

# Consideration of timestamp accuracy with MII-extender in coherent 800GBASE-ER1



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IEEE 802.3dj Task Force

# Purpose



- Consideration of timestamping accuracy of PTP with segmented FEC with Coherent technologies as presented in [nicholl 3dj 02a 2307](#)
- Exploration of techniques for achieving high precision PTP timestamping across 800GBASE-ER1 with segmented FEC

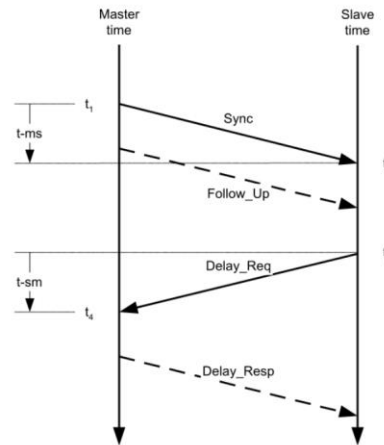
# Background



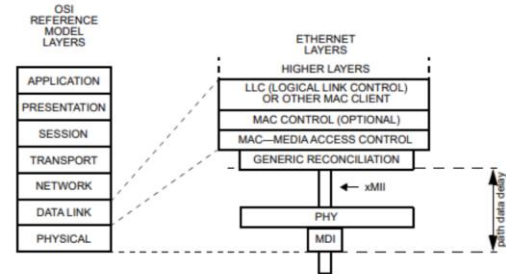
[dekoos 3df 01 230130](#) contribution regarding PTP in presence of MII-extenders

## PTP/Timestamping Background

- Synchronize Time-of-Day across a network by exchanging messages and their measured arrival/departure times.
- With the round-trip delay, the time difference between the TimeTransmitter and TimeReceiver can be calculated.
- Requirements for time synchronization accuracy are defined in ITU-T Recommendation G.8273.2
  - “Class D” targets end-to-end accuracy to within +/- 5ns!
- The more precise the timestamps, the smaller the end-to-end TimeSyncError.



## Timestamping Model for Ethernet



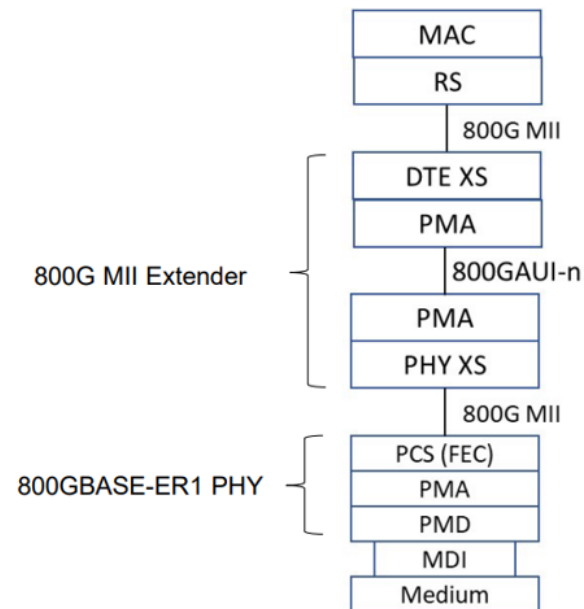
- A timestamp is simply a packet’s arrival or departure time
- 802.3 specifies that the timestamp is calculated as the time at the Generic Reconciliation Sublayer (gRS), and then adjusted to account for the delay through the PHY (path data delay).
- 802.3cx explains how to account for the cyclic delay variations through the PHY (e.g. FEC parity bits) and use a constant value for the path data delay.

- Note that the gRS has awareness of the Alignment Marker position inserted (Tx) or deleted (Rx) by the PCS
  - In 802.3cx, this is done by “passing notes” about the AM location from the PCS
  - Passing such notes isn’t possible if the PCS is not in the same physical device as the gRS

# IEEE 802.3cx



NOTE—When TX\_NUM\_BIT\_CHANGE and RX\_NUM\_BIT\_CHANGE are not available (e.g., over physical interfaces such as instantiated xMII or AUI), it is recommended to avoid insertion and removal of idles, alignment markers, and codeword markers in the sublayers below the xMII/AUI, when possible, to reduce timestamping accuracy impairments (see Annex 90A).

