Technical and implementation details on the FEC for 802.3da

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Starting point

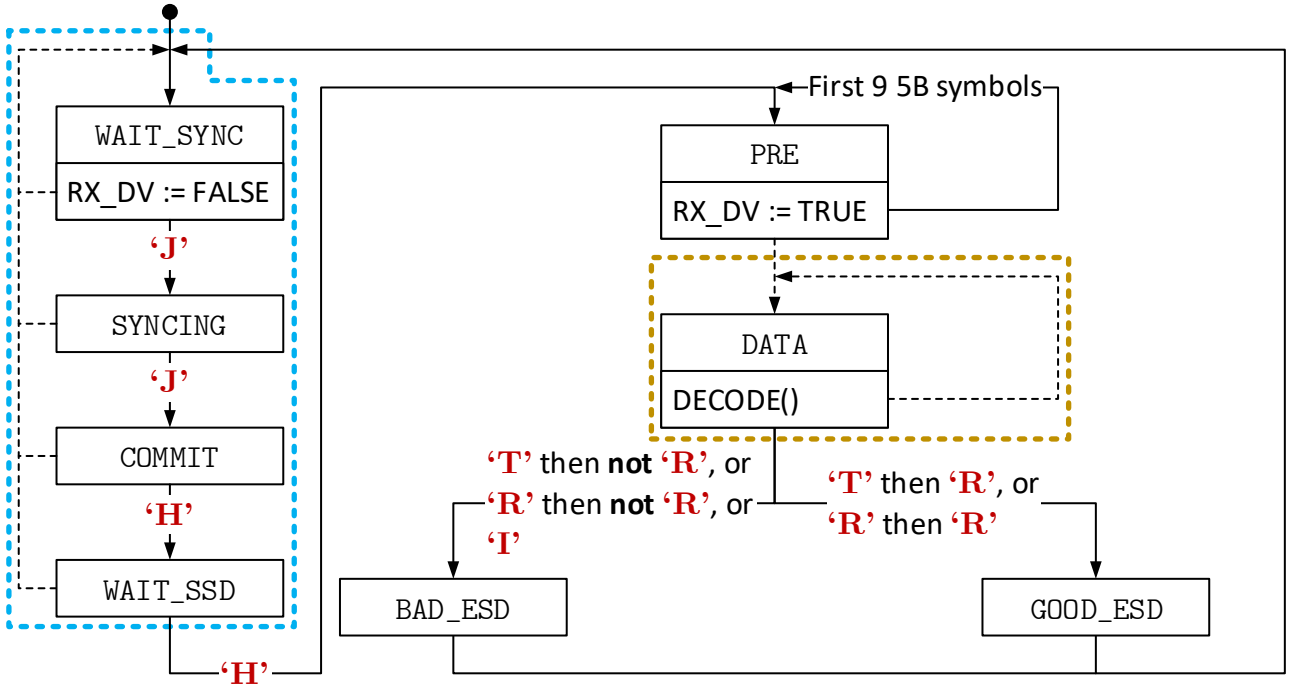
- Introductory presentation given on the 16th of June 2021 with title “FEC for 802.3da”*
- All technical details on the topics has been released shortly afterward**
- Base idea is to form 19 5B channel symbol codeword out of 19 4B user data symbols, such that it is backward compatible with Clause 147, by avoiding Forbidden Symbols (FS), and that it can correct 1 5B symbols error or 2 5B symbols erasures in each codeword
- Burst error/erasure resilience is per-frame configurable via interleaving

* https://www.ieee802.org/3/da/public/061621/huszak_zimmerman_fec_3da_06162021.pdf

