Skew Variation for 50G/100G PMDs and PMAs

IEEE P802.3cd Task Force ad hoc

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Introduction

- Draft (D1.1) skew variation values are not yet defined (TBDs).
  - Multiple comments were submitted on the topic (#33, #34, #74, #80)

- 50G / 100G PMDs include both single and multi-lane PMDs that multiplex 2/4 FEC lanes.
  - The multiplexing of 2x26.5GBd lanes to 1x53GBd is done in the module

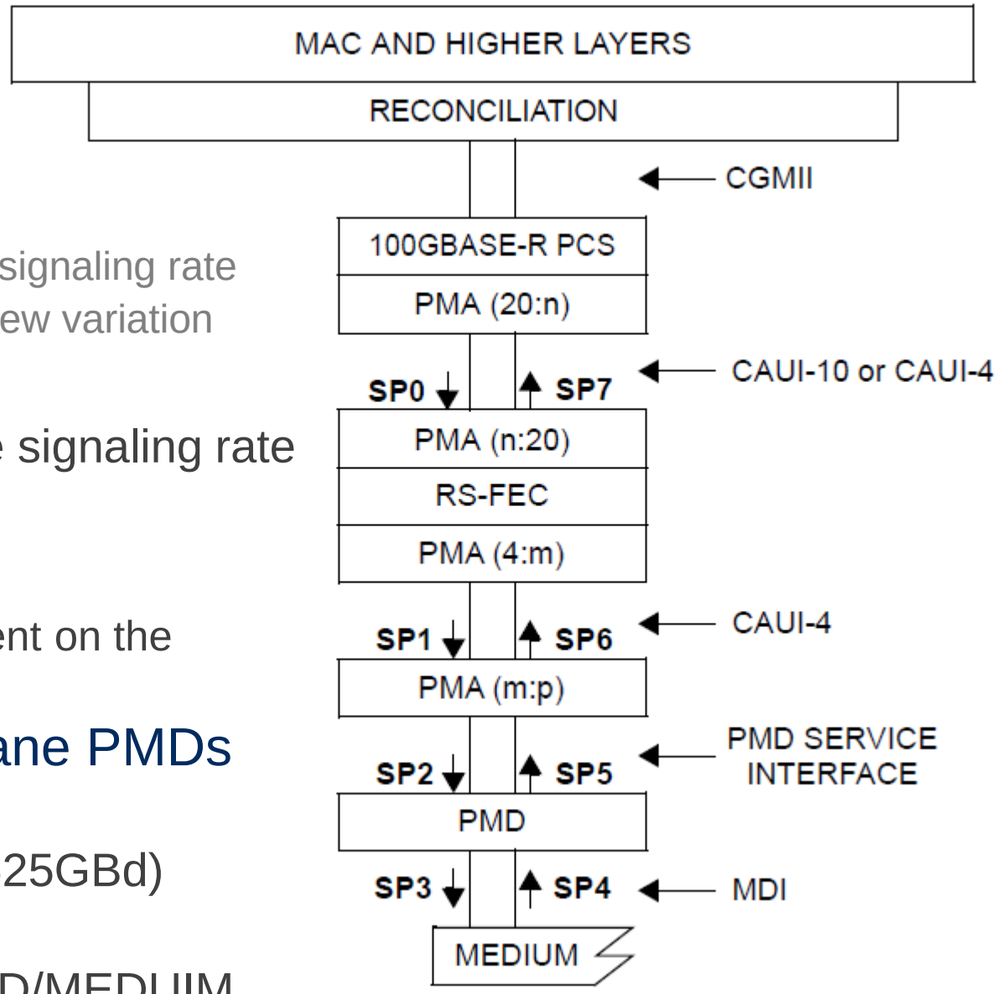
- The Skew variation was analyzed in 802.3ba for 40G/100G. (anslow_01_0508)
  - The 802.3ba analysis was used as the basis for the protocols that followed.
  - SFI-5.2 specifies 1.5UI of relative wander, poll of three vendors: ~ 1UI - 1.5UI
  - 1.5UI was rounded up to 2UI / 200ps for 10G lanes.

- PMAs that mux multiple lanes (n != m) are required to handle the skew variation (dynamic skew).