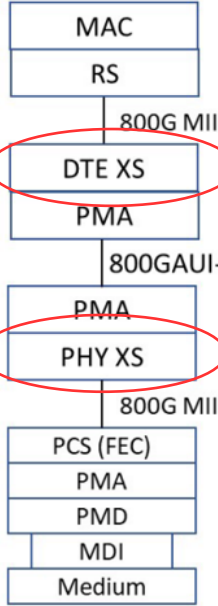
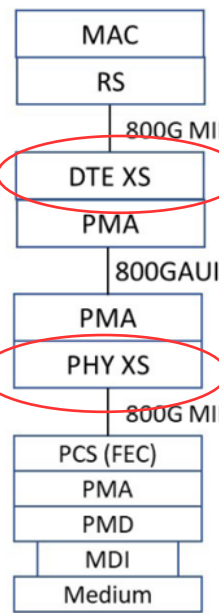


- To conform to a 800GMII presented by PHY XS to 800GBASE-ER1 PHY, AM insertion/removal + rate adaptation is needed



# Sender

# Receiver



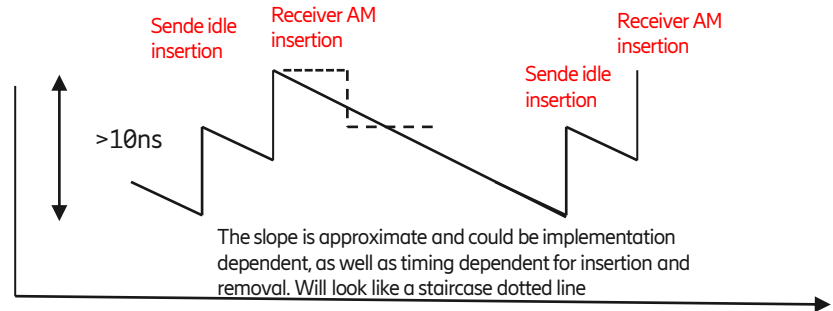
Am insertion  
Rate adaptation

Am removal  
