

100GBASE-BR10 Updated MPI Penalty Calculation: Support for comments against D2.2

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June 24, 2024
IEEE Comment Resolution Meeting

Supporters

Overview

- MPI penalty for all variants, 100GBASE-BR10/20/40 recalculated (using two calculations) based on latest assumptions presented in P802.3dj, 800G/1.6T Ethernet with 200Gb/s per lane signaling
 - Used “Monte Carlo MPI Spreadsheet Model”, by J. King,
http://www.ieee802.org/3/bs/public/adhoc/smf/16_01_07/king_02_0116_smf.7z
 - with ~80,000 iterations; placing $\frac{1}{2}$ the max IL at the mid-point of the span; Cell A5 => $\frac{4}{3}$ times $2.4e-4$ for PAM4 BER.
 - John Johnson Matlab script.
 - with ~1M iterations; placing $\frac{1}{2}$ the max IL at the mid-point of the span

Results:

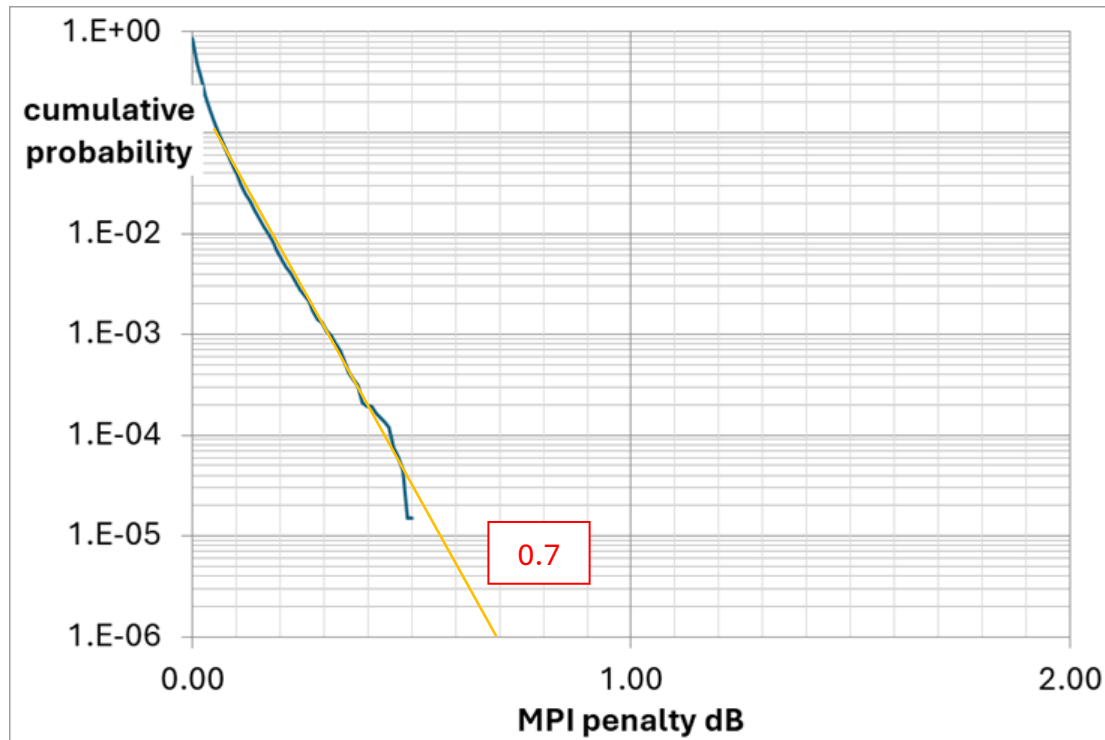
- MPI penalty for 100GBASE-BR10 recalculated to be less than current value.
 - Comments on D2.2 proposing to reduce power penalties and subsequently lower Tx launch values.
{Leave Rx values unchanged. Lower Tx launch should result in lower overall power dissipation.}
- MPI penalty for 100GBASE-BR20 in D2.2 is ok.
 - No change to D2.2.
- MPI Penalty for 100GBASE-BR40 in D2.2 is ok.
 - No change to D2.2.