** https://search.ieice.org/bin/pdf_advpub.php?category=B&lang=E&fname=2021EBP3016&abst=

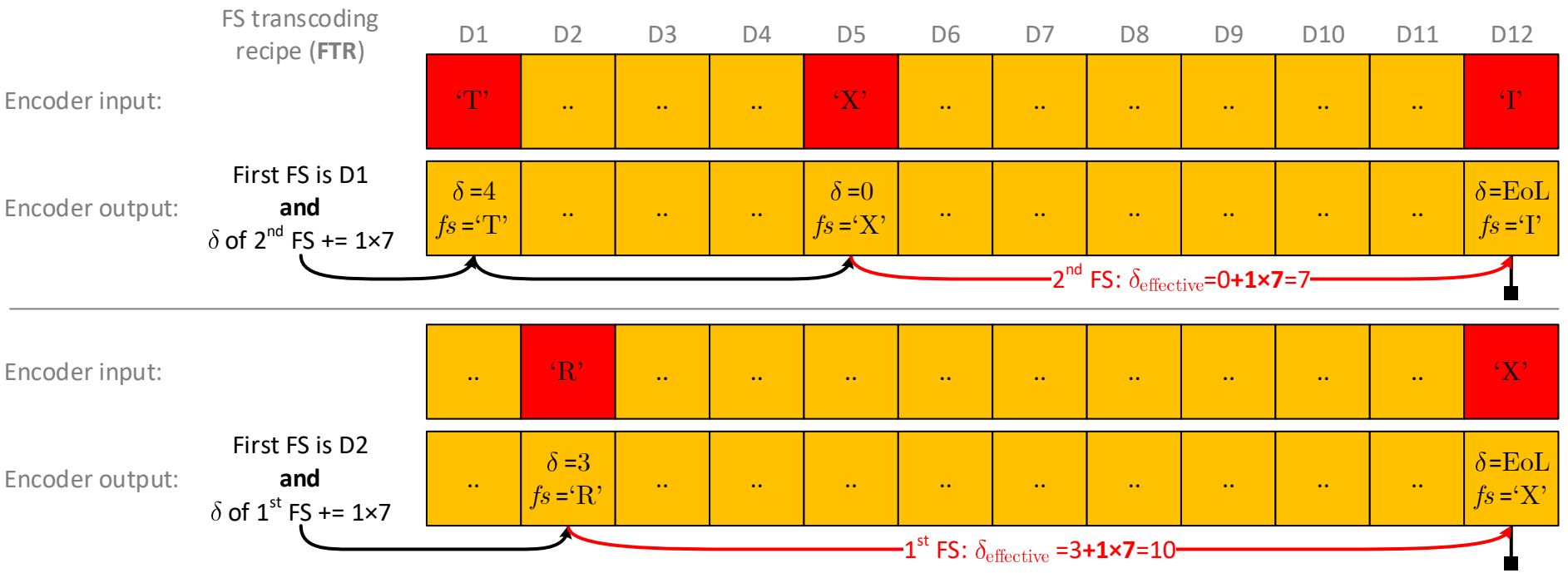
Forbidden Symbols (FS)

- There is only **one** reasonable way to lock Clause 147 PHY into a cyclic, which prevents T, R and I from being sent → **FS**



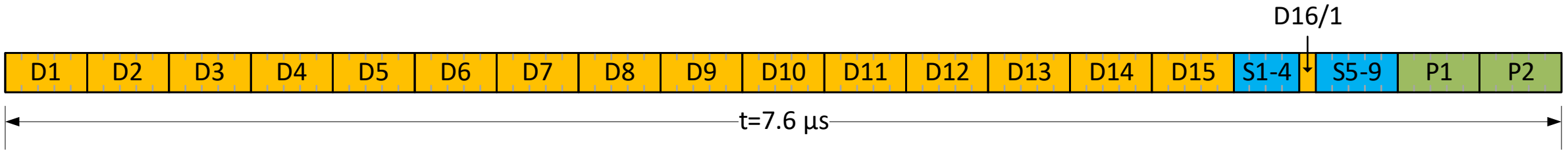
Legend:
'J', 'H', 'T', 'R', 'I': 5B symbols as per "Table 147–1—4B/5B Encoding" in IEEE Std 802.3cg-2019
---ELSE branch-->

