PCS, FEC and PMA Baseline Proposal

IEEE P802.3ck

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Introduction

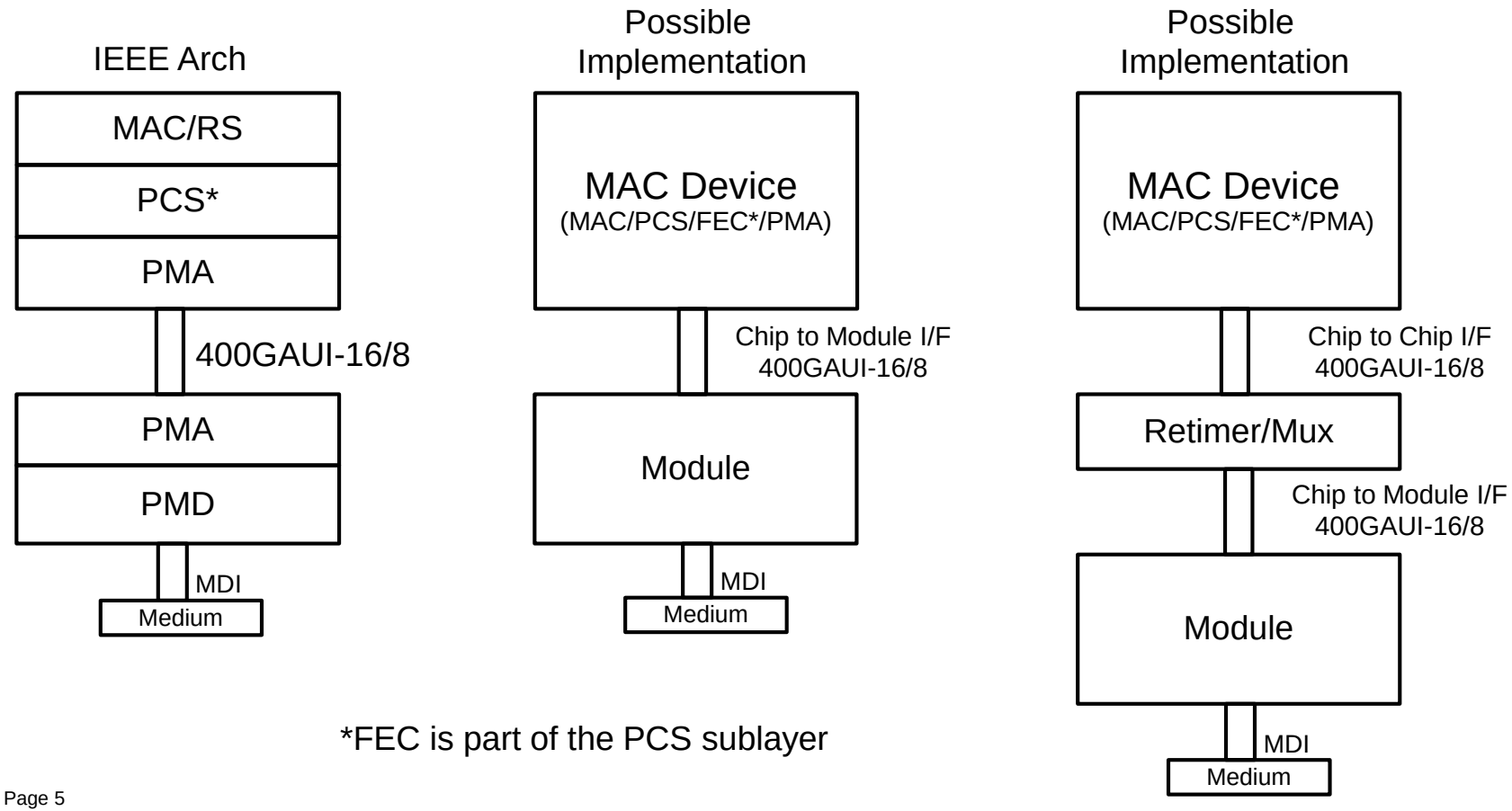
- This describes a possible PCS/FEC/PMA baseline proposal for the various Ethernet speeds covered by the 802.3ck task force
- It proposes to reuse existing PCS/FEC/PMA sublayers that have been defined in 802.3bs and 802.3cd for many of the interfaces
- For the most difficult interfaces at 100GbE, it adds a new FEC sublayer that interleaves two RS(544,514) codewords

