Addressing Delay, Skew, and Skew Variation
Comments: 77-96, 121

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Introduction

- In P802.3cd Draft 1.0 the delay, skew, and skew variations for the various sublayers have been left as TBD.
- This presentation proposes values to use for these TBD values.
- Generally, values from the corresponding sublayers in related Clauses are suggested.
- For the single-lane PMDs, it is proposed that the skew values in corresponding Clauses be adjusted to account for no skew being added by single-lane PMD and medium.
- For backplane, it is proposed to separate delay target for for medium from that for PMD and AN.

Delay Constraints

Adee

Delay Constraints Introduction

- The general proposal is to use the delays for corresponding sublayers for 40GBASE-R, 100GBASE-R, and 200GBASE-R.
- For the PCS and FEC, the delay values need to be scaled due the dependence on bit rate.
- For the backplane PMDs, it is proposed that the medium delay be specified separately from the PMD.

PCS delay

- 50GBASE-R PCS is based on 40GBASE-R scale-up (12.890625 GB/s per lane instead of 10.3125 Gb/s)
- The delay constraint for the 40GBASE-R PCS is 281.6 ns = 11264 BT
  - This is equal to 44 times the 4x64 bit “unit delay” of the PCS
- Scaling up the bit rate would result in:
  - The same digital delay (11264 BT, 22 pause_quanta)
  - The absolute time constraint is 225.28 ns

RS-FEC delay

Clause 134 RS-FEC is based on Clause 91 with...

- The same codeword size
- Half the data rate

Allocated delay in clause 91 is 409.6 ns or 40960 bit times - about 7.5 codewords' worth in RS(514, 544) mode

- Encoding delay is negligible
- The minimum decoding delay is ~55 ns for storing a codeword; another ~55 for error marking; this leaves ~5.5 codewords' worth (~300 ns) for processing

For Clause 134, codeword delay is twice that of Clause 91, but the processing time can be similar to clause 91 (decoding is the same)

Proposed value for clause 134 is based on same processing time and twice the codeword time, so 300 + 220 = 520 ns; rounded to an integer (50) pause_quanta yields 512 ns

Backplane Delay

Currently PMD/AN and medium delay combined in one number.

- Unlike optical or copper cable in which medium is separate
- Current value is same as the copper cable (PMD+AN only), 81.92 ns (based on clause 94)
- Backplane PMDs and copper cable PMDs likely to use the same components, so same delay is expected

Proposal (in response to comment #137) is to align delays and skews of backplane and copper cable PMDs, by specifying only PMD/AN delay constraints on both cases

- "The sum of the transmit and receive delays at one end of the link contributed by the PMD~~,~~ and the AN~~, and the medium in one direction~~ shall be…"
- "It is assumed that the one-way delay through the medium is no more than ~~8~~20 ns."

Proposed delay constraints per clause (excluding medium)

Sublayer	P802.3cd location	Current Delay	Proposal				Source
		ns	ns	PQ[1] (50, 100, 200)			
132 MAC, +RS	132.1.4	327.68[2]	no change	no change			
133 PCS	133.3	TBD	225.28	22			See Slide 6
134 FEC	134.4	TBD	512	50			See Slide 7
135 PMA	135.5.4	TBD	92.16	9	18		120.5.4
136 CR	136.5	81.92	81.92	8	16	32	94.3.3
137 KR	137.5	81.92	81.92	8	16	32	94.3.3
138 SR	138.3.1	81.92	20.48	8	16	32	124.3.1
139 LR/FR	139.3.1	20.48	20.48	2			122.3.1
140 DR	140.3.1	20.48	20.48		4		121.3.1

1. Proposed delay constraint in bit times is 512 times the value in PQ.
2. Not TBD. Here for information only.

Delay Constraints Conclusions

- For backplane PMDs
  - separate the PMD/AN delay from the medium delay.
  - For the medium use 20 ns per slide 6.
- For the PHY sublayers being defined in this project use the delay constraints provided in the table in slide 9.