Linked list to escape FS among D1-12*



* For the sake of simplicity, this example shows only 12 5B symbols

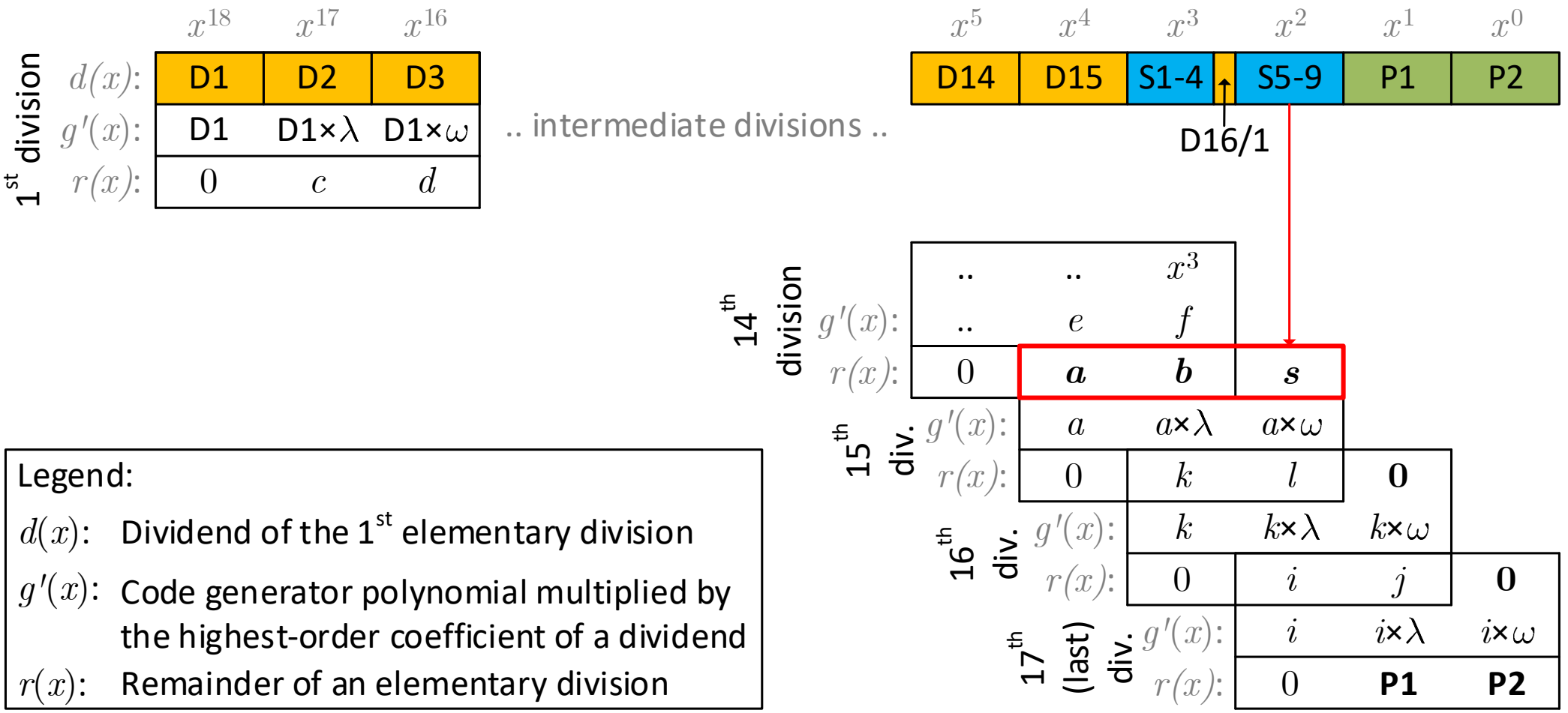
Codeword of a {19, 19} coding scheme



Legend:

