

500 m SMF PSM4 Baseline Proposal Update

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Introduction

- This presentation provides updates to the PSM4 baseline specification proposal given in [anderson_01a_0313_optx](#) for a retimed PMD to address the P802.3bm objective:
Define a 100 Gb/s PHY for operation up to at least 500 m of SMF.
- These baseline updates include:
 - Correction to TX OAM analytic expression and Figure 1 to cover the case when TDP is less than 0.8 dB
 - Maximum discrete reflectance confirmed to be -35 dB [per petrilla_02_0513_optx](#)
 - Tx Optical Return Loss tolerance is adjusted to -7.94 dB, as derived for 12dB ORL at Rx and 4 in-line connectors at 35dB ORL each (per upper-bound analysis)
- This baseline specification is the basis for the P802.3bm Editor's draft PSM4 Clause 86 provided in [8023bm-96_PSM4_01.pdf](#)
- This baseline specification is proposed for adoption by P802.3bm Task Force for fulfilling the 500m SMF objective.

100GBASE- ?R4 Illustrative link power budget

Parameter	Unit	Proposed 100GBASE-?R4 500m	Comment
Power budget (at max TDP)	dB	7.06	
Operating distance	km	0.50	
Maximum fiber loss	dB/km	0.50	Ref. kolesar_02_0313_optx
Optical connection and splice loss	dB	3.0	
Channel insertion loss (max) ^a	dB	3.26	
Channel insertion loss (min)	dB	0	
Maximum discrete reflectance	dB	-35	Transmitter and Receiver module connectors are at -12dB. In-line connectors confirmed to be -35 dB ; sensitivity to reflectance performance should be equivalent to or better than 10GBASE-LR.
Allocation for penalties (at max TDP) ^b	dB	3.8	
Additional insertion loss allowed	dB	0	

Note a: The maximum channel insertion loss is calculated using the specified operating distance and maximum optical fiber (for in-door/out-door plant specified in ANSI/TIA-568-C.3-2008 *Optical Fiber Cabling Components Standard*) attenuation loss of 0.50 dB/km at 1310 nm plus allocation for connection and splice loss as specified.

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

100GBASE- ?R4 Transmit Characteristics

Parameter	Unit	Proposed 100GBASE-?R4 500m	Comment
Signaling rate, each lane (range)	GBd	25.78125 +/- 100 ppm	
Lane wavelengths (range)	nm	1295 to 1325	
Side-mode suppression ratio (SMSR)(min)	dB	30	
Total average launch power (max)	dBm	8.0	
Average launch power, each lane (max)	dBm	2.0	
Average launch power, each lane (min) ^a	dBm	-9.4	At ER =10 dB
Optical Modulation Amplitude (OMA), each lane (max)	dBm	2.2	
Optical Modulation Amplitude (OMA), each lane (min)	dBm	See Note b	
Transmitter and dispersion penalty (TDP), each lane (max)	dB	3.8	

Note a: Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this value does not ensure compliance.

