

Baseline proposals for 200G/L PMD specifications for single wavelength 500m and 2km standards

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Overview

- Continuation of work shown in [welch_3dj_01a_230206](#)
 - No change to any spec tables
 - Addition of logic diagrams and ancillary details
- Two PMD types under consideration:
 - Single Wavelength 500m: 200GBASE-DR1, 400GBASE-DR2, 800GBASE-DR4, 1.6TBASE-DR8
 - Single Wavelength 2km: 200GBASE-FR1, 800GBASE-DR4-2, 1.6TBASE-DR8-2
- Two options shown for each
 - Option A (Type 1[†]): Use RS(544,514) FEC protection for PMD
 - Option B (Type 2[†]): Use RS(544,514)+Inner Code FEC protection for PMD

[† From brown_3dj_optx_adhoc_01a_230222](#)

BER Requirements

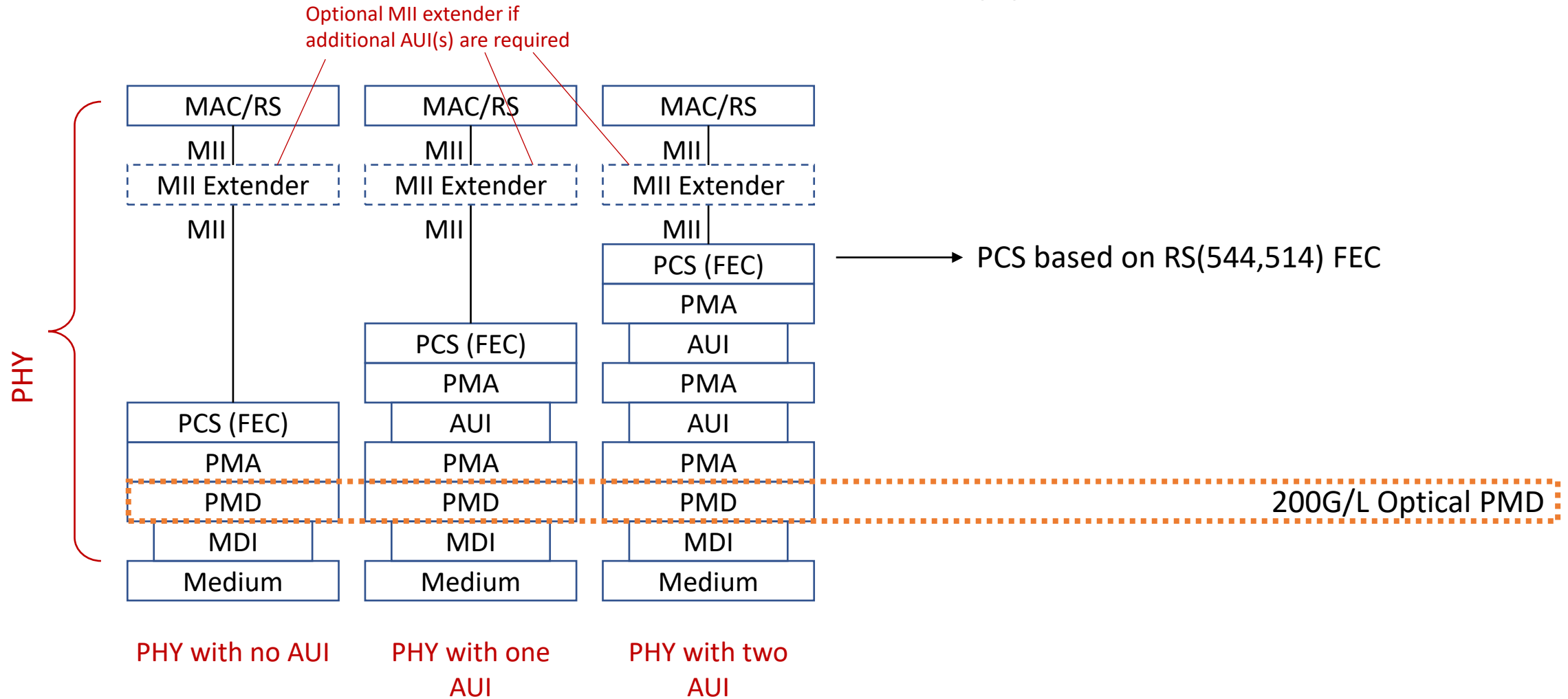
- **Option A:** The BER of the PMD link shall be less than 2.4×10^{-4} provided that the error statistics are sufficiently random that this results in a frame loss ratio of less than 1.7×10^{-12} for 64-octet frames with minimum interpacket gap when processed with an 800GBASE-R/1.6TBASE-R PCS.
- **Option B:** The BER of the PMD link shall be less than 4.85×10^{-3} provided that the error statistics are sufficiently random that this results in a frame loss ratio of less than 1.7×10^{-12} for 64-octet frames with minimum interpacket gap when processed with an 800GBASE-R/1.6TBASE-R PCS and inner code FEC sublayer.
 - Note: Exact pre-FEC BER level for Option B may vary.

