

# IEEE P802.3dj Coherent PHYs

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# Overview

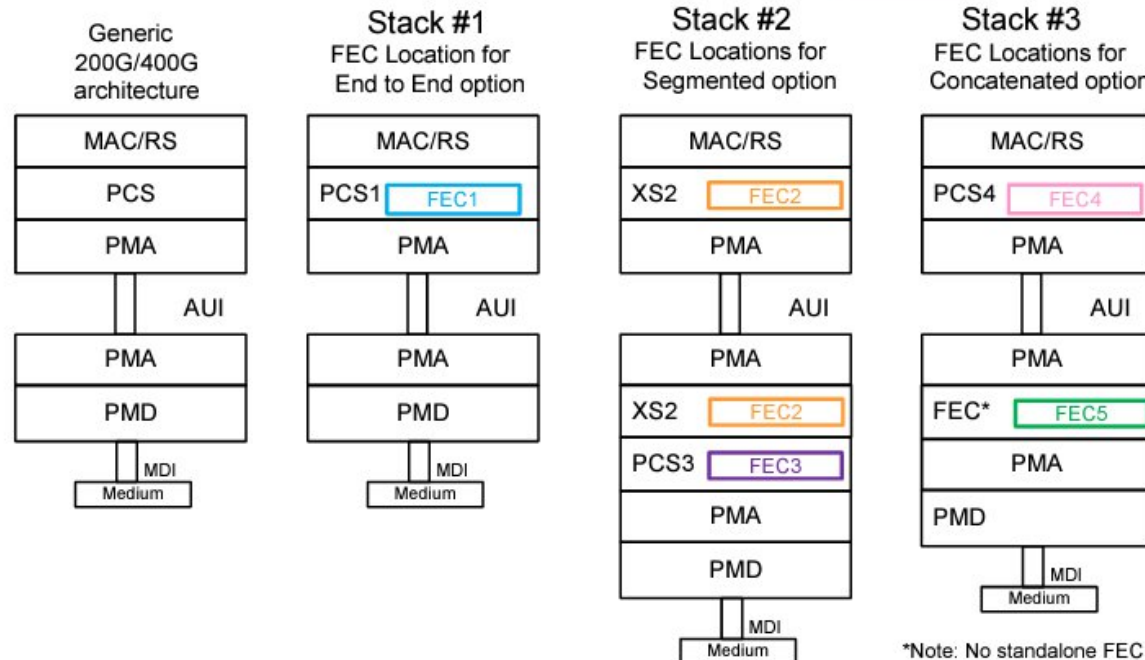
- IEEE P802.3dj has 10, 20, and 40km objectives being addressed using coherent optical approaches
- Logical specifications have been adopted, and optical specifications are under development
- Key items being discussed are laser implementations, Transmitter specifications, and PTP support

# 802.3dj Optical FEC implementations

## Proposed 200GbE/400GbE Architecture

- How various FEC schemes fit into the architecture
- FECs might or might not be reused across schemes

- FEC1** = End to End FEC
- FEC2** = AUI FEC for Segmented
- FEC3** = PMD FEC for Segmented
- FEC4** = Outer FEC for Concatenated
- FEC5** = Inner FEC for Concatenated



