

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

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Overview

- Continuation of work shown in [welch_3dj_01b_2305](#)
- Two PMD types under consideration:
 - Single Wavelength 500m: 200GBASE-DR1, 400GBASE-DR2, 800GBASE-DR4, 1.6TBASE-DR8
 - Single Wavelength 2km: 200GBASE-FR1, 400GBASE-DR2-2, 800GBASE-DR4-2, 1.6TBASE-DR8-2
- Consolidating RS(544,514) only, and RS(544,514)+Hamming(128,120) operation into a common spec.
 - Allow for wider permissible transmitter operating range, with inner FEC chosen based on transmitter performance (or host override)
 - Receiver specification is expanded to cover the entire permissible transmitter operation range.
 - See [welch_3dj_04_2307.pdf](#) for more details

BER Requirements

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

- **RS(544,514) only**: 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.
- **RS(544,514)+Hamming(128,120)**: The BER of the PMD link shall be less than 3×10^{-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 Inner FEC is not finalized. Convolutional interleaver bypass options may yield pre-FEC BER level $\lesssim 2 \times 10^{-3}$.

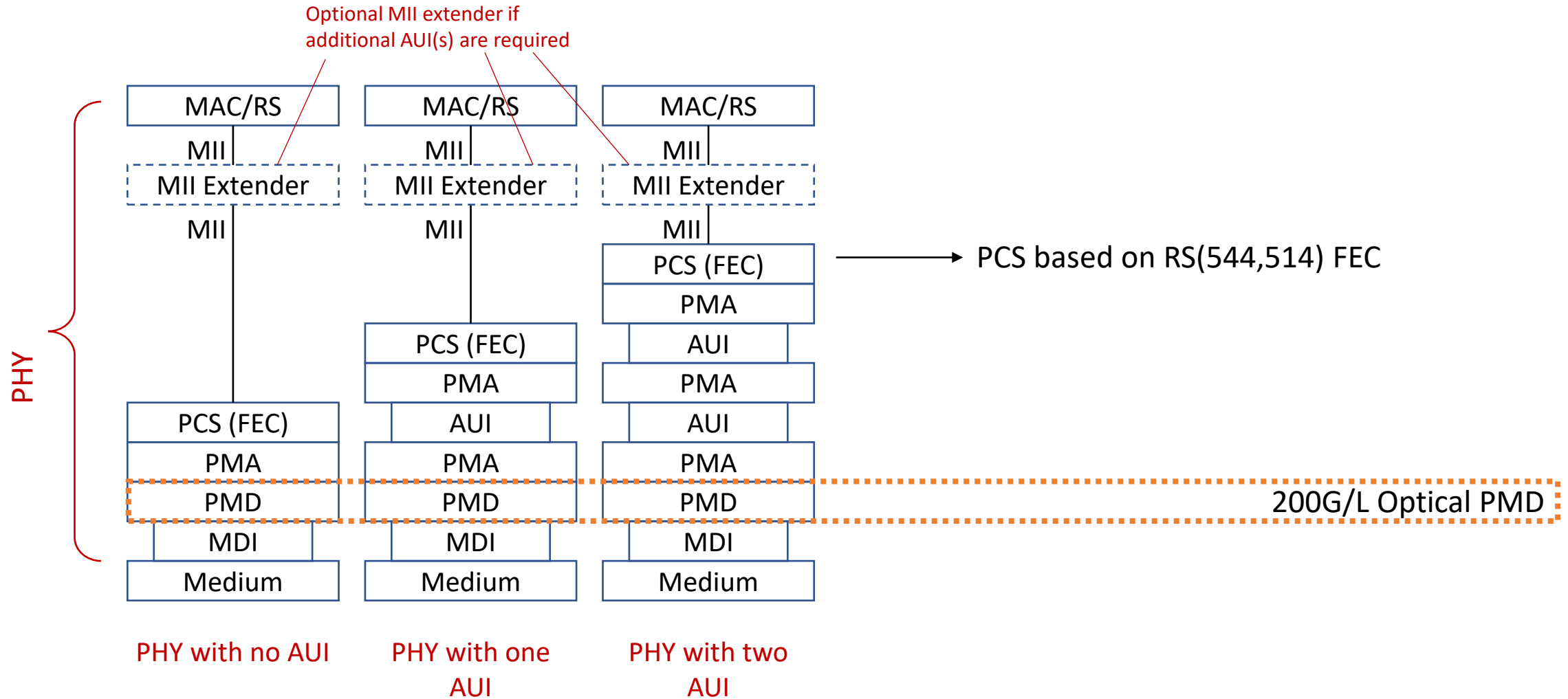
TDECQ/TECQ/SECQ Reference Receiver

- TDECQ reference filter expanded from FFE5 (1 main + 4 pre/post cursors) to FFE9 (1 main + 8 pre/post cursors)
 - Introduce tap weight limits (Currently **TBD**) → Mitigate concerns of extreme TX BW restriction that could have deleterious effects on receiver performance/design

Tap Limits	Min	Max
Main Cursor	TBD	TBD
First Pre/Post Cursor	TBD	TBD
Second Pre/Post Cursor	TBD	TBD
All Other	TBD	TBD
Sum of all taps	1	1

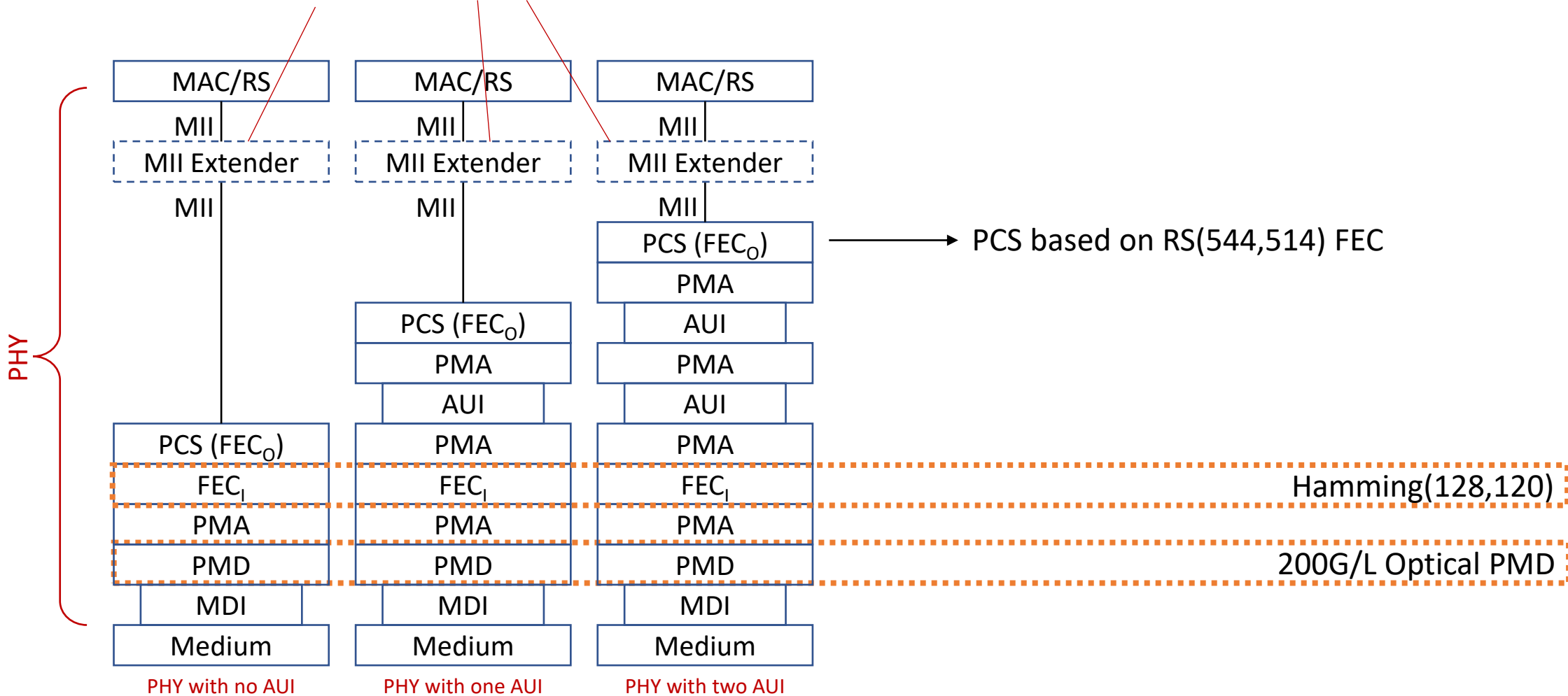
- Note: TECQ/TDECQ/SECQ values and target SER revised to **TBD**, pending resolution of the questions raised in:
https://www.ieee802.org/3/dj/public/adhoc/optics/0623_OPTX/leyba_3dj_optx_01_230629.pdf

