# EPoC PCS structure

how to help your PCS Clause editor

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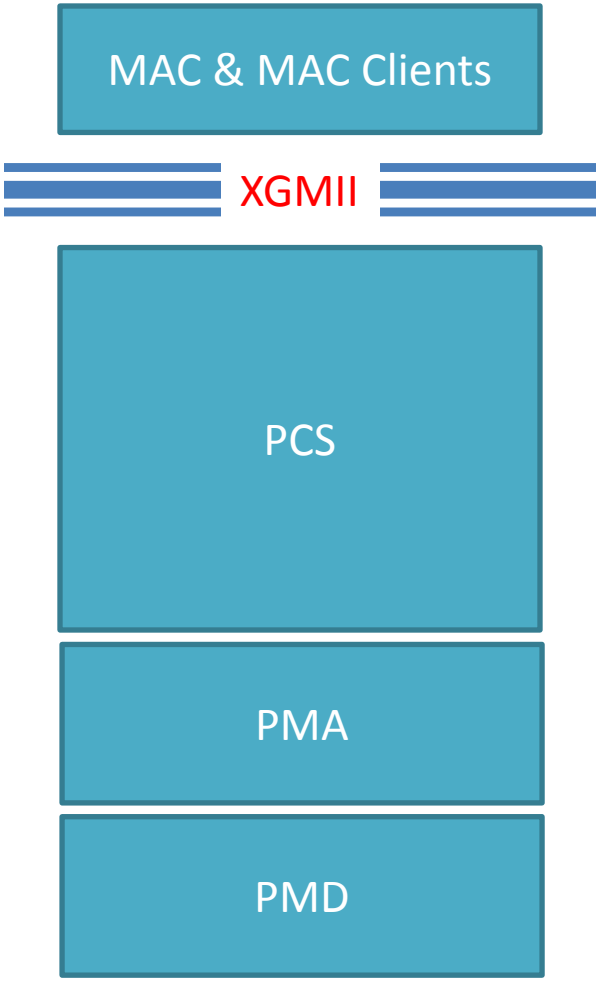
# Summary

- 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, 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 observed 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 EFC encoding and Data Detector processes are combined into a single functional block

The receive direction shown on the following slide

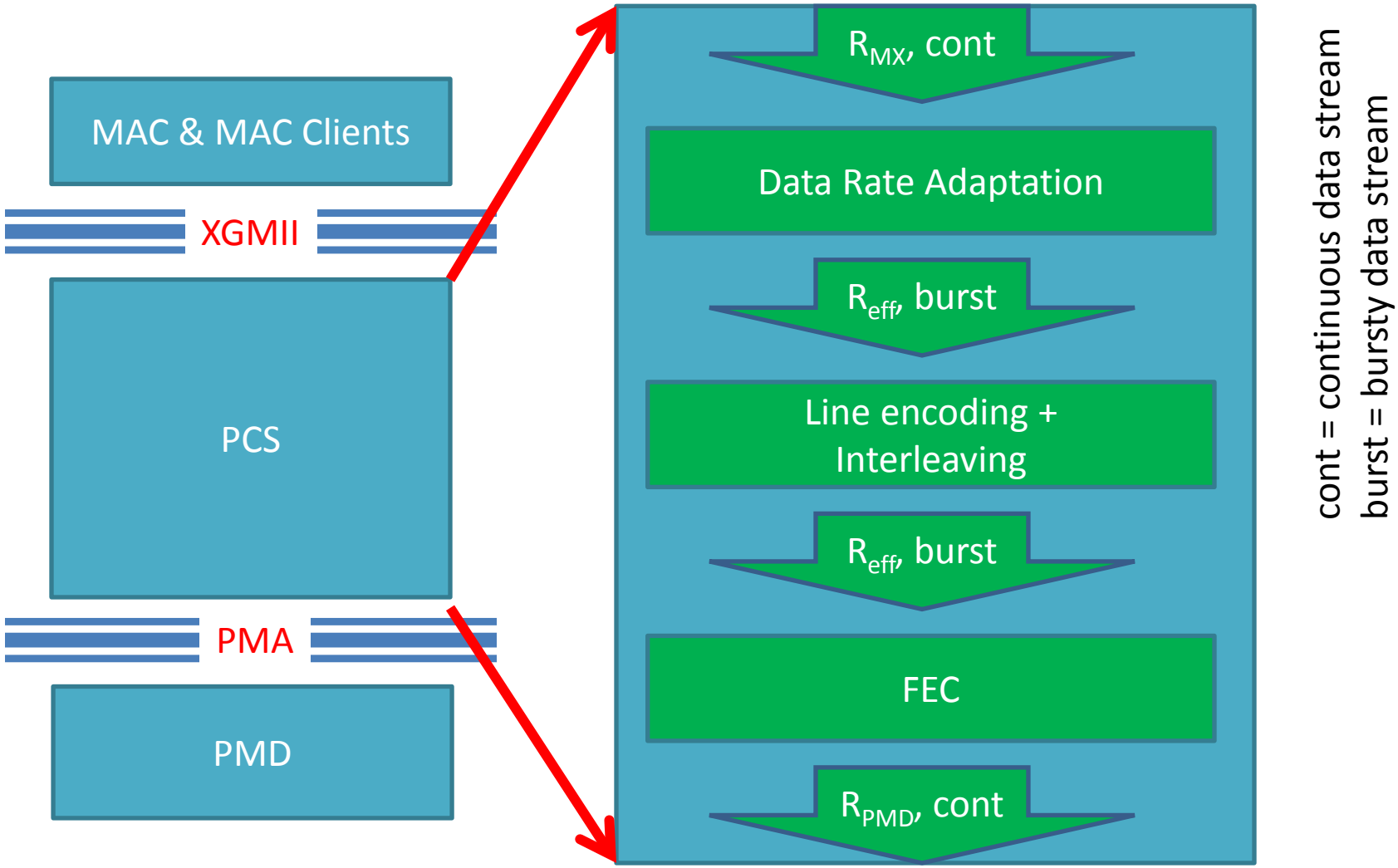
# What is used in 10G-EPON in Rx?

- 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?

- 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
  - We cannot keep on discussing EPoC at high level. This is a PMD development project and we need to get our hands dirty.

# THANK YOU