Proposal for the revision on Skew budget for PMD portion (40GBASE-LR4, 100GBASE-LR4/ER4)

IEEE P802.3ba Interim Session
New Orleans, January 12-16, 2009

Hideki Isono	**Fujitsu**
Hirotaka Oomori	**Sumitomo Electric**
Kiyo Hiramoto	**Opnext**
Chris Cole	**Finisar**
Mike Dudek	**JDSU**

The background of the proposal

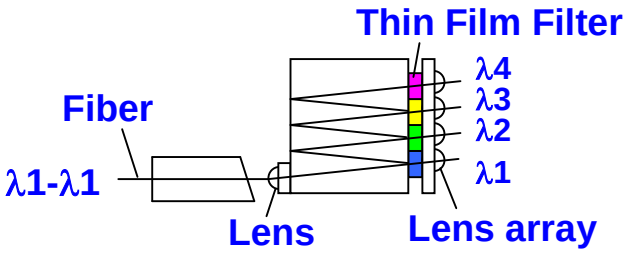
- In draft 1.1, the skew budget for PMD portion is calculated as follows. (See Table 80-3, attached in the last page of Annex)
  - 1ns for Sending portion (SP3-SP2= 44-43= 1ns)
  - 2ns for Receiving portion (SP5-SP4= 146-144= 2ns)
- However, this budget is extremely tight if we consider more flexible optical Mux/Demux device selection including TFF (Thin Film Filter) based approaches shown in the next page.
- **The assignment of additional 10 ns to each sending and receiving portion respectively, allows more flexible device selection at this point.**
- **The other point is that the skew definition point does not match the current hardware interface of the PMD.**

- **The new proposal for 1) the skew budget & 2) skew point is shown on Page 5 & page 6, respectively.**

TFF based Optical MUX/DEMUX options

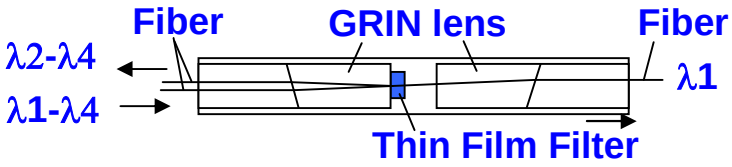
1) Zig-Zag type O-MUX/DEMUX has advantage for small size, but has disadvantage for tight assembly angle tolerance (+/-0.35deg*1) due to large incident angle
2) 2x1port type O-MUX/DEMUX has been popularly used in DWDM, and has advantage for assembly angle tolerance (+/-1.0deg) due to small incident angle
3) Hybrid of 2port O-DEMUX(MUX) and ROSA(TOSA) is one of available and low cost solutions

1) Zig-Zag type O-DEMUX (O-MUX)

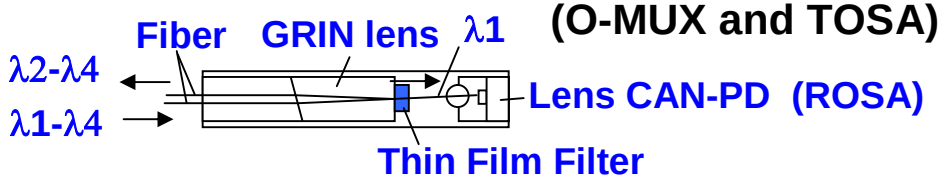


- Large incident angle

2) 2x1port type O-DEMUX (O-MUX)



3) Hybrid of 2port O-DEMUX and ROSA (O-MUX and TOSA)