TDECQ reference equalizer

- Propose to continue the use of a 5-tap T-spaced FFE as the TDECQ reference equalizer
- Longer reference equalizers reduce the demand on the Tx but transfer this to the Rx, since the test signal for the stressed Rx sensitivity test is calibrated using the reference equalizer
- Longer reference equalizers may lead to interoperability issues, as they mask a wider range of Tx impairments
- Rx implementations may use significantly more capable equalization, even MLSE, to achieve margin relative to the specifications. A longer reference equalizer reduces the potential margin
- Target SER for TDECQ measurement: Option A = $4.8e-4$, Option B = $9.7e-3$

Option A (Type 1): RS(544,514)

Location in Ethernet Stack: Type 1



Proposed Transmitter Specifications

Option A: RS(544,514), Pre-FEC BER = 2.4e-4

Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Signaling rate, each lane (Range)	106.25 ± 50 ppm	106.25 ± 50 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	30	dB
Average launch power, each lane (max)	4	4	dBm
Average launch power, each lane (min)	-1.9	-2.1	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	4.2	4.2	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) for TDECQ < 1.4dB	0.2	0.9	dBm
for 1.4 dB ≤ TDECQ ≤ 3.4 dB	-1.2+TDECQ	-0.5+TDECQ	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.4 [†]	3.4 [†]	dB
TECQ (max)	3.4 [†]	3.4 [†]	dB
TECQ - TECQ (max)	2.5	2.5	dB
Average launch power of OFF transmitter, each lane (max)	-15	-15	dBm
Extinction ratio, each lane, (min)	3.5	3.5	dB
Transmitter transition time (max)	8.5	8.5	ps
Transmitter over/under-shoot (max)	22	22	%
RIN _x OMA (max)	-137	-137	dB/Hz
Optical return loss tolerance (max)	21.4 (15.5 for DR1)	21.4 (17.1 for FR1)	dB
Transmitter reflectance (max)	-26	-26	dB

[†] Measured with FFE5 reference equalizer and SER = 4.8e-4

400GBASE-DR2-2 is not an active 802.3dj objective

Proposed Receiver Specifications

Option A: RS(544,514), Pre-FEC BER = 2.4e-4

Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Signaling rate, each lane (Range)	106.25 ± 50 ppm	106.25 ± 50 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	1304.5 to 1317.5	nm
Damage threshold, each lane	5	5	dBm
Average receive power, each lane (max)	4	4	dBm
Average receive power, each lane (min)	-4.9	-6.1	dBm
Receive power, each lane (OMA _{outer}) (max)	4.2	4.2	dBm
Receiver reflectance (max)	-26	-26	dB
Receiver sensitivity (OMA _{outer}), each lane (max)			
for TECQ < 1.4dB	-2.9	-3.5	dBm
for 1.4 dB ≤ TECQ ≤ 3.4 dB	-4.3+TECQ	-4.9+TECQ	dBm
Stressed receiver sensitivity (OMA _{outer}), each lane (max) [†]	-0.9	-1.5	dBm
Conditions of stressed receiver sensitivity test:			
SECQ	3.4 [†]	3.4 [†]	dB
OMA _{outer} of each aggressor lane	2.1	2.1	dBm