Rate adaptation

Am removal->  
Rate adaptation  
Idle insertion

Am insertion<-  
Rate adaptation  
Idle removal

e2e latency



Time

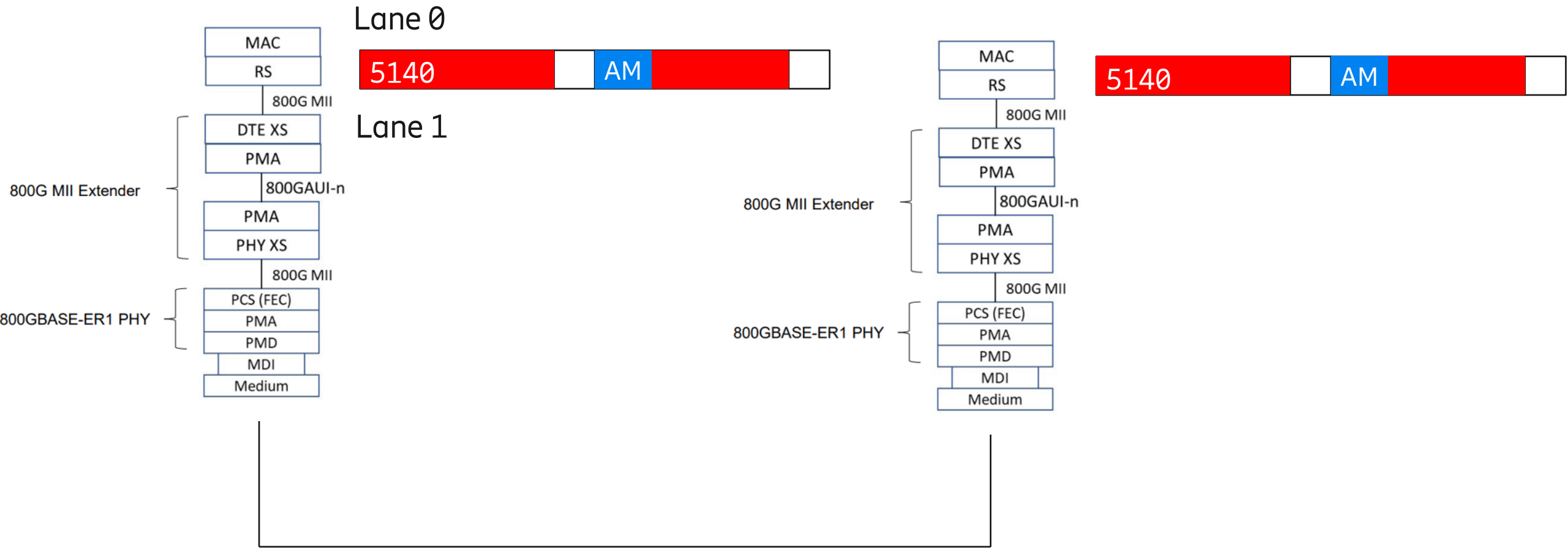


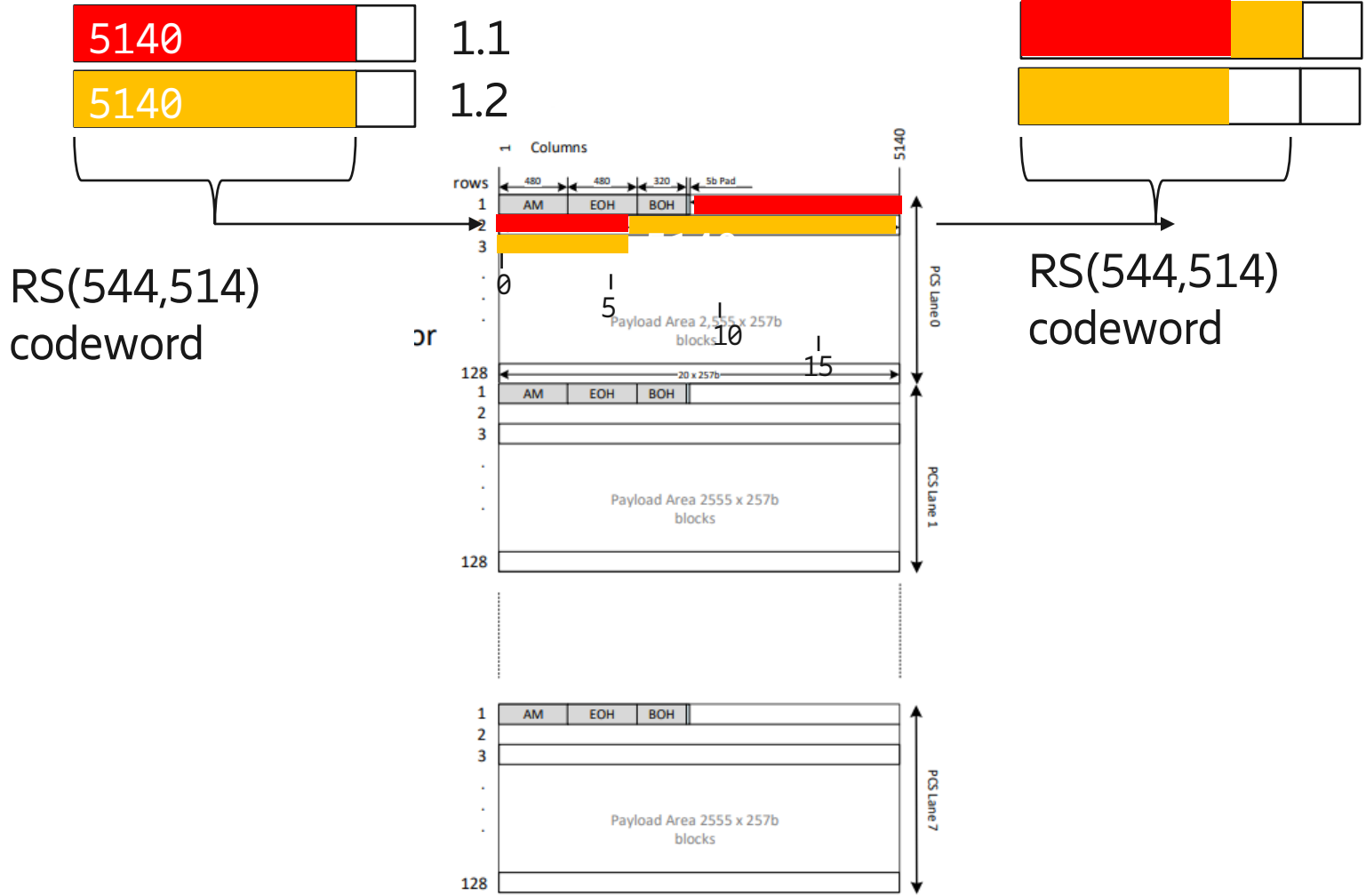
Sender DTE XS RS(544,514) codeword and AM alignment != Reciver DTE XS (544,514)

