

Baseline proposal for 200G/L PMD specification for 4 wavelengths over a single SMF in each direction with lengths up to at least 2km

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Supporters

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Overview

- Continuation of work shown in [welch_3dj_03b_2303](#)
 - RIN_OMA revised to – 139 dB/Hz from -137 dB/Hz, to reflect the doubling in measurement bandwidth from 100G (RIN_OMA for 100G was -136 dB/Hz)
 - TDECQ reference receiver revised to FFE9 from FFE5, with tap weight restrictions
- Proposing to support BOTH RS(544,514) only and RS(544,514)+Inner Code FEC options
 - See [welch_3dj_03a_0523](#) for details
 - Option A (Type 1[†]): Use RS(544,514) FEC protection for PMD
 - Option B (Type 2[†]): Use RS(544,514) + Inner Code (128,120) FEC protection for PMD

[†] From [brown_3dj_01a_2303.pdf](#)

BER Requirements

This contribution does not recommend a specific option on the FEC architecture. FEC options are under study and still require more information

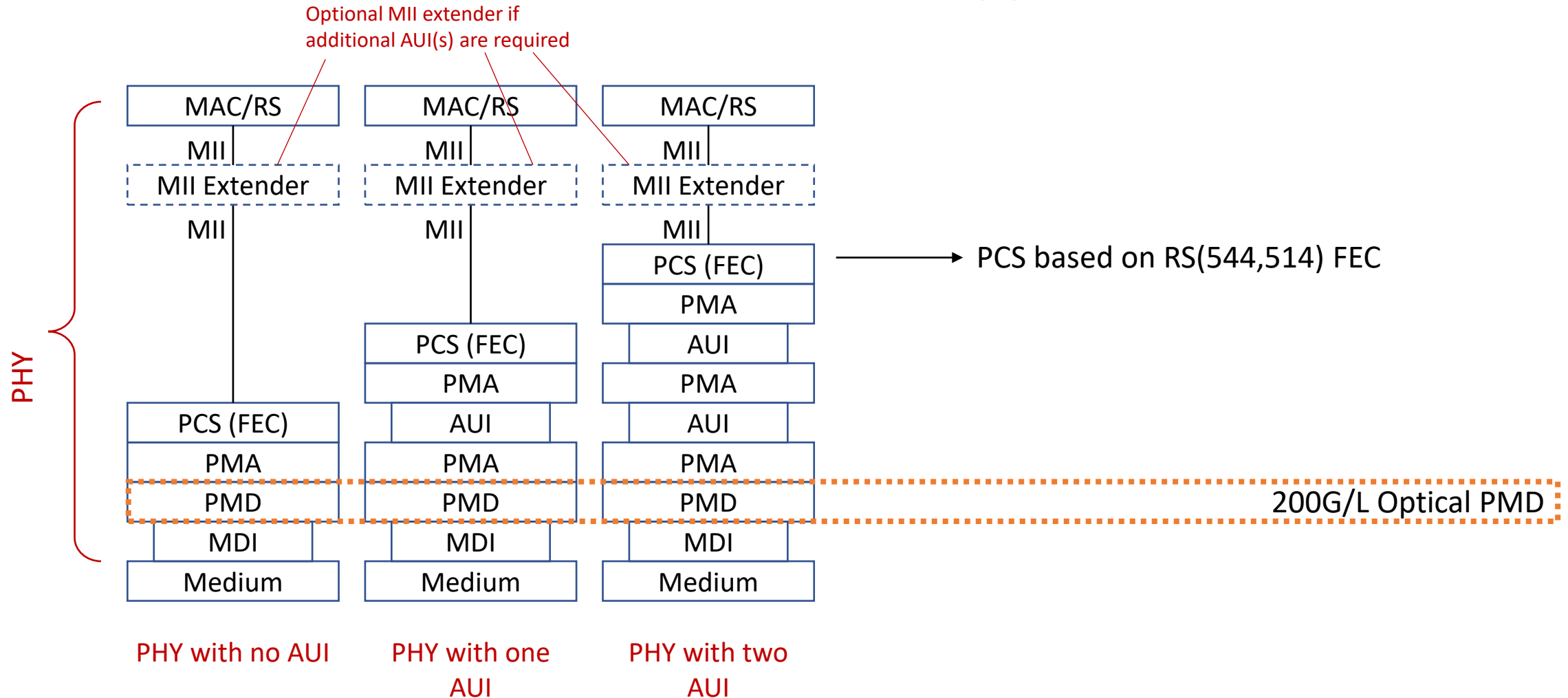
- **Option A:** The BER of the PMD link shall be less than 2.4×10^{-4} provided that the error statistics are sufficiently random that this results in a frame loss ratio of less than 1.7×10^{-12} for 64-octet frames with minimum interpacket gap when processed with an 800GBASE-R/1.6TBASE-R PCS.
- **Option 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 is not finalized.