[†] Measured with FFE5 reference equalizer and SER= 4.8e-4

400GBASE-DR2-2 is not an active 802.3dj objective

Proposed Link Budget

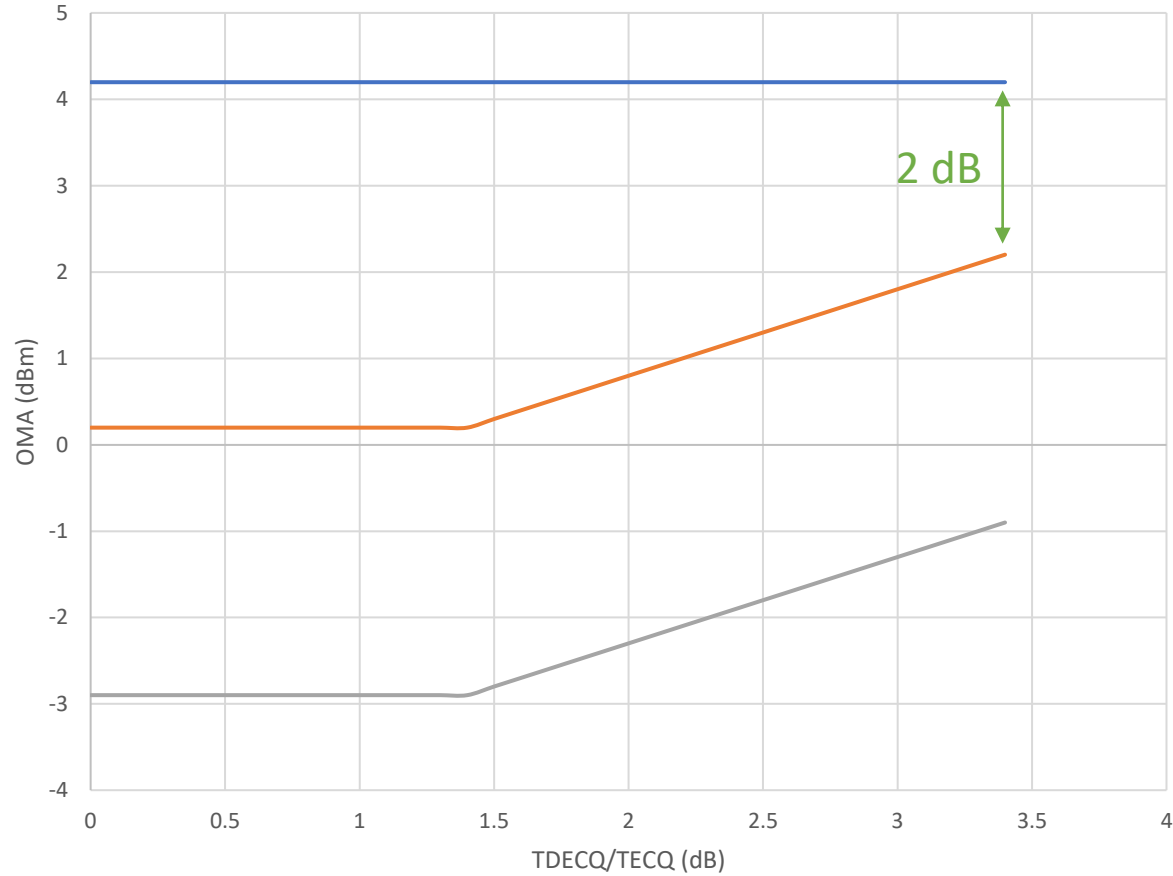
Option A: RS(544,514), Pre-FEC BER = 2.4e-4

Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Power budget (for max TDECQ)	6.5	7.8	dB
Operating distance	500	2000	m
Channel insertion loss	3	4	dB
Maximum discrete reflectance	-35	-35	dB
Allocation for penalties (for max TDECQ)	3.5	3.8	dB
Additional insertion loss allowed	0	0	dB