100GBASE-BR10 MPI Calculation

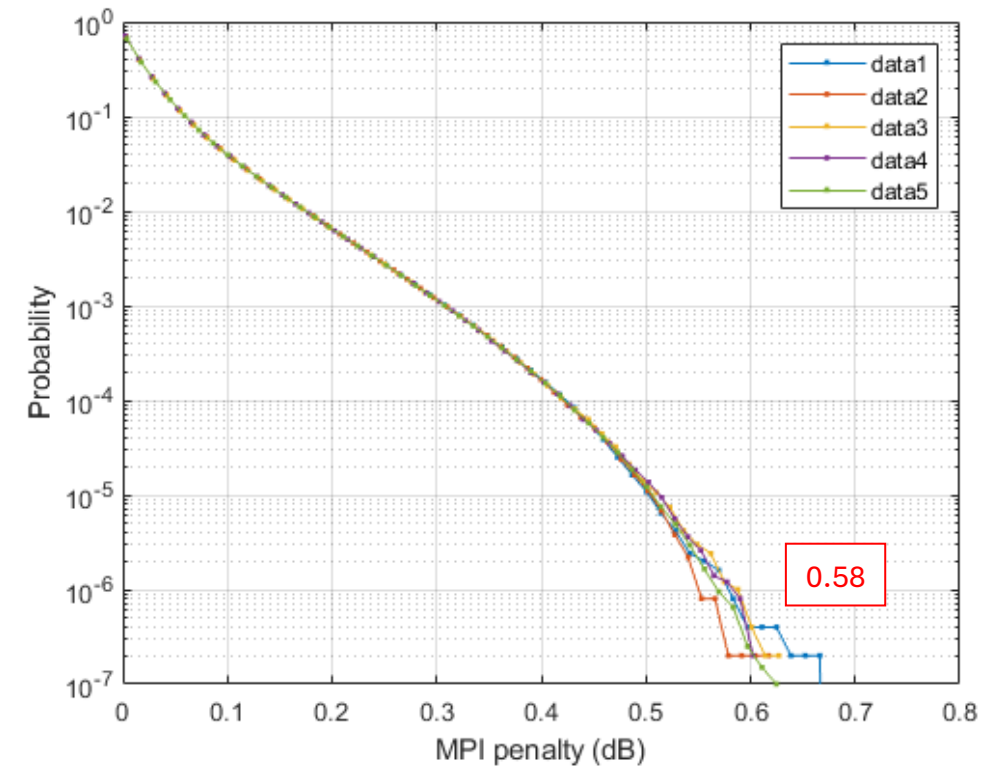
IL = 6.3dB; ER(min) = 3.5dB; 10 connectors: 4 @ -55dB, 6 @ -35dB

