1.6T OTN mapping reference point and Q11/15 liaison

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Purpose of OTN mapping reference point

- The OTN mapping reference point establishes a canonical format for a given MAC rate, enabling OTN mappings to be PMD-agnostic, codeword-transparent, and timing-transparent (i.e., frequency-transparent)
  - The PMD-agnostic property is critical in telco applications – the distance from customer equipment to service provider equipment can vary at the two ends of a service, so it is important to be able to use different PMDs at the two ends of the OTN service
  - OTN has provided timing-transparent mappings for 1000BASE-X and faster Ethernet clients
  - A mapping that carries all the bits of the client is not desirable when the client uses FEC
- The chosen point has historically been inside the PCS and does not include AMs
  - For 100G, it was chosen to be 66b blocks; since not all 100G PHYs use FEC, this was the only point of commonality across all PHYs
  - For 200G and 400G, all PHYs do use FEC, but the mapping point was kept as 66b blocks because that enabled reuse on the OTN side
  - For 800G and 1.6T, the chosen point shifted to 257b blocks (enabling more efficient mapping and closer bit rates between native Ethernet PHYs and OTN)

Why doesn't the OTN mapping reference point include AMs?

- For an 802.3 PHY, AMs serve two purposes:
  - Identification and deskew of PCS lanes
    - I.e., supporting inverse multiplexing of the serial signal received from the MII
  - Frame delineation for RS FEC
    - The text of 802.3 does not explicitly describe an RS FEC frame, but anchoring the FEC codewords to the AMs means that the AMs delineate a FEC frame since they are what enables the receiver to find the FEC codeword boundaries
- Neither of those is relevant to Ethernet over OTN, so there is no need to carry the AMs over the OTN; they are overhead that can be reinserted at the other end
  - OTN mappings serialize the PCS lanes before mapping into the payload area of the OTN container
  - OTN mappings terminate the RS FEC from the Ethernet PHY (correcting errors incurred on the native Ethernet PHY), use different FEC across the OTN, and re-add RS FEC in the de-mapper
    - I.e., Ethernet over OTN is a segmented FEC architecture across the two native Ethernet attachment circuits and the OTN link
- PTP accuracy was not a primary consideration for codeword-transparent mappings
  - There are other solutions for PTP transport in OTN applications

800G and 1.6T OTN mapping reference points

- For 800G, the mapping reference is in each of the two flows, just after the 257b transcoder
  - The OTN mapping (defined by Q11/15) needs to merge the flows and maintain awareness of which blocks came from which flows
  - OTN de-mapping must recreate the same two flows that were mapped (i.e., the 257b blocks that were part of flow 0 at ingress must be part of flow 0 at egress)
- For 1.6T, the 257b transcoder was moved outside of the two flows to enable a single OTN mapping reference point and therefore a simpler definition of the OTN mapping in Q11

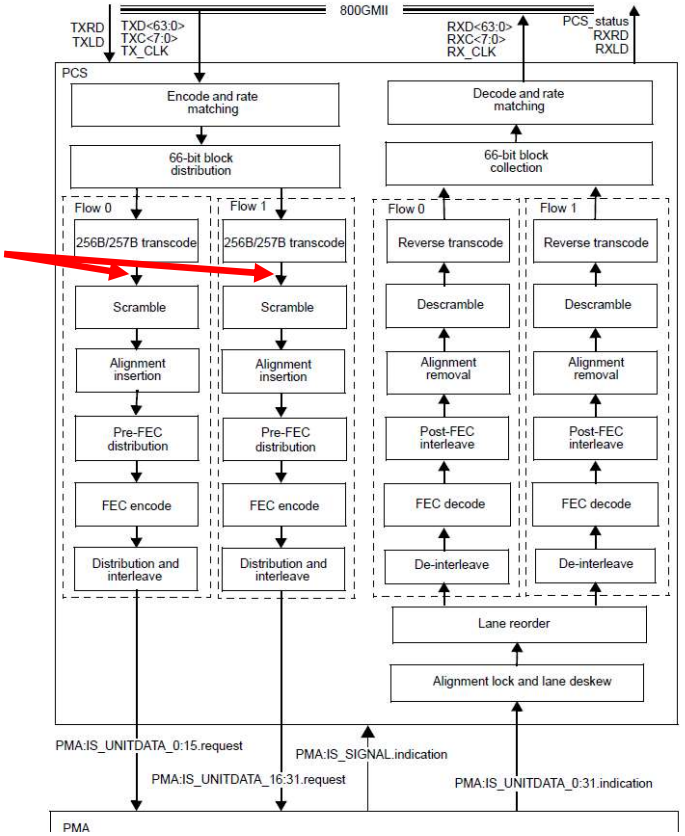
What was the problem with 800GBASE-ER1 wrt PTP accuracy?