TDECQ/TECQ/SECQ Reference Receiver

- TDECQ reference filter expanded from FFE5 (1 main + 4 pre/post cursors) to FFE9 (1 main + 8 pre/post cursors)
 - Maintain the same absolute FFE length (as 100G/L) to manage reflection concerns
- Introduce tap weight limits of +/- .25 for first pre-post cursor and +/- 0.1 for all other taps (measured relative to the main tap).
 - Mitigate concerns of extreme TX BW restriction that could have deleterious effects on receiver performance/design
- Open question on target SER for inner code: Can soft-decision performance be assumed in a reference receiver?
 - Alternatively, we could codify hard-decision target SER for TDECQ/TECQ/SECQ.

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	800GBASE-FR4	Unit
Signaling rate, each lane (Range)	106.25 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Average launch power, each lane (max)	4.9	dBm
Average launch power, each lane (min)	-1.5	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	4.8	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) [†] for TDECQ < 1.4dB	1.3	dBm
for 1.4 dB ≤ TDECQ ≤ 3.6 dB	-0.1+TDECQ	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max) [†]	3.6	dB
TECQ (max) [†]	3.6	dB
TDECQ - TECQ (max) [†]	2.5	dB
Average launch power of OFF transmitter, each lane (max)	-15	dBm
Extinction ratio, each lane, (min)	3.5	dB
Transmitter transition time (max)	8.5	ps
Transmitter over/under-shoot (max)	22	%
RIN _x OMA (max)	-139	dB/Hz
Optical return loss tolerance (max)	17.1	dB
Transmitter reflectance (max)	-26	dB

[†] Measured with FFE9 reference equalizer with tap weight restrictions of +/- 0.25 for 1st pre/post cursor, +/- 0.1 for all other taps (relative to the main tap), and SER = 4.8e-4

Proposed Receiver Specifications

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

Description	800GBASE-FR4	Unit
Signaling rate, each lane (Range)	106.25 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Damage threshold, each lane	5.9	dBm
Average receive power, each lane (max)	4.9	dBm
Average receive power, each lane (min)	-5.5	dBm
Receive power, each lane (OMA _{outer}) (max)	4.8	dBm
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMA _{outer}), each lane (max) for TECQ < 1.4dB	-3.1	dBm
for 1.4 dB ≤ TECQ ≤ 3.6 dB	-4.5 + TECQ	dBm
Stressed receiver sensitivity (OMA _{outer}), each lane (max) [†]	-0.9	dBm
Conditions of stressed receiver sensitivity test:		
SECQ [†]	3.6	dB
OMA _{outer} of each aggressor lane	2.6	dBm

[†] Measured with FFE9 reference equalizer with tap weight restrictions of +/- 0.25 for 1st pre/post cursor, +/- 0.1 for all other taps (relative to the main tap), and SER = 4.8e-4