Location in Ethernet Stack: RS(544,514) only



Location in Ethernet Stack: RS(544,514)+Hamming(128,120)

Optional MII extender if additional AUI(s) are required



Proposed Transmitter Specifications

Description	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8		200GBASE-FR1 400GBASE-DR2-2 800GBASE-DR4-2 1.6TBASE-DR8-2		Unit
	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	
Signaling rate, each lane (range)	106.25 ± 50 ppm	113.4375 ± 50 ppm	106.25 ± 50 ppm	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)	-2.8		-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 < 1.4 dB	0.2		0.9		dBm
for 1.4 dB ≤ TDECQ ≤ TDECQ (max)	-1.2 + TDECQ		-0.5 + TDECQ		dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.4 ^a	TBD ^b	3.4 ^a	TBD ^b	dB
TECQ (max)	3.4 ^a	TBD ^b	3.4 ^a	TBD ^b	dB
TDECQ - TECQ (max)	2.5 ^a	TBD ^b	2.5 ^a	TBD ^b	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		8		ps
Transmitter over/under-shoot (max)	22		22		%
RIN _x OMA (max)	-139		-139		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

^a Measured with FFE9 reference equalizer with SER = 4.8e-4

^b Measured with FFE9 reference equalizer with SER = TBD

Proposed Receiver Specifications

Description	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8		200GBASE-FR1 400GBASE-DR2-2 800GBASE-DR4-2 1.6TBASE-DR8-2		Unit
	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	
Signaling rate, each lane (range)	106.25 ± 50 ppm	113.4375 ± 50 ppm	106.25 ± 50 ppm	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)	-5.8		-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 < 1.4 dB	-2.9		-3.5		dBm
Receiver sensitivity (OMA _{outer}), each lane (max) for 1.4 dB ≤ TECQ ≤ SECQ	-4.3 + TECQ		-4.9 + TECQ		dBm
Stressed receiver sensitivity (OMA _{outer}), each lane (max)	-0.9 ^a	TBD ^b	-1.5 ^a	TBD ^b	dBm
Conditions of stressed receiver sensitivity test:					
SECQ	3.4 ^a	TBD ^b	3.4 ^a	TBD ^b	dB
OMA _{outer} of each aggressor lane ^c	4.2		4.2		dBm

^a Measured with FFE9 reference equalizer with SER = 4.8e-4

^b Measured with FFE9 reference equalizer with SER = TBD

^c No aggressors needed for 200GBASE-DR1 or 200GBASE-FR1

Proposed Link Budget

Description	200GBASE-DR1 400GBASE-DR2 800GBASE-DR4 1.6TBASE-DR8		200GBASE-FR1 400GBASE-DR2-2 800GBASE-DR4-2 1.6TBASE-DR8-2		Unit
	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	RS(544, 514)	RS(544, 514) + Hamming(128, 120)	
Power budget (for max TDECQ)	6.5	TBD	7.8	TBD	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	TBD	3.8	TBD	dB
Additional insertion loss allowed	0		0		dB

Summary

- Baseline proposals for all 200G/L single wavelength objectives at 500m and 2km have been proposed.
- Proposals contain requirements for operation with inner FEC bypassed or enabled.
- For inner FEC enabled operation parameters derived from a target SER (including TDECQ, TECQ, SECQ, and SRS) have been indicated as TBD

Thank You

& Backup