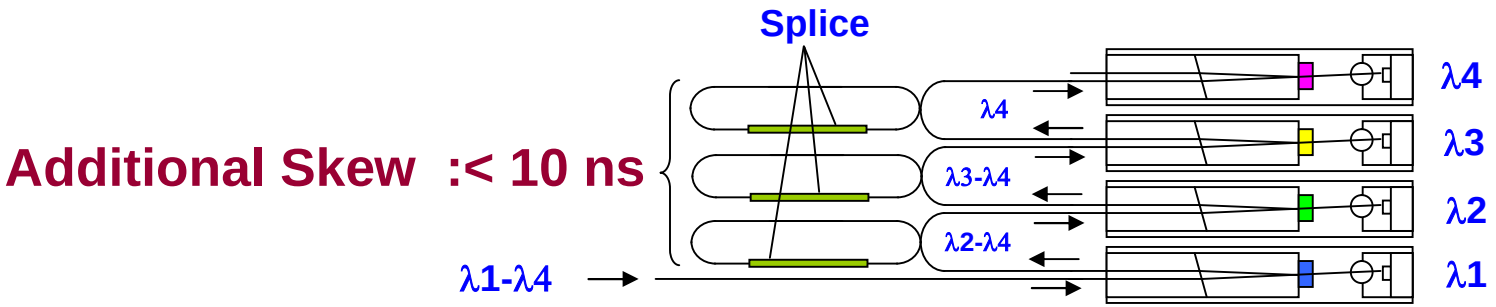
- small incident angle

*1: traverso_03_0308

Skew budget proposal for PMD portion

- In case of Hybrid type Tx and Rx (2port O-MUX+TOSA and O-DEMUX+ROSA), the relaxation of skew due to cascaded fiber connection is necessary.
- **The additional skew of 10ns for each Tx and Rx is proposed.**

Cascaded Hybrid type Rx (2port O-DEMUX+ROSA)

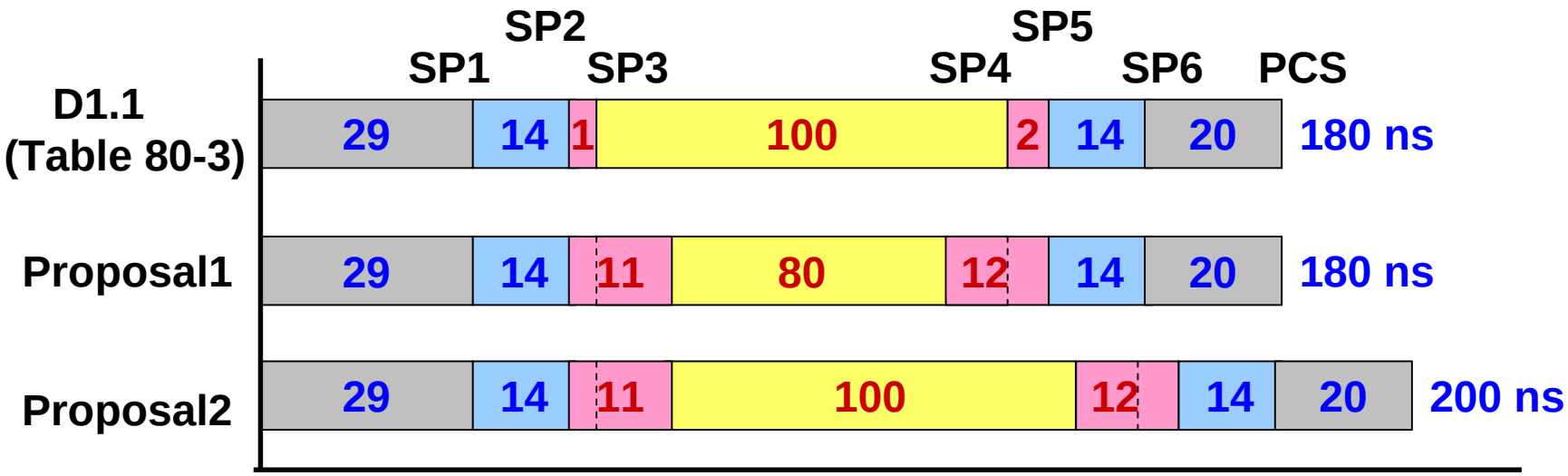


Proposal

Reconsider for skew budget for PMD portion

Budget for PMD	Draft 1.1	Proposal
SP3-SP2(Sending)	1ns (44ns-43ns)	11ns
SP5-SP4(Receiving)	2ns(146ns-144ns)	12ns