-26 -35 -55 -55 -35 -35 -35 -35 -55 -55 -35 -26

Spreadsheet Result



Matlab Result

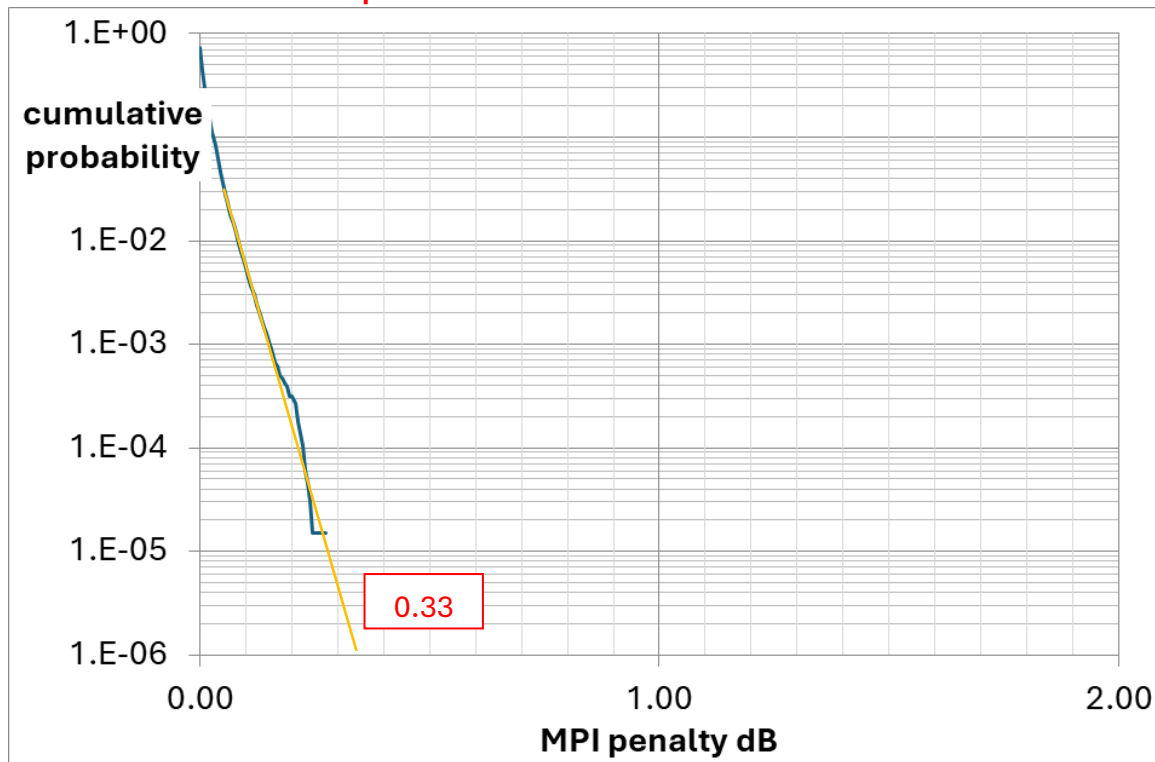


100GBASE-BR20 MPI Calculation

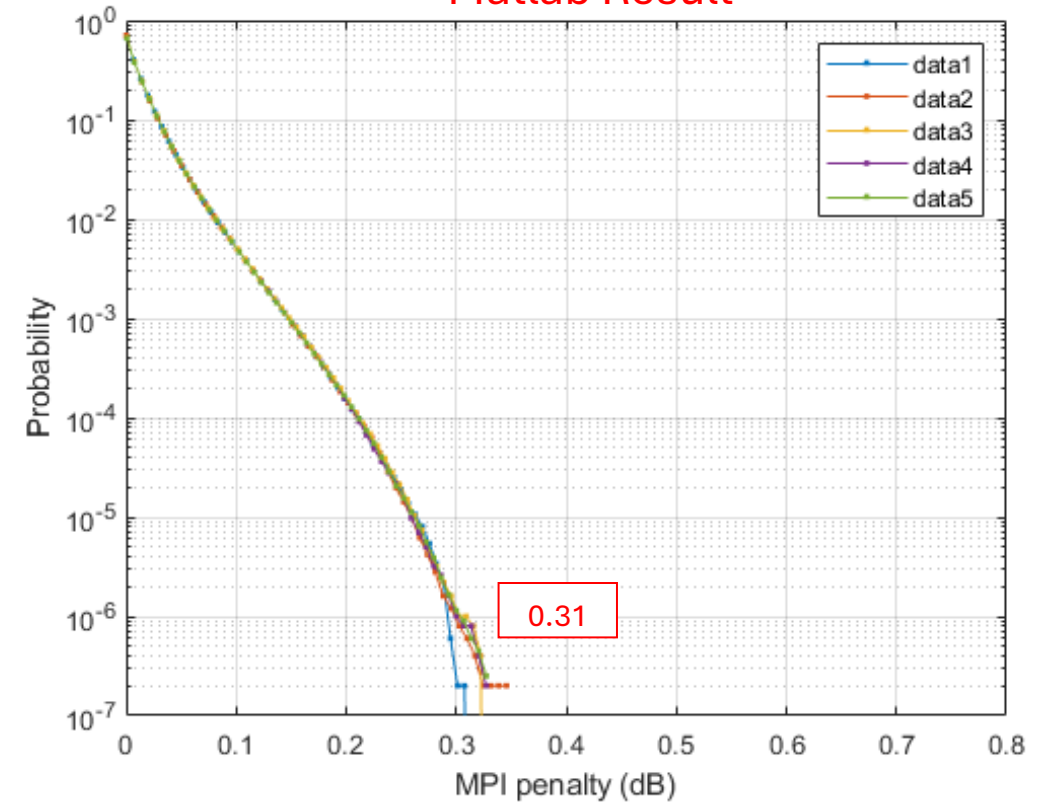
IL = 10dB; ER(min) = 5.0dB; 10 connectors: 4 @ -55dB, 6 @ -35dB