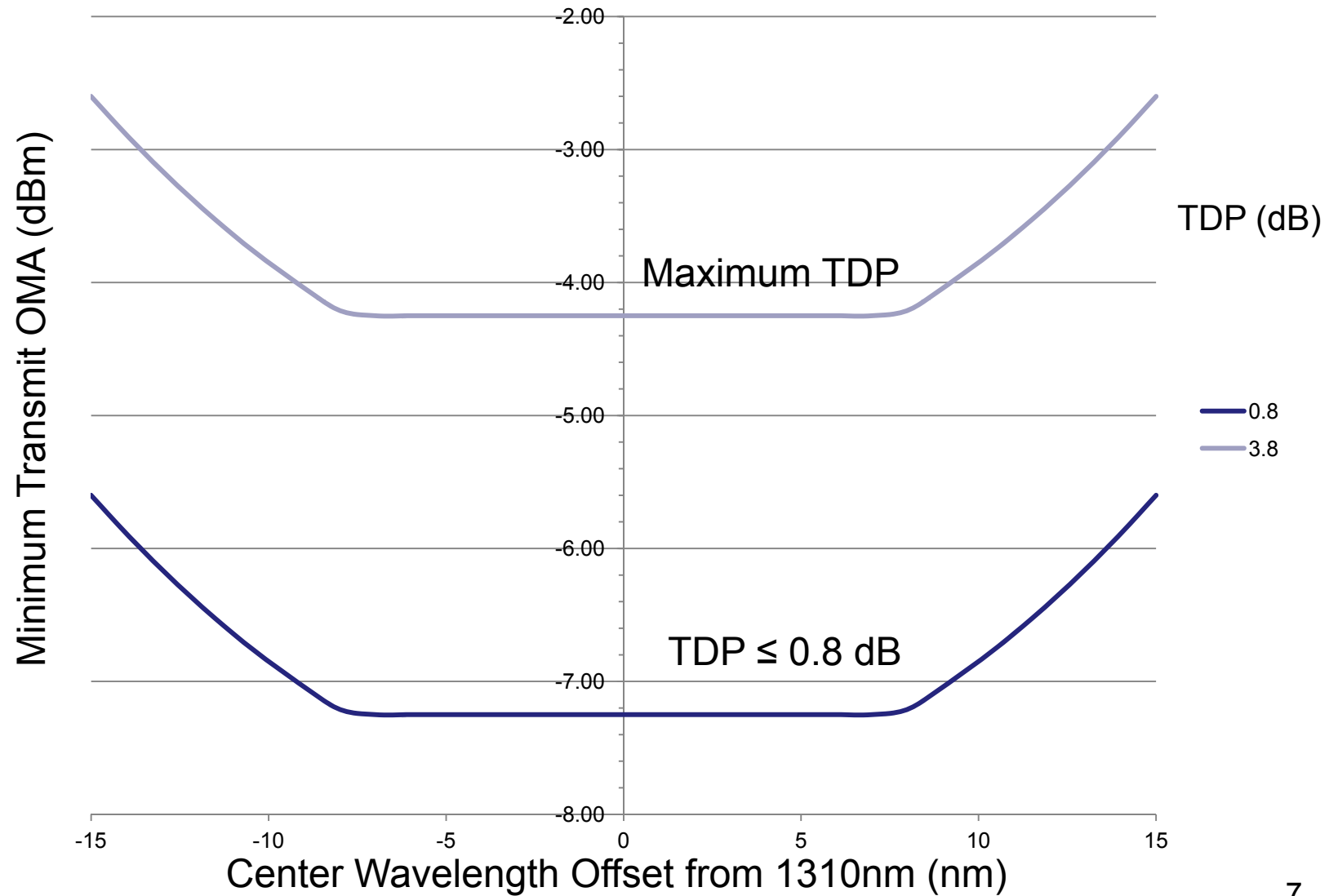
Note b: Trade-offs are available between minimum transmit OMA, center wavelength offset and TDP, as defined by Equation 1 and illustrated in Figure 1.

Equation 1: 100GBASE- ?R4 minimum transmit OMA as a function of 1310nm center wavelength offset and TDP

$$\text{TX OMA} \geq \text{MAX}(-8.65 + (\Delta\lambda)^2/100, -8.05) + \text{MAX}(\text{TDP}, 0.8) \text{ dBm}$$

where $\Delta\lambda$ is center wavelength offset (in nm) from 1310 nm and TDP is in the range of 0.8 to 3.8 dB. This is illustrated in Figure 1 for both maximum TDP and for $\text{TDP} \leq 0.8$ dB.

Figure 1: 100GBASE- ?R4 minimum transmit OMA as a function of 1310nm center wavelength offset and TDP



100GBASE- ?R4 Transmit Characteristics Cont.

Parameter	Unit	Proposed 100GBASE-?R4 500m	Comment
Average launch power of OFF transmitter, each lane (max)	dBm	-30	
Extinction ratio (min)	dB	3.5	
Optical return loss tolerance (max)	dB	7.94	Accounts for 12dB ORL at Rx and 4 in-line connectors at 35dB ORL each (per upper-bound analysis)
Transmitter reflectance (max) ^c	dB	-12	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		TBD	

Note c: Transmitter reflectance is defined looking into the transmitter.

100GBASE- ?R4 Receive Characteristics

Parameter	Unit	Proposed 100GBASE-?R4 500m	Comment
Signaling rate, each lane (range)	GBd	25.78125 +/- 100 ppm	
Lane wavelengths (range)	nm	1295 to 1325	
Damage threshold ^a	dBm	3.0	
Average receive power, each lane (max)	dBm	2.0	
Average receive power, each lane (min) ^b	dBm	-12.66	At ER =10 dB
Receive power, each lane (OMA) (max)	dBm	2.2	
Receiver reflectance (max)	dB	-12	
Receiver sensitivity at target BER (OMA), each lane (max) ^c	dBm	See Note d (Q=3.8905, 5E-5 BER)	KR4 FEC corrects 100GBASE- nR4 BER to ≤ 1E-12

Note a: The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

Note b: Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

Note c: Receiver sensitivity (OMA), each lane (max) is informative.