- The presentation provides a skew variation proposal for 802.3cd
  - Based on the work that was done for 10GBd per lane.
  - Maintaining the defined skew variation for the existing 802.3bm CAUI-4 interfaces and similar 50G LAUI-2 I/F.
  - Separates the analysis between Parallel PMDs and Serial PMDs.

Skew Variation Contributors

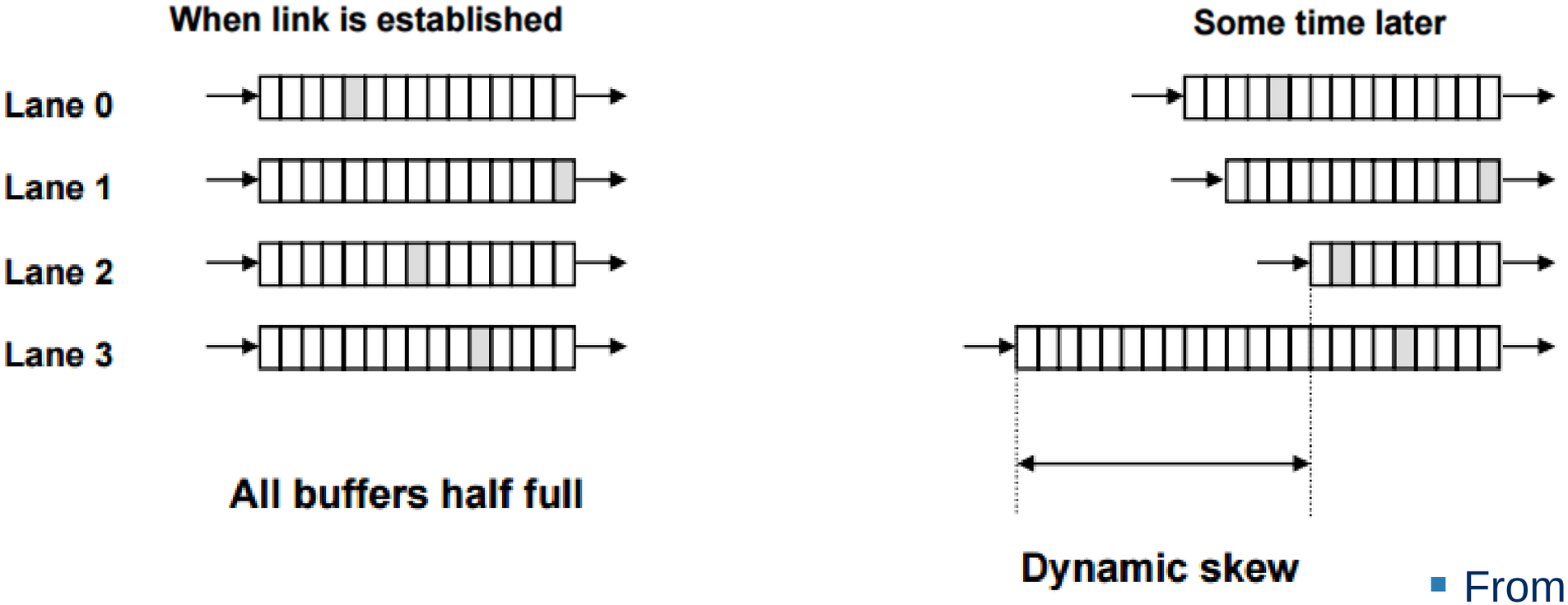
- SP0 / SP1 / SP2 / SP6 / SP7
  - Skew variation contribution originates from PMA + AUI / PPI
    - PMA logic (accounts for ~ 75% of the skew variation at 10GBd)
      - Results from logic / clock schemes – proportional to UI
    - AUI / PPI
      - Results from channel / temperature variations – not dependent on the signaling rate
      - 802.3ba allowed 1ns skew mismatch for PCB traces and ~ 50ps for skew variation
- SP3 / SP5
  - Skew variation contribution from the PMD - not dependent on the signaling rate
- SP4
  - Skew variation contribution from the fiber / copper channel
    - Results from laser temperature / wavelength variations - not dependent on the signaling rate
- Transition from 10.3GBd per lane to 26.5GBd/53GBd per lane PMDs
  - SP0 Contribution – 0.2 ns/ 5 UI (Based on legacy PMA/CAUI-4)
  - SP1/2/6/7 Contribution – 1.5UI + 50ps = 0.11 ns / ~3 UI (@26.5625GBd)
  - SP3/5 Contribution – Similar to 10G = 0.2ns / 5 UI
  - SP4 Contribution – Similar to 10G value in ns / Based on the PMD/MEDUIM



