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EEE for 802.3ch

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EEE

- Previous presentations have discussed EEE implementation similar to 1000BASE-T1.

- This presentation proposes EEE based on 1000BASE-T1 (Clause 97) with the following functional modifications:

  – Support for low bandwidth data transmission during LPI (asymmetrical data transmission)

  – Add Alert signal before wake, similar to10GBase-T

  – Take out limitation on Wake frame start

  – Master/Slave refresh are exactly half QR cycle apart

Timing Synchronization – Partial Frames

- Similar to 1000BASE-T1, we will have a frame counter synchronized between master and slave so that we can align refresh properly. This counter can be a maximum of one count different between master and slave.
  - All proposed full RS frames are quite long in 2.5G/5G/10GBASE-T1
  - Concept of partial frame counter was introduced in 1GBase-T1
- We define a partial frame as 1/8 the time period of a PHY FEC frame. The following timings are based on FEC of RS1024(576,514).

RS1024(576,514)	2.5G	5G	10G
PHY frame (ns)	2048	1024	512
Partial PHY frame (ns)	256	128	64
PAM4 symbols per partial Frame	360	360	360

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Signal Timing
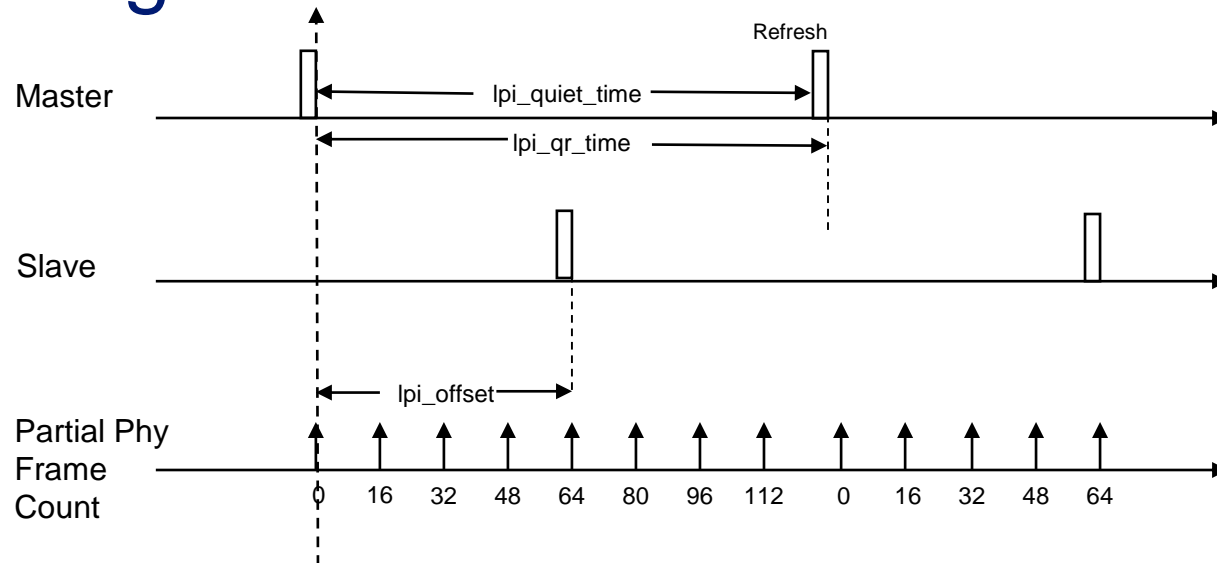
|	PFrame	2.5G	5G	10G
Quiet/Refresh Cycle	128	32.768us	16.384us	8.192us
Refresh	6	1.536uS	768ns	384ns

- lpi_offset = lpi_qr_time / 2

Refresh signaling and asymmetric data transmission rate

- As in 1GBase-T1 EEE operation, PCS sends out zero's during LPI in place of data, it only sends OAM and RS parity in its usual location when the PHY frame holds a refresh.

- For equivalent operation in 10GBase-T1, assuming RS(576,514) adoption, refresh period is 4320 bits, 620 of these are taken by the RS parity, and 10 by the OAM, and the rest are zero's (side stream scrambler is active so there is activity on the line during PCS=0)

- Low bandwidth data stream in EEE is achieved by allowing the last 512/513B before the refresh OAM to flow through. This yields a data rate of 1/1280 of data mode.