Previous Work

- gustlin_3ck_01_0518.pdf, proposes re-use of the 802.3bs and 802.3cd PCS/FEC/PMA sublayers in this project
- anslow_3ck_adhoc_01_072518.pdf, initial FEC performance analysis
- gustlin_3ck_01_0718.pdf, proposes a possible RS symbol muxing scheme in the PMA sublayer, this is no longer being considered
- anslow_3ck_01_0918.pdf, updated FEC performance analysis
- gustlin_3ck_01_1118.pdf, proposes a new interleaved FEC sublayer for the most difficult channels at 100GbE
- anslow_3ck_01_1118.pdf, analyses the interleaved FEC performance
- nicholl_3cn_01b_181211.pdf, proposes baseline for CGMII extender

802.3bs Architecture – 200GbE and 400GbE

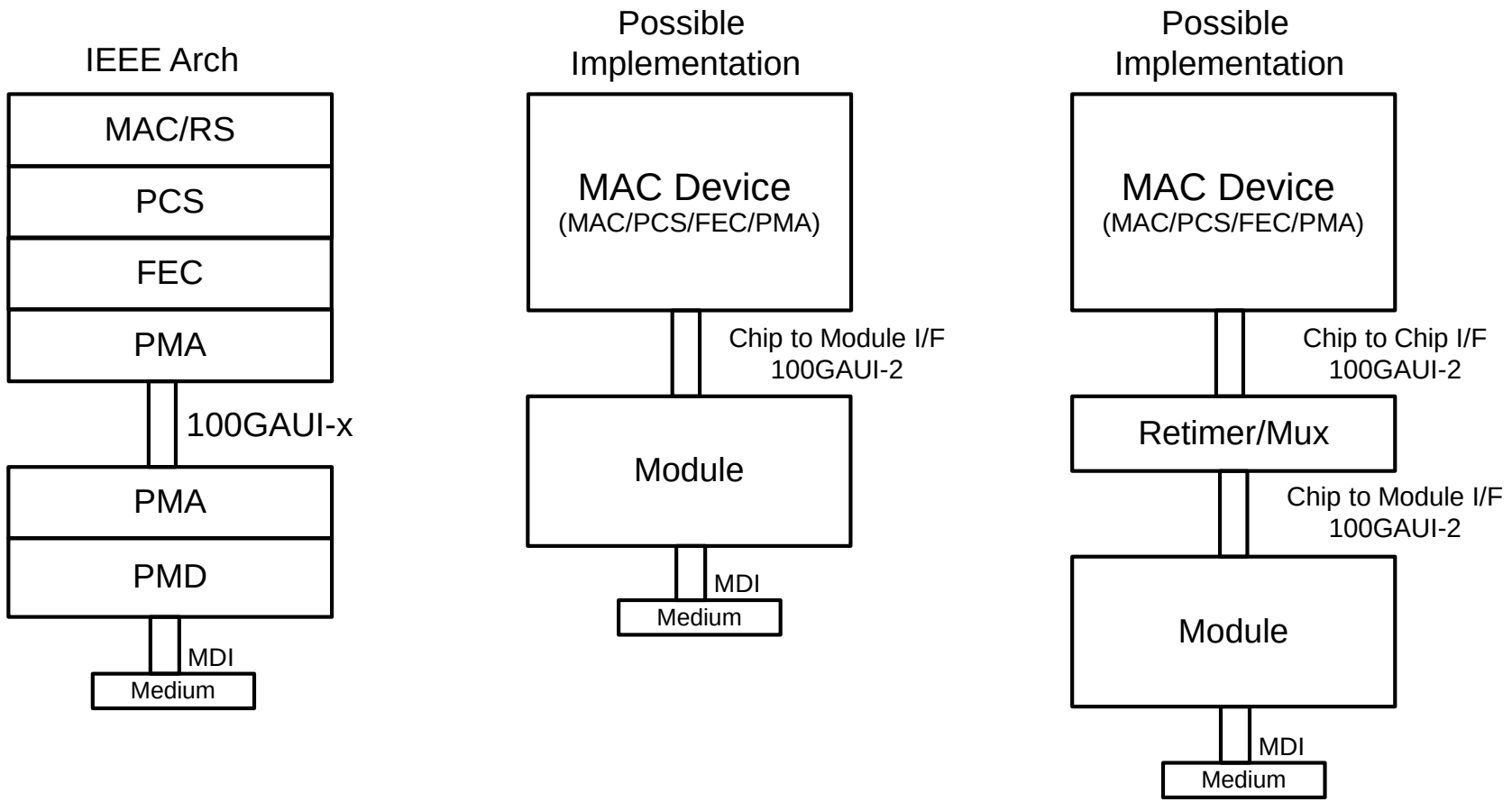
- Adopted architecture and possible implementations are shown below for 400GbE
  - 200GbE is identical except for # lanes and MAC rate
- FEC is part of the PCS sublayer utilizing the RS(544,514) aka “KP4” FEC code.
- An extender sublayer is also defined