IMDD has a mix of Stack 1&3

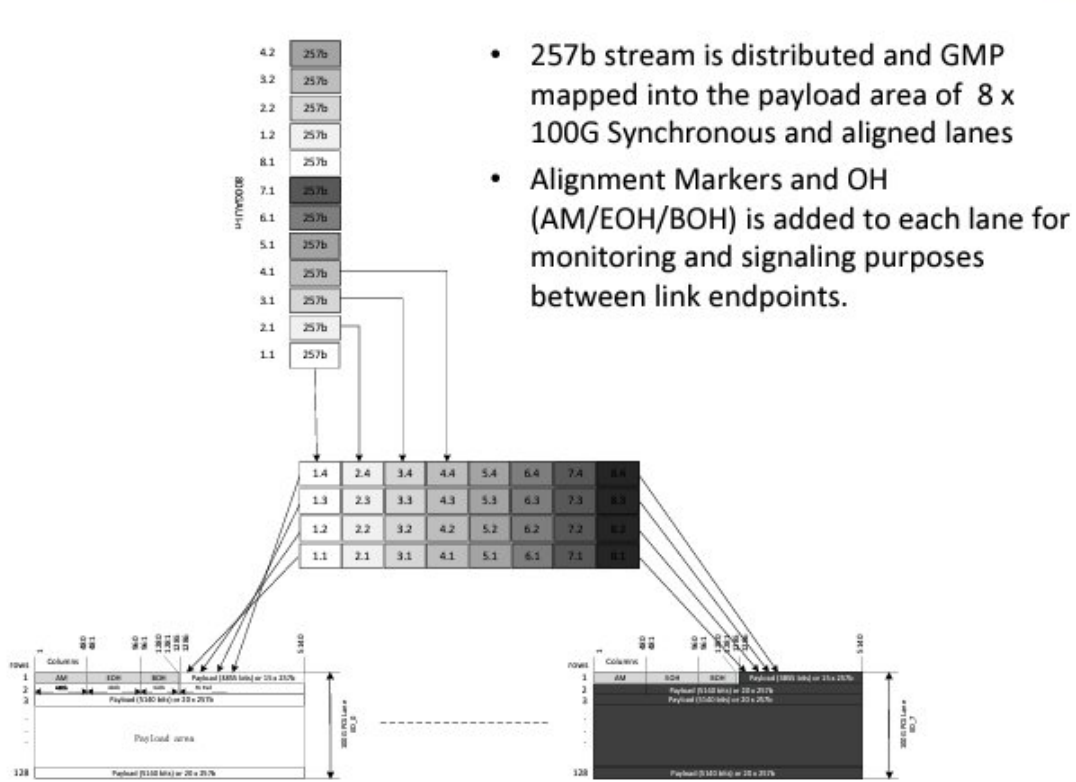
Coherent has a mix of Stack 2&3

# 800GBASE-LR1 & ER1 standards alignment

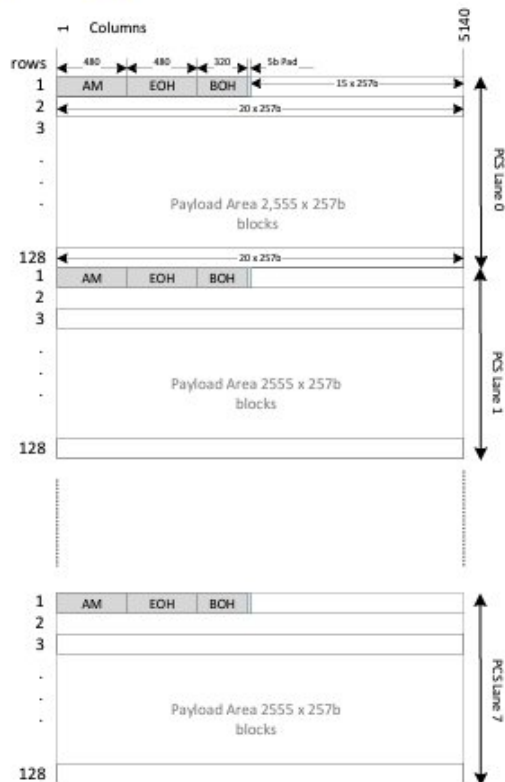
- The 800GBASE-ER1 specifications uses a similar logical implementation to FlexO-8e-DO and OIF 800ZR
- 800GBASE-LR1 uses a common logical approach with OIF 800LR, and is a synchronous Ethernet approach