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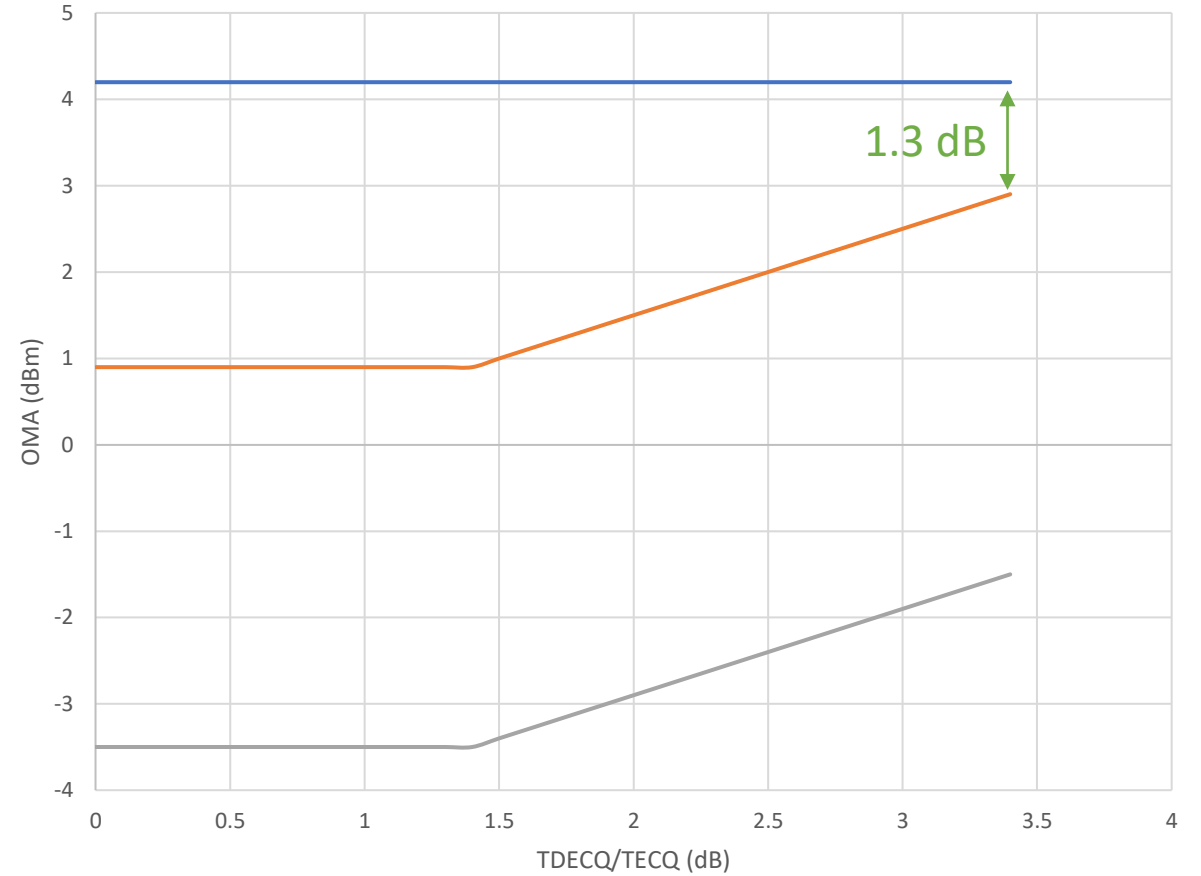
Illustrative Spec

Option A : 500m



— OMA (max) — OMA (min) — Sensitivity (max)

