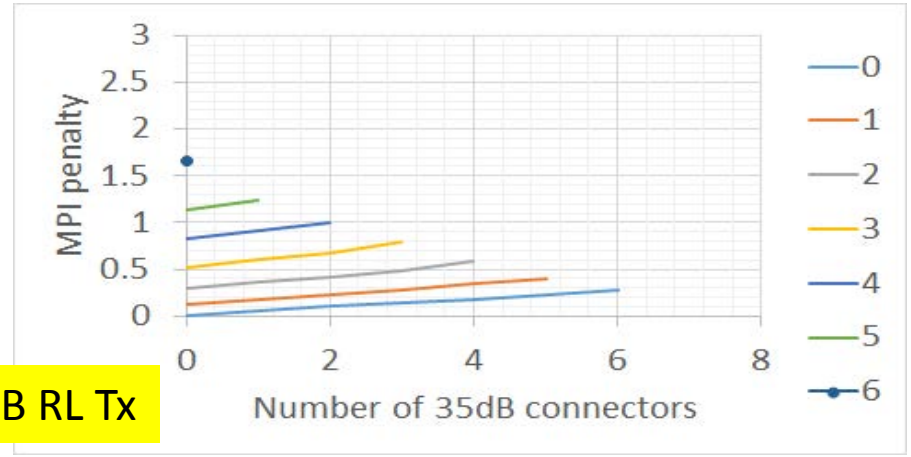
25G-ER	4	dB ER						
Tx RL	12	dB RL						
	1E-06	35						
		0	1	2	3	4	5	6
26	0	0.03	0.13	0.24	0.34	0.45	0.56	0.68
	1	0.35	0.46	0.57	0.7	0.88	0.96	
	2	0.74	0.88	1.04	1.16	1.38		
	3	1.24	1.4	1.6	1.7			
	4	1.8	2.05					
	5	2.55						
	6							

12 dB RL Tx



25G-ER	4	dB ER						
Tx RL	20	dB RL						
	1E-06	35						
		0	1	2	3	4	5	6
26	0	0.01	0.05	0.1	0.14	0.18	0.22	0.28
	1	0.13	0.18	0.23	0.28	0.34	0.4	
	2	0.29	0.36	0.42	0.48	0.58		
	3	0.52	0.6	0.67	0.8			
	4	0.82	0.91	1				
	5	1.14	1.23					
	6	1.66						

20 dB RL Tx



25G-ER	4	dB ER										
Tx RL	26	dB RL										
	1E-06	35										
		0	1	2	3	4	5	6	7	8	9	10
26	0	0.005	0.03	0.05	0.08	0.1	0.14	0.16	0.21	0.25	0.28	0.35
	1	0.06	0.1	0.13	0.17	0.21	0.26	0.32	0.36	0.44	0.5	
	2	0.17	0.21	0.26	0.32	0.38	0.44	0.52	0.56	0.6		
	3	0.3	0.4	0.42	0.56	0.62	0.68	0.77	0.87			
	4	0.52	0.6	0.72	0.82	0.89	1.05	1.14				
	5	0.82	0.88	0.98	1.18	1.25	1.32					
	6	1.2	1.26	1.36	1.43	1.58						

26 dB RL Tx