# 800GBASE-ER1 & 800GBASE-ER1-20 Logic

## PCS - 257b distribution & GMP mapping

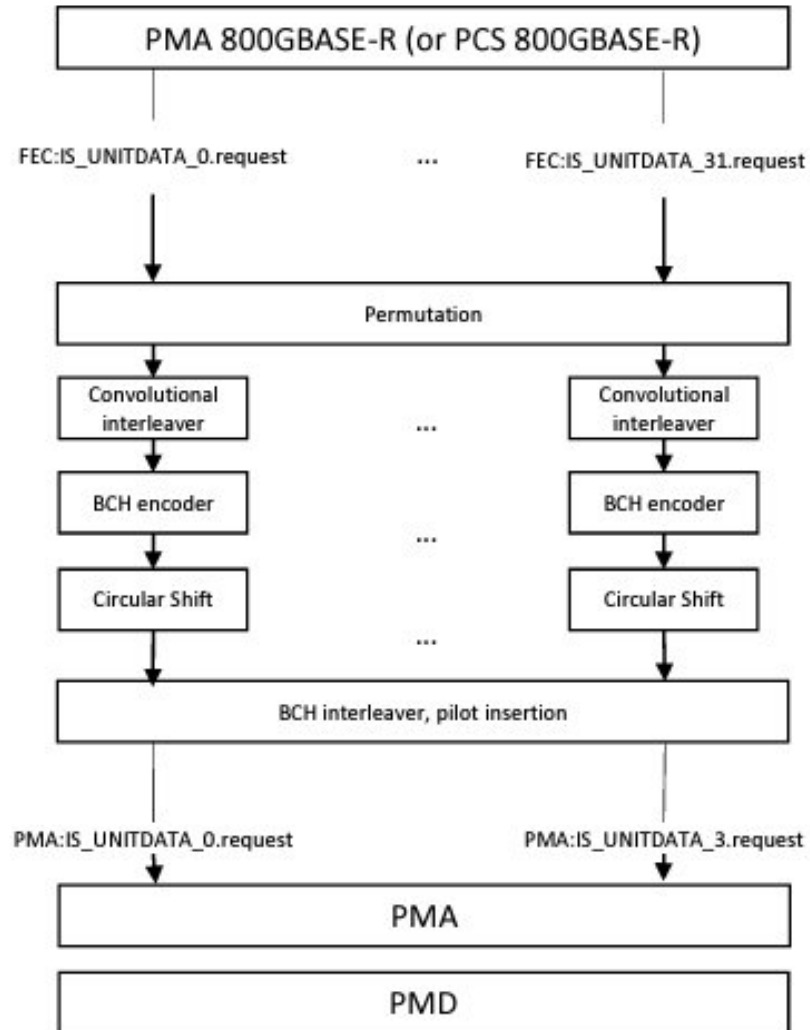


- 257b stream is distributed and GMP mapped into the payload area of 8 x 100G Synchronous and aligned lanes
- Alignment Markers and OH (AM/EOH/BOH) is added to each lane for monitoring and signaling purposes between link endpoints.



- 800GBASE-ER1 uses a common logical approach with OIF 800ZR and FlexO-8e-DO
- RS FEC is terminated, and 257b blocks are GMP mapped into the payload area of a FlexO frame
- oFEC is used as the FEC scheme
- The Ethernet traffic is asynchronous from the coherent line

# 800GBASE-LR1 Logic



- 800GBASE-LR1 uses a synchronous mapping of RS-FEC encoded 257b blocks into an inner BCH FEC
- This approach is common with the OIF 800LR logical scheme
- The basic architecture including a convolutional interleaver, FEC, and circular shift is similar to 800GBASE-FR4 and LR4 802.3dj IMDD clauses

See:

[https://www.ieee802.org/3/dj/public/23\\_07/kota\\_3dj\\_01a\\_2307.pdf](https://www.ieee802.org/3/dj/public/23_07/kota_3dj_01a_2307.pdf)

# Key Optical Specifications

Description	800GBASE-LR1	800GBASE-ER1-20	800GBASE-ER1	Unit
Signaling Rate	123.6364±50ppm	118.2±TBD	118.2±TBD	GBd
Tx Power (min)	TBD	-11	-5	dBm
Modulation Format	DP-16QAM	DP-16QAM	DP-16QAM	---
Carrier Frequency	228.675±TBD	193.7±1.8 GHz	193.7±1.8 GHz	THz
Rx Power (min)	TBD	-18	-18	dBm
Operating Distance	10	20	40	km
Channel Insertion Loss	6.3	6.5	12	dBm