-26 -35 -55 -55 -35 -35 -35 -35 -55 -55 -35 -26

Spreadsheet Result



Matlab Result

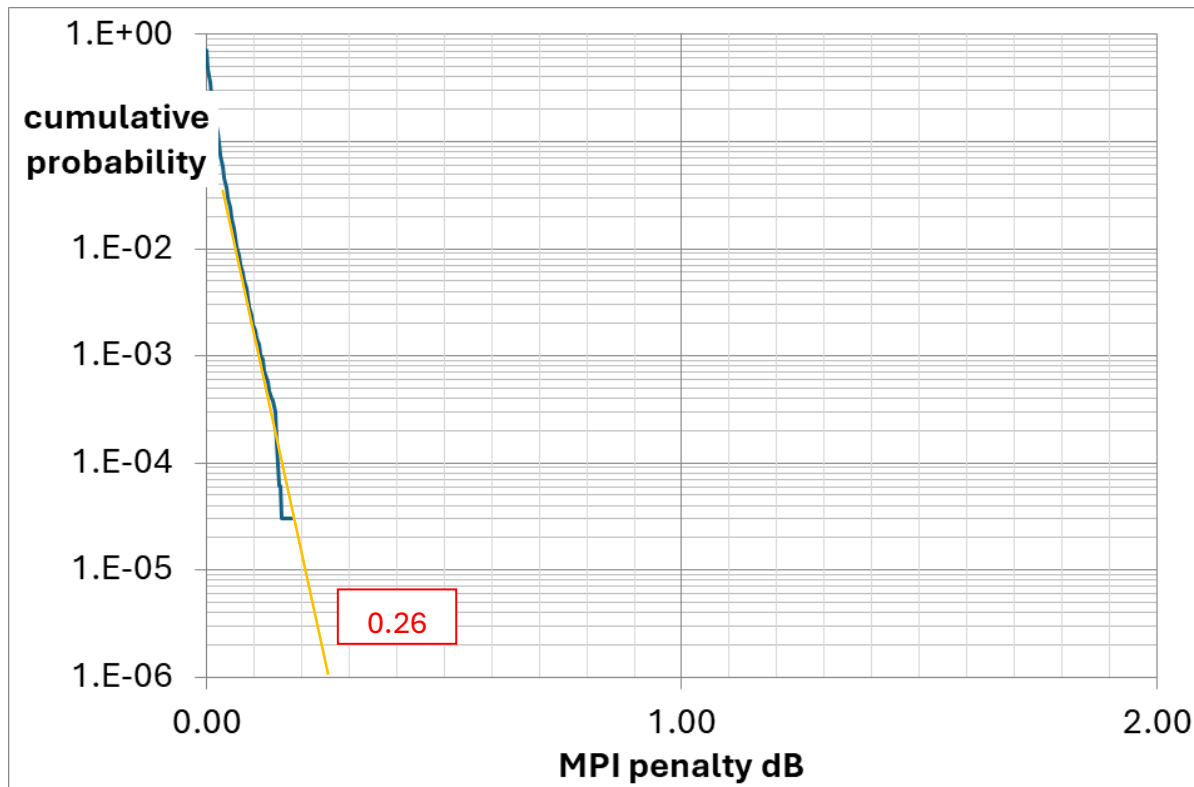


