

Pre-Baseline Discussion for 400GPL Single Wavelength Objectives

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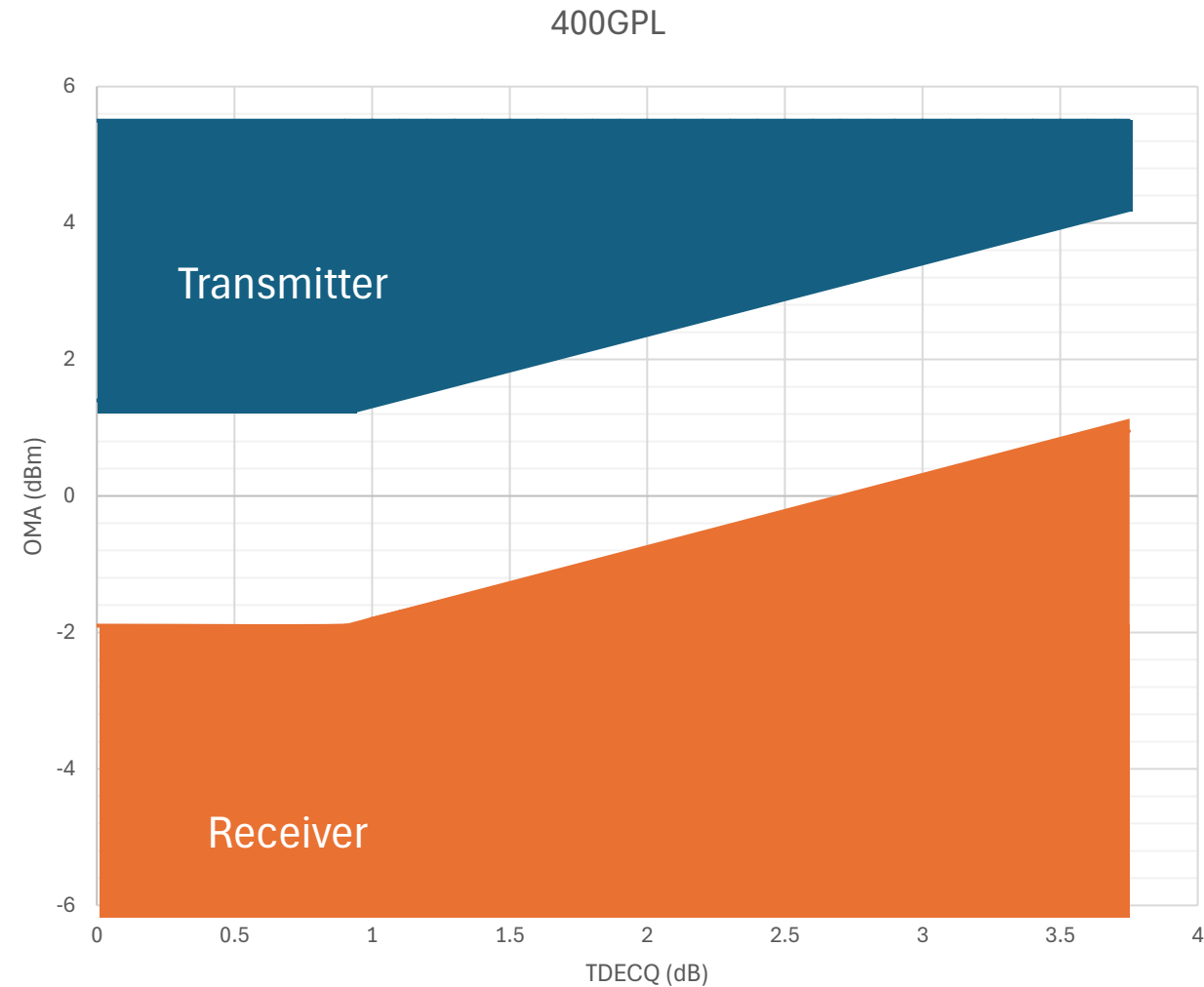
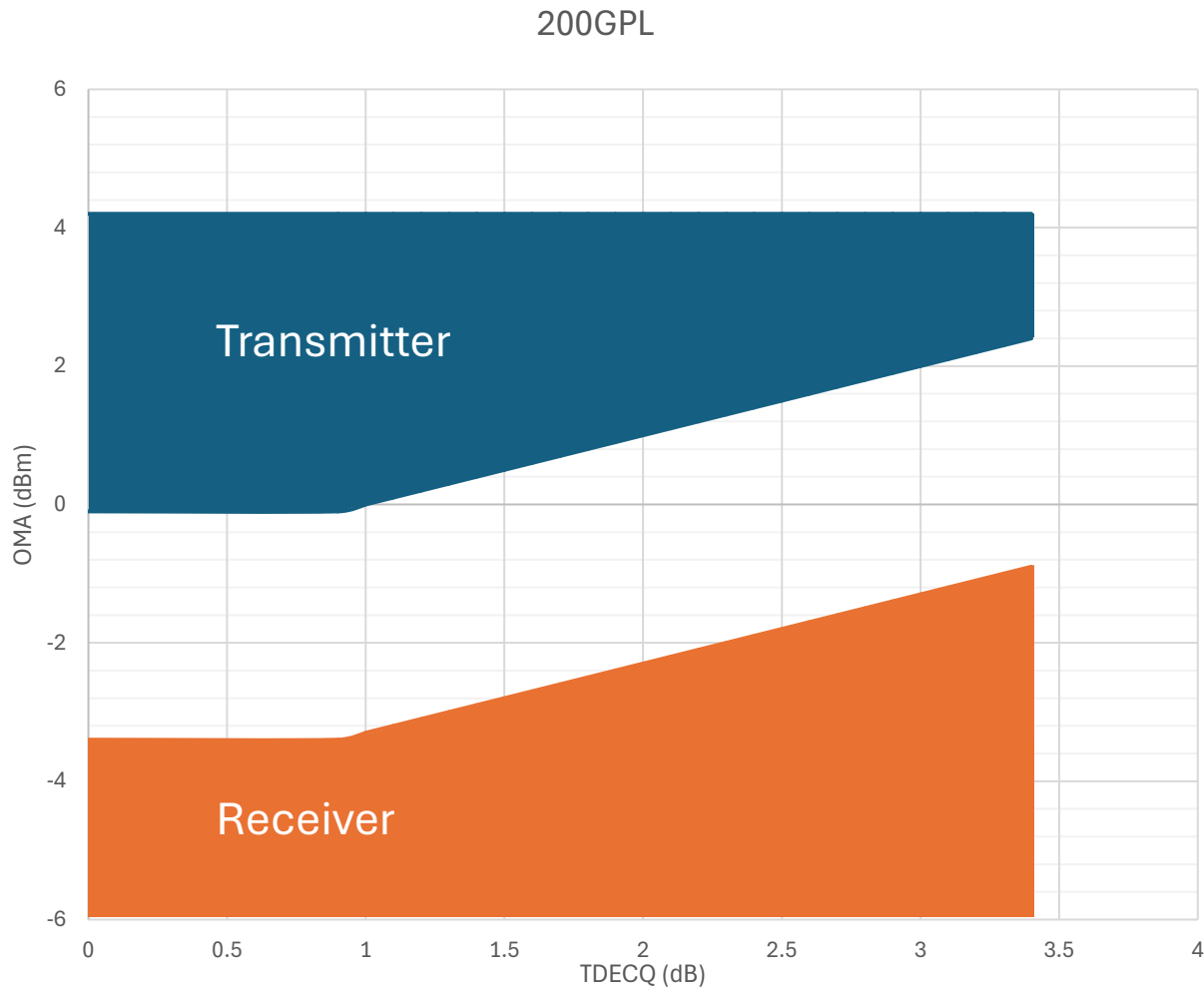
Overview