IEEE 802.3cx assumption on mirroring and usage of gRS RX/TX\_num\_bit\_change not possible as it would give incorrect result

Mitigation maintaining RS(544,514) codeword and AM alignment across optical link

Pass MII-extender RS(544,514) codeword and AM alignment information





RS(544,514)  
codeword

RS(544,514)  
codeword

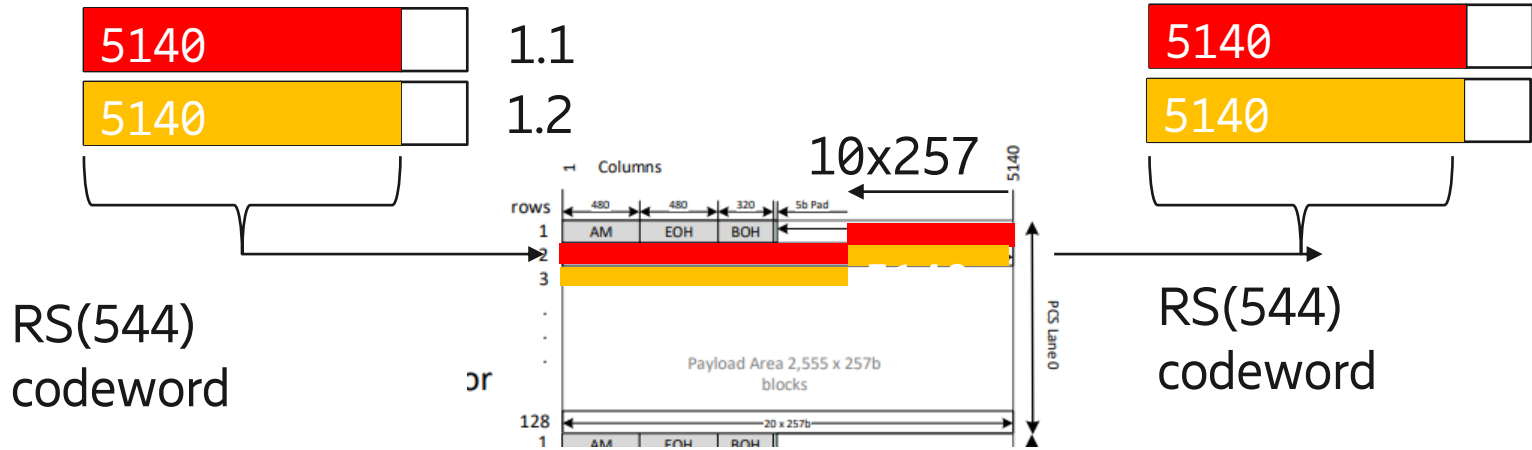
A GMP payload area Contains  
127,75 RS(544,514) codewords  
worth of data.