Dynamic Skew and PMA gearbox (m != n)

- For designs with a PMA gearbox (m != n), the gearbox has a wander buffer per input lane
  - Size is 2x the max dynamic skew for that corresponding path (in bits)
    - High speed FIFO in the optical module, which cost power and area.
  - Start reading out of the wander buffers when they are half full

Example 100GAUI-4 4x26.5Gbs ⇔ 53GBd gearbox

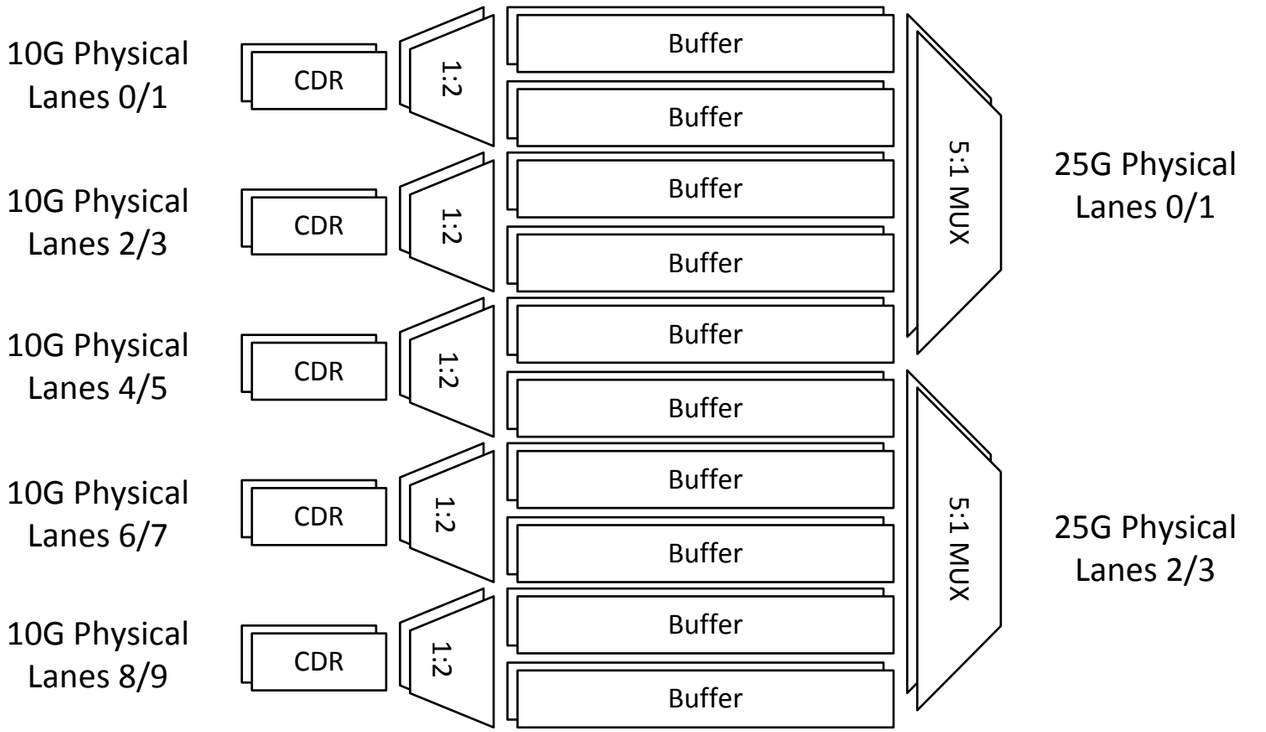


- From: anslow_01_0508

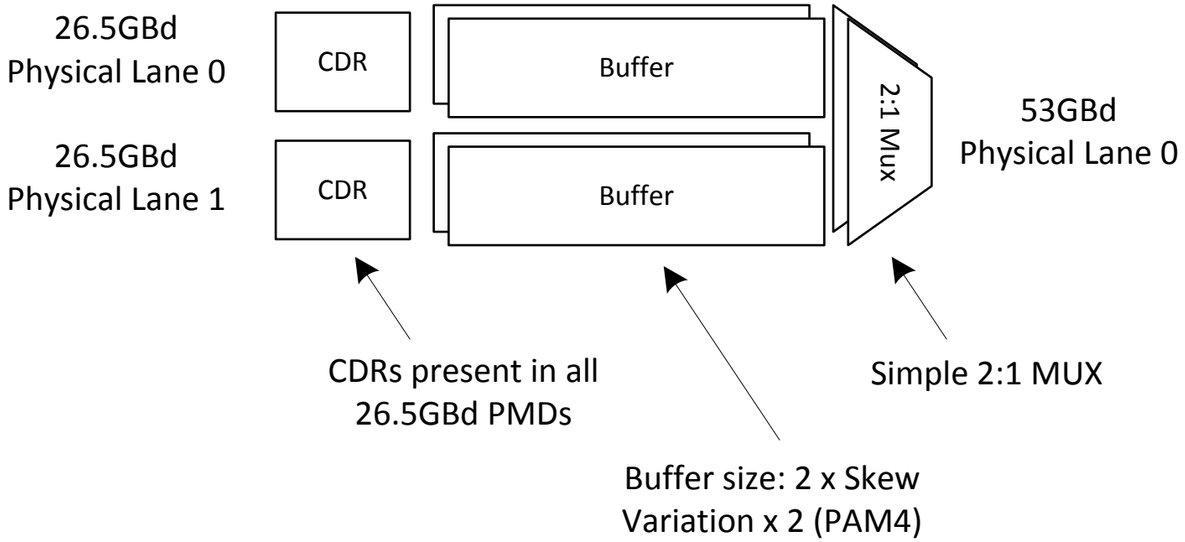
100G 10:4 MLD and 100GBASE-DR 2:1 Muxing

- The skew variation buffer accounts for most of the 2:1 Mux area and power
- 100GBASE-DR modules are expected to fit in small / low power form factors
- The skew variation should be defined based on the interface requirements.
- Unnecessary requirement → unnecessary power consumption, cost.

10:4 100G MLD



100GBASE-DR 2:1 MUX



Skew Variation for 50G/100G Single Lane PMDs

Skew points	Maximum Skew Variation Contribution [ns]	Maximum Skew Variation (ns)	Maximum Skew Variation for 26.5625GBd PMD lane (UI)	Notes
SP0	0.20	0.20	5	Similar to CAUI-4
CL91/134 RS-FEC resets the skew variation				