Skew and Skew Variation

Matt

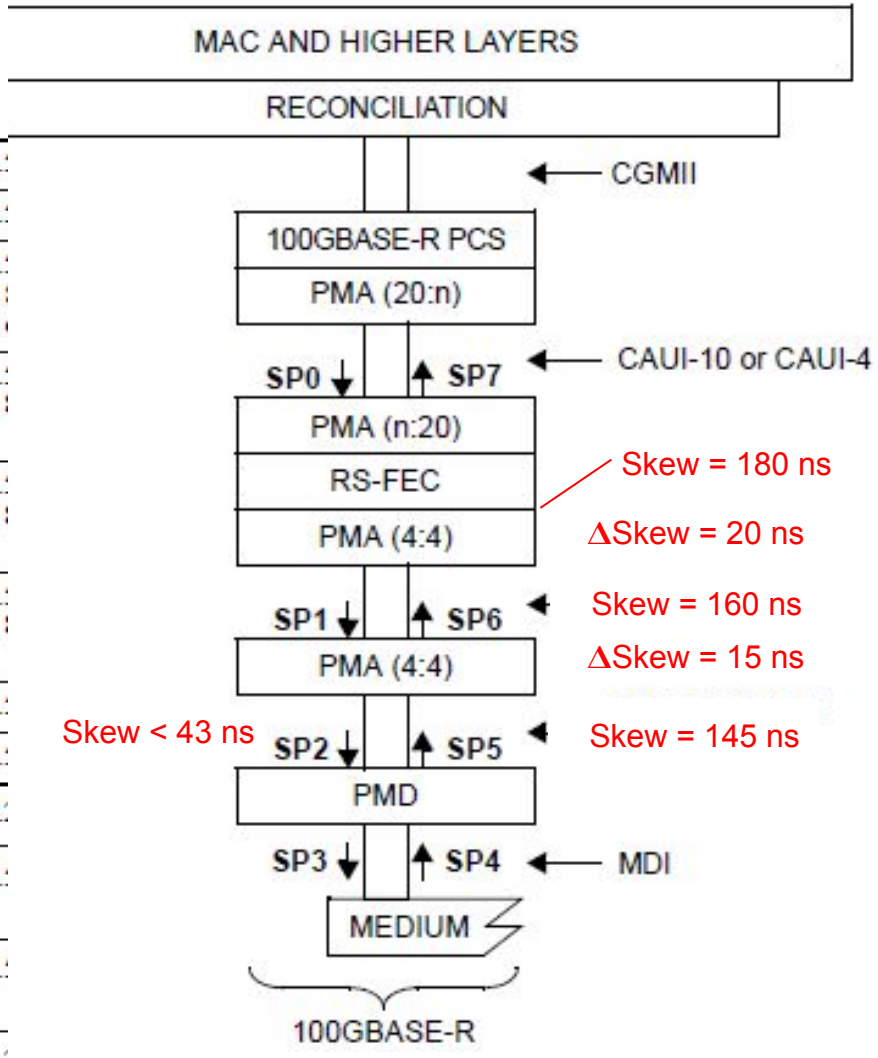
Skew and Skew Variation Constraints Introduction

- It is proposed that we use values of Skew and Skew Variation already established for 40GBASE-R, 100GBASE-R, and 200GBASE-R with the following exception.
- For 50GBASE-R and 100GBASE-DR PMD the numbers are adjusted with the following considerations:
  - skew variation is zero at the PMD transmit input, transmit output, receive input, and receive output
  - there is no skew addition due to the PMD and the medium