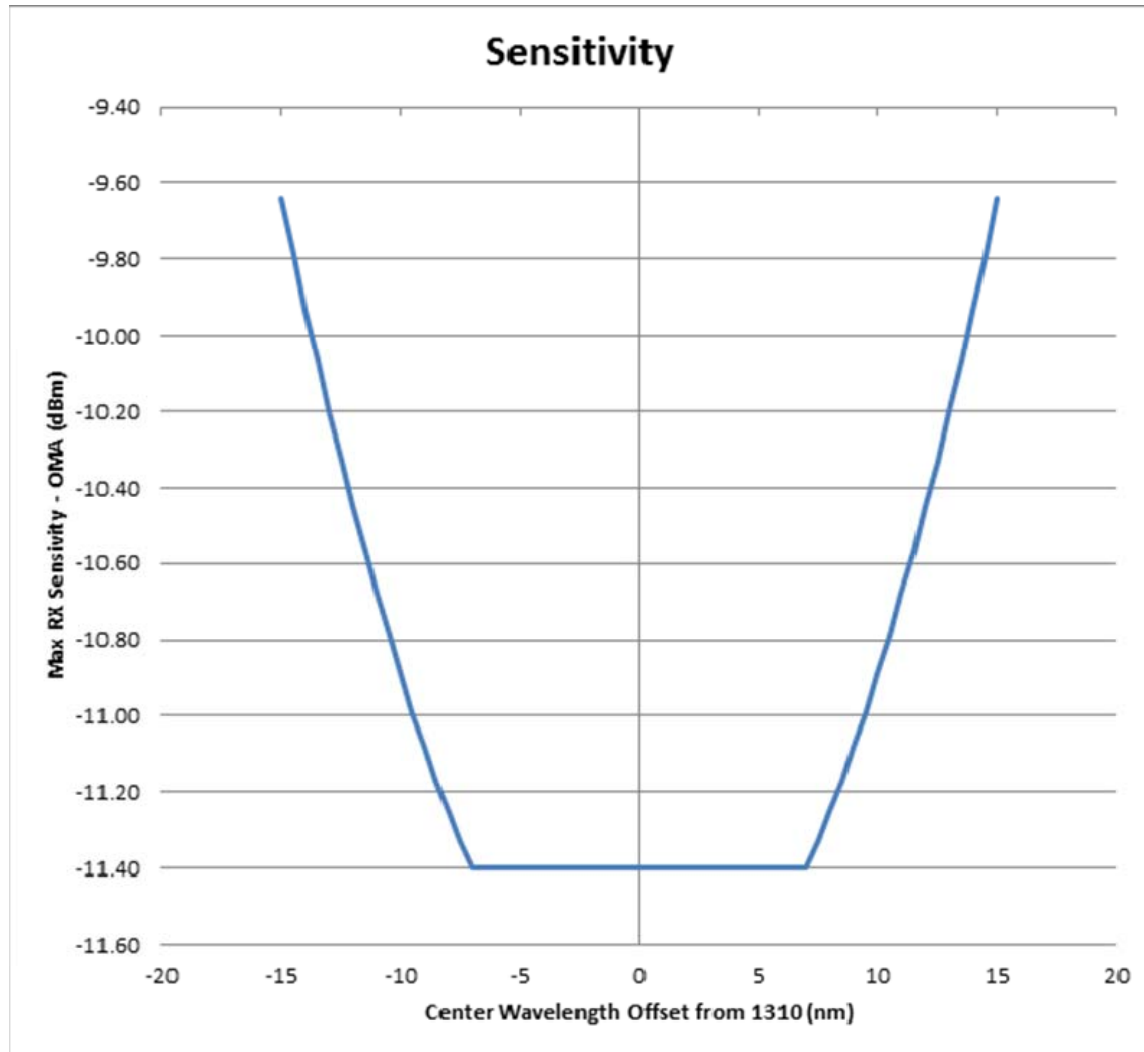
Note d: Maximum receiver sensitivity may exhibit a wavelength dependency defined by Equation 2 and illustrated in Figure 2.

Equation 2: 100GBASE- ?R4 maximum receiver sensitivity at target BER (OMA) as a function of 1310nm center wavelength offset

$$\text{RX SENS (OMA)} = \text{MAX}(-11.89 + (\Delta\lambda)^2/100, -11.4),$$

where $\Delta\lambda$ is center wavelength offset (in nm) from 1310 nm.

Figure 2: 100GBASE- ?R4 maximum receiver sensitivity at target BER (OMA) as a function of 1310nm center wavelength offset



100GBASE- ?R4 Receive Characteristics Cont.

Parameter	Unit	Proposed 100GBASE-nR4 500m	Comment
Stressed receiver sensitivity (OMA), each lane (max) ^d	(dBm)	TBD	
Conditions of stressed receiver sensitivity test:			
Vertical eye closure penalty, each lane ^e	(dB)	1.8	
Stressed eye jitter, each lane ^e	(UI)	TBD	Harmonize with 100GBASE-SR4 on a common methodology.

Note d: Measured with conformance test signal at TP3 (see 87.8.11) for BER = 5E-5.

Note e: Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Summary & Next Steps

- An updated PSM4 baseline specification proposal for the 500 m SMF objective 100GBASE-R4 has been presented.
- This baseline specification is proposed for adoption by P802.3bm Task Force for fulfilling the 500 m SMF objective.

End of Presentation

Thanks!