Baseline Proposals for EPoC TF

Supporters and Contributors

(ordered by first name)

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Summary

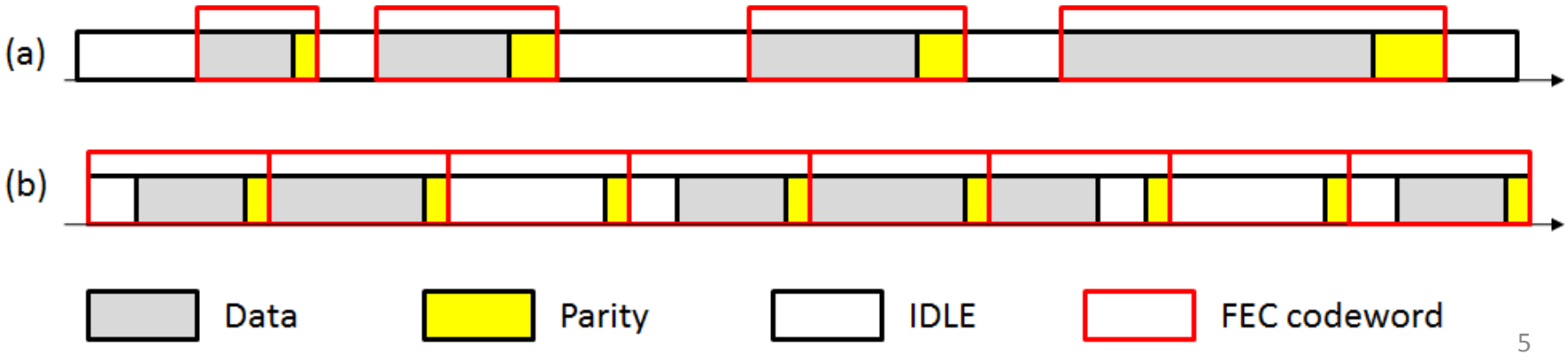
- To kick-start draft development, a Task Force must have a set of concrete technical proposals for individual features, e.g., FEC, line coding, PCS structure, MPCP operation.
- The purpose of this slide deck is to provide a set of first, hopefully non-controversial baseline proposals for EPoC to pave the way to more detailed discussions at this and the following meetings.
- Their adoption will allow individual appointed editors to move with the development of initial drafts for their assigned clauses.

FEC in EPoC (I)

- FEC is a typical way to improve signal quality in access systems, making them more immune to interference, noise and environmental conditions.
- All access systems running on coaxial media use either mandatory or optional FEC (see various generations of DOCSIS for example)
- 1G-EPON and 10G-EPON use optional and mandatory FEC, respectively.
- FEC should be also used in EPoC, primarily to improve the immunity to noise and EM interference in metallic medium, or improve system performance (capacity) when operating already in optimum conditions.

FEC in EPoC (II)

- Stream-based (b) and frame-based (a) FEC
  - Stream-based FEC encodes both data and idles. FEC codewords are not aligned with MAC frames. Overhead is constant and frame-size distribution independent. FEC codeword size is fixed. Parity is transmitted after each FEC codeword.
  - Frame-based FEC is aligned with MAC frames and FEC codeword size is equal to MAC frame size + parity transmitted at the end of the FEC codeword. Overhead is variable and frame-size dependent.