100GBASE-BR40 MPI Calculation

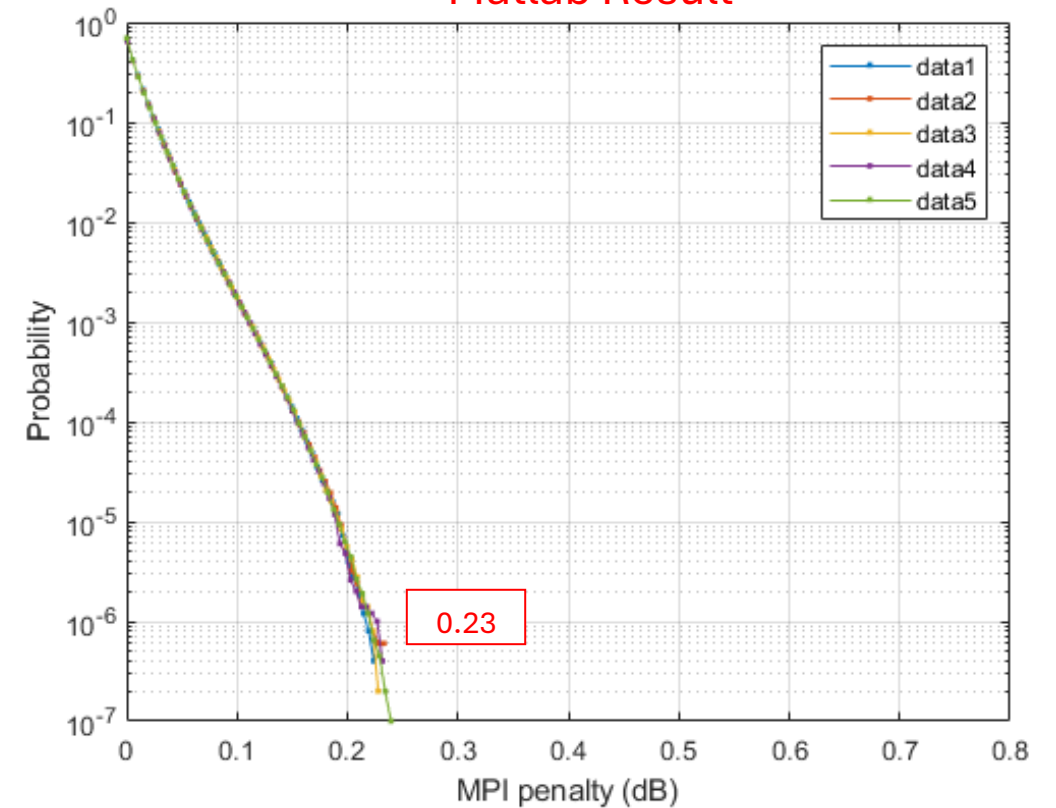
IL = 18dB; ER(min) = 5.0dB; 10 connectors: 4 @ -55dB, 6 @ -35dB