- The 800GBASE-ER1 PHY removes AMs before mapping the stream of 257b blocks to the ER1 tributary frame (which is a derivative of the FlexO frame defined by Q11/15), and re-inserts them at the de-mapper
  - In the general case, the location where AMs are inserted is not the same as where they were removed
  - The movement of the AMs impairs the accuracy of PTP to an unacceptable degree for some applications (e.g. mobile telephony)
- A feature was added to 800GBASE-ER1 to mitigate the impairment by providing a mechanism to convey the location of the AMs between the two systems, enabling the far end to insert the AMs exactly where they were removed

The 800G OTN mapping reference point did not cause the PTP issues in 800GBASE-ER1

- 800GBASE-ER1 is an Ethernet PHY, not an OTN mapping
  - The OTN mapping reference point is in the PCS
  - 800GBASE-ER1 FEC sublayer isn't the PCS and doesn't have an OTN mapping reference point
  - ER1 is reusing the direct Ethernet to FlexO mapping, not the mapping to the OTN path layer
- OTN has other solutions for transporting PTP with high accuracy
- The applications that were identified by MOPA that prompted the AML feature in 800GBASE-ER1 don't use OTN

OTN mapping reference point in 800GBASE-R PCS per 802.3df



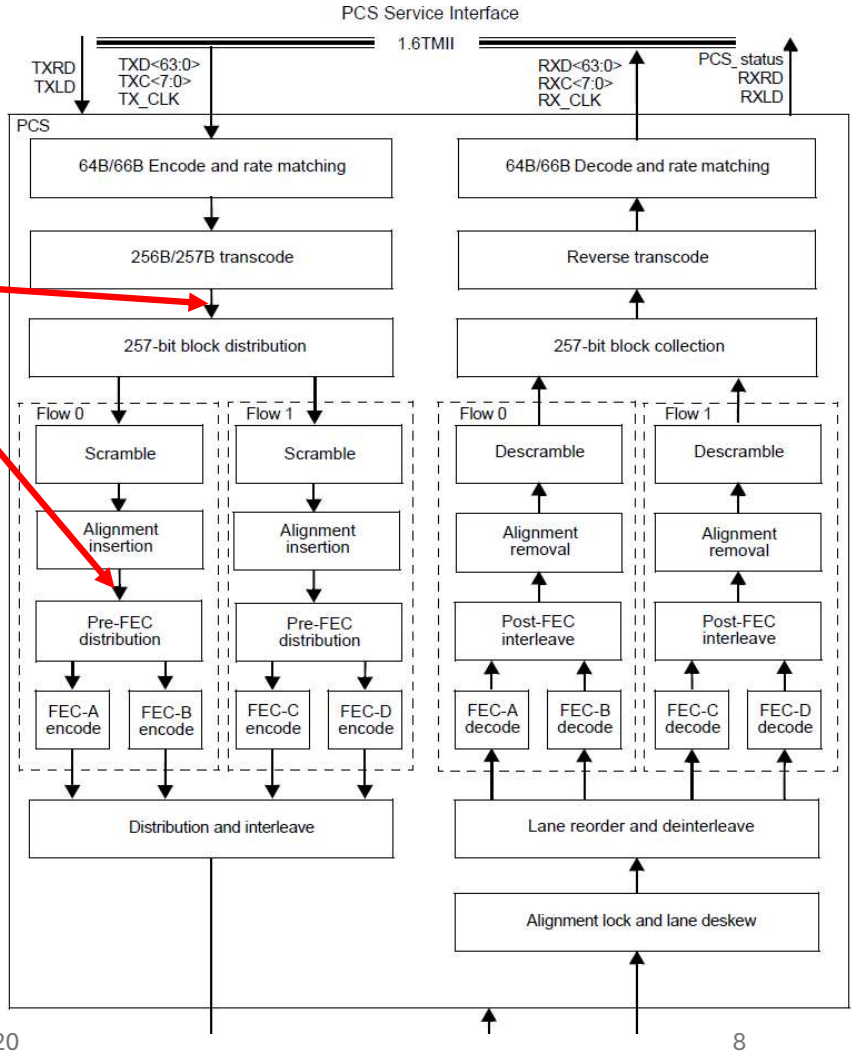
Liaison activity with Q11/15

- Our liaison to Q11/15 (from September) requested allocation of a FlexO payload type for 802.3dj for use with 800GBASE-ER1 (and ER1-20)
  - We had originally intended to re-use the FlexO payload type that had been allocated to OIF for 800ZR since we were using exactly the same mapping and overhead
  - The introduction of the alignment marker location feature to mitigate PTP errors introduced by the ER1 mapping is a divergence from OIF, and therefore requires a unique FlexO payload type for 800GBASE-ER1/ER1-20
- In their response, Q11/15 observed that the root cause of the PTP issues with 800GBASE-ER1 is that AMs are discarded and re-inserted
- Based on that, Q11/15 asked if 802.3 expects to have 1.6T PHYs with the same PTP accuracy problems as 800GBASE-ER1, and if so, whether we might want to reconsider the 1.6T OTN mapping reference point to include AMs

1.6T OTN mapping reference point

OTN mapping reference as specified today in 802.3dj D1.4

OTN mapping reference if we change it to include AMs



- Q11/15 suggests that maybe the OTN mapping reference for 1.6T should be changed to include AMs