Concatenated vs Segmented

40km requires optical amplification

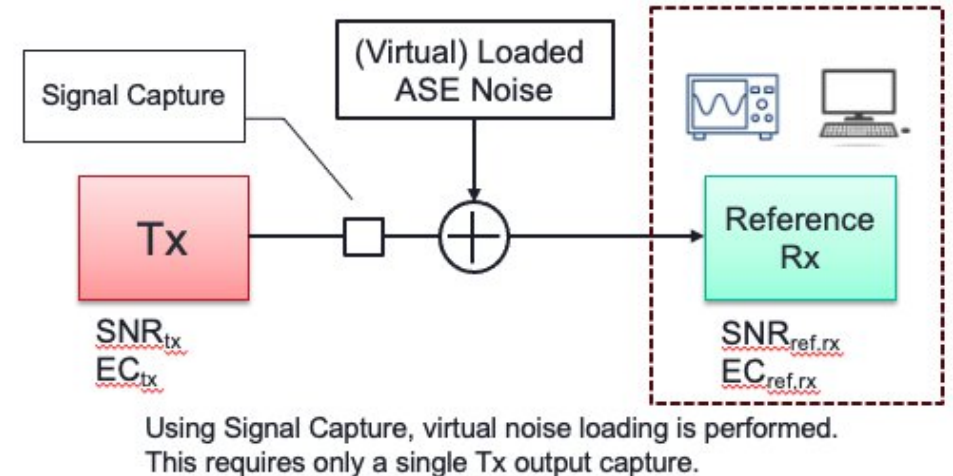
LR1 designed to remove wavelength locker in O Band. ER1 using locked C Band lasers

ER1 allows 20/40km interop

C Band reduces fiber loss for ER1

# Transmit Quality Metric (TQM)

- In OIF IA's, parametric specifications define a transmitter
  - EVM is defined, but without a specification
- ITU-T G698.2 and IEEE 802.3ct use EVM as a TQM
- New TQM's are proposed in both ITU-T Q6 and 802.3dj based on measurements of a transmitter's SNR
- The term "Extended TCC" is being used to refer to Tx-only RSNR Penalty in Q6



Using a reference receiver, proposals define a TQM based on a penalty allocated to a realistic transmitter.

See:

1. Q. Fan & X. Liu, TH2A.26, OFC 2024,
2. [https://www.ieee802.org/3/dj/public/24\\_05/maniloff\\_3dj\\_02\\_2405.pdf](https://www.ieee802.org/3/dj/public/24_05/maniloff_3dj_02_2405.pdf)
3. Transmitter Quality Metric in a revised G.698.2 for Beyond-400G, <https://www.itu.int/md/T22-SG15-C-1216/en>



# PTP support

- Support for PTP timestamp accuracy can require timing uncertainty of  $\sim 1\text{ns}$  in pluggable modules [1].
- RS-FEC Alignment Marker removal/insertion in 800GBASE-ER1 can result in  $\sim 5\text{ns}$  timing uncertainty at 800G
- A proposed mechanism in 802.3dj uses JC9-7 in the OH to transmit the position of the AM removal, allowing the far end to re-insert AM's at identical locations [2].

1. Mobile Optical Pluggables Alliance (MOPA) Technical paper Version 2.2

[https://mopa-alliance.org/wp-content/uploads/2023/10/MOPA\\_Technical\\_Paper-v2.2-Final.pdf](https://mopa-alliance.org/wp-content/uploads/2023/10/MOPA_Technical_Paper-v2.2-Final.pdf)

2. [https://www.ieee802.org/3/dj/public/24\\_05/sluyki\\_3dj\\_01a\\_2405.pdf](https://www.ieee802.org/3/dj/public/24_05/sluyki_3dj_01a_2405.pdf)

# Summary

- IEEE P802.3dj is developing coherent optical specifications for 10-40km SMF reaches
- Key items under discussion for these specifications are being aligned with OIF and ITU-T where appropriate
  - TQM will be aligned with ITU-T
  - Logical specifications will be aligned between all bodies

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