Option A : 2km

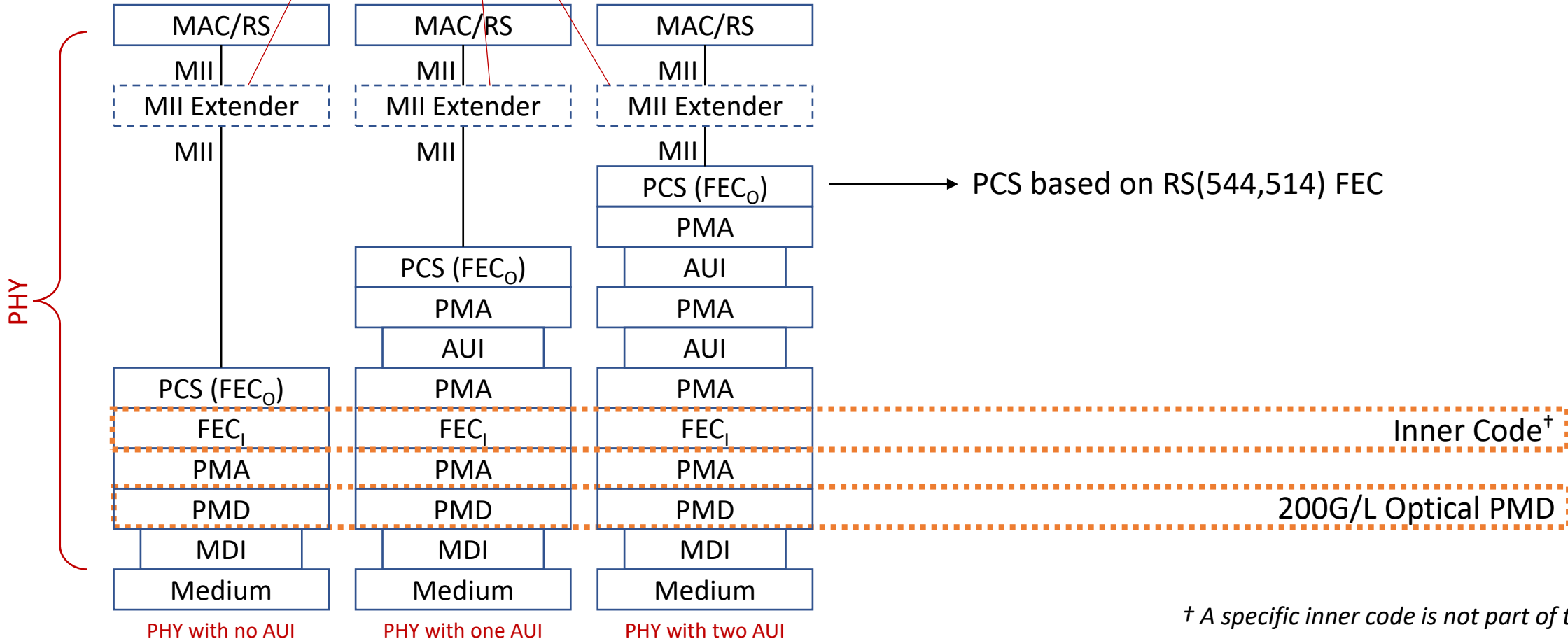


— OMA (max) — OMA (min) — Sensitivity (max)

Option B (Type 2):
RS(544,514)+Inner Code

Location in Ethernet Stack: Type 2

Optional MII extender if additional AUI(s) are required



[†] A specific inner code is not part of this proposal

Proposed Transmitter Specifications

Option B: RS(544,514) + Inner Code, Pre-FEC BER = 3.85e-3

Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Signaling rate, each lane (Range)	112.5 -113.4375 ± 50 ppm	112.5 -113.4375 ± 50 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	30	dB
Average launch power, each lane (max)	4	4	dBm
Average launch power, each lane (min)	-2	-2.2	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	4.2	4.2	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) for TDECQ < 1.3dB	0.1	0.8	dBm
for 1.3 dB ≤ TDECQ ≤ 2.8 dB	-1.2+TDECQ	-0.5+TDECQ	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	2.8 [‡]	2.8 [‡]	dB
TECQ (max)	2.8 [‡]	2.8 [‡]	dB
TDECQ - TECQ (max)	1.9	1.9	dB
Average launch power of OFF transmitter, each lane (max)	-15	-15	dBm
Extinction ratio, each lane, (min)	3.5	3.5	dB
Transmitter transition time (max)	8.0	8.0	ps
Transmitter over/under-shoot (max)	22	22	%
RIN _x OMA (max)	-137	-137	dB/Hz
Optical return loss tolerance (max)	21.4 (15.5 for DR1)	21.4 (17.1 for FR1)	dB
Transmitter reflectance (max)	-26	-26	dB

‡ Measured with FFE5 reference equalizer and SER = 9.7e-3

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Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Signaling rate, each lane (Range)	112.5 -113.4375 ± 50 ppm	112.5 -113.4375 ± 50 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	1304.5 to 1317.5	nm
Damage threshold, each lane	5	5	dBm
Average receive power, each lane (max)	4	4	dBm
Average receive power, each lane (min)	-4.9	-6.1	dBm
Receive power, each lane (OMA _{outer}) (max)	4.2	4.2	dBm
Receiver reflectance (max)	-26	-26	dB
Receiver sensitivity (OMA _{outer}), each lane (max) for TECQ < 1.3dB	-3	-3.6	dBm
for 1.3 dB ≤ TECQ ≤ 2.8 dB	-4.3+TECQ	-4.9+TECQ	dBm
Stressed receiver sensitivity (OMA _{outer}), each lane (max) [‡]	-1.5	-2.1	dBm
Conditions of stressed receiver sensitivity test:			
SECQ [‡]	2.8 [‡]	2.8 [‡]	dB
OMA _{outer} of each aggressor lane	1.6	1.6	dBm