Codeword start would move by 5  
x 257b per row

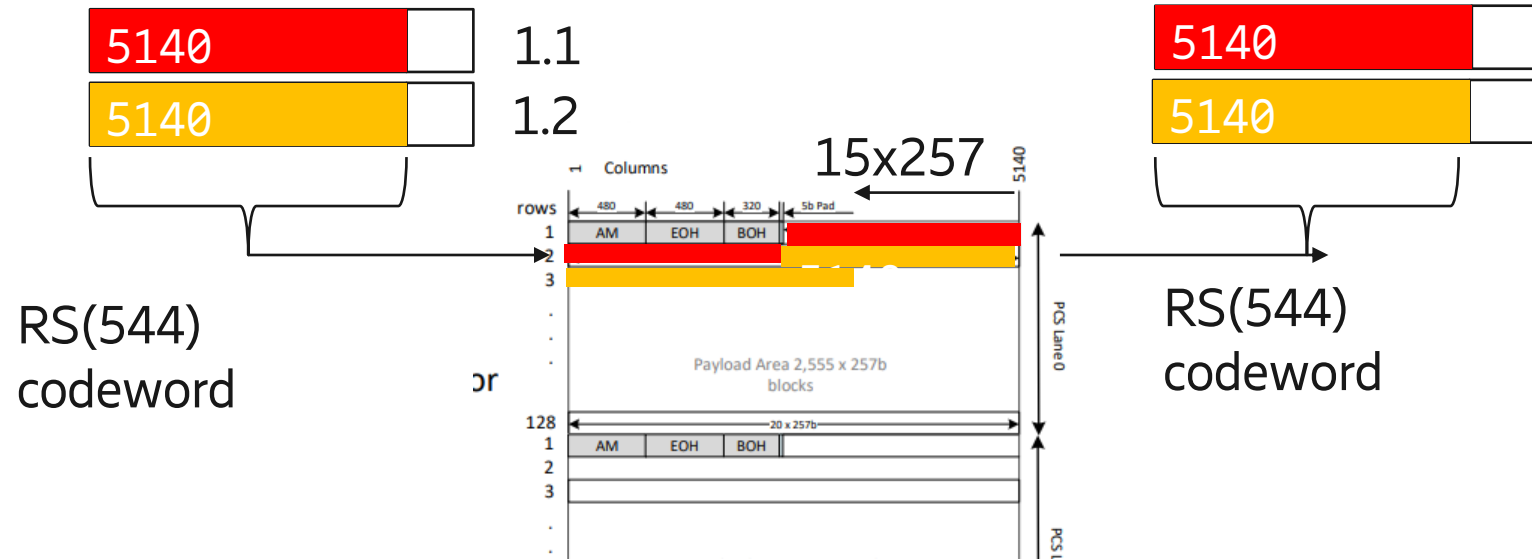
None trivial task to recreate  
codewords on receiver side



# Two methods for easy identification of codeword

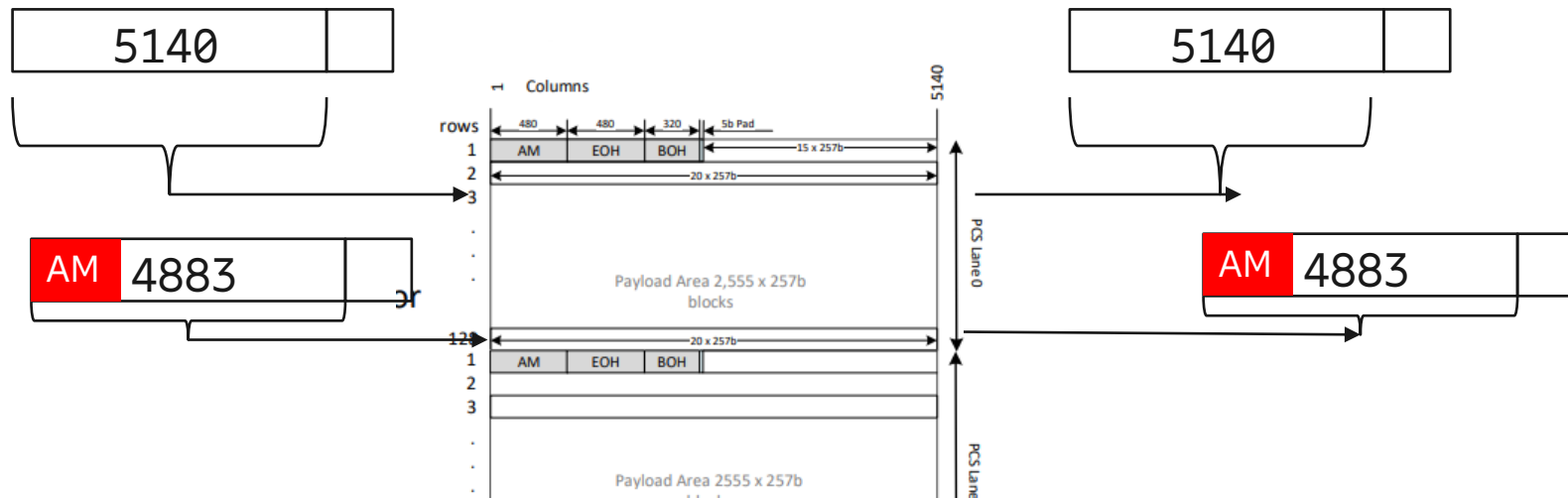


GMP payload area contains 127,5 RS(544,514) codewords worth of data.



GMP payload area contains 127,75 RS(544,514) codewords worth of data.