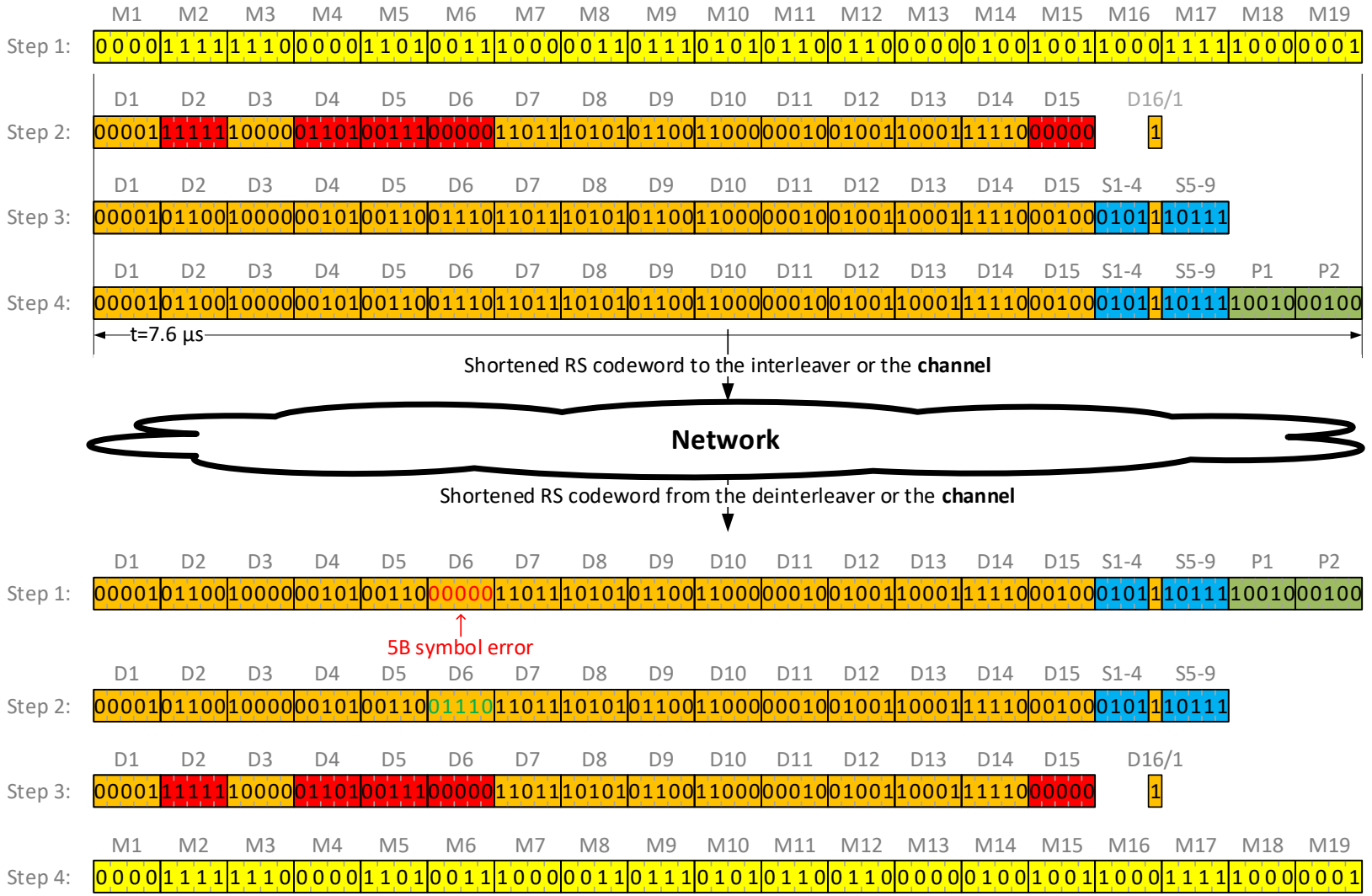
- Dx: data symbol concatenated from MII data, 5B (**DS**)
- Sx: signaling bits (**SB**)
- Px: parity symbol, 5B (**PS**)

Coding scheme to escape FS among P1-2*



* This example represents the {19, 19} coding scheme

Encoding and decoding example



Implementation-dependent aspects: Erasure detection & DME redundancy

- Known properties of the PMA may be used to signal erasure*
- Known properties of the DME allow for increased efficiency of decoding through:
  - Replace threshold-level-based decoding with something more resilient to noise: check for
  - A single DME bit erasure can be corrected even without FEC (other interpretation: DME has an inherent 1-erasure correcting FEC in it)

* 147.5.4.1 Transmitter output voltage

To be specified: beginning of frame

- If we want to adopt this, 802.3da needs to specify error-resilient encoding of the following information is needed while maintaining backward-compatibility:
  - Preamble
  - Coding parameters (at least that of interleaving)
  - Other parameters may be included, such as, optionally OAM
- The resilience of this should be at least as good as that of the packet
- Overhead and coding delay should be minimized
- Contributions appreciated

Improvements which could be specified: Efficiency of end of frame

- Frame is currently extended to fit in a superblock, which introduces a minor efficiency loss of medium use
  - Error-resilient shortening of last codeword or the superblock
  - Again, the resilience of this should be at least as good as that of the packet
  - Again, overhead and coding delay should be minimized
- Contributions appreciated

Straw Poll:

- I would be interested in further contributions on FEC for 802.3da
- Y:
- N:
- A:

Thanks for your kind attention

Any Questions?