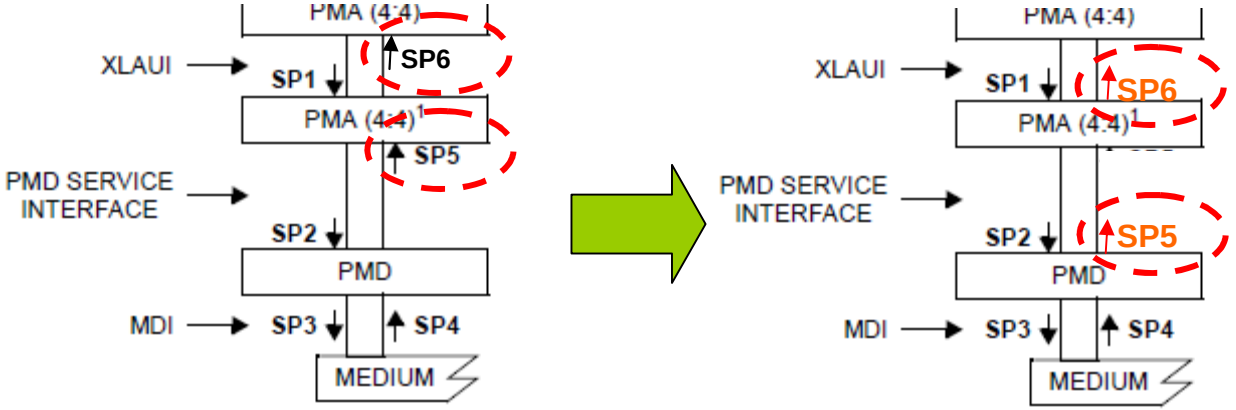
There are two options for the skew diagram design, which is specifically shown in below.



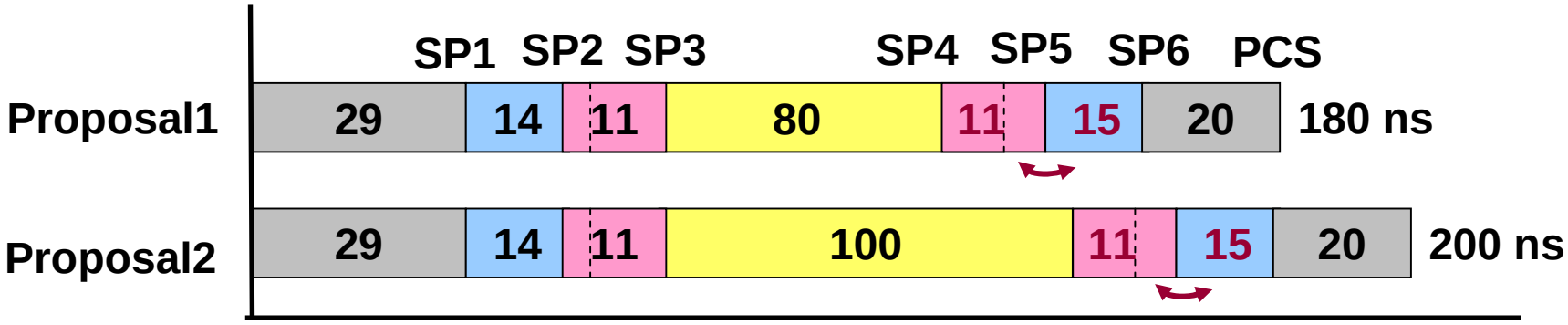
Skew points reconsidered

Skew definition points (SP5 & SP6) reconsidered.