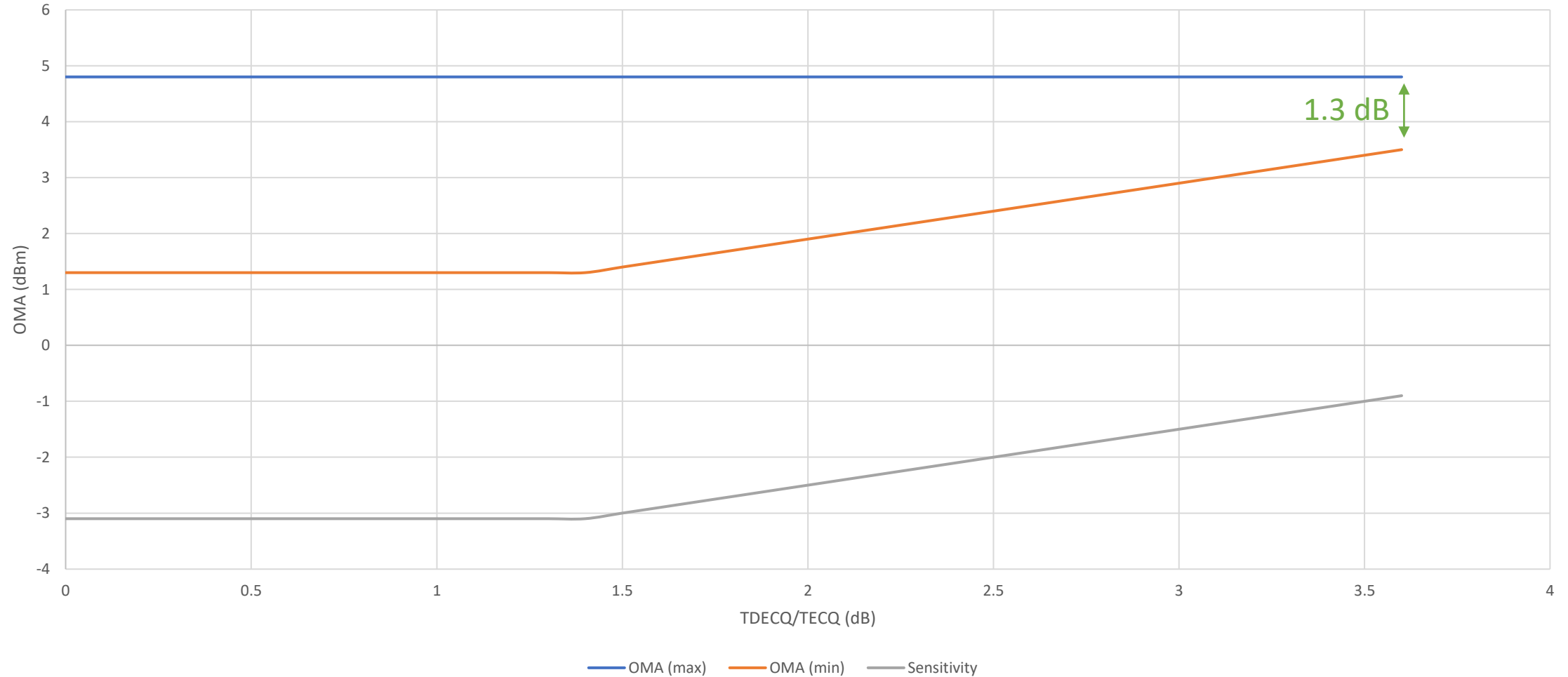
Proposed Link Budget

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

Description	800GBASE-FR4	Unit
Power budget (for max TDECQ)	8	dB
Operating distance	2000	m
Channel insertion loss	4	dB
Maximum discrete reflectance	-35	dB
Allocation for penalties (for max TDECQ)	4	dB
Additional insertion loss allowed	0	dB