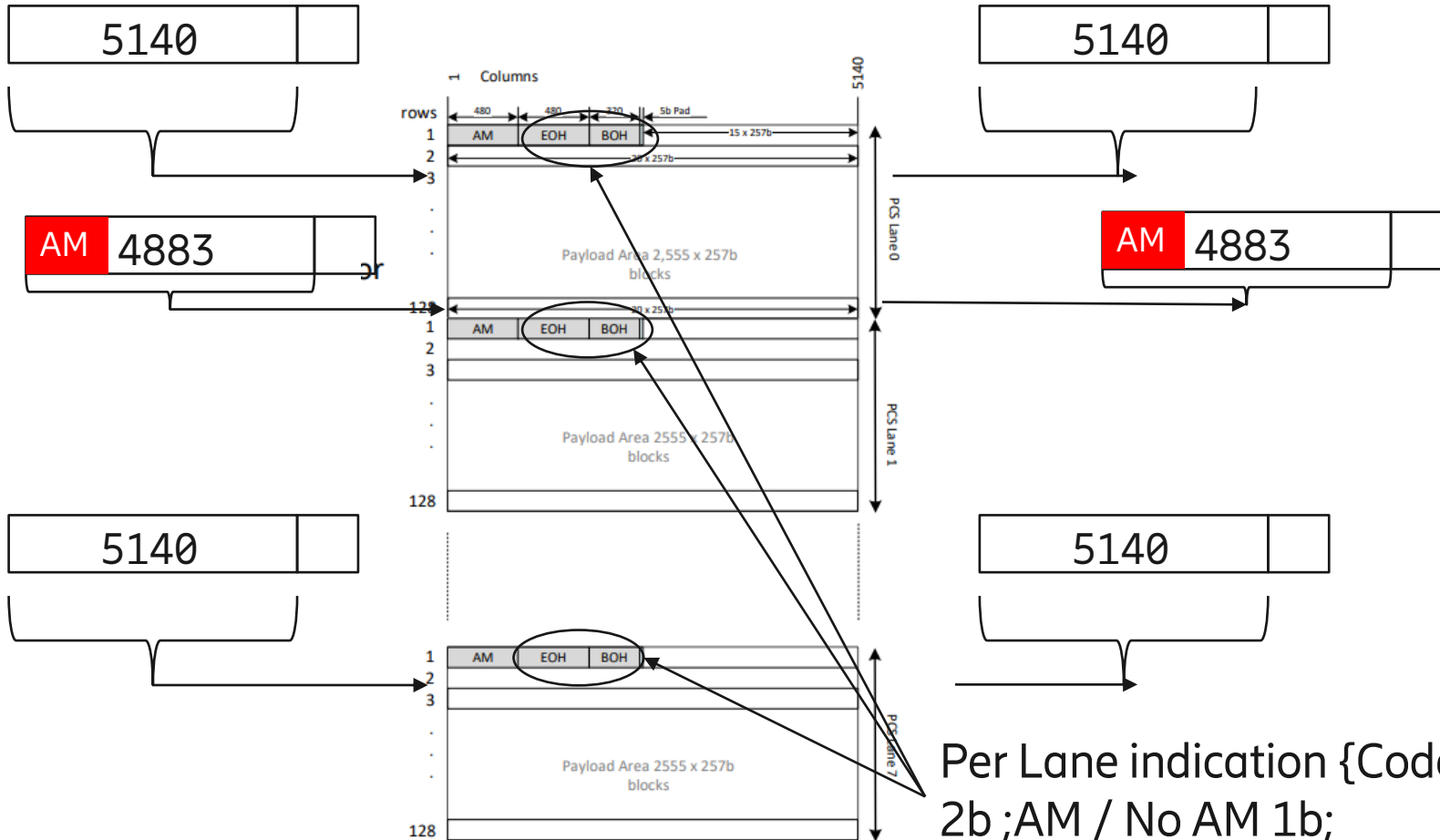
Indicate spillover in terms of 5 x 257b blocks from lane previous GMP payload area



- Pass AM as is from PHY XS to PCS <- No BW expansion
- Codeword with AM will move in GMP payload area across time, as GMP payload area is not a integer divisor

$$81920/2555$$

$$81920/2540$$



Per Lane indication {Codeword spillover over 2b ;AM / No AM 1b;  
AM POS 0:127 7b}



Thank You