Considerations on FEC for 4x200G objectives in P802.3dj

Peter Stassar, Huawei
P802.3dj ad hoc meeting, 2 November 2023

Supporters List

- Tom Huber, Nokia
- Eric Maniloff, Ciena
- Guangcan Mi, Huawei

Introduction

- Over the past months the dj Task Force has had considerable debates over how to address the need for operating the optical link without inner FEC.

- As defined in dambrosia_3dj_01b_230921:
  - **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

- TF Decisions so far:
  - 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 via Motions #5 March 2023, #9 May 2023 and #9 July 2023
  - Adopted direction to “adding an option to support only RS544 FEC (aka Bypass Inner FEC) for the single wavelength 500m and 2km optical PMDs“ via Motion #4 July 2023

Status of discussions

- As noted in the unapproved minutes of the 19 October ad hoc meeting, during which the P802.3dj Task Force Chair stated:
  - Lack of consensus on the FECo and FECi topics has schedule implications.
  - A proposal for a single PHY was brought forward in September and there was strong opposition against it.
  - If the task force decides to go down a two PHY path then there are procedural and process items that need to be addressed
- In bernier_3dj_optx_01b_231019 it was proposed to:
  - Define an optical PMD with mandatory Mode_FECi
  - And define a Mode_FECo either optional or leave it unspecified.
- The author views an optional optical PMD specified as the worst of all, generally suggesting optional for the end-user, but mandatory for the supplier.

Author views

- IEEE 802.3 creates specifications for interfaces, not implementations.
- It is always the implementer’s choice to make a single implementation, meeting more than one specification. The actual implementation is outside the scope of the standard, even when taken into account at the time of the creation of the specification.
- The operational conditions of FECi and FECo modes are distinctly different, especially the baudrate.
- A single PHY, would suggest that EVERY module would need to meet both FECo and FECi requirements, being a burden on the implementer.
- Therefore the author believes it is unavoidable to create two separate PMDs, and additional/new objectives to address both FECo and FECi operation.
- However, ……, next slide