SP1 (50GAUI-2)	0.11	0.11	3	1.5UI + 50psec
SP2	0.00	0.11	3 (6 @ 53GBd)	Single lane PMD
SP3	0.00	0.11	3 (6 @ 53GBd)	Single lane PMD
SP4	0.00	0.11	3 (6 @ 53GBd)	Single lane PMD
SP5	0.00	0.11	3 (6 @ 53GBd)	Single lane PMD
SP6 (50GAUI-2)	0.11	0.22	6	1.5UI + 50psec
CL91/134 RS-FEC resets the skew variation				
SP7	0.2	0.2	5	Similar to CAUI-4
At FEC transmit		0.31	8	SP0+PMA
At FEC receive		0.33	9	SP6+PMA
At PCS receive		0.4	10	SP7+ CAUI-4 PMA

Skew Variation for 100G PMDs with 26.5625GBd PMD lanes

Skew points	Maximum Skew Variation Contribution [ns]	Maximum Skew Variation (ns)	Maximum Skew Variation for 26.5625GBd PMD lane (UI)	Notes
SP0	0.20	0.20	5	CAUI-4
CL91/134 RS-FEC resets the skew variation				
SP1 (100GAUI-4)	0.11	0.11	3	1.5UI + 50psec
SP2	0.11	0.22	6	Single lane PMD
SP3	0.20	0.42	11	200psec
SP4	2.80	3.22	86	2.8 nsec - TBD
SP5	0.20	3.42	91	Single lane PMD
SP6 (100GAUI-4)	0.11	3.55	94	1.5UI + 50psec
CL91/134 RS-FEC resets the skew variation				
SP7	0.20	0.20	5	CAUI-4
At FEC transmit		0.32	8	SP0+PMA
At FEC receive		3.66	97	SP6+PMA
At PCS receive		0.40	10	SP7+ CAUI-4 PMA

Thank You