40G/100GBASE-R Skew constraints per Clause 80

Table 80–6—Summary of Skew constraints

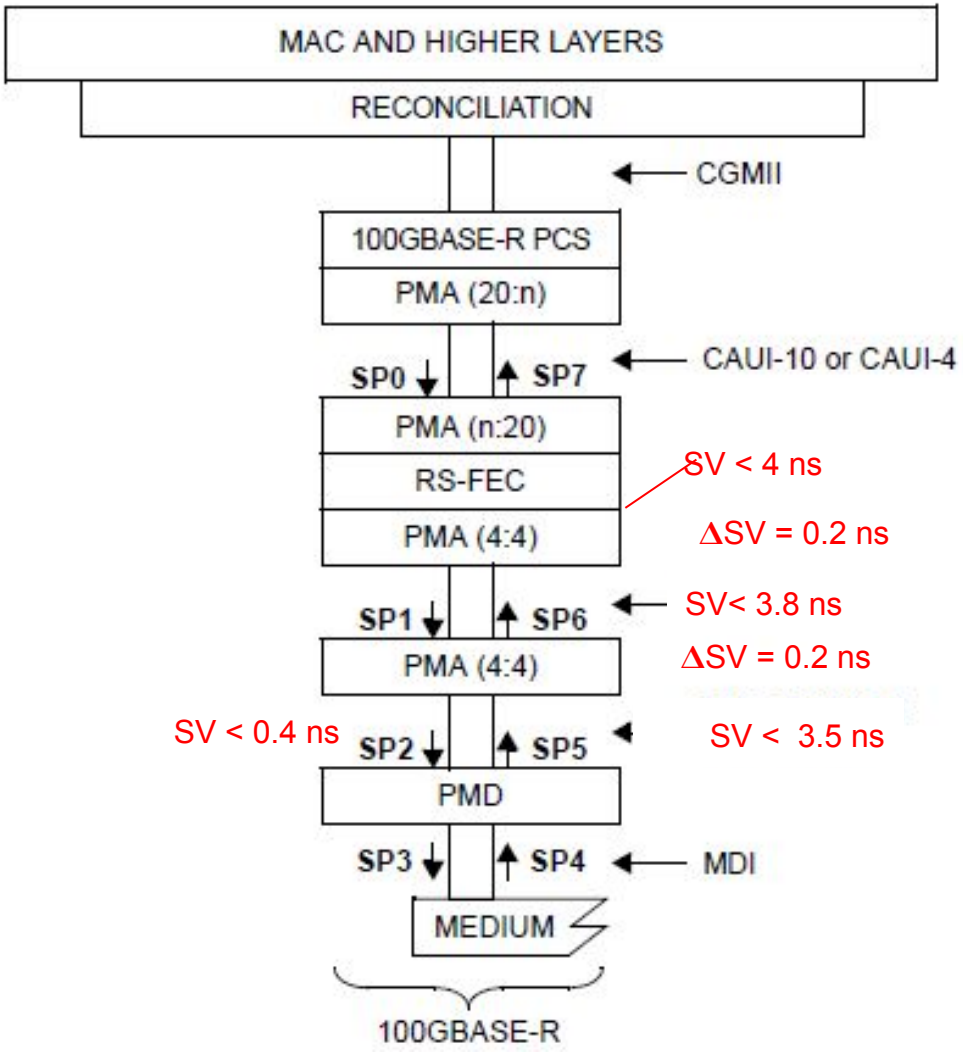
Skew points	Maximum Skew (ns)[a]	Maximum Skew for 40GBASE-R PCS lane (UI)[b]	Maximum Skew for 100GBASE-R PCS lane (UI)[c]	
SP0	29	N/A	≈ 150	See 83.
SP1	29	≈ 299	≈ 150	See 83.
SP2	43	≈ 443	≈ 222	See 83. 87.3.2, 94.3.4,
SP3	54	≈ 557	≈ 278	See 84. 88.3.2, 95.3.2
SP4	134	≈ 1382	≈ 691	See 84. 88.3.2, 95.3.2
SP5	145	≈ 1495	≈ 748	See 84. 88.3.2, 95.3.2
SP6	160	≈ 1649	≈ 824	See 83.
SP7	29	N/A	≈ 150	See 83.
At PCS receive	180	≈ 1856	≈ 928	See 82.
At RS-FEC transmit	49	N/A	≈ 253	See 91.
At RS-FEC receive[e]	180	N/A	≈ 4641	See 91.
At PCS receive (with RS-FEC)	49	N/A	≈ 253	See 82.



