

# **100G SR4 100m & 20m Support**

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# 100G SR4 100m & 20m Support Summary

## Presentation Objectives:

- Update exemplary set of values for link model attributes for a 100G SR4 100 m MMF link.
- Provide results from a study of link margin as a consequence of TP1 and TP4 jitter allocation.

## Conclusion:

The example link model shows support of operation over 100 m of OM4 fiber.

The ability to remove retimers and support operation over 100 m of OM4 does not seem likely without a significant upgrade of the transceiver attributes in the example link model.

The ability to remove retimers and support operation over 40 m of OM4 may be feasible with modest upgrades in transceiver model attributes, perhaps combined, with shorter reaches.

## Recommendation:

Additional effort should be applied to definition of TP1 and TP4 jitter allocation for the non-retimed case.

Additional effort should be applied to investigate possible upgrades to the transceiver attributes in the example link model.

# Fiber Optic Links Interfaces

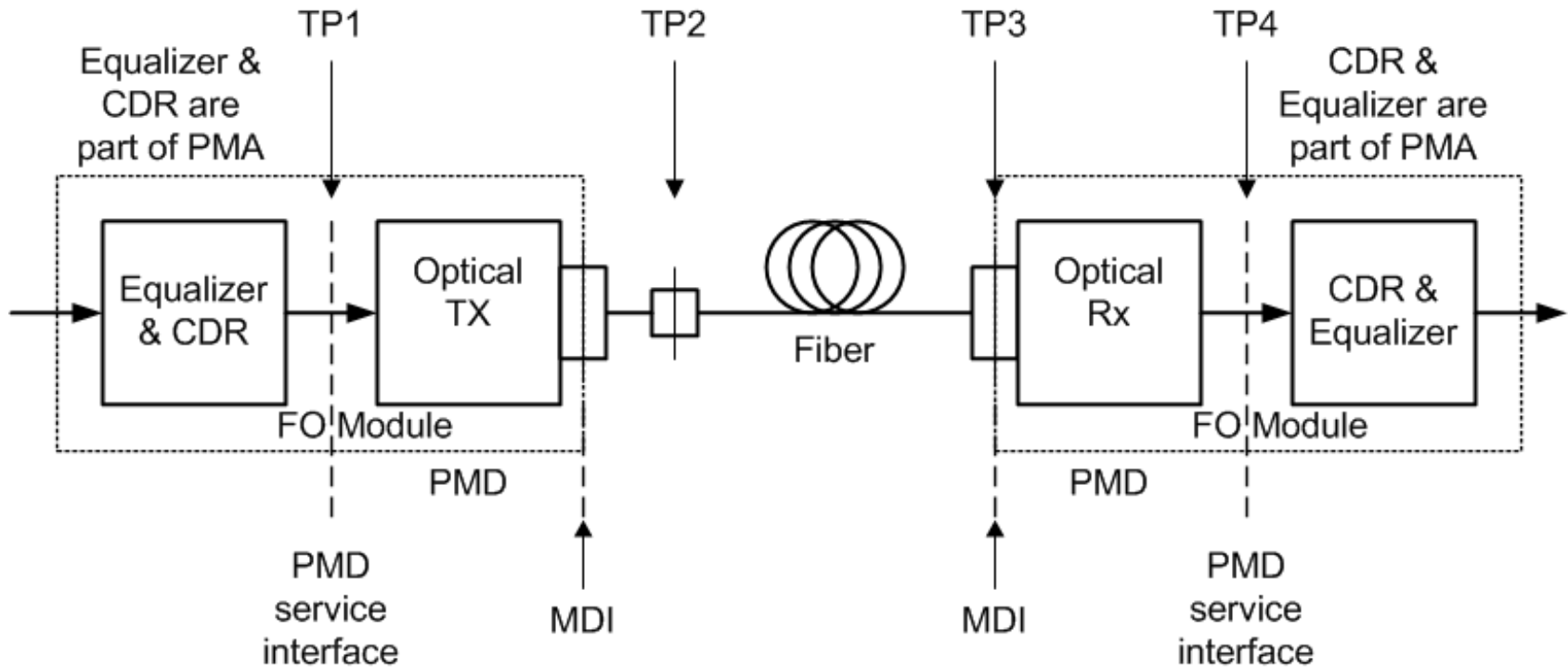


Figure 1

- For cases, as shown above in Figure 1, where retimers are incorporated in the optical module, the PMD service interface is not exposed. TP1 and TP4 remain as points on the PMD service interface and, consequently not exposed.
- The high speed signal inputs and outputs of the optical module are expected to be defined by CAUI-4.

# Update of RS(528, 514, 7, 10) benefits for 100G SR4

## Optical Link

- Reducing Q for the MMF link from  $Q_0 = 7.034$  for a BER =  $10^{-12}$  to  $Q_i = 4.02661$  for a BER =  $2.83 \times 10^{-5}$  enhances the Rx sensitivity by  $10 \log(Q_0/Q_i) = 2.42$  dB, providing a larger signal power budget.

## CAUI-4

- Expected to be defined as not relying on FEC

## CAUI-4 – SR4 – CAUI-4 Link

- Maintains signal and baud rate of NRZ, 64b/66b encoded, 25.78125 Gb/s signals

# 100G SR4 with FEC: Tx Link Model Attributes (each lane)

Parameter	Unit	100G SR4	