*FEC is part of the PCS sublayer

802.3cd Architecture – 100GbE

- Adopted architecture and possible implementations are shown below for 100GbE
- FEC is in the FEC sublayer, RS(544,514) aka “KP4” FEC
  - An AUI may exist between the PCS and FEC sublayers

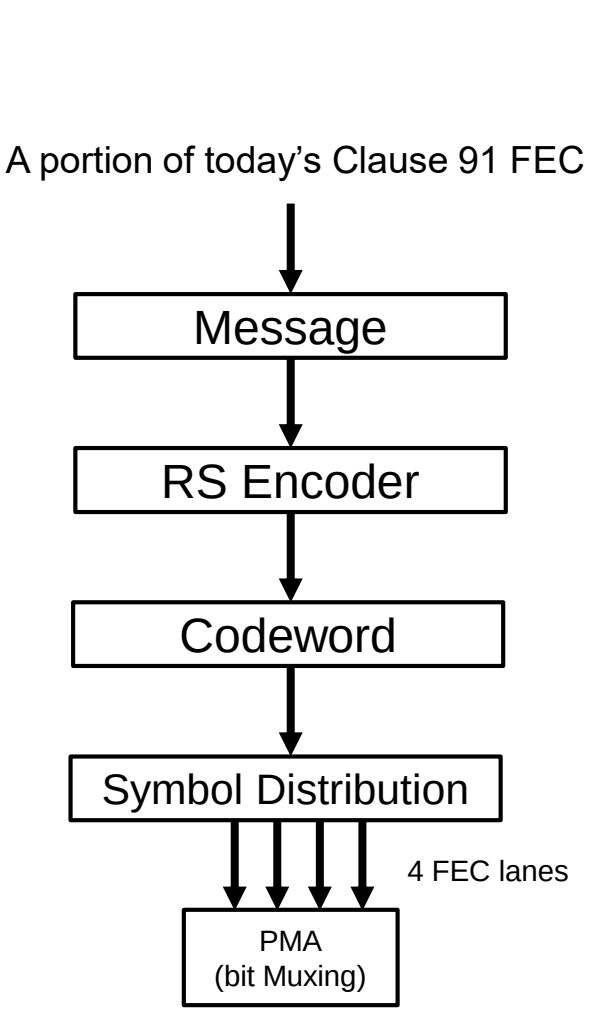


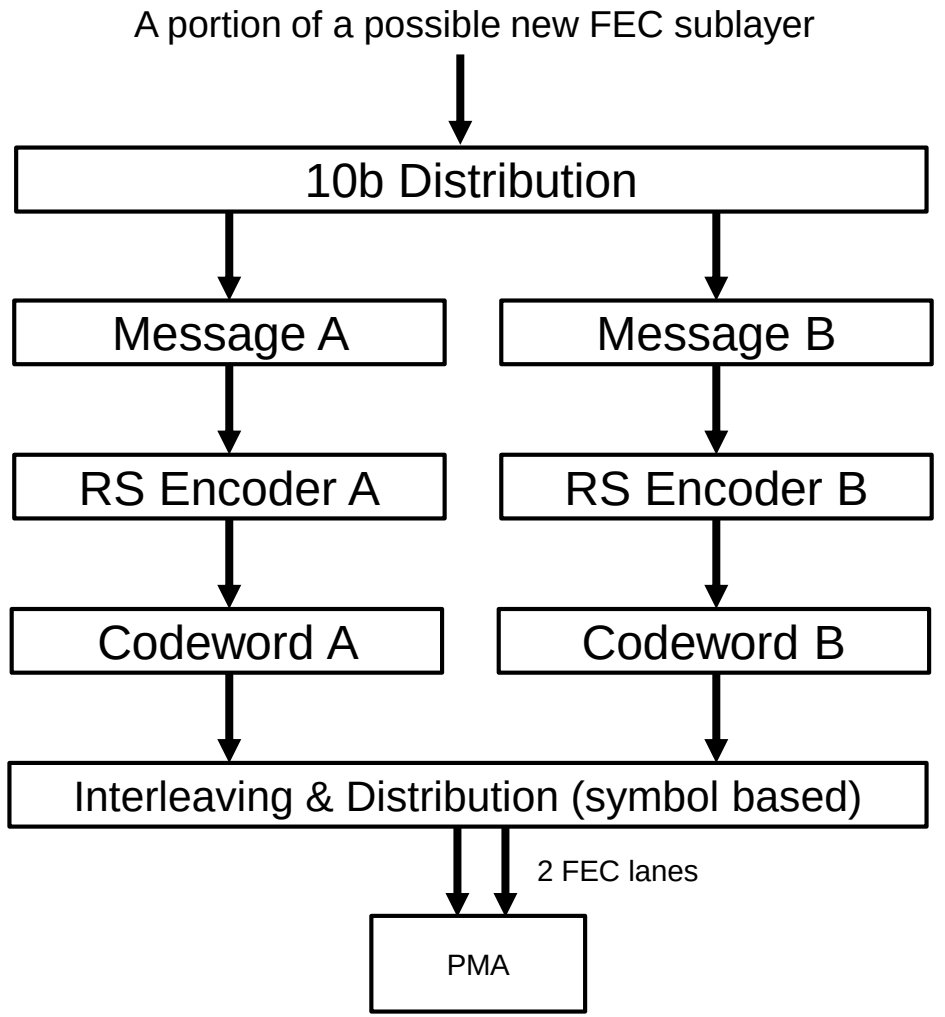
Proposal

- For 200GbE and 400GbE, adopt the 802.3bs Extender, PCS and PMA sublayers including the RS(544,514) FEC code for use in 802.3ck project
  - Clauses 118-120
- For 100GBASE-CR and 100GBASE-KR PHYs, adopt the 802.3cd PCS, a new 2:1 interleaved FEC sublayer based on RS(544,514) and the 802.3cd PMA sublayers for 100GbE
  - Clause 82, a new interleaved FEC clause, clause 135
- For the 100GbE C2M, C2C and all other related PHYs, adopt the PCS, FEC and PMA used in 802.3cd, including the RS(544,514) FEC code for use in 802.3ck project
  - Clauses 82, 91, 135
- Adopt the CGMII Extender Sublayer (100GXS) as proposed in 802.3cn
- Add all 802.3ck AUIs and copper/backplane PHYs to the list of interfaces with precoding capability
  - As in 802.3cd, PMA output lanes must support capability; PMA input lanes optional to implement, optional to enable