Illustrative Spec

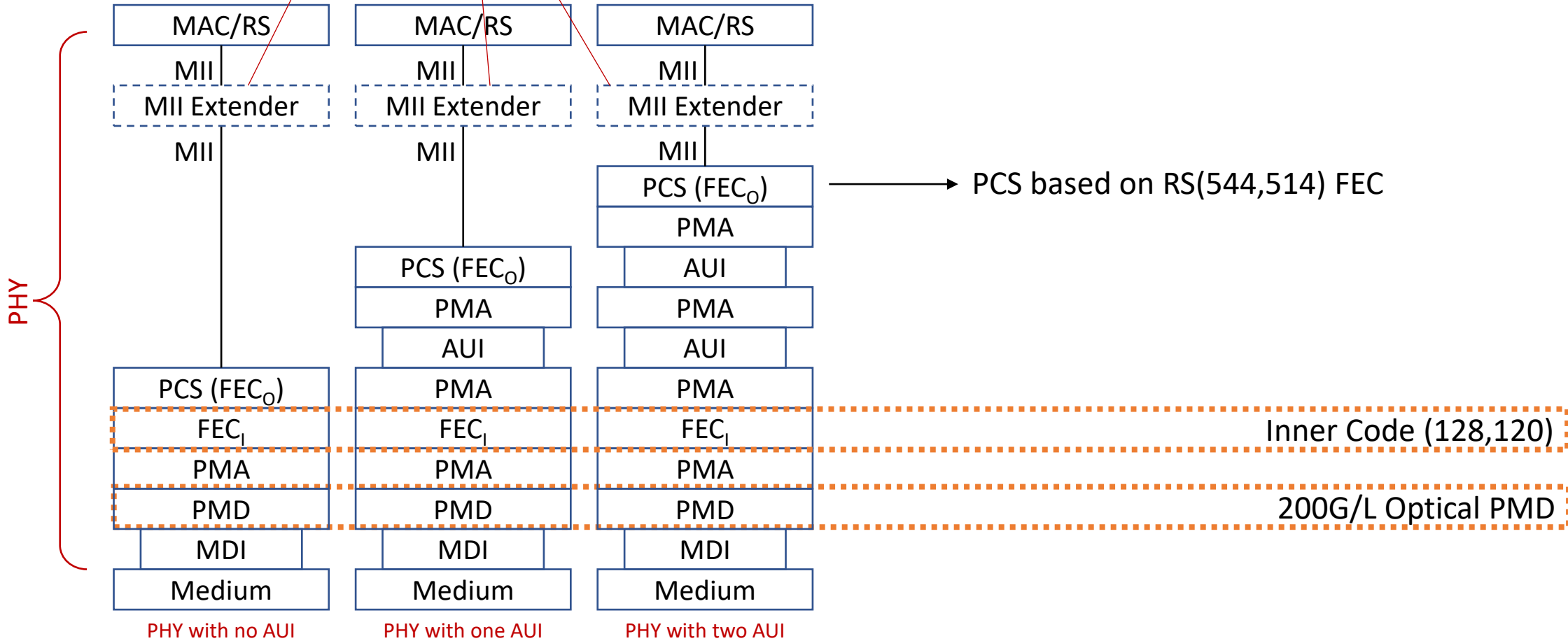
Option A : 800G-FR4



Option B (Type 2): RS(544,514) +
Inner Code (128,120)

Location in Ethernet Stack: Type 2

Optional MII extender if additional AUI(s) are required



Proposed Transmitter Specifications

Option B: RS(544,514) + Inner Code (128,120), Pre-FEC BER = 4.85e-3

Description	800GBASE-FR4	Unit
Signaling rate, each lane (Range)	112.5 -113.4375 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Average launch power, each lane (max)	4.9	dBm
Average launch power, each lane (min)	-1.6	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	4.8	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) [†] for TDECQ < 1.3dB for 1.3 dB ≤ TDECQ ≤ 2.9 dB	1.2 -0.1+TDECQ	dBm dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max) [†]	2.9	dB
TECQ (max) [†]	2.9	dB
TDECQ - TECQ (max) [†]	1.9	dB
Average launch power of OFF transmitter, each lane (max)	-15	dBm
Extinction ratio, each lane, (min)	3.5	dB
Transmitter transition time (max)	8	ps
Transmitter over/under-shoot (max)	22	%
RIN _x OMA (max)	-139	dB/Hz
Optical return loss tolerance (max)	17.1	dB
Transmitter reflectance (max)	-26	dB

[†] Measured with FFE9 reference equalizer with tap weight restrictions of +/- 0.25 for 1st pre/post cursor, +/- 0.1 for all other taps (relative to the main tap), and SER = 9.7e-3

Proposed Receiver Specifications

Option B: RS(544,514) + Inner Code (128,120), Pre-FEC BER = 4.85e-3

Description	800GBASE-FR4	Unit
Signaling rate, each lane (Range)	112.5 -113.4375 ± 50 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	nm
Damage threshold, each lane	5.9	dBm
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Receive power, each lane (OMA_{outer}) (max)	4.8	dBm
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMA_{outer}), each lane (max)		
for TECQ < 1.3dB	-3.3	dBm
for 1.3 dB ≤ TECQ ≤ 2.9 dB	-4.6 + TECQ	dBm
Stressed receiver sensitivity (OMA_{outer}), each lane (max) [†]	-1.7	dBm
Conditions of stressed receiver sensitivity test:		
SECQ [†]	2.9	dB
OMA_{outer} of each aggressor lane	1.9	dBm

[†] Measured with FFE9 reference equalizer with tap weight restrictions of +/- 0.25 for 1st pre/post cursor, +/- 0.1 for all other taps (relative to the main tap), and SER = 9.7e-3