‡ Measured with FFE5 reference equalizer and SER = 9.7e-3

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Proposed Link Budget

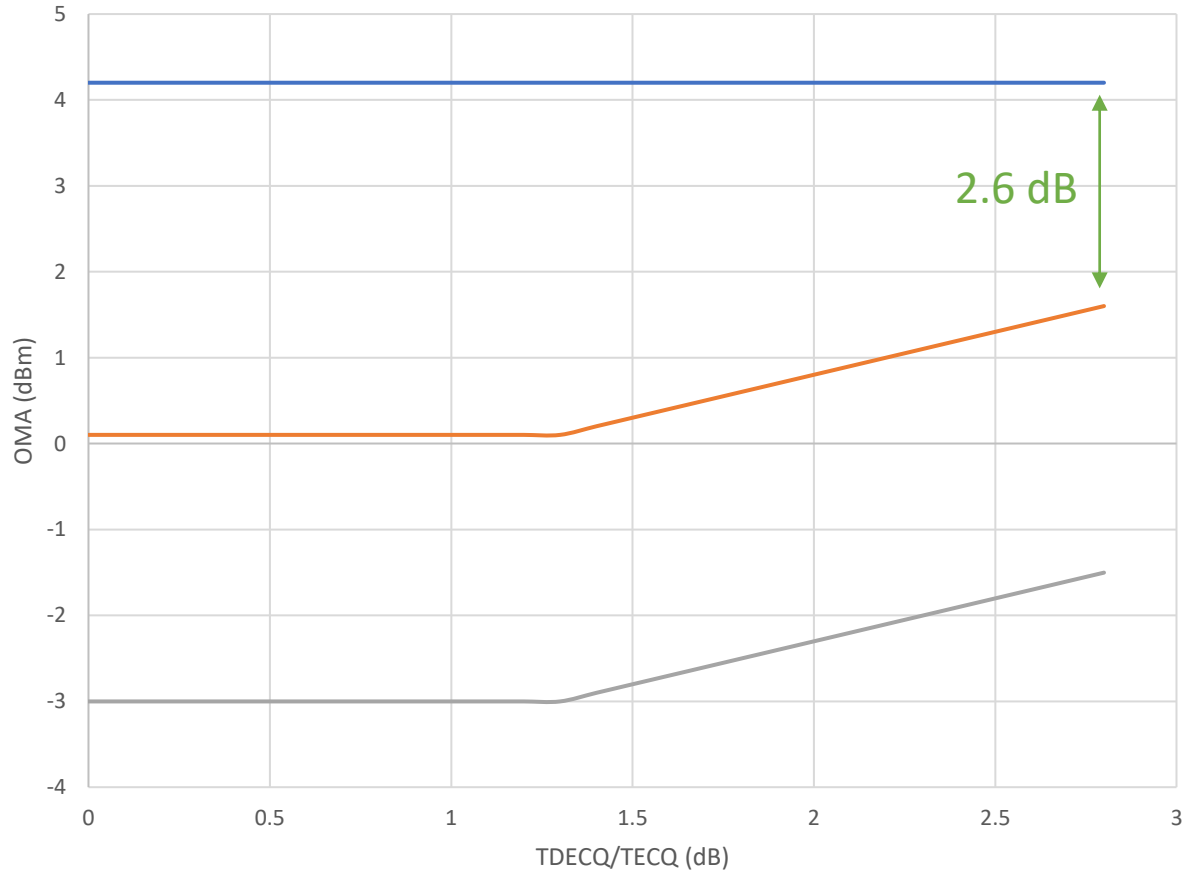
Option B: RS(544,514) + Inner Code, Pre-FEC BER = 3.85e-3