Signal rate	GBd	25.78125	
Q (BER)		4.02661 (2.83 E-5)	FEC corrects BER to < 1.0E-15
Center Wavelength, min	nm	840	
Spectral Width, max	nm	0.6	
OMA at max TDP, min	dBm	-3	
Extinction ratio, min	dB	4	
Tx output transition times, 20% -80%, max	ps	21	
RIN <sub>12</sub> OMA, max	dB/Hz	-128	
RIN coefficient		0.7	
MPN coefficient		0.3	
Modal Noise Penalty	dB	0.135	Scaled with Q
Tx reflectance, max	dB	-12	
Tx optical return loss tolerance, max	dB	12	

Attributes and values in the above table are provided in order to populate example link models and are not presented as specification recommendations.

## 100G SR4 with FEC: Rx Link Model Attributes (each lane)

Parameter	Unit	100G SR4	
Signal rate	GBd	25.78125	
Q (BER)		4.02661 (2.83 E-5)	FEC corrects BER to < 1.0E-15
Wavelength, min	nm	840	
Rx sensitivity (OMA), max	dBm	-10.81	-8.09 dBm at Q = 7.034
Rx Bandwidth, min	MHz	18,047	
RMS base line wander coefficient		0.0125	
Rx reflectance, max	dB	-12	

Attributes and values in the above table are provided in order to populate example link models and are not presented as specification recommendations.

# 100G SR4 with FEC: Link Model Channel Attributes (each lane)

Parameter	Unit	100G SR4	
Signal rate	GBd	25.78125	
Q (BER)		4.02661 (2.83 E-5)	FEC corrects BER to < 1.0E-15
Reach	m	100	
Fiber Attenuation	dB/km	3.5	For 850 nm center wavelength
Dispersion min Uo	nm	1316	
Dispersion So	ps/nm <sup>2</sup> km	0.10275	
Fiber modal bandwidth	MHz·km	4400	For 840 nm center wavelength
Reflection Noise Factor		0	
Signal power budget at max TDP	dB	7.81	Model output
Connector & splice loss allocation	dB	1.5	
Fiber Insertion loss	dB	0.36	Model output
Allocation for penalties at max TDP	dB	4.04	Model output
Allocation for target TP4 eye at max TDP	dB	1.91	Model output
Additional insertion loss allowed	dB	0	Model output

Attributes and values in the above table are provided in order to populate example link models and are not presented as specification recommendations. Various model outputs are provided as examples.