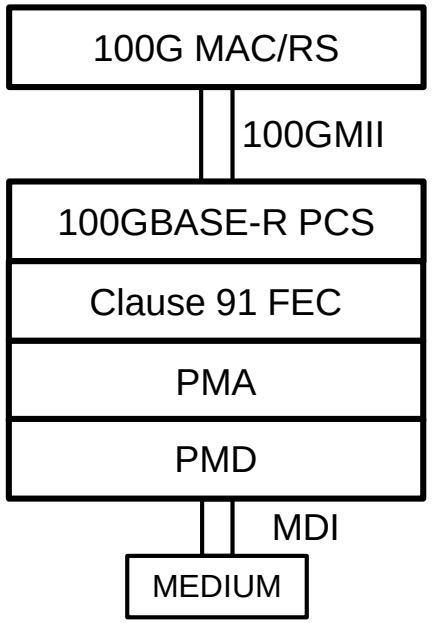
New 100GbE Interleaved FEC Sublayer

- Based on 2x50G RS(544,514) FEC interleaving, similar to 802.3bs

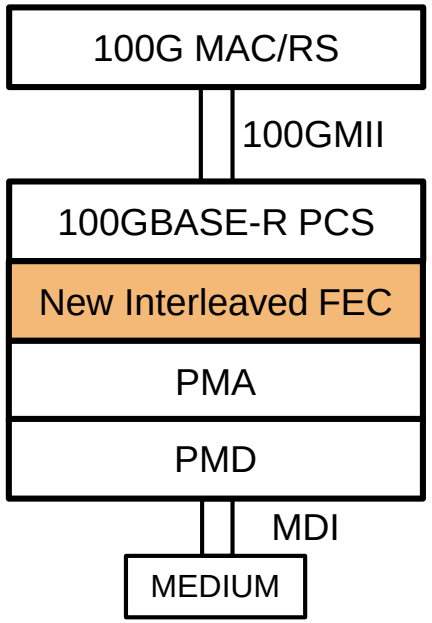




Proposed 100GbE FEC Sublayer Architectural View