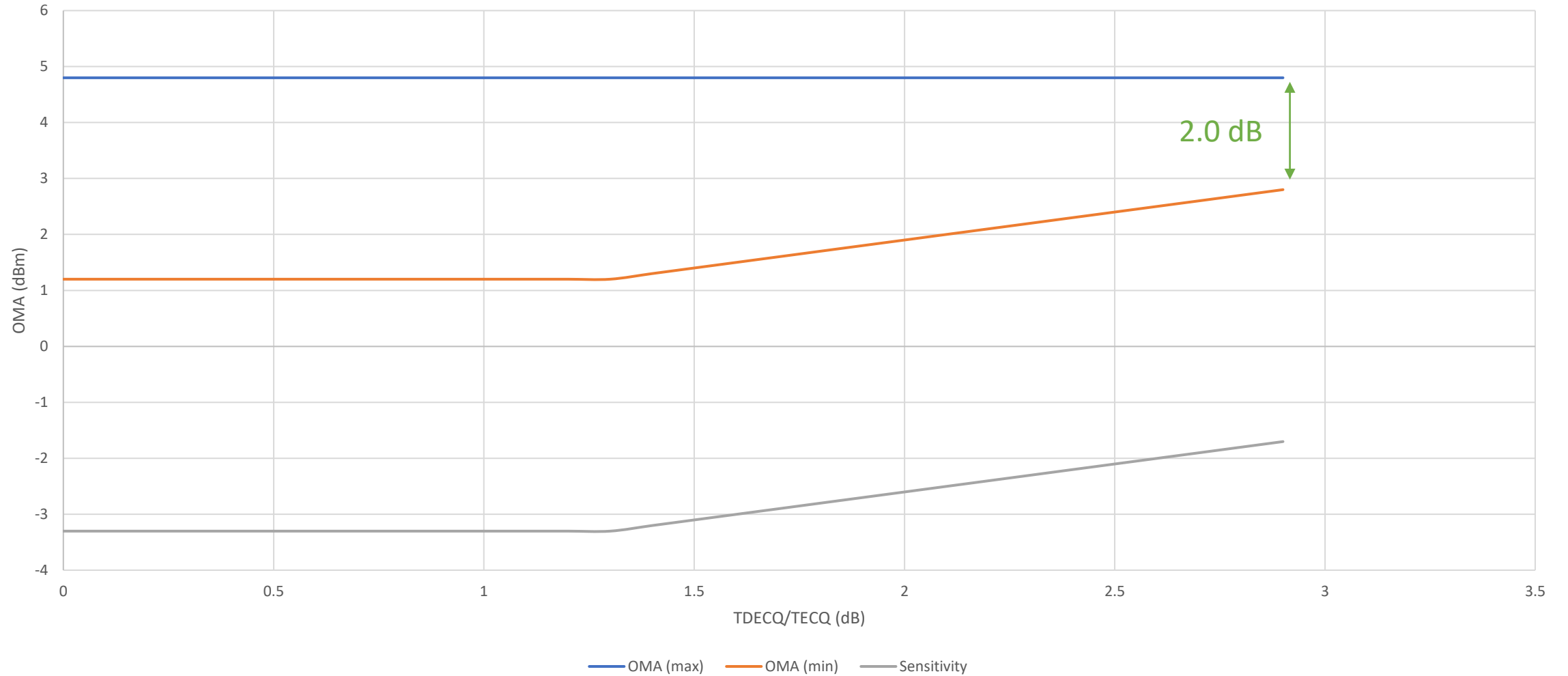
Proposed Link Budget

Option B: RS(544,514) + Inner Code (128,120), Pre-FEC BER = 4.85e-3

Description	800GBASE-FR4	Unit
Power budget (for max TDECQ)	7.4	dB
Operating distance	2000	m
Channel insertion loss	4	dB
Maximum discrete reflectance	-35	dB
Allocation for penalties (for max TDECQ)	3.4	dB
Additional insertion loss allowed	0	dB

Illustrative Spec

Option B : 800G-FR4



Summary

- Baseline proposals are presented for the 800G 2km four wavelength reach objective, for two different FEC options [RS(544,514) only vs. RS(544,514) + Inner Code (128,120)]
 - Options differ from each other in signaling rate and BER/SER specifications (and affiliated specifications).