

EPoC PCS structure

how to help your PCS Clause editor

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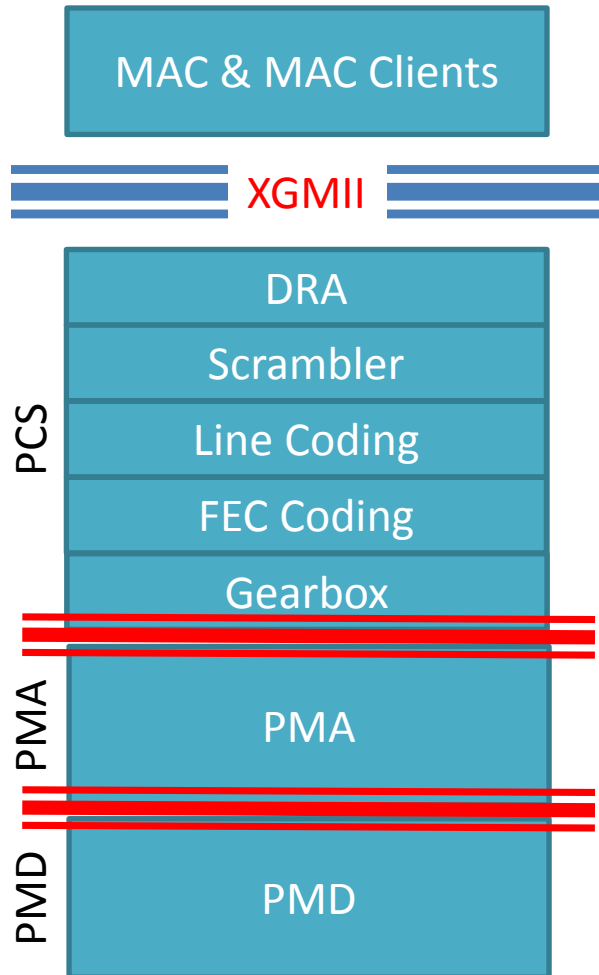
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Summary

- To progress work on PCS further, we need first to agree on the overall structure of PCS, presence (or absence) of specific functions, etc.
- Once that is done, work can be separated into smaller, dedicated teams to come up with specific proposals for, e.g., FEC, interleaver, line code.
- Baseline proposals into the draft, at best, would be then welcome to facilitate development of the first TF draft for review.
- **DISCLAIMER** – this presentation ***does not advocate in favor or against*** MMP, specific FEC solutions, line coding etc., but focuses on interaction between specific functions

PCS structure (graphical view)



- PCS is located between XGMII and PMD and is responsible for conditioning MAC data stream for transmission across medium
- Primarily PCS functions include: line encoding, FEC, data rate adaptation functions (if needed), scrambling, etc.
- PMA may contain functions like serialization/deserialization and clock recovery. In 10G-EPON, PMA function was significantly simplified.
- The partitioning of functions between the PMA and PCS is a subject for discussion within the TF

Why is it all important?

- All 802.3 PHYs have been designed with layers and functional blocks. This makes PHY design modular and reusable.
- XGMII, PCS/PMA, and PMA/PMD interfaces (marked in red on slide 3), and functional division within PCS facilitate development of specifications, with contributions focusing on just selected function and not the whole PHY.
 - This works fine as long as interfaces between functions are defined in terms of speed, data type, etc.

What is used in 10G-EPON in Tx?

- In 10G-EPON, the following order of processing is used in Tx direction:
 - IDLE Deletion function (data rate adaptation)
 - 64b/66b encoding
 - Scrambling
 - FEC encoding
 - Data Detector
 - Gearbox

Note that FEC encoding and Data Detector processes are combined into a single functional block