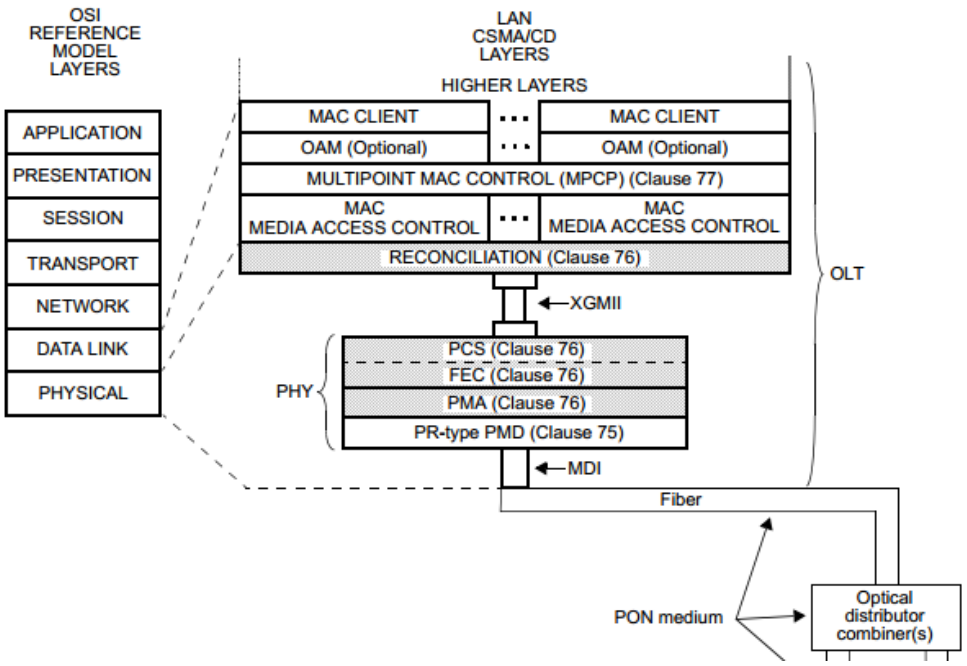


Baseline proposal I

- EPoC PHY shall use Forward Error Correction (FEC) in upstream and downstream directions (mandatory to support). The selection of specific FEC code is FFS at this time.
- If ability to disable FEC is required, provide necessary management parameters to enable / disable FEC on per logical link (LLID) basis. The ability to disable FEC is FFS at this time.

- Moved by:
- Seconded by:
- Technical motion (>=75%)
- Yes / No / Abstain

EPoC PMA definition I



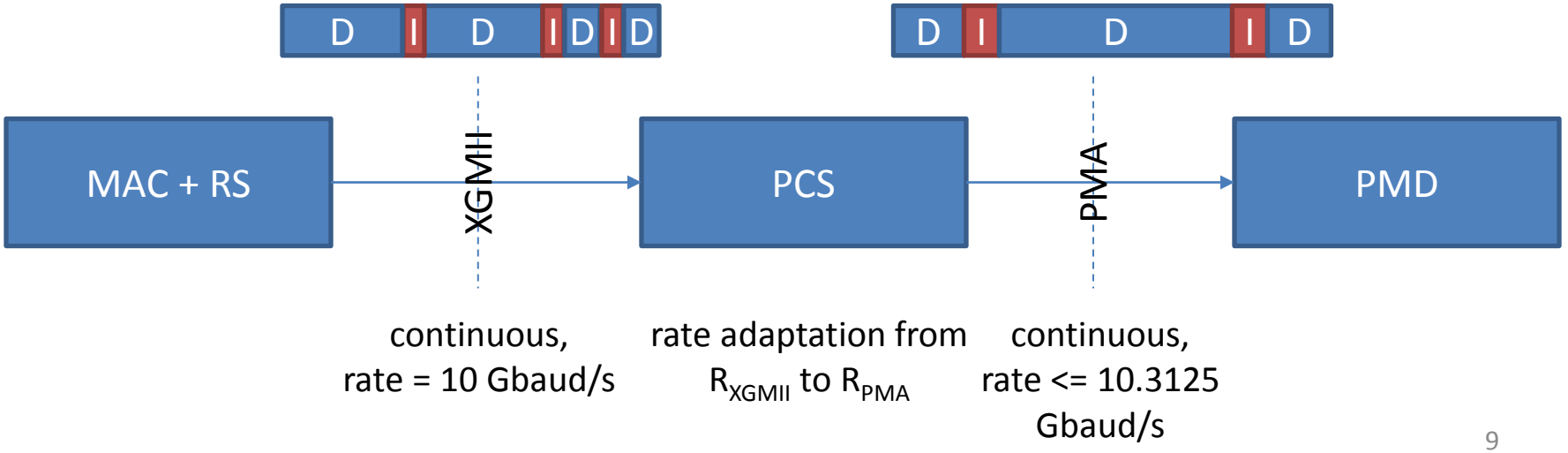
- PMA in EPON is part of PCS definition (Clause 76). It is a serial interface, providing continuous data stream at 10.3125 GBaud/s.
- In EPoC, given the wide range of data rates supported by PMD, PMA data rate will have to be flexible

EPoC PMA definition II

- There are two ways to achieve flexible data rate across PMA:
  - Option A: De-rate PMA interface, by operating at a lower clock rate than the rest of PCS. While simple on paper, that might require the presence of different clock sources within a single implementation.
  - Option B: Allow delivery of data across PMA interface in bursts. In this case, whole PCS operates at 10.3125 GBaud/s, but PMA bursts data only from time to time. This will require playout buffer in PMD to perform matching between bursty input rate from PMD to continuous transmission across medium.
- In both options, PMD may operate in burst or continuous mode, depending on the selected operation mode.

