Work towards a baseline proposal for 25G copper and backplane PMD clauses

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Introduction

- This presentation aims at laying out the required components of a baseline proposal, listing the likely candidates or several options where the choice does not seem obvious.
- The three objectives accepted by the study group in the September interim serve as the foundation:

- Define a single-lane 25 Gb/s PHY for operation over a printed circuit board backplane consistent with channels specified in IEEE Std 802.3bj-2014 Clause 93
- Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 3m
- Define a single-lane 25 Gb/s PHY for operation over links consistent with copper twin axial cables, with lengths up to at least 5m

General ideas

- Assume a new clause will be created for a single-lane backplane PMD
  - Refer back to clause 93 wherever appropriate
- Assume a new clause will be created for a single-lane copper cable PMD
  - Refer back to clause 92 wherever appropriate
- Share the structure between the backplane and cable PMD clauses where possible
- Possible new concepts for cable PMD:
  - More than one loss budget, so multiple channel constructions
  - More than one PMD “class” (exact definition has to be decided), so multiple electrical specifications
  - More than one FEC type and possibly PCS encoding; method of decision
  - Breakout from 100GBASE-CR4 port

Note: “class” used here temporarily until we decide on nomenclature (type, subtype, optional feature, or combinations)

General structure – copper cable clause

(**Boldface text** means a likely non-obvious change from clause 92; ~~strikethrough text~~ means subclause can be omitted)

- Overview
- PMD service interface
- **PCS requirements for AN**
- Delay constraints
- ~~Skew constraints~~
- PMD MDIO function mapping
- **PMD functional specifications**
- **PMD electrical characteristics**
- **Channel characteristics**
- **Test fixtures**
- Environmental specifications
- PICS

Details of likely non-trivial changes

- **PCS requirements for AN**
  - AN may determine choice of FEC encoding (which may in turn affect PCS behavior)
  - AN already supports this (clause 74 enable/disable), but the possible 25G AUI implementation case requires new text
- **PMD functional specifications**
  - PMD control function (training) may affect choice of FEC encoding; possibly new change message format, variables
  - Should also address operation over the 25G AUI
- **PMD electrical characteristics**
  - Several sets of specifications
- **Channel characteristics**
  - Several sets of parameters for PMD combinations
  - Could include cable assembly characteristics and MDI specification
- **Test fixtures**
  - Could be moved to an annex, since they can be shared with 25G AUI

General structure – backplane clause

(**Boldface text** means a likely non-obvious change from clause 93; ~~strikethrough text~~ means subclause can be omitted)

- Overview
- PMD service interface
- **PCS requirements for AN**
- Delay constraints
- ~~Skew constraints~~
- PMD MDIO function mapping
- **PMD functional specifications**
- PMD electrical characteristics
- Channel characteristics
- Environmental specifications
- PICS

Details of likely non-trivial changes

- **PCS requirements for AN**
  - AN may determine choice of FEC encoding, as in the copper cable case
  - Re-use the copper cable solution
- **PMD functional specifications**
  - PMD control function (training) may affect choice of FEC encoding, as in the copper cable case
  - Re-use the copper cable solution

No additional non-trivial work relative to the copper cable clause

More details on loss budgets for cable

- Two loss budget divisions were discussed at length in the SG:
  1. 5 meter cable reach: keeping mandatory RS-FEC, PMD electrical specifications and COM parameters based on clause 92
  2. 3 meter cable reach
     a. Keeping PMD electrical specifications similar to clause 92, and using the lower loss to allow operation without FEC (or with clause 74 FEC)
     b. Keeping RS-FEC, and using the lower loss for relief of PMD electrical specifications, allowing higher loss on host PCB
- Also mentioned: reduced host PCB loss for asymmetric allocation
- We may have two or three sets of PMD specs
  - This implies three to six possible combinations and cable budgets!
  - Also could imply multiple AUI-C2M specs and error budgets; but since 25GBASE-SR will always use RS-FEC, we may assume only one (likely, the worst case loss)
- If we go this way, consider methods to enable interoperability
  - Spans multiple clauses: PMD, AN, PCS, RS-FEC (and possibly base-R FEC), MDIO, management

Combinations of 25GBASE-CR classes and the implied cable reaches

Different combinations of two classes can support different reaches. The table may serve as an example.

