



5G PCS Options and Scrambling for Ethernet Backplane

17 September 2015

William Lo, Marvell

Agenda

- ▶ **List a few options to leverage existing IEEE clauses to 5G**
- ▶ **Discussion on scrambling and why it is good**

5G PCS Options

▶ Option 1: 10GBASE-R Based

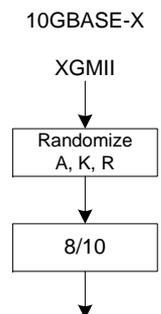
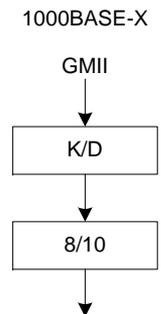
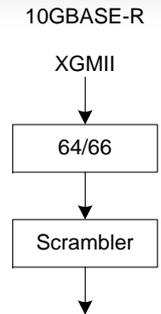
- Simply scale down 10BASE-R (Clause 49) to half speed
- 64/66 bit coding – with scrambling
- Can leverage KR PHY training as is
 - (assuming training is a desired feature)
- 5.1625 Gb/s raw line rate

▶ Option 2: 1000BASE-X Based

- Simply scale up 1000BASE-X (Clause 36) 5 times
- 8bit / 10 bit coding – no scrambling, fixed K/D idle code
- No PHY training defined
- 6.25 Gb/s raw line rate