EPoC PMA definition III

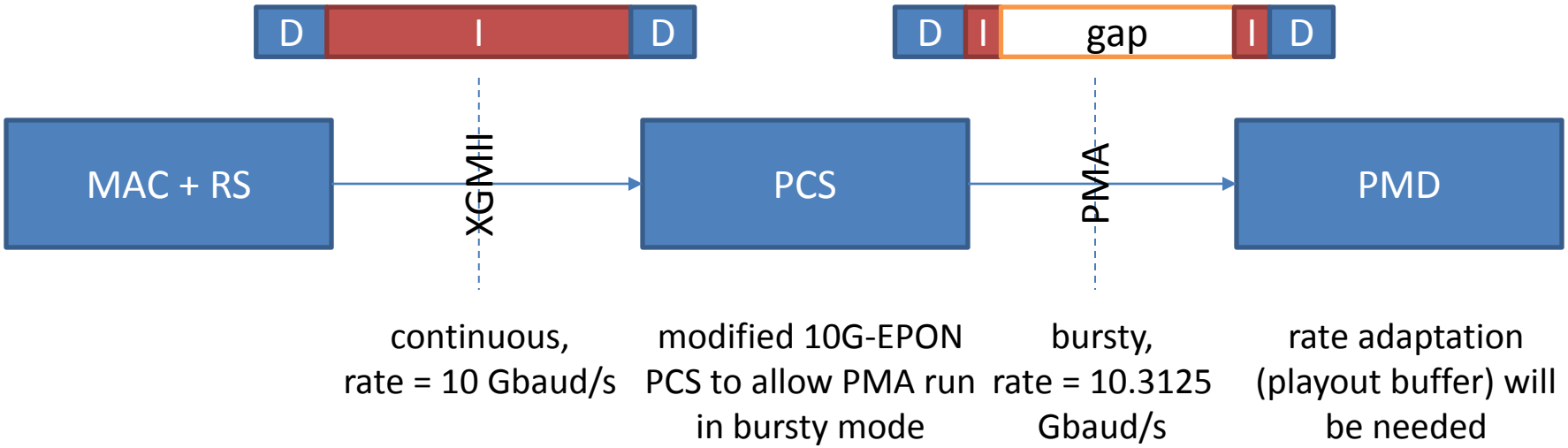
- PMA Option A:
  - XGMII operates as defined in EPON, at the effective rate of 10 Gbit/s
  - PMA operates at data rate up to 10.3125 Gbit/s (typically, much lower than this value)
  - PCS needs to perform rate adaptation between XGMII and PMA rates, providing necessary buffering, synchronization and frame adjustments.
  - PCS may need to locally generate PMA clock through synthesis of XGMII clock in transmit direction. In receive direction, PCS clock might need to be synthesized from PMA clock (additional constrains on PMA rate might be applicable to simplify this task)



Size of Idle characters is not representative of the actual Idle size across XGMII/PMA

EPoC PMA definition IV

- PMA Option B:
  - XGMII operates as defined in EPON, at the effective rate of 10 Gbit/s.
  - PMA operates at data rate of 10.3125 Gbit/s but in a bursty fashion.
  - PCS operates pretty much like in 10G-EPON, but bursty transmission across PMA is allowed. There is no need for extra clock synthesis.
  - PMD will have to include rate adaptation buffer, receiving bursts of data at 10.3125 Gbaud/s and replaying it at lower rate, depending on medium conditions, negotiated speed etc.
  - Clock synthesis will be needed in receive direction within PMD to create 312.5 MHz clock typical for 10GE implementations. This may create additional restrictions on coax data rates



Size of Idle characters is not representative of the actual Idle size across XGMII/PMA