-26 -35 -55 -55 -35 -35 -35 -35 -55 -55 -35 -26

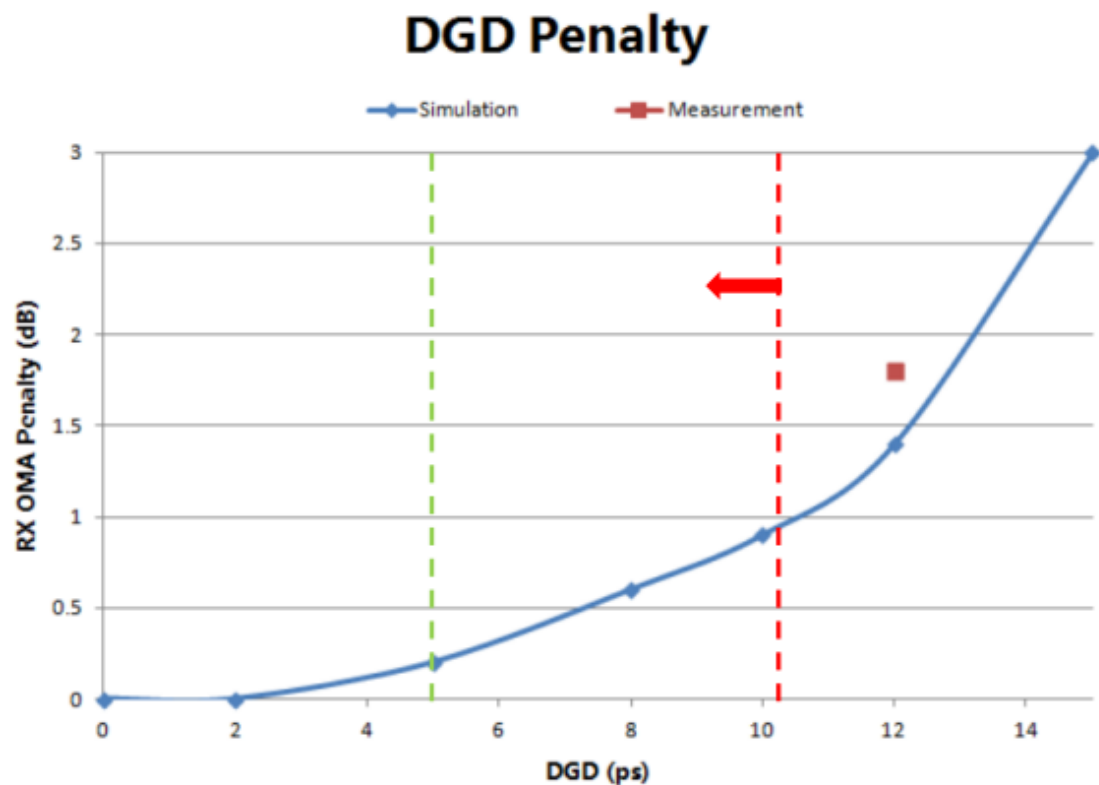
Spreadsheet Result



Matlab Result



DGD Penalty *(no change from previous analysis)*



From: shuai_3cu_adhoc_050119.pdf

	100GBASE-BR10	100GBASE-BR20	100GBASE-BR40	
DGD_max ^c	3.1	3.9	5.0	ps

↓

100GBASE-	BR10	BR20	BR40
DGD Penalty	0.1 dB	0.2 dB	0.3dB

Total Penalty (DGD+MPI)

100GBASE-BR10: **0.68dB** Total allocation: $3.4 (TDECQ_{max}) + 0.7 = 4.1dB$

100GBASE-BR20: **0.51dB** Total allocation: $3.4 (TDECQ_{max}) + 0.5 = 3.9dB$

100GBASE-BR40: **0.53dB** Total allocation: $3.9 (TDECQ_{max}) + 0.5 = 4.4dB$

100GBASE-	BR10	BR20	BR40	
Allocation for penalties ^b (for maximum TDECQ)	X3 4.1	3.9	4.4	dB
	Change by -0.2dB	no change	no change	

Current values
In D2.2

Proposed Changes

(Table 168-6, Tx Characteristics)

$-0.3 + \max(TECQ, TDECQ)$ (168-1)
 $-3.7 + \max(TECQ, TDECQ)$ (168-2)
 $3.9 + \max(TECQ, TDECQ)$ (168-3)