Description	500m	2km	Unit
	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8	200GBASE-FR1 <i>400GBASE-DR2-2</i> 800GBASE-DR4-2 1.6TBASE-DR8-2	
Power budget (for max TDECQ)	5.9	7.2	dB
Operating distance	500	2000	m
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Maximum discrete reflectance	-35	-35	dB
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Additional insertion loss allowed	0	0	dB

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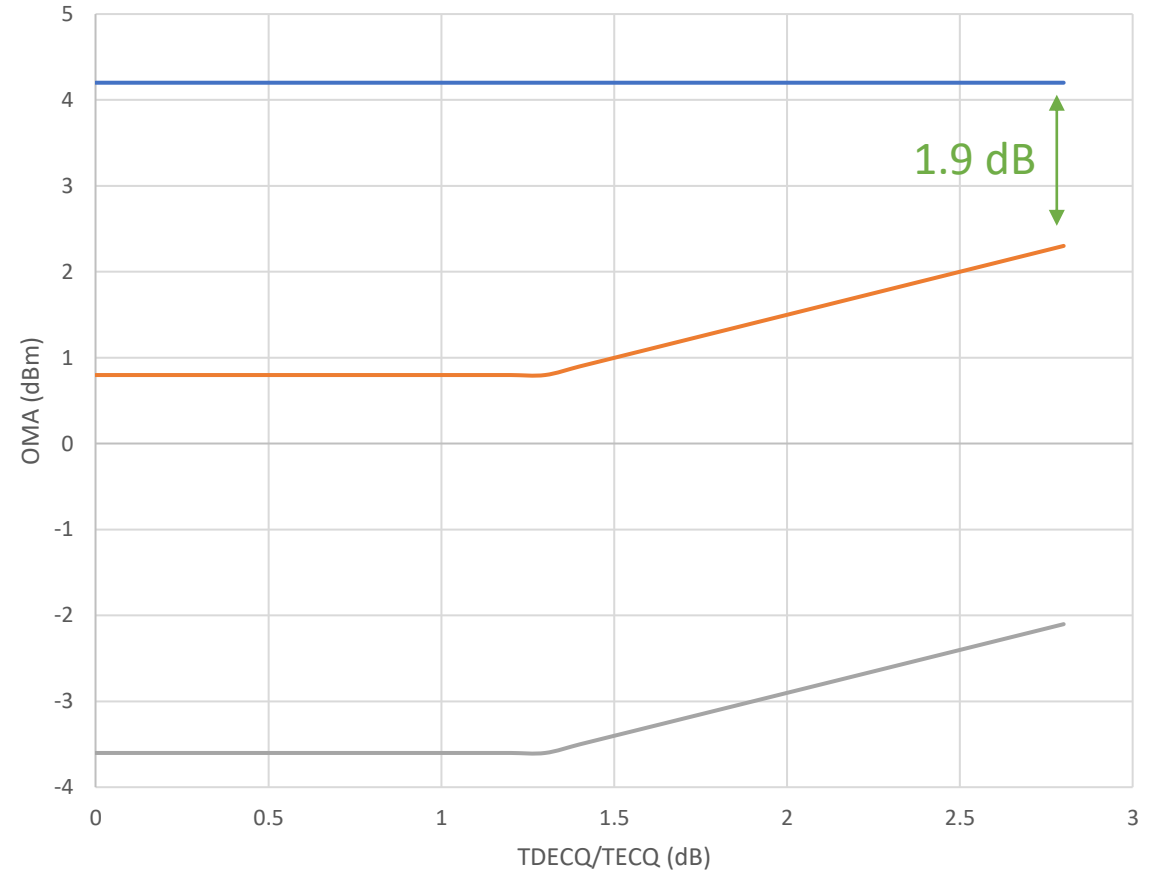
Illustrative Spec

Option B : 500m



— OMA (max) — OMA (min) — Sensitivity (max)

Option B : 2km



— OMA (max) — OMA (min) — Sensitivity (max)

Summary

- Baseline proposals are presented for 500m and 2km 200G/L single wavelength reach objectives, for two different FEC options [RS(544,514) only vs. RS(544,514) + inner code]
 - Options differ from each other in signaling rate and BER/SER specifications (and affiliated specifications).

Backup

Relationship to 200G/L AUIs