Author views, continued

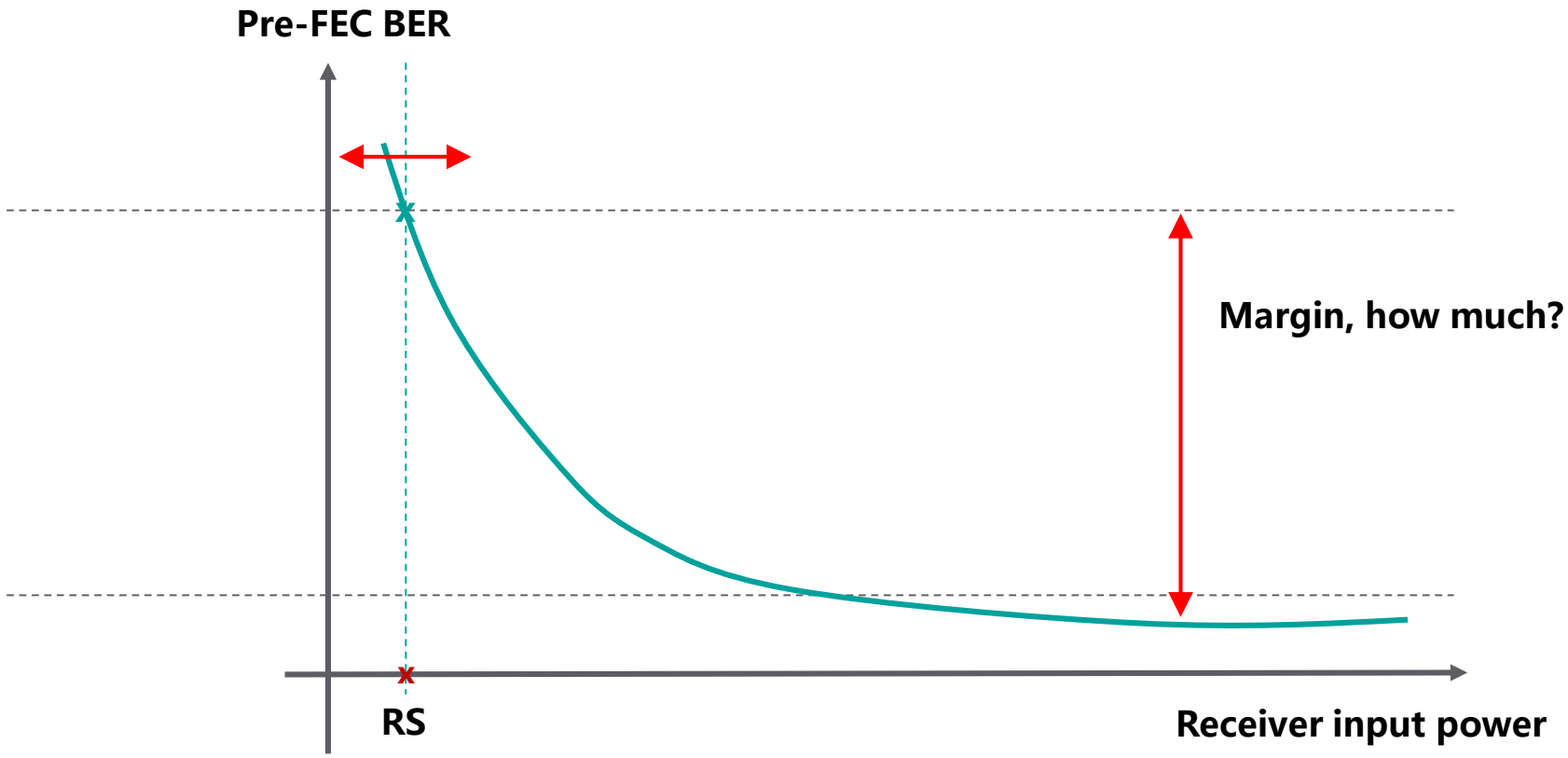
- If the P802.3dj TF decides to create additional (parallel) objectives to address FECo performance, the following needs to be taken into account:
  - Broad market potential
  - Technical feasibility
  - Distinct identity
- **Broad market potential** identifying the need for low latency solutions, would suggest that FECo operation is sufficiently good.
- **Technical feasibility** would need to be demonstrated that not only a sufficiently high power budget can be achieved but especially a sufficiently low BER floor for a variety of implementations, e.g. CPO, pluggables, etcetera.
- **Distinct identity**, some seem to think this can be established by setting different reach objectives, but that may be questionable, if resulting PMD specifications for FECo and FECi will be identical.

Author views on technical feasibility

- The author is of the view that considerations on power budget (and indirectly reach) are of secondary importance, while BER performance and especially the level of the BER floor is of primary importance.

- If the BER floor is not at a sufficiently low level then the author believes that the associated FEC is not sufficient, irrespective of whether it is FECi or FECo, and that technical feasibility is not demonstrated,

Author views, continued, technical feasibility



- Primary importance, where is the BER floor?
- Secondary importance, if the BER floor is sufficiently low what is the Rx sensitivity? Then it's possible to establish the available power budget

Author views, continued, distinct identity by reach

What is determining the reach?

- Available loss budget and reach related penalties (TDECQ minus TECQ, DGD)
- In a 3 dB power budget, the loss for 500m is max 0.25 dB (O-band)
- In a 4 dB power budget, the loss for 2km is max 1 dB (O-band)

What would we gain by reducing reach?

- Reducing 500m to e.g. 250m would gain 0.125 dB.

If the available loss would be the same for both FECi and FECo then there should be no technical need to operate over reduced reach.

Recommendations

The author suggests to:

1. Gather experimental data from on-line testing of devices becoming available
2. Identify the level of the BER floor, which is key to any PMD specification
3. Identify potential Tx/Rx/Link budgets,
4. Identify the impact on reach.

Thanks!