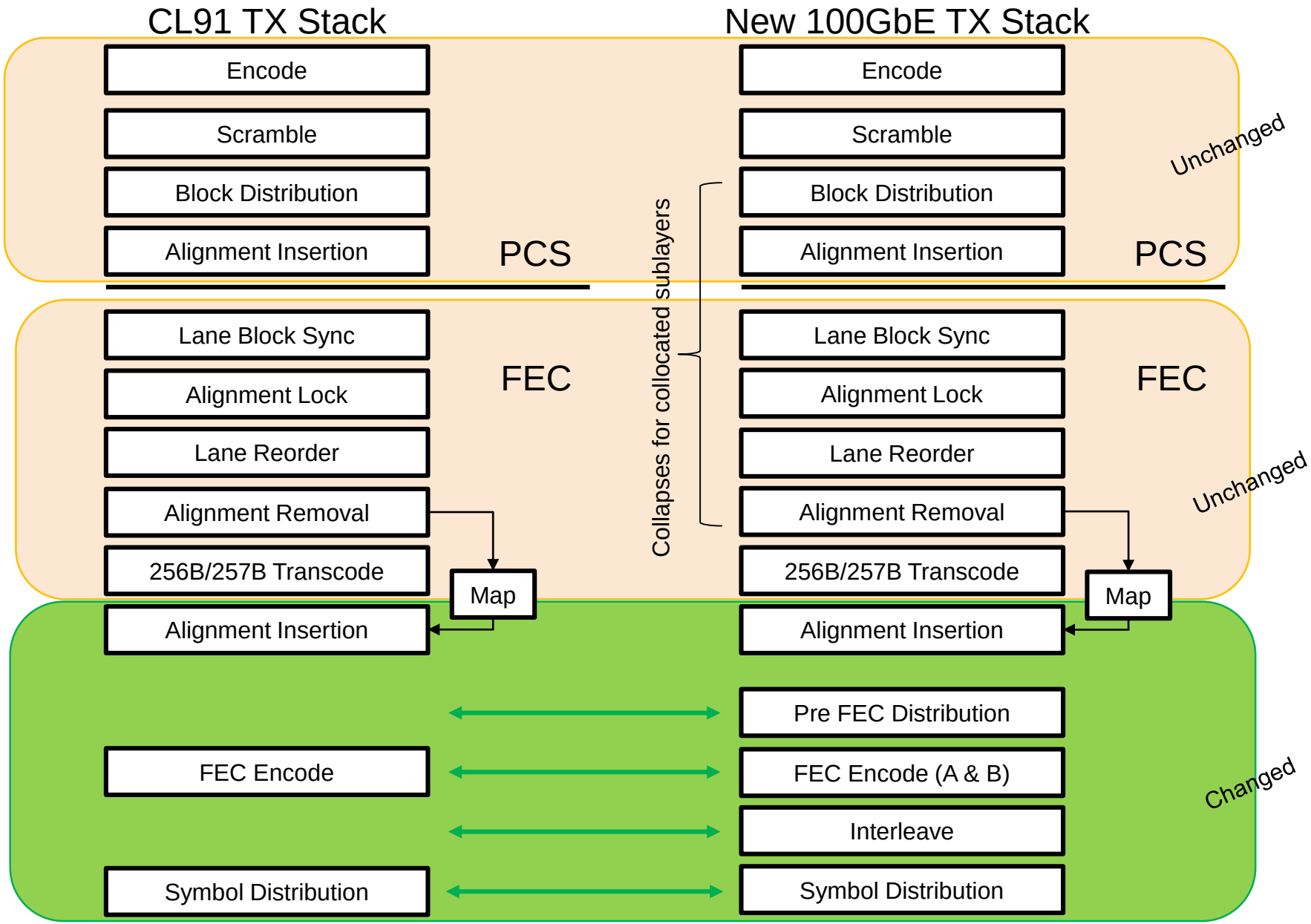


100GBASE-DR
C2M/C2C I/F



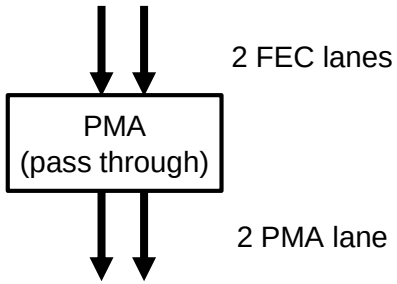
100GBASE-KR
100GBASE-CR

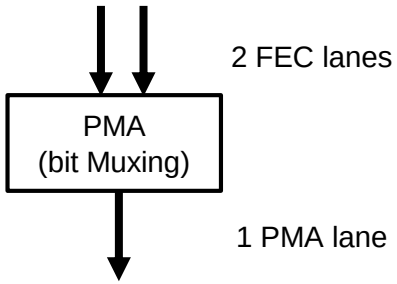
New Interleaved Protocol Stack Comparison with CL91