Refresh period = 4320 bits

Line		Side stream scrambler only	D	OAM	RS Parity	

| | 1440 | 3177 | 513 | 10 | 620 | |
| PCS | Zero's | Zero's | Zero's | D | OAM | RS Parity | Zero's |

RS frame = 5760 bits

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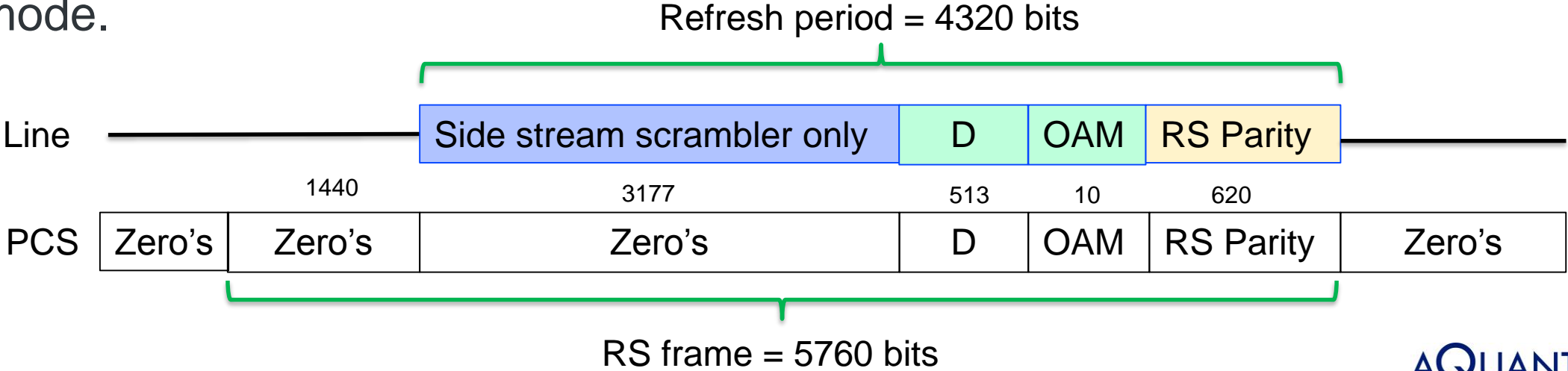
Alert

- Similar to 10GBase-T, in order to reduce complexity, a low frequency Alert signal is introduced. This signal can be detected without the need for use of the full DSP path. Alert can start at the beginning of any full phy frame.

- Alert sequence is a unique PAM2 64-bit sequence repeated 7 times, followed by sixty four zero's for a total of 512 bits. Unique sequence for master/slave.

- The sequence is directly copied from 10GBase-T. Whereas the sequence is bit-repeated 2x in 10GBase-T, we bit-repeat it 16x here.
  - 512 bits x 16 bit-repeat = 8192 symbols
  - This sequence is padded by 448 zero's to fill three phy frames

- Alert is always followed by one full phy frame WAKE
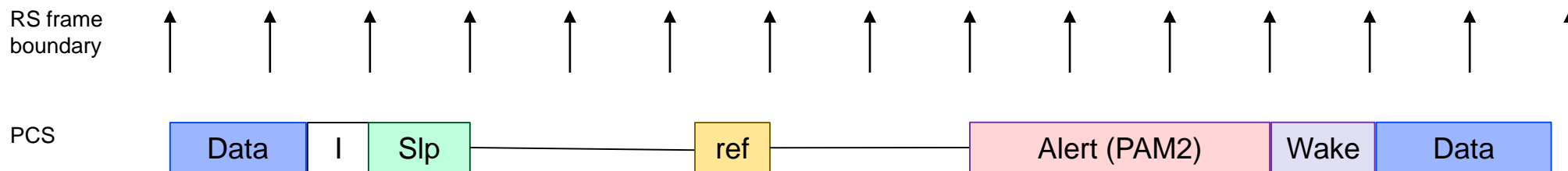
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