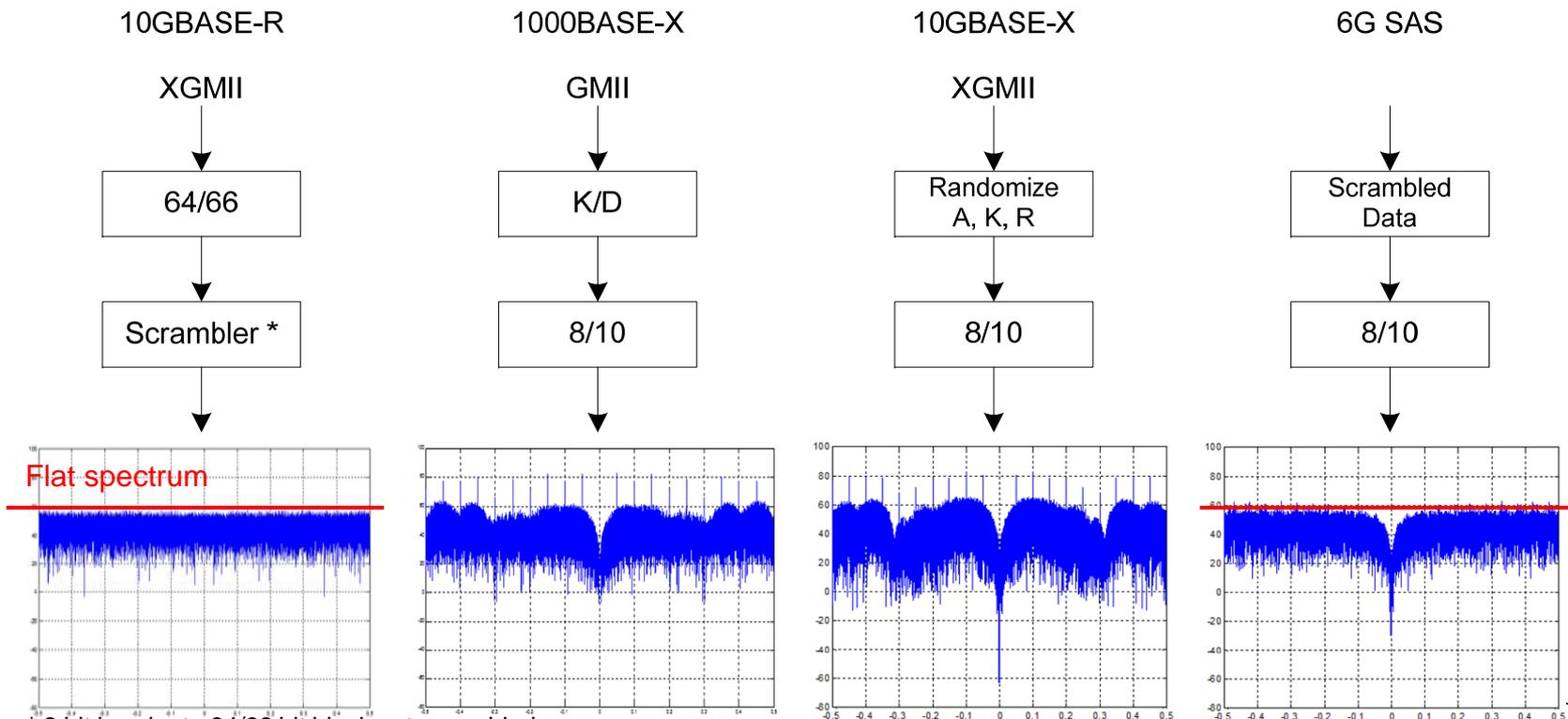
▶ Option 3: 10GBASE-X4 Based

- Symbol mux 4 lanes of 10GBASE-X4 (Clause 48) into 1 lane and run lane at 2x speed
- 8bit / 10 bit coding – no scrambling except idle bytes randomized with 3 possible idle codes (A, K, R)
- No PHY training defined
- 6.25 Gb/s raw line rate



Scrambling Effect on Spectrum

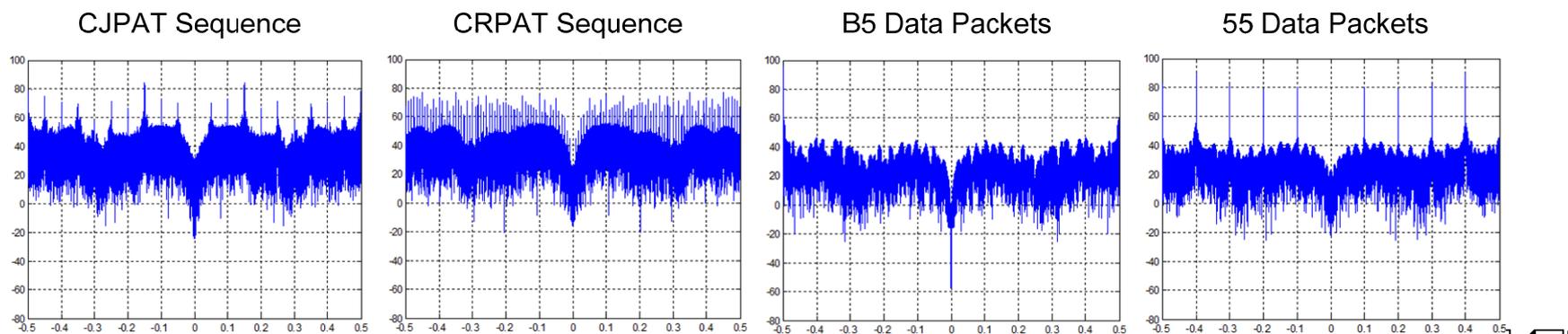
- ▶ Receiver need to adapt to spectrum seen during normal operation for optimal equalization
 - Repetitive idle patterns in 1000BASE-X and 10GBASE-X colors spectrum
 - Unscrambled data spectrum differs from unscrambled idles spectrum
 - Scrambling in 10GBASE-R and 6G SAS whitens spectrum



* 2 bit header to 64/66 bit block not scrambled

Examples of non-scrambled 8/10 coding

- ▶ Receiver equalizes differently based on data pattern received
- ▶ Observed cases in field (RXAUI 6.25G) where receiver equalizes error free to idle pattern at startup followed by CRC error on first packet
- ▶ Bottom line message – Scrambling is Good



5G PCS Recommendation

- ▶ **10GBASE-R Based (Option 1) is the better option**
- ▶ **Scrambling provider better equalization of channel at receiver**
 - Flat spectrum
 - No difference between data and idle spectrum
- ▶ **Lower raw bit rate (5.1625 vs 6.25 Gb/s)**
 - Lower power
 - Lower requirements on channel
- ▶ **KR training already defined in BASE-R PCS**
 - Most likely do not need KR training at 5 Gb/s – but is an easy option to add

THANK YOU