- General direction/philosophy for building 400GPL 500m baselines was introduced in [welch_400GPL_01b_260630](#)
 - Starting point was 200GPL 500m standard, with a view to change only what is needed to enable 400GPL
 - General theme to shift link budgets up by 1.5dB vs. comparable 200GPL specifications, to share additional rate burden between transmitter and receiver
 - Reuse FECo (RS544 only), and increase reference receiver equalized FFE while maintaining FFE+DFE architecture
- This presentation is restricted to optical compliance, other topics (ie, link training) are not discussed.

Comparison of Key Specifications

Description	200GBase-DR1 400GBase-DR2 800GBase-DR4	400GBase-DR1 800GBase-DR2 1.6TBase-DR4	Unit
Signaling rate, each lane (range)	106.25 ± 50 ppm	212.5 ± 50 ppm	GBd
Average launch power, each lane (max)	4	5.5	dBm
Average launch power, each lane (min)	-3.1	-1.6	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane (max)	4.2	5.7	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) for MAX(TECQ,TDECQ) < 0.9 dB	-0.1	1.4	dBm
for 0.9 dB ≤ MAX(TECQ,TDECQ) ≤ 3.4 dB	-1 + max(TECQ,TDECQ)	0.5 + MAX(TECQ, TDECQ)	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.4	3.75	dB
Extinction ratio, each lane, (min)	3.5	3	dB
Average receive power, each lane (max)	4	5.5	dBm
Average receive power, each lane (min)	-6.1	-4.6	dBm
Receiver sensitivity (OMA _{outer}), each lane (max) for TECQ < 0.9 dB	-3.4	-1.9	dBm
for 0.9 dB ≤ TECQ ≤ SECQ	-4.3 + TECQ	-2.8 + TECQ	dBm
Channel Insertion Loss	3	3	dB

Comparison of Key Specifications - Illustrated



Detailed Optical Transmitter Specifications

Description	400GBase-DR1	Unit
	800GBase-DR2	
	1.6TBase-DR4	
Signaling rate, each lane (range)	212.5 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Average launch power, each lane (max)	5.5	dBm
Average launch power, each lane (min)	-1.6	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane (max)	5.7	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min)		
for MAX(TECQ,TDECQ) < 0.9 dB	1.4	dBm
for 0.9 dB ≤ MAX(TECQ,TDECQ) ≤ 3.75 dB	0.5 + MAX(TECQ, TDECQ)	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.75	dB
TECQ (max)	3.75	dB
TDECQ – TECQ , each lane (max)	2.5	dB
Average launch power of OFF transmitter, each lane (max)	-15	dBm
Transmitter functional symbol error histogram, each lane (max)	TBD	
Extinction ratio, each lane, (min)	3	dB
Transmitter transition time (max)	TBD	ps
Transmitter over/under-shoot (max)	TBD	%
RIN _{xOMA} (max)	TBD	dB/Hz
Optical return loss tolerance (max)	TBD	dB
Transmitter reflectance (max)	-26	dB

Detailed Optical Receiver Specifications

Description	400GBase-DR1	Unit
	800GBase-DR2	
	1.6TBase-DR4	
Signaling rate, each lane (range)	212.5 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	nm
Damage threshold, each lane	6.5	dBm
Average receive power, each lane (max)	5.5	dBm
Average receive power, each lane (min)	-4.6	dBm
Receive power, each lane (OMOuter) (max)	5.7	dBm
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMOuter), each lane (max)		
for TECQ < 0.9 dB	-1.9	dBm
for 0.9 dB ≤ TECQ ≤ SECQ	-2.8 + TECQ	dBm
Stressed receiver sensitivity (OMOuter), each lane (max)	0.95	dBm
Conditions of stressed receiver sensitivity test:		
SECQ	3.75	dB
OMOuter of each aggressor lane	5.7	dBm

Comparison of Illustrative Power Budget

Description	200GBase-DR1	400GBase-DR1	Unit
	400GBase-DR2 800GBase-DR4 1.6TBase-DR8	800GBase-DR2 1.6TBase-DR4	
Power budget (for max TDECQ)	6.7	7.05	dB
Operating distance	500	500	m
TECQ/TDECQ (max)	3.4	3.75	
Channel insertion loss	3	3	dB
Maximum discrete reflectance	-35	-35	dB
Allocation for penalties (for max TDECQ) - includes 0.3 dB MPI/DGD allocation	3.7	4.05	dB
Additional insertion loss allowed	0	0	dB

Discussion/Other

- Expectation that reference receiver will have mild enhancement
 - Longer FFE ~ 22 taps
 - More pre-cursors ~ 5 taps
 - Higher DFE tap value ~ 0.7 (may require pre-coder)
- Tradeoff/balance between transmitter and receiver challenging & critical to a successful spec.
 - Transmitters likely to degrade in TDECQ and ER (while being asked to deliver more OMA).
 - Receiver sensitivity also challenged by operating closer to technology F_t limits

End