# 100G SR4 with FEC: Link Model Jitter Attributes (each lane)

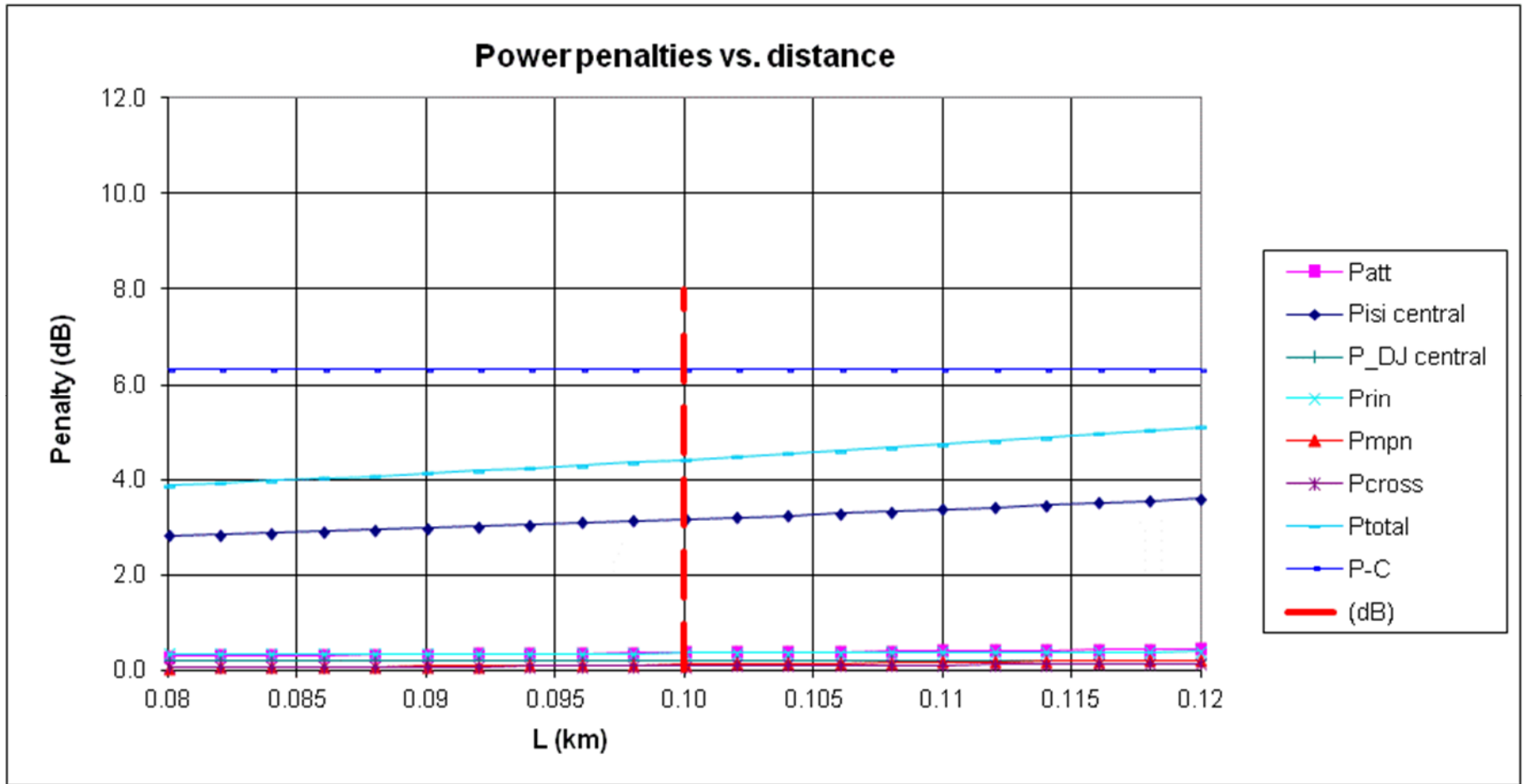
Parameter	Unit	100G SR4	
Signal rate	GBd	25.78125	
Q (BER)		4.02661 (2.83 E-5)	FEC corrects BER to < 1.0E-15
TP1 RJrms tolerance, min	UI	0.0079	
TP1 DJ tolerance, min	UI	0.11	
TP3 DCD tolerance, min	UI	0.05	
TP3 DJ tolerance, min	UI	0.23	
TP4 J2, max	UI	0.438	Model output
TP4 TJ at BER, max	UI	0.780	Model output

Attributes and values in the above table are provided in order to populate example link models and are not presented as specification recommendations. Various model outputs are provided as examples.