PMA for the New 100GbE FEC Sublayer

- PMA can be used as a pass through (2x53G)
- Or to bit mux down to a single lane (1x106G)
- Simple bit muxing
- Re-use of Clause 83





Alignment Markers for Interleaved 100GbE FEC

- Existing Clause 82/91 Marker Format

FEC lane, i	Reed-Solomon symbol index, k (10-bit symbols)					
	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33					
0	0 amp_tx_0 63	0 amp_tx_4 63	0 amp_tx_8 63	0 amp_tx_12 63	0 amp_tx_16 63	(5-bit pad)
1	0 amp_tx_1 63	0 amp_tx_5 63	0 amp_tx_9 63	0 amp_tx_13 63	0 amp_tx_17 63	
2	0 amp_tx_2 63	0 amp_tx_6 63	0 amp_tx_10 63	0 amp_tx_14 63	0 amp_tx_18 63	
3	0 amp_tx_3 63	0 amp_tx_7 63	0 amp_tx_11 63	0 amp_tx_15 63	0 amp_tx_19 63	

= 5-bit pad

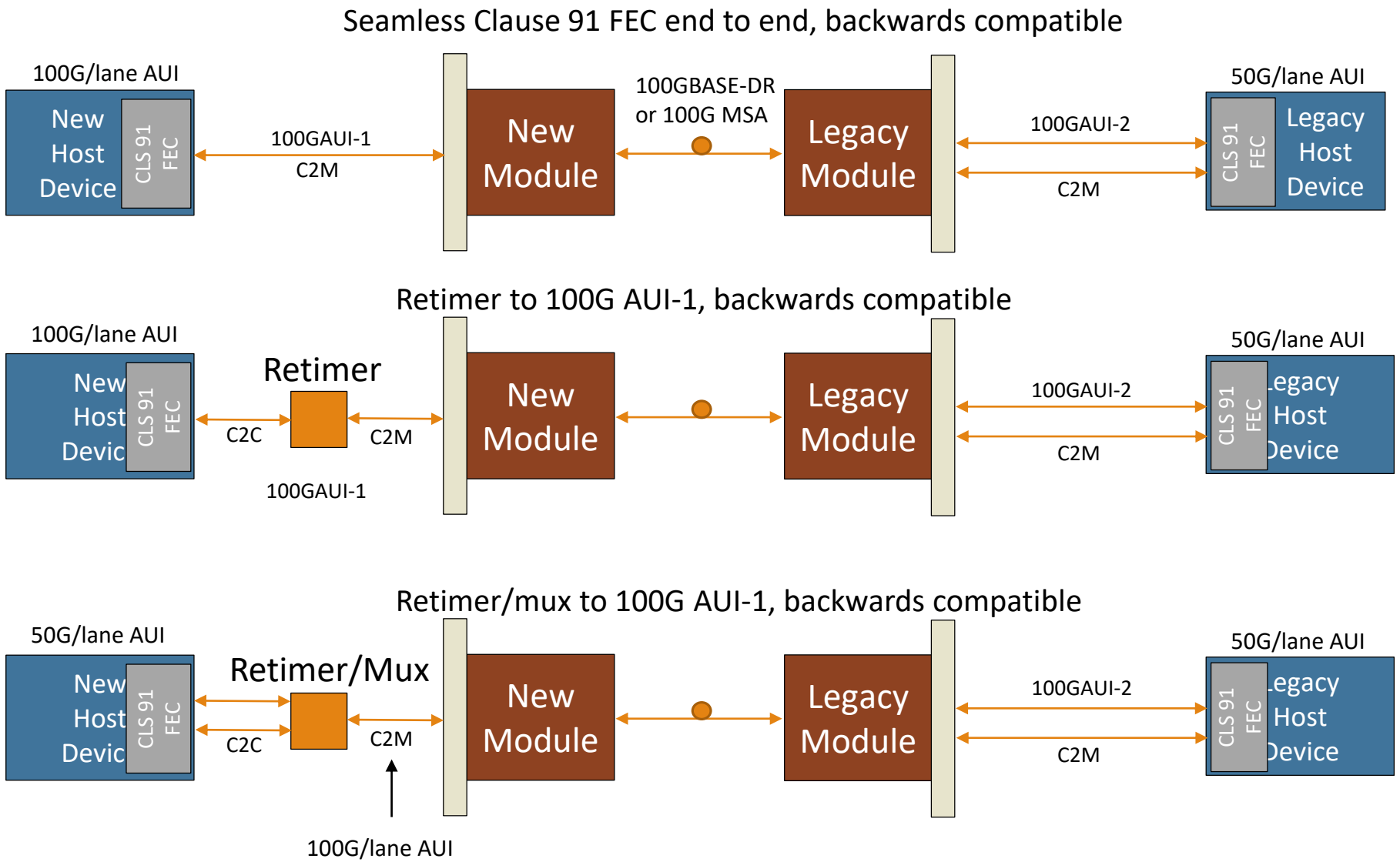
tx_scrambled

Figure 91–4—Alignment marker mapping to FEC lanes

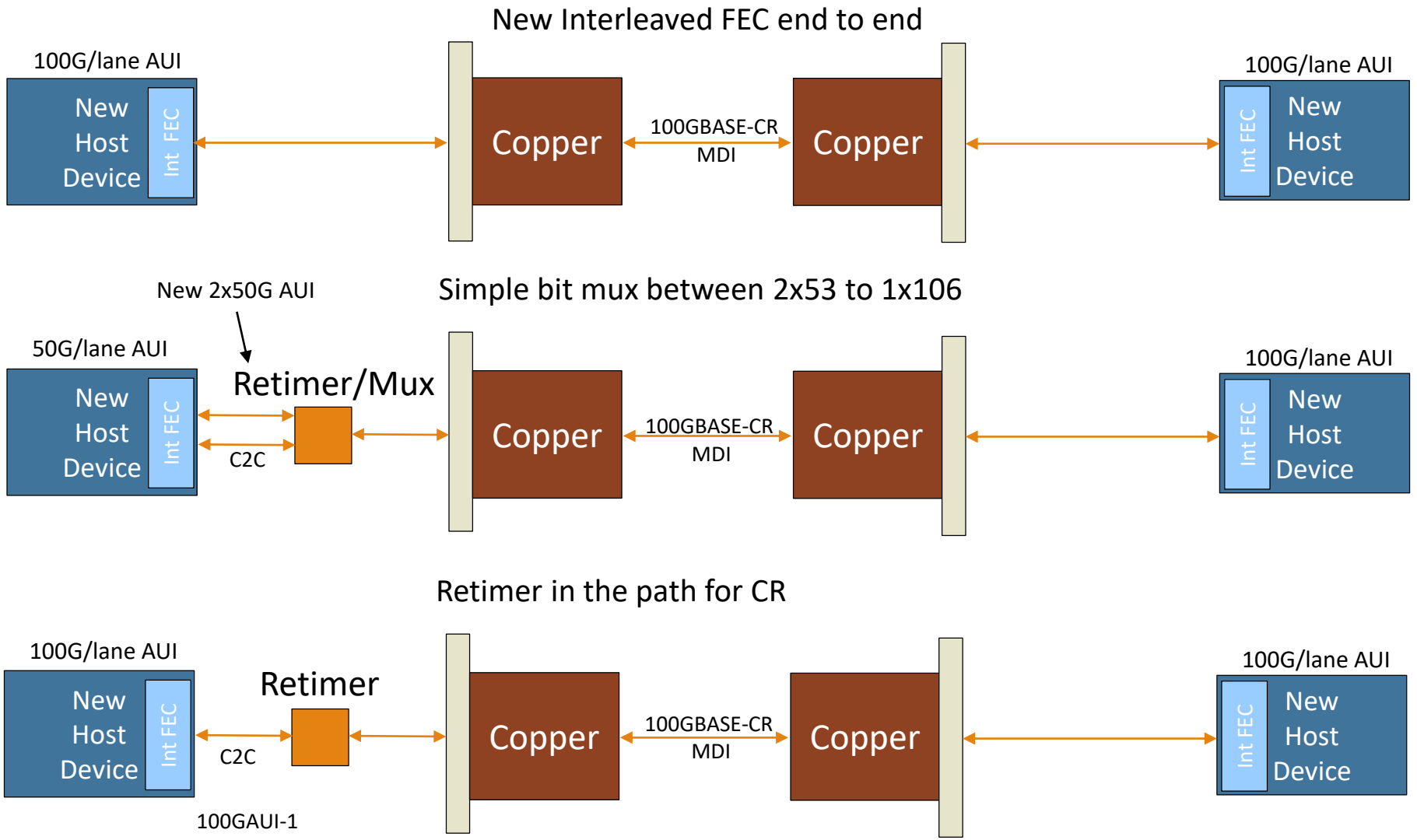
- Proposed New Interleaved Marker Format (supporting two FEC lanes)
  - amp_tx_0 = am0, amp_tx_1= am0, amp_tx2 = am2 etc.
  - No repetition at the end of the AM block