-0.5

Table 168-6—100GBASE-BRx transmit characteristics

Description	100GBASE-BR10	100GBASE-BR20	100GBASE-BR40	Unit
Signaling rate (range)	53.125 ± 100 ppm			GBd
Modulation format	PAM4			—
100GBASE-BRx-D center wavelength (range)	1308.1 to 1310.1			nm
100GBASE-BRx-U center wavelength (range)	1303.6 to 1305.6			nm
Side-mode suppression ratio (SMSR), (min)	30			dB
Average launch power (max)	4.8 4.6	1.0	9.1	dBm
Average launch power ^a (min)	-9 -2.1	-5.3	2.3	dBm
Outer Optical Modulation Amplitude (OMA _{outer}) (max)	X 4.8	1.2	9.3	dBm
Outer Optical Modulation Amplitude (OMA _{outer}) (min) ^b : for max(TECQ, TDECQ) < 1.4 dB for 1.4 dB ≤ max(TECQ, TDECQ) ≤ TDECQ(max)	X 0.9 Equation (168-1)	-2.3 Equation (168-2)	5.3 Equation (168-3)	dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)	3.4	3.4	3.9	dB
TECQ (max)	3.4	3.4	3.9	dB
TDECQ – TECQ (max)	2.5	2.5	2.7	dB
Transmitter overshoot and undershoot	22			%
Transmitter power excursion (max)	X 2.9	-1.9	6.4	dBm
Extinction ratio (min)	3.5	5.0	5.0	dB

Proposed Changes

(assuming lower Tx launch values are adopted)

Table 168–7—100GBASE-BRx receive characteristics

Description	100GBASE-BR10	100GBASE-BR20	100GBASE-BR40	Unit
Signaling rate (range)	53.125 ± 100 ppm			GBd
Modulation format	PAM4			—
100GBASE-BRx-D center wavelengths (range)	1303.6 to 1305.6			nm
100GBASE-BRx-U center wavelengths (range)	1308.1 to 1310.1			nm
Damage threshold ^a	5.8 5.6	2.2	0.1	dBm
Average receive power (max)	4.8 4.6	1.0	−0.9	dBm
Average receive power ^b (min)	−2 −8.4	−15.3	−15.7	dBm
Receive power (OMA _{outer}) (max)	X 4.8	1.2	−0.7	dBm
Receiver reflectance (max)	−26			dB
Receiver sensitivity (OMA _{outer}) ^c (max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ SECQ	−6.1 −7.5 + TECQ	−12.8 −14.2+TECQ	−13.2 −14.6+TECQ	dBm dBm

+1 dB greater than max avg Rx power

Max avg Tx launch minus IL(min) => +4.6 – 0 = +4.6dBm

Min avg Tx launch minus IL(max) => -2.1 – 6.3 = -8.4dBm

Max Tx (OMA) minus IL(min)=> +4.8-0 = +4.8dBm

Proposed Changes

(Table 168-8, Illustrative link power budgets)

Table 168–8—100GBASE-BRx illustrative link power budgets

Parameter	100GBASE-BR10	100GBASE-BR20	100GBASE-BR40	Unit
Power budget (for maximum TDECQ)	10.6 10.4	13.9	22.4	dB
Operating distance	10	20	40	km
Channel insertion loss	6.3 ^a	10 ^a	18 ^a	dB
Maximum discrete reflectance ^{c,d}	–35	–35	–35	dB
Allocation for penalties ^b (for maximum TDECQ)	4.3 4.1	3.9	4.4	dB

^a The channel insertion loss is calculated using the maximum distance specified in Table 168–5 for 100GBASE-BR10, 100GBASE-BR20, and 100GBASE-BR40 and fiber attenuation of 0.4 dB/km plus an allocation for connection and splice loss given in 168.10.2.1.

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

^c See 168.10.2.2 for details and specifications as a function of the number of discrete reflectances within the channel.

^d Maximum value for each discrete reflectance with 6 discrete reflectances above –55 dB within the channel.

Thanks!