Nomenclature: Terms TP1, TP2, TP3 and TP4 are used as defined in 802.3 clause 86 and shown in above Figure 1. Note that TP1 is downstream of the input CDR and equalizer for an optical transmitter.

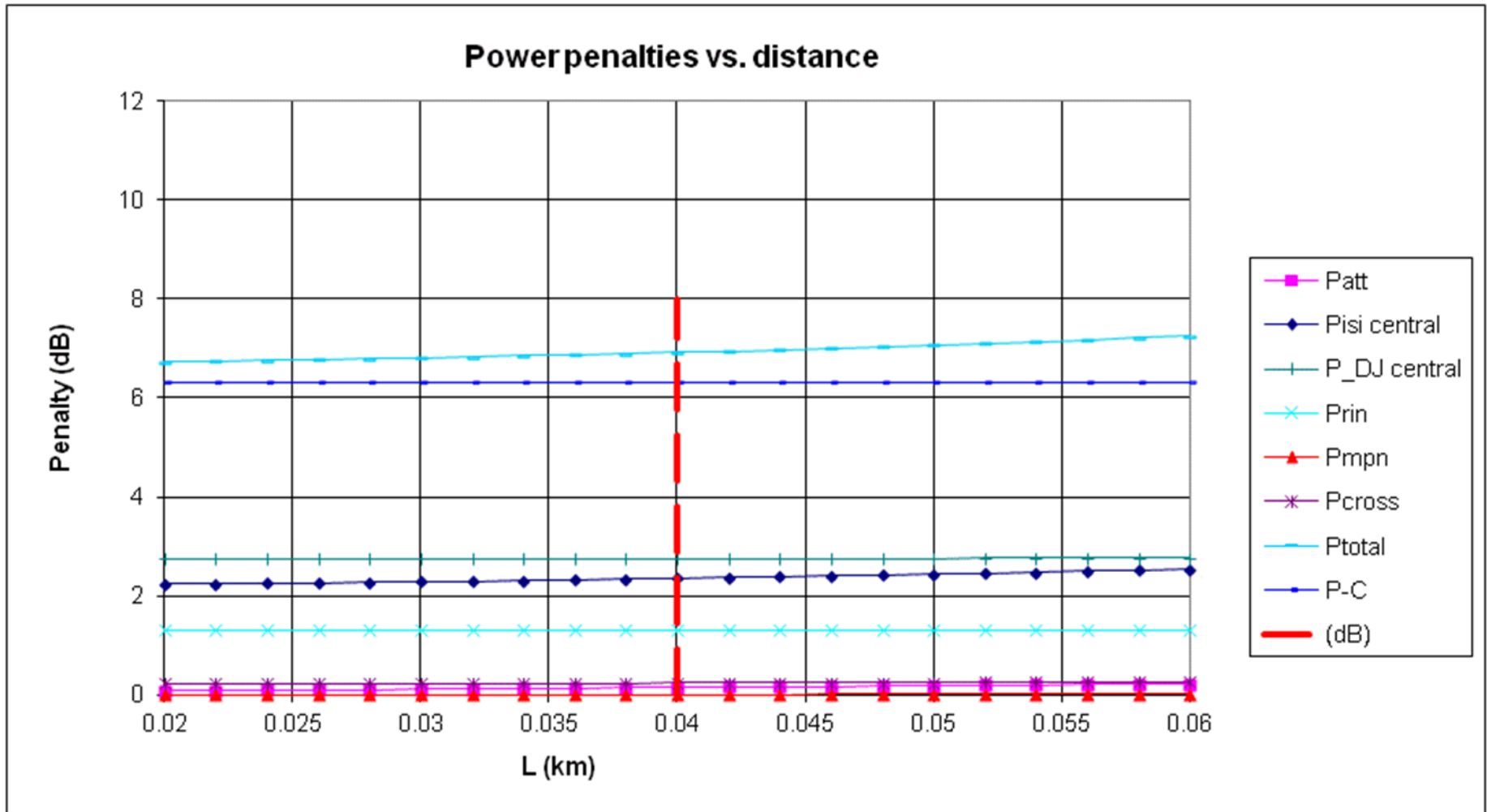


# 100G SR4 with FEC: Example Link Model Power Penalties



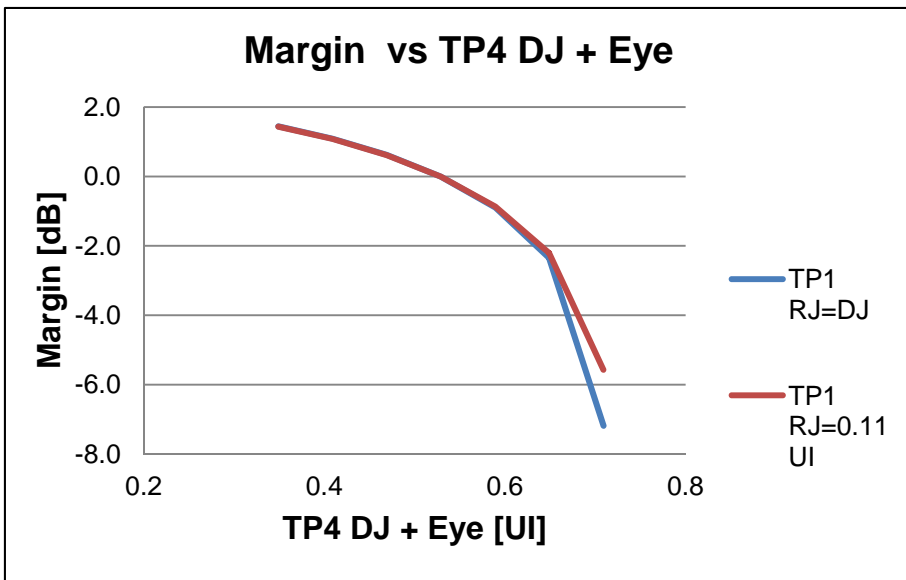
- The above chart is provided by the example link model for TP1 DJ = TP1 RJ = 0.11 UI and TP4 TJ = 0.78 UI
- It does not show the power required for the target TP4 eye opening,  $P_{eye}$ , nor include  $P_{eye}$  in  $P_{total}$ . For the example link model,  $P_{eye}$  at 100 m of OM4 equals 1.91 dB yielding zero margin.