Baseline proposal II

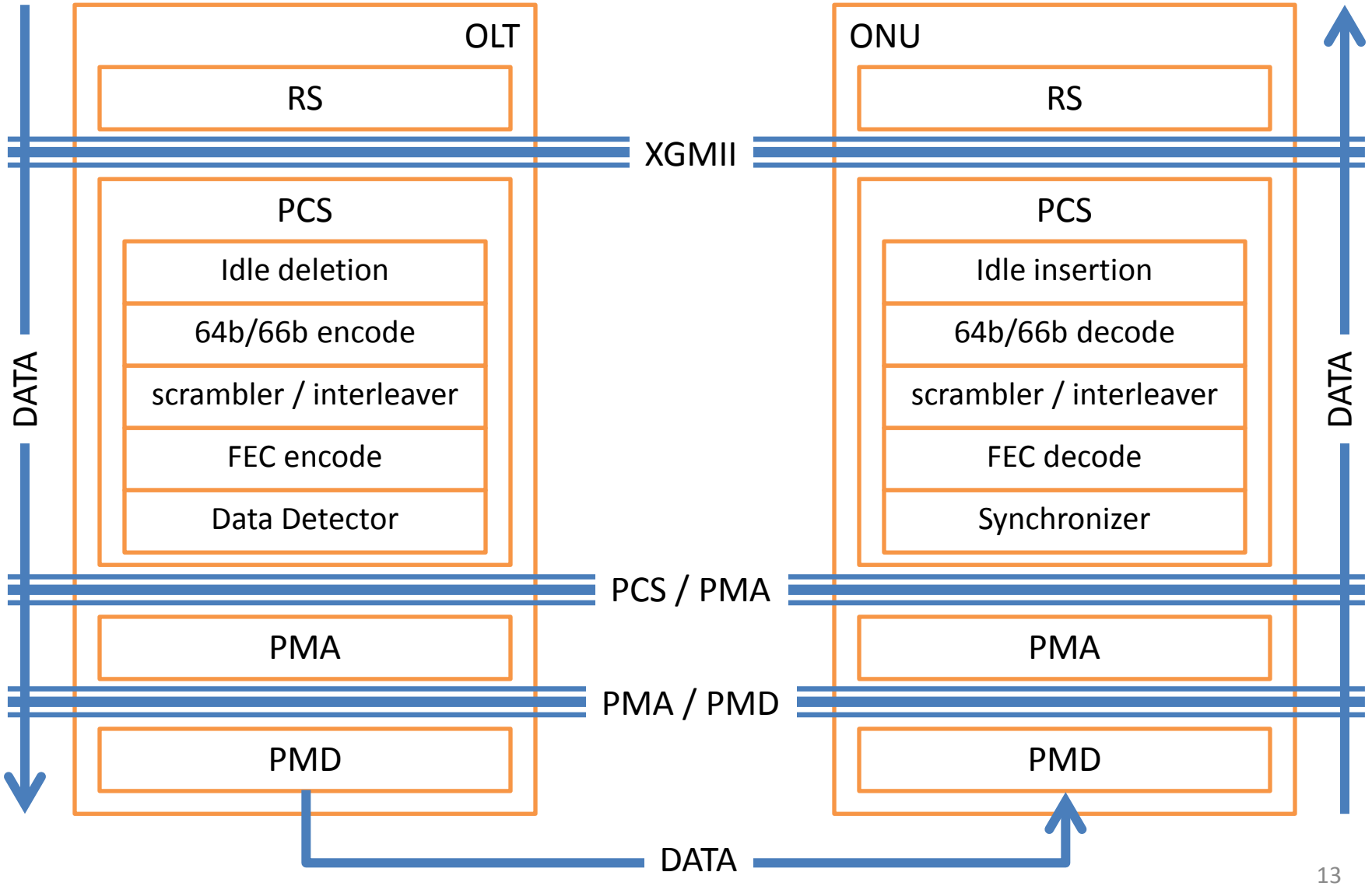
- EPoC PCS to use bursty PMA concept (Option B), with the playout buffer for rate adaptation to be located in PMD.
- Target data rates for PMD to allow for simple synthesis of PCS/PMA clock. Exact data rates on coax are TBD at this time

- Moved by:
- Seconded by:
- Technical motion (>=75%)
- Yes / No / Abstain

PCS design I

- PCS in EPON is responsible for a number of functions, including, encoding / decoding received bit stream from PMD, scrambling / descrambling, FEC encoding / decoding, burst detection in the upstream direction, synchronization, BER estimation.
- This is a complex system, with interaction between multiple functions and processes, and takes long to design and debug.
- It is always easier to start designing it from a working, well-known and understood PCS design, to be treated as first approximation design. Changes can be introduced on per-need basis.

PCS design II (downstream example)



Baseline proposal III

- Adopt 10G-EPON PCS as the first-order approximation for EPoC PCS, with the following changes:
  - EPoC FEC code selection is TBD at this time. 10G-EPON RS(255,232) will be used as a place-holder at this time. FEC code may be modified in the future when and if a proposal is made
  - The presence of scrambler and/or interleaver in PCS is TBD at this time. The need for interleave shall be further investigated pending link model.

- Moved by:
- Seconded by:
- Technical motion (>=75%)
- Yes / No / Abstain

Baseline proposal IV

- Adopt the draft outline shown in EPoC_1209_hajduczenia_2.pdf for further development by the appointed TF editor(s).

- Moved by:
- Seconded by:
- Technical motion (>=75%)
- Yes / No / Abstain

Baseline proposal V

- Adopt definitions of terms per EPoC_1209_hajduczenia_1.pdf for further development by the appointed TF editor(s).

- Moved by:
- Seconded by:
- Technical motion (>=75%)
- Yes / No / Abstain

THANK YOU