The receive direction shown on the following slide

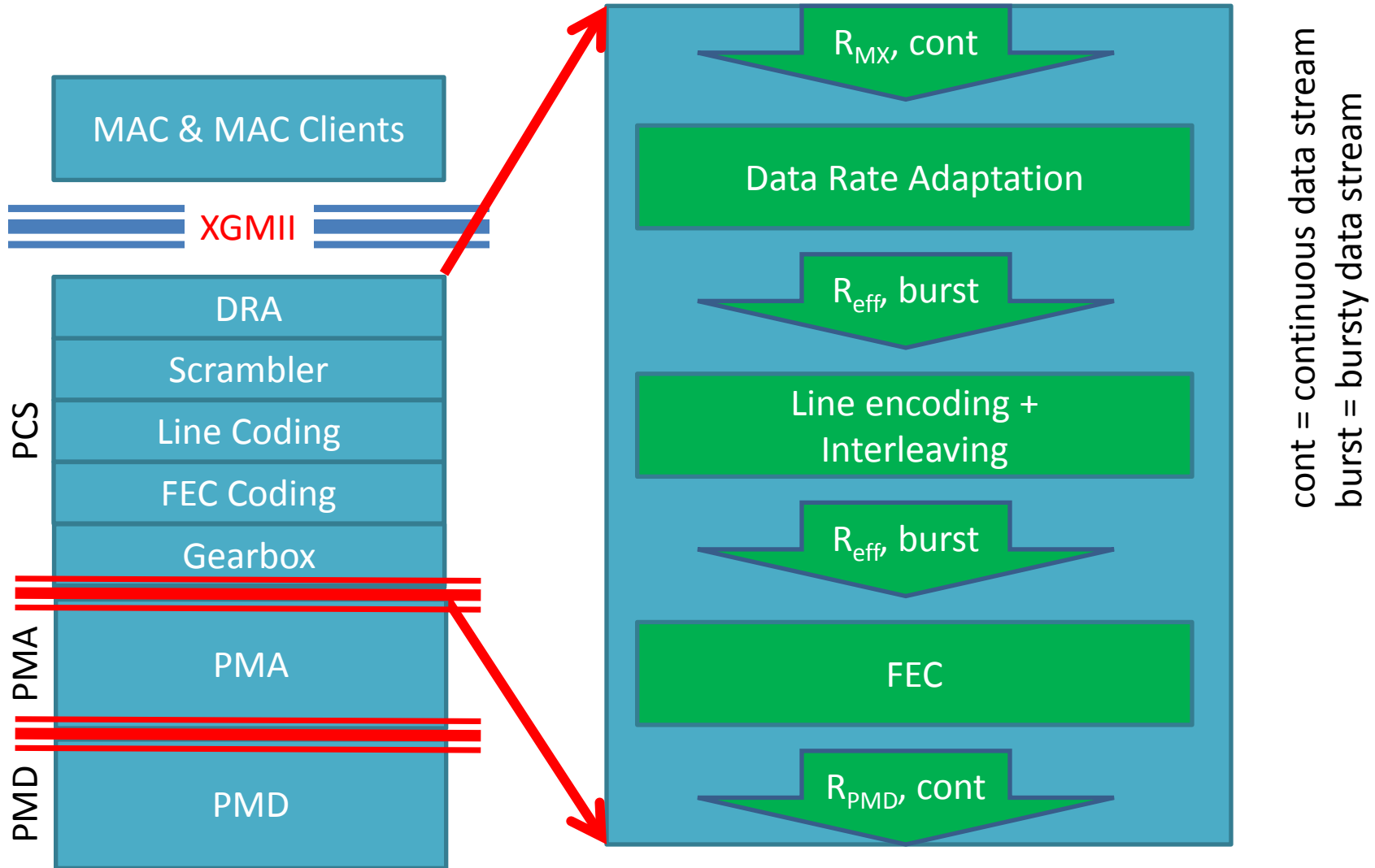
What is used in 10G-EPON in Rx?

- In 10G-EPON, the following order of processing is used in Rx direction:
 - Synchronizer
 - FEC decoding
 - Descrambling
 - 66b/64b decoding
 - IDLE Insertion function (data rate adaptation)

What do we need to decide on?

- As the first order of PCS work, we need to decide on the following items:
 - What basic functions are really required in EPoC PCS (FEC, interleaving, line encoding, etc.)
 - In what order the basic functions are to be executed in EPoC PCS (e.g., do we perform FEC before interleaving or vice versa)
 - Identify what interfaces will be used between individual functions, whether data exchanged between function is bursty or continuous, and whether data rate is fixed or variable ...