FEC Lane, i	Reed-Solomon symbol index, k (10-bit Symbols)						
	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20			OOO	50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65		
0	amp_tx_0	amp_tx_2	amp_tx_4		amp_tx_16	amp_tx_18	(5-bit pad)
1	amp_tx_1	amp_tx_3	amp_tx_5		amp_tx_17	amp_tx_19	

100GbE Example Use Cases - Optical

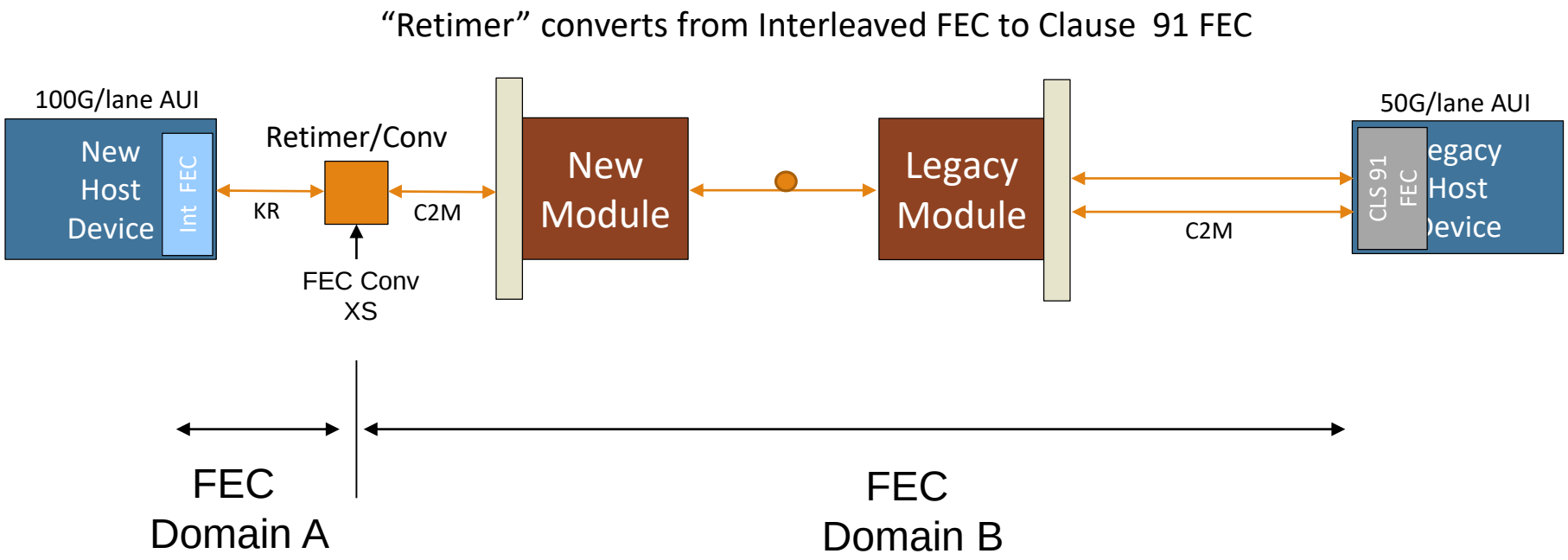


100GbE Example Use Cases – Copper



100GbE Example Use Cases – With an XS

- A CGMII Extender (proposed in 802.3cn) can be used for this scenario



Conclusion

- Once sufficient simulations and other work is done to show that the RS(544,514) FEC is sufficient for the 802.3ck channels, adopt these slides as the baseline for the PCS/FEC/PMA sublayers, including the new interleaved FEC sublayer

Thanks!