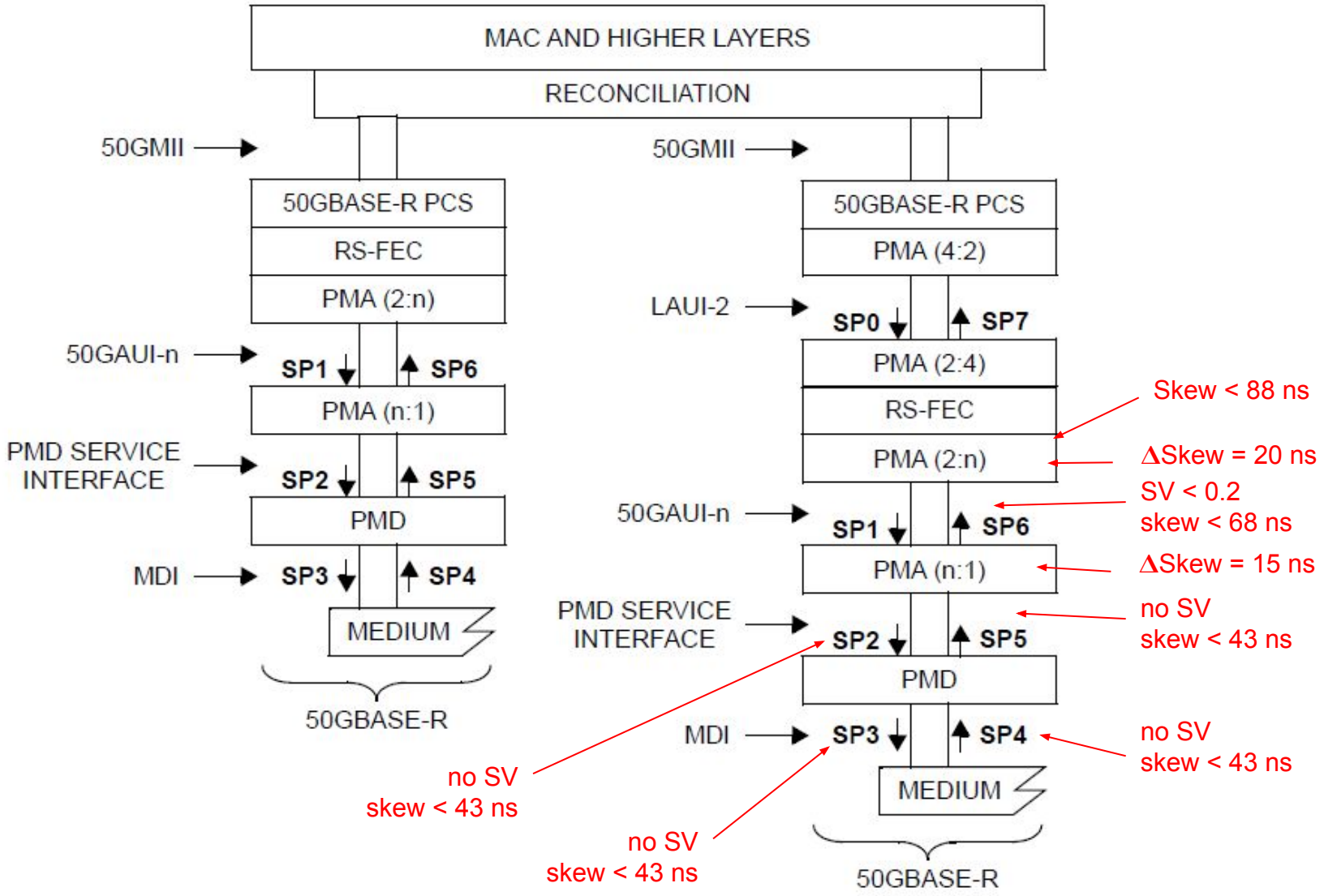
40G/100GBASE-R Skew Variation (SV) constraints per Clause 80

