Multi-Gig PHY Training and FEC Interleaving Depth

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Motivation

- Task force adopted use of interleaver to handle with variable length burst error due to transient pulse (ISO 7637-3)
  - Move to adopt the interleaver as depicted on slide #9 of “tu_3ch_01a_0918.pdf” as the baseline.
- Currently several proposals are on the table in terms of choosing interleaving depth for each PHY
  - Mike Tu (tu_3ch_04_1018.pdf)
  - William Lo (Lo_3ch_04_1018.pdf)
- Choosing interleaving depth impacts training frame format for all PHYs

Interleaving Depth (L) Under Consideration

- Mike Tu (tu_3ch_04_1018.pdf) suggests that TX of all PHYs (2.5G/5G/10GBASE-T1) should support interleaving depth = 1, 2, 4, or 8
- William Lo (Lo_3ch_04_1018.pdf) suggests two options
  - 120ns of burst error protection
    - 10G → [4, 8]
    - 5G → [2, 4]
    - 2.5G → [1, 2]
  - 60ns of burst error protection
    - 10G → 4
    - 5G → 2
    - 2.5G → 1
- Choosing L for PAM2 training frame format for all PHYs?
  - Mike Tu (tu_3ch_04_1018.pdf) suggests to use training frame with L = 8
  - This is bit over-kill for low speed PHY, which does not need burst error protection of 480ns!

Interleaving Depth and Training Frame for all PHYs

- All PHY start with default Interleaving depth (L) = 1 without interleaving
- PAM2 Training frame format (N=360, K=326, m = 10) with L = 1
  - 1800 PAM2 symbols
  - Use 10 partial frame (PF)
  - Each PF consists of 180 symbols same as 1000BASE-T1
  - First bit of each partial frame is inverted same as 1000BASE-T1
  - infoField is XOR'ed at the start of the 10th partial frame
- Actual L needed for data mode is exchanged through infoField during training
- Minor change to 1000BASE-T1 state diagram

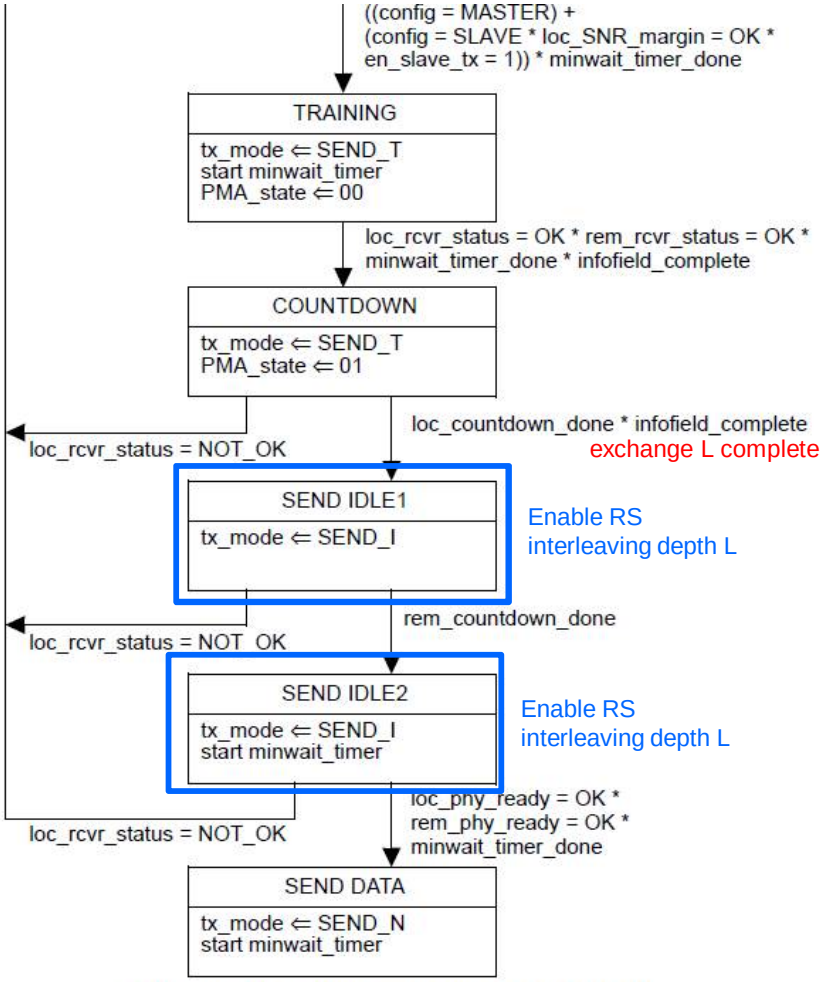

Figure 97–26—PHY Control state diagram

Interleaving Depth

- There are mixed opinions on choosing 60ns or 120ns of burst error protection for 10GBASE-T1?
- Start-up
  - Default L=1 for all PHYs
- Choose <=60ns as “must”
  - safe guard burst error protection
  - Trade-off between latency and power
- Choose 120ns as “optional” for unknowns
- SEND IDLE1, SEND IDLE2, and Data Mode

	Must	Optional
2.5G	[1]	[2]
5G	[1, 2]	[4]
10G	[1, 2, 4]	[8]

Conclusions

- All PHYs should have one single interleaving depth for training frame and that should not add additional burden to lower speed PHYs
- Later the interleaving depth can be adjusted based on exchanged infoField
- Choosing default interleaving depth L = 1 for all PHYs for simplicity for PHY training frame format
- Interleaving for Data mode
  - Choose bare minimum interleaving depths (L) to safe guard burst error protection up to 60ns as must
  - Choose other interleaving levels for some specific use cases to address 120ns burst error protection as an optional

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