# Proposal – Support for Multiple FEC modes

**IEEE 802.3dj 21 Sept 2023 Interim**

**John D'Ambrosia, Futurewei, U.S. Subsidiary of Huawei**
- Chair, IEEE P802.3dj Task Force

**Mark Nowell, Cisco**
- Chair, IEEE P802.3dj Optical Track / Ad hoc

**Gary Nicholl, Cisco**
- Chair, IEEE P802.3dj Logic Track / Ad hoc

# Introduction

▣ IEEE P802.3dj has DRx, DRx-2, FR4, and LR4 "physical layer specification" objectives @ 200 GbE, 400 GbE, 800 GbE, and 1.6 TbE.

– Mar 2023 – Motion #5

• A concatenated FEC approach (see patra_3dj_01b_2303) has been adopted for DRx, DRx-2, FR4, and LR4 for relevant objectives @ 200 GbE, 400 GbE, 800 GbE, and 1.6 TbE.

– July 2023 - Motion #9

• Adopted direction to "adding an option to support only RS544 FEC (aka Bypass Inner FEC) for the single wavelength 500m and 2km optical PMDs"

▣ There is a clear desire for an option to support 500 m and 2 km single wavelength optical PMDs that operate without the Hamming(128, 120) inner code

▣ The lack of test data is contributing to the group's concerns related to the FEC approach.

▣ This presentation proposes an approach to move forward.

# Relevant Straw Polls

15 Aug 2023 Joint Logic / Optics Ad Hoc Meeting

➢ Straw Poll: I would support adding objectives to support physical layer specifications based on only RS544 FEC for:

1. Single wavelength 500m and 2km optical PMDs:

- 200GBASE-DR1, 200GBASE-FR1, 400GBASE-DR2, 400GBASE-DR2-2, 800GBASE-DR4, 800GBASE-DR4-2, 1.6TBASE-DR8, and 1.6TBASE-DR8-2

2. Four-wavelength 2km PMDS:

- 800GBASE-FR4

Result (#1) Yes: 30 No: 26 Abstain:16

Result (#2) Yes:20 No: 34 Abstain:18

September 2023 Interim

➢ Straw Poll #9: FEC modes:  Is there a market need for both FECo and FECi modes

Results (all): Y:  48,  N:  17, NMI:  21,  A: 18

➢ Straw Poll #10: FEC modes: Does the market need the FECo mode for a PMD to have same reach as the FECi mode (for single wavelength reaches under 2km)?

Results (all): Y: 36   ,N: 28  , A:  37

➢ Straw Poll #11:  FEC modes: Considering the network operators deploying a FECi and  FECo capable solution, do FECo mode reaches need to be specified in the standard as:

A) Normative  B) Informative C) Not specified D) Abstain

(Pick one) Results (all): A:  40,  B: 21,    C: 17,   D:   20

(Chicago rules) Results (all): A:  50,  B: 42,    C: 25,   D: 20

# Proposed Definitions

- **Mode_FECo** : Optical link runs with RS(544,514) FEC protection

- **Mode_FECi** : Optical link runs with RS(544,514) FEC protection operating as an outer code, supplemented by Hamming(128,120) FEC protection operating as an inner code
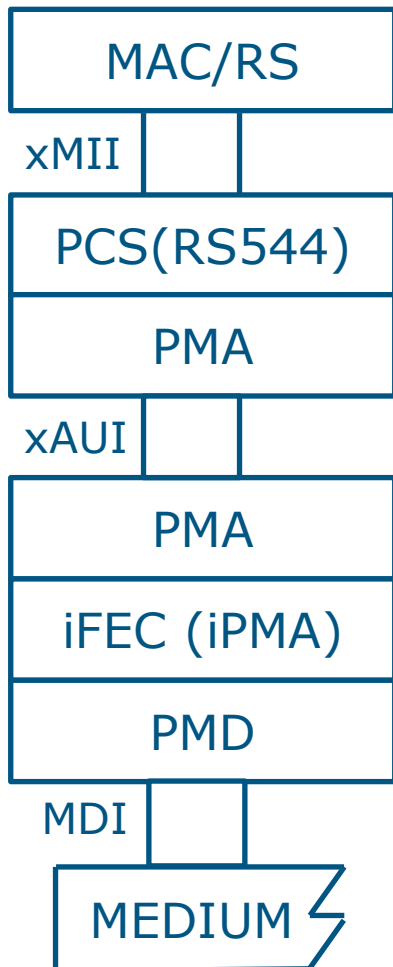
## Logic Proposal Overview (Based on Single PHY)

```
┌─────────────────┐
│     MAC/RS      │
├──────┬──────────┤
│ xMII │          │
├──────┴──────────┤
│   PCS(RS544)    │
├─────────────────┤
│      PMA        │
├──────┬──────────┤
│ xAUI │          │
├──────┴──────────┤
│      PMA        │
├─────────────────┤
│   iFEC (iPMA)   │
├─────────────────┤
│      PMD        │
├──────┬──────────┤
│ MDI  │          │
├──────┴──────────┤
│    MEDIUM       │
└─────────────────┘
```

xBASE-DRx
xBASE-DRx-2

- RS544 FEC Embedded in PCS – mandatory to implement
- iFEC (Hamming(128,120) – mandatory to implement

- Two FEC modes are supported:
  - Mode_FECi – iFEC sublayer is enabled on both Tx / Rx
  - Mode_FECo – iFEC sublayer is disabled on both Tx / Rx

- BASE-DRx and DRx-2 PHYs shall support operation in both Mode_FECi and Mode_FECo FEC Modes

- When forming a complete Physical Layer, the PMD BER requirements depends on the FEC mode
  - If a PHY operates in Mode_FECi mode, the PMD is required to operate with a BER of yyy or better
  - If a PHY operates in Mode_FECo mode, the PMD is required to operate with a BER of 2.4e-4 or better
- Reaches TBD

# Future Work that would be needed

- What FEC mode does the PHY start in - Mode_FECi or Mode_FECo?
- Approach to switching between Mode_FECi /  Mode_FECo?
- Reaches associated with Mode_FECi / Mode_FECo?
- Transmitter / Receiver / Link Budget specifications?

- The availability of future test data is needed to evaluate the FEC schemes.