Note: the titles and numbers in this table are for illustration only. They are practically TBD.

Host B \ Host A	"Higher loss"	Clause 92 spec	"Lower loss"
"Higher loss"	RS-FEC: 3 m	3 m with RS-FEC	RS-FEC: 5 m no FEC: 3 m
Clause 92 spec	RS-FEC: 3 m	RS-FEC: 5 m no FEC: 3 m	RS-FEC: 5 m no FEC: 3 m
"Lower loss"	RS-FEC: 5 m no FEC: 3 m	RS-FEC: 5 m no FEC: 3 m	no FEC: 5 m

This creates either two or four types of cable specifications – 3/5 m and possibly with/without RS-FEC.

Highlighted cells may support even longer reaches, but I suggest that we use these conservative values, in order to limit the number of cable specifications.

Specifying different cable/PMD classes

- All PMD and cable classes use the same test point definitions
- Transmitter characteristics at TP2 will be different per PMD class
  - Can be summarized in a table like 92-6, with multiple columns
  - Return losses, specified as frequency masks in 92.8.3.2 – 92.8.3.4, may differ
  - Transmitter output waveform linear fit procedure (92.8.3.5.1) may use either the same value or separate values of N_p; specified limits will likely differ
  - Recommended TP0-TP2 and TP3-TP5 (92.8.3.6) will be different per class. They may move to an annex (note that recommended TP0-TP1 and TP4-TP5 already appear in an annex, which the 25G AUI-C2C can re-use)
  - SNDR definition and/or specified limit (92.8.3.7) may differ
- Receiver characteristics will be different per PMD class
  - Return losses (92.8.4.2 – 92.8.4.3) may differ
  - Interference tolerance test channel parameters (92.8.4.4) will likely differ – may have 6 test cases (low/medium/high loss × with/without RS-FEC)
- Cable assembly parameters will be different per cable class (which is supported by combinations of PMD classes)
  - Maximum insertion loss, possibly return and conversion loss masks (92.10.2 – 92.10.6)
  - Signal paths (92.10.7.1.1) used for calculating COM

Choices we have to make

1. Required FEC modes – what would be mandatory to support?
   - RS-FEC mandatory, no FEC/Fire code optional?
   - No FEC mandatory, RS-FEC/Fire code optional?
   - Other combination?

   Note, PCS and FEC details are ancillary to the PMD clause – not a predecessor to decision

2. Method for deciding on FEC type
   - AN protocol based, possibly supplemented by medium information (out of scope) – no effect on PMD clause
   - Training based – included in PMD clause
   - Both (highest FEC request wins) – affects PMD clause
   - Something else?

3. PMD port classes for the copper cable PHY
   - Separate PMDs, no addressing of interoperability (user beware)
   - One PMD with minimum requirement and one or more options, creating several classes (e.g. “extended reach”, “super-reach”, “no-FEC capable”)
   - Something else?

   Note, detailed parameters of these classes may be left as TBD for now – not a predecessor to decision

4. Cable classes that can be used with each combination of port classes (budget)
   - 3m/5m cable specifications – should we assign new nomenclature?
   - Are there additional classes?

   Note, detailed parameters of the classes we choose may be left as TBD for now – not a predecessor to decision

5. Which MDIs? Breakout cables?
   - May be addressed after a baseline proposal

Next steps

- Feedback to this presentation during the teleconference may narrow some of the choices
- Request straw polls (SurveyMonkey) to sense which choices have likely consensus
- Craft a baseline proposal based on the results