SP5 & SP6 definition points should be changed to the output portion of PMD & PMA respectively, considering the hardware interface among PMD, PMA and the upper layer.



Reflected budget is as follows.



Draft change proposal *(Proposal1)*

< Skew Point revision (Page6) is assumed >

Table 80–3—Skew constraints (informative)

Skew Points	Maximum Total Skew (ns)[a]	Maximum Total Skew for 40GBASE-R PCS lane (UI)[b]	Maximum Total Skew for 100GBASE-R PCS lane (UI)[c]	Notes
SP1	29	~ 299	~ 150	See 83.5.3.1.
SP2	43	~ 443	~ 222	See 83.5.3.3.
SP3	~~41~~ 54	~~~ 454~~ ~557	~~~ 227~~ ~278	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP4	~~141~~ 134	~~~ 1484~~ ~1382	~~~ 742~~ ~691	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP5	~~146~~ 145	~~~ 1505~~ ~1495	~~~ 753~~ ~748	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP6	160	~ 1649	~ 824	See 83.5.3.3
At PCS receive	180	~ 1856	~ 928	See 82.2.12.

[a]The skew limit includes 1 ns allowance for PCB traces that are associated with the skew points.
[b]Note that for 40GBASE-R, 1 UI is equal to 96.969697 ps at PCS lane signaling rate of 10.3125 GBd.
[c]Note that for 100GBASE-R, 1 UI is equal to 193.9394 ps at PCS lane signaling rate of 5.15625 GBd.

This proposal leaves 80 ns for the transmission, which is still much larger than required by the existing PMDs

Draft change proposal *(Proposal2)*

< Skew Point revision (Page6) is assumed >

Table 80–3—Skew constraints (informative)

Skew Points	Maximum Total Skew (ns)[a]	Maximum Total Skew for 40GBASE-R PCS lane (UI)[b]	Maximum Total Skew for 100GBASE-R PCS lane (UI)[c]	Notes
SP1	29	~ 299	~ 150	See 83.5.3.1.
SP2	43	~ 443	~ 222	See 83.5.3.3.
SP3	~~41~~ 54	~~~ 454~~ ~557	~~~ 227~~ ~278	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP4	~~141~~ 154	~~~ 1484~~ ~1588	~~~ 742~~ ~794	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP5	~~146~~ 165	~~~ 1505~~ ~1702	~~~ 753~~ ~851	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP6	180~~160~~	~~~ 1649~~ ~1856	~~~ 824~~ ~928	See 83.5.3.3
At PCS receive	200~~180~~	~~~ 1856~~ ~2063	~~~ 928~~ ~1031	See 82.2.12.

[a]The skew limit includes 1 ns allowance for PCB traces that are associated with the skew points.
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[c]Note that for 100GBASE-R, 1 UI is equal to 193.9394 ps at PCS lane signaling rate of 5.15625 GBd.

This keeps 100ns for the transmission, and total skew will be increased to 200ns.

Related change

Below related sections be revised according to the skew budget revision.