# 100G SR4 with FEC: Modified Link Model Power Penalties



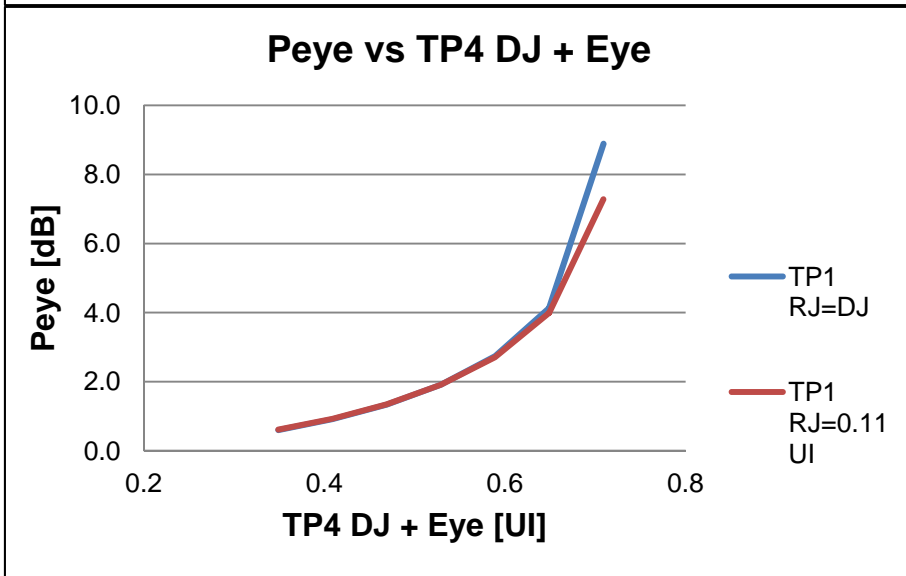
- The above chart is provided by the example link model for TP1 DJ = TP1 RJ = 0.15 UI and TP4 TJ = 0.70 UI
- It includes the power required for the target TP4 eye opening,  $P_{eye}$ , in the other power penalties. For the example link model,  $P_{eye}$  at 40 m of OM4 equals 3.61 dB yielding -0.61 dB margin at 40 m.

# 100G SR4 with FEC: Jitter Allocations & Link Model Results

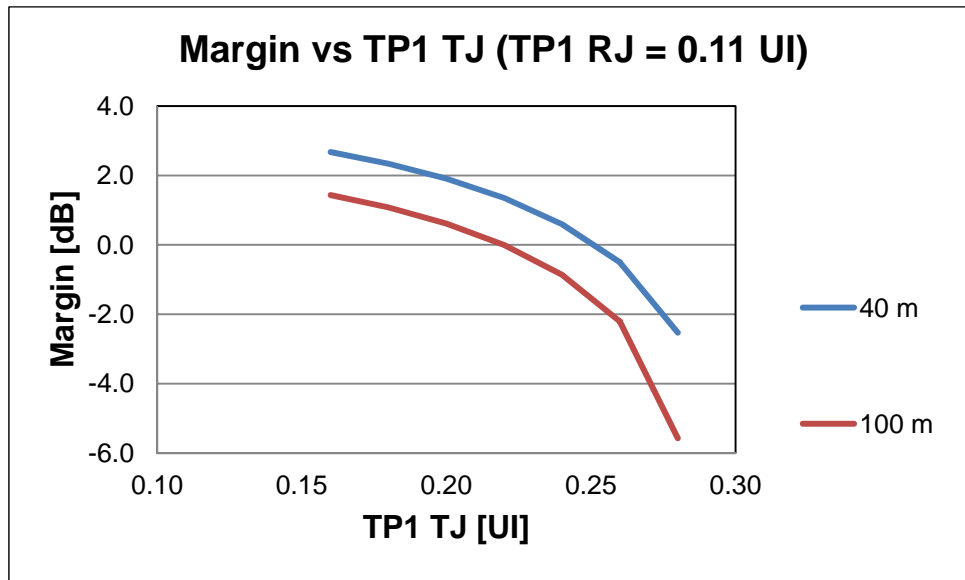


- In the charts on the left Margin and Peye are shown as a function of combined TP4 DJ plus the desired TP4 eye opening for two cases of TP1 RJ & DJ jitter allocation where the desired TP4 eye opening is set to twice the TP1 DJ allocation.

- It's expected that operation without retimers requires supporting a TP4 eye and TP1 TJ allocation ~ 0.30 UI to 0.35 UI. Here, the equivalent is a TP4 DJ + Eye in the range of 0.65 UI to 0.71 UI. Supporting such operation seems unlikely.



# 100G SR4 with FEC: Reach, Jitter Allocations & Link Model Results



•The above chart shows link margin for two reaches of OM4. As with previous charts, the target TP4 eye opening is set to twice the TP1 DJ allocation. Although supporting a TP4 eye and TP1 TJ allocation ~ 0.30 UI to 0.35 UI is not achieved, it looks promising and further study is appropriate.