- This would be inconsistent with other rates and awkward because it requires awareness of the two flows (as was the case at 800G)

Should we change the OTN mapping reference point for 1.6T?

- Considerations
  - 802.3dj is defining the 1.6TBASE-R PCS, and thus the OTN mapping reference point for all 1.6T PHYs
    - Changing the OTN mapping reference point in a future project would be detrimental – the entire point of the OTN mapping reference point is that it is the same for all PHYs with the same rate
    - Even if a future project defines a new PCS, it needs to maintain the same OTN mapping reference point
  - 802.3dj does not include any 1.6T PHYs that have the PTP accuracy problem that 800GBASE-ER1 has
  - We cannot predict what the architecture of potential future 1.6T PHYs will be
    - We can reasonably imagine there will be a future project that defines 1.6TBASE-FR, -LR, and/or -ER PHYs that will require stronger FEC than RS(544,514) alone, but we can't be sure that mapping like 800GBASE-ER1 would be used
    - If we do select a solution like 800GBASE-ER1, we have a solution to the PTP problem, even if it is a bit awkward
  - The potential alternative location of the OTN mapping reference point that would include AMs requires flow awareness in the OTN mapping, which is awkward
  - Including AMs would make 1.6T different than all other Ethernet rates
  - The definition of the OTN mapping reference point is not related to the PTP accuracy issues that were identified in 800GBASE-ER1
- Conclusion: in the absence of a good reason to change the 1.6T OTN mapping reference point, we should not make a change

How to respond to the liaison?

- The response should:
  - Thank Q11/15 for informing us of the assignment of the FlexO Payload Type for use by 800GBASE-ER1 and -ER1-20
  - Describe our understanding of the purpose of the OTN mapping reference (per these slides) and note that the OTN mapping reference point was not the cause of the PTP accuracy issues with 800GBASE-ER1
  - Conclude that based on that understanding, the uncertainty as to how future 1.6T PHYs will be architected, and the alignment marker location solution we have for 800GBASE-ER1 being extensible to any potential future 1.6T PHYs that use the same FEC architecture as 800GBASE-ER1, we do not think a change to the OTN mapping reference point is necessary or beneficial