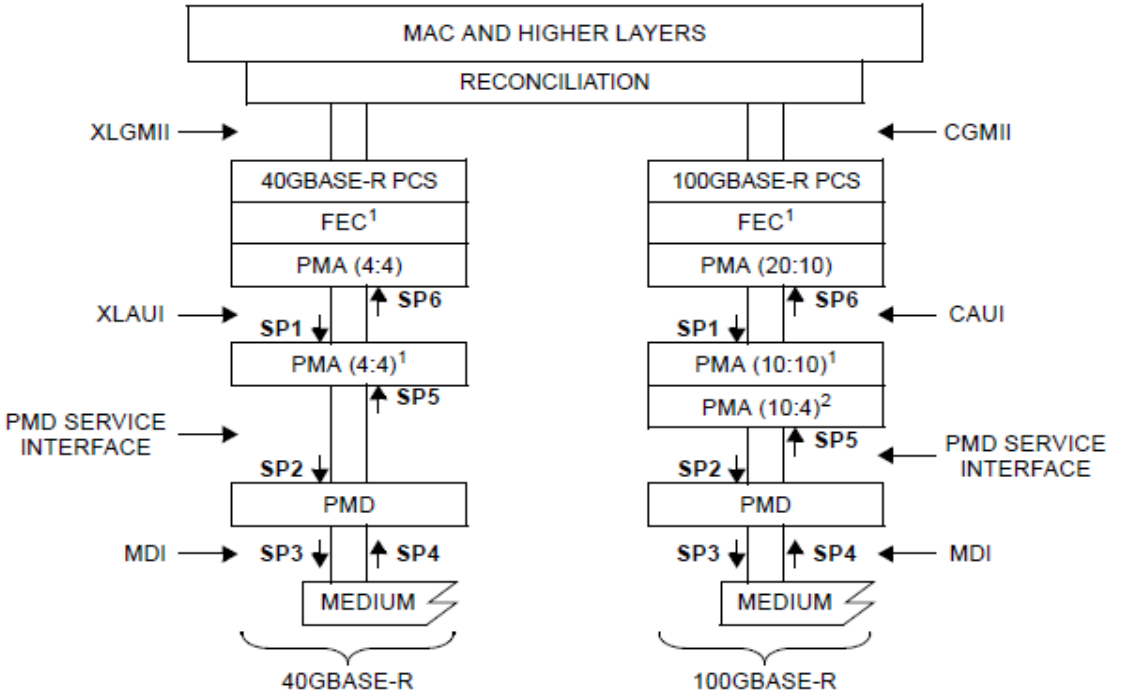
84.5 Skew constraints: The 3rd & 4th paragraph
85.5 Skew constraints: The 3rd & 4th paragraph
86.2.2 Skew &Dynamic Skew constraints: The 3rd & 4th paragraph
87.3.2 Skew constraints: The 3rd & 4th paragraph
88.3.2 Skew constraints: The 3rd & 4th paragraph

Annex

Reference (Draft 1.1)

80.4 Skew constraints

Skew (or relative delay) can be introduced between lanes by both active and passive elements of a 40GBASE-R or 100GBASE-R link. The PCS deskew function (See 82.2.12) compensates for all lane-to-lane skew observed at the receiver. The Skew between the lanes must be kept within limits so that the information on the lanes can be reassembled by the PCS. Dynamic Skew may be introduced due to variations in electrical, thermal or environmental characteristics. The Dynamic Skew must be limited to ensure that a given PCS lane always traverses the same physical lane.



CAUI = 100 Gb/s ATTACHMENT UNIT INTERFACE
CGMII = 100 Gb/s MEDIA INDEPENDENT INTERFACE
FEC = FORWARD ERROR CORRECTION
MAC = MEDIA ACCESS CONTROL
MDI = MEDIUM DEPENDENT INTERFACE
PCS = PHYSICAL CODING SUBLAYER
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT
XLAUI = 40 Gb/s ATTACHMENT UNIT INTERFACE
XLGMII = 40 Gb/s MEDIA INDEPENDENT INTERFACE

NOTE1—OPTIONAL
NOTE2—CONDITIONAL BASED ON PMD TYPE

Figure 80–2—40GBASE-R and 100GBASE-R skew points 1

Table 80–3—Skew constraints (informative)

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SP1	29	~ 299	~ 150	See 83.5.3.1.
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SP3	44	~ 454	~ 227	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP4	144	~ 1484	~ 742	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP5	146	~ 1505	~ 753	See 84.5 or 85.5 or 86.2.2 or 87.3.2 or 88.3.2
SP6	160	~ 1649	~ 824	See 83.5.3.3
At PCS receive	180	~ 1856	~ 928	See 82.2.12.

[a]The skew limit includes 1 ns allowance for PCB traces that are associated with the skew points.
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