EPoC PCS structure (Tx example)



PCS in EPoC (Tx direction)

- Functions of PCS in EPoC (Tx direction):
 - Receive data stream from MAC across XGMII (at data rate of 10Gbit/s)
 - Adapt data stream from MAC to effective data rate supported by coaxial PMD (TBD, may changed dynamically, if TF decides to do so)
 - Perform scrambling / interleaving to improve signal properties for transmission over coax PMD
 - Perform FEC encoding to improve bit / frame error ratio performance
 - Construct serial bit stream(s) to be fed into PMD across PMA interface

Tx direction in EPoC (example)

- EPoC could reuse similar data processing order used in 10G-EPON in Tx direction:
 - IDLE Deletion function (data rate adaptation)
 - 64b/66b encoding (more discussion is needed)
 - Interleaving (type is TBD)
 - FEC encoding (FEC type is TBD)
 - Data Detector (likely to be reused)
 - Gearbox (adaptation between 66-bit vector and selected PMA width)

PCS in EPoC (Rx direction)

- Functions of PCS in EPoC (Rx direction):
 - Receive data stream(s) from coax PMD across PMA at some effective data rate (TBD, may changed dynamically, if TF decides to do so)
 - Perform FEC decoding, removing parity data and dealing with any correctable / uncorrectable errors.
 - Perform descrambling / deinterleaving to recover the original bit stream order
 - Adapt data stream for transmission across XGMII towards MAC, by inserting IDLE characters where needed
 - Transmit data towards MAC across XGMII (at data rate of 10Gbit/s)

Rx direction in EPoC (example)

- EPoC could reuse similar data processing order used in 10G-EPON in Rx direction:
 - Synchronizer
 - FEC decoding (FEC type is TBD)
 - Deinterleaving (type is TBD)
 - 66b/64b decoding (more discussion is needed)
 - IDLE Insertion function (data rate adaptation)

Why is this important to decide?

- PCS Clause in our draft needs to have a clearly organized structure, that corresponds to the way we believe (as TF) that PCS should work.
- In 10G-EPON, PCS clause description was organized in the following manner:
 - Overview
 - RS description
 - PCS description
 - Overview
 - Tx direction
 - Rx direction

Reuse, don't reinvent

- Reusing functional separation used in 10G-EPON allows us to work in parallel
 - A team of interested people can go off and work on FEC proposal, others can provide interleaver contribution, etc.
 - We are in need of baseline proposals, and not high level overview presentations at this point of time
 - As an Editor for PCS Clause, I need to start developing the outline and fill in details to extent possible based on accepted baselines
 - Not a whole lot to do for now ...

How to help your PCS Clause Editor (I) ?

- Let's decide on order of functions in PCS first
 - In Tx and Rx directions, listing just functions. No specific selection of FEC, interleaver etc. for now
- Once order of functions is settled, let's identify people interested in developing baseline proposal for the given function
 - Work on FEC baseline and Data Rate Adaptation is already ongoing
 - We will need volunteers on interleaver, 64b/66b line encoder, and other functions defined in PCS

How to help your PCS Clause Editor (II) ?

- It would be most welcome to receive contributions for each subclause in the format similar to its counterpart in 10G-EPON
 - For example, for IDLE Deletion function – see 76.3.2.1, for FEC encoder – see 76.3.2.4, etc.
- Text should be ideally in Word (or some similar format) to be copied directly into draft
 - PowerPoint presentations always take much more time to convert and are most often incomplete
 - Please remember we do not need ***white papers*** on OFDM, coding etc. We need clear description of how the given function works in line of 10G-EPON spec.
- Drawings (SDs, etc.) are welcome in editable format (Visio, or similar) for simpler reproduction

What level of detail is needed? (i)

- Please take a look at the best source of information available: 802.3av (10G-EPON)
 - <http://www.ieee802.org/3/av/public/baseline.html>
- Slides 3-7 in [3av_0703_mandin_2.pdf](#) show a detailed baseline proposal for burst structure
 - There were open issues at the time, but they got worked out later on through commenting on draft and technical contributions
 - We need first proposals for all features in PCS (not just burst structure) to kick start draft development and focus our work
 - Line code, burst structure, FEC, interleaver etc., are likely candidates for first-order proposals, to help drive the development of PCS Clause.

What level of detail is needed? (ii)

- Another example is the FEC framing baseline
 - Derived from a series of presentations:
[3av 0701 effenberger 1.pdf](#),
[3av 0703 kramer 1.pdf](#),
[3av 0705 lynoskey 1.pdf](#).
 - Again, further changes to this proposal were added over time during the TF, WG and Sponsor ballots. Technical contributions and comments addressed this topic.
 - FEC framing structure will depend on many other proposals as well (line code, scrambler, PMA, PHY etc.) but we need to put the first stake in the ground at some point
- We cannot keep on discussing EPoC at high level. This is a PHY development project and we need to get our hands dirty.

THANK YOU