Table 80–7—Summary of Skew Variation cc

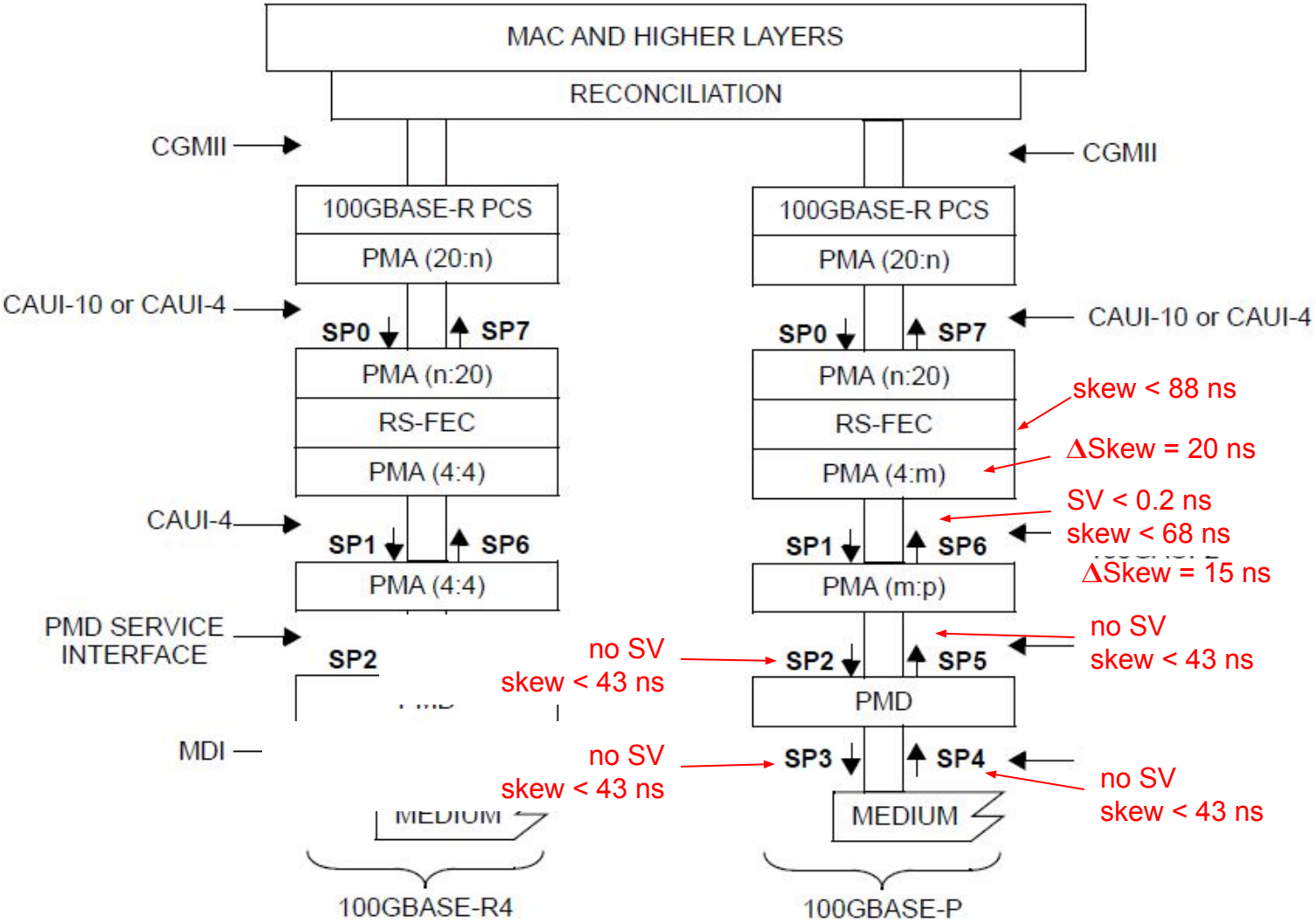
Skew points	Maximum Skew Variation (ns)	Maximum Skew Variation for 10.3125 GBd PMD lane (UI)[a]	Maximum Skew Variation for 25.78125 GBd PMD lane (UI)[b]
SP0	0.2	≈ 2	N/A
SP1	0.2	≈ 2	N/A
SP2	0.4	≈ 4	≈ 10
SP3	0.6	≈ 6	≈ 15
SP4	3.4	≈ 35	≈ 88
SP5	3.6	≈ 37	≈ 93
SP6	3.8	≈ 39	≈ 98
SP7	0.2	≈ 2	N/A
At PCS receive	4	≈ 41	N/A
At RS-FEC transmit	0.4	N/A	≈ 10
At RS-FEC receive[d]	4	N/A	≈ 103
At PCS receive (with RS-FEC)	0.4	N/A	≈ 10



50GBASE-CR/KR/SR/FR/LR PMD skew and skew variation



100GBASE-DR Skew and Skew Variation (SV)



Skew Budget for 50GBASE-*R and 100GBASE-DR

Skew Points	40GBASE-R 100GBASE-R (ns)	50GBASE-*R 100GBASE-DR (ns)
SP0	29	29
SP1	29	29
SP2	43	43
SP3	54	43
SP4	134	43
SP5	145	43
SP6	160 (145+15)	68 (43+15)
SP7	29	29
at PCS Rx w/o RS-FEC	180	N/A
at RS-FEC Tx	49	49
at RS-FEC Rx	180 (160+20)	88 (68+20)
at PCS Rx with RS-FEC	49	49

Skew Variation Budget for 50GBASE-*R and 100GBASE-DR

Skew Points	40GBASE-R 100GBASE-R	50GBASE-*R 100GBASE-DR
SP0	0.2	0.2
SP1	0.2	0.2
SP2	0.4	0
SP3	0.6	0
SP4	3.4	0
SP5	3.6 (3.4+0.2)	0
SP6	3.8 (3.6+0.2)	0.2
SP7	0.2	0.2
at PCS Rx w/o RS-FEC	4	N/A
at RS-FEC Tx	0.4	0.4
at RS-FEC Rx	4	0.4 (0.2+0.2)
at PCS Rx with RS-FEC	0.4	0.4

Skew and Skew Variation Constraints Conclusions

- For 50GBASE-R, update the skew budget and skew variation budget in Clause 131 and the constraints in each of the relevant sublayer clauses according to the proposed values in Slide 17 and Slide 18, respectively.
- For 100GBASE-DR PMD update the skew to be 43 ns at SP2, SP3, SP4, and SP5
- For 200GBASE-*R, PMDs and all other 100GBASE-*R PMDs update the skew and skew variation constraints consistent with budgets in Clause 116 and Clause 80, respectively.

Thanks!