Baseline Proposals of 100G Bidi PMDs for 10/20km

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Introduction

- In January and Feburary meeting, there have been extensive discussion on the technology choice for 100G and 200G Bidi Optical PMDs. A consensus seems have been built for 100G Bidi Optical PMDs for 10km and 20km:

100G/lambda optical signaling rate is the feasible choice

- Further a straw poll has been made with possible wavelength choice for the two objectives,

Straw poll #1: I support specification of 100 Gb/s per wavelength for 10 km and 20 km objectives (1304.6 and 1309.1 nm). (17 attendees)
Y: 13 N: 0 Need more info: 0

- However, after talking to some module vendor and browsing through the spec sheet, it has come to the attention of the authors that a reconsideration on the wavelength assignment is necessary.
- This contribution intend to discuss our view on selecting wavelengths and propose a set of baseline based on the observation

Think of Implementation

- Although IEEE defines only interface specs, not implementation, it is always important that we make sure the specs are feasible, mass producible and sufficiently low cost, so that we standardize the most cost effective solution.
- 5G/6G front haul application will take up a big part, if not the biggest part, of the overall shipment of 100G Bidi optical modules. These modules will be in SFP form factor. This size constraint mainly applies to the 10km and 20km objective. This brings two questions:
  - > **Do we really want multiple wavelengths in Tx: T**he answers is better not when the Tx (EML/MZM) can still keep up with the signaling rate growth
  - > **Can we afford narrowing the wavelength grid:** Maybe, but at the expense of bigger Bidi block and likely higher cost

Size comparison between SFP and QSFP

Think of Supply Chain

- Thanks to the tremendous volume of DCN market, the four CWDM wavelengths will always provide the most cost effective choice, as long as the link budget can be closed.
- It has been a good practice in the industry to share the supply chain with previous generations, i.e. backward compatibility by simply tuning down the signaling rate
  - Shared Tx wavelength
  - Shared Rx Sensitivity Range (PIN vs APD/PIN+SOA)
  - Shared WDM component
- Looking at 802.3cu/cp and 100G-LAMBDA MSA, we noticed that for 10km case, all used CWDM wavelengths

Table 160–6—50GBASE-BRx transmit characteristics

Description	50GBASE-BR10	50GBASE-BR20	50GBASE-BR40	Unit
Signaling rate (range)	26.5625 ± 100 ppm			GBd
Modulation format	PAM4			—
50GBASE-BRx-D center wavelengths (range)	1320 to 1340	1306 to 1322		nm
50GBASE-BRx-U center wavelengths (range)	1260 to 1280	1281 to 1297		nm

Table 151–5—400GBASE-FR4 and 400GBASE-LR4-6 wavelength-division-multiplexed lane assignments

Lane	Center wavelength	Wavelength range
L_0	1271 nm	1264.5 to 1277.5 nm
L_1	1291 nm	1284.5 to 1297.5 nm
L_2	1311 nm	1304.5 to 1317.5 nm
L_3	1331 nm	1324.5 to 1337.5 nm

2 400G-LR4-10 OPTICAL SPECIFICATIONS

2.1 WAVELENGTH-DIVISION-MULTIPLEXED LANE ASSIGNMENTS

The wavelength range for each lane of the 400G-LR4-10 PMD is defined in Table 2-1. The center wavelengths are spaced at 20 nm.

Table 2-1: Wavelength-division-multiplexed lane assignments

Lane	Center wavelength	Wavelength range
L_0	1271 nm	1264.5 to 1277.5 nm
L_1	1291 nm	1284.5 to 1297.5 nm
L_2	1311 nm	1304.5 to 1317.5 nm
L_3	1331 nm	1324.5 to 1337.5 nm

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Baseline Proposal for 100G-BR10,100G-BR20 Transmitter Spec

Signaling rate (range)	53.125± 50 ppm		GBd
Modulation format	PAM4		
100GBASE-BRx-D	1324.5~1337.5*	1304.5 to 1317.5/1304.5	nm
100GBASE-BRx-U	1264.5~1277.5*	1284.5 to 1297.5/1309.1	nm
SMSR(min)	30		
Average Launcher Power(max)	5.1	5.8	dBm
Average Launcher Power(min)	-2.7	-1.1	dBm
Outer Optical Modulation Amplitude (OMAouter) (max)	4.4	5	dBm
Outer Optical Modulation Amplitude (OMAouter)(min): for TDECQ < 1.4 dB	0.3	1.9	
for 1.4 dB ≤TDECQ ≤ 3.9 dB	-1.1+TDECQ	0.5+TDECQ	dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max))	3.9+	3.9	dB
|TDECQ-TECQ|(max)	2.5	2.5	dB
Over/under-shoot (max)	22	22	%
Transmitter power excursion (max)	2.5	TBD	dBm
Average launch power of OFF transmitter (max)	-16	-20	dBm
Extinction ratio (min)	3.5	3.5	dB
Transmitter transition time (max)	17		ps
RIN15.6 OMA	-136		dB/Hz
Optical return loss tolerance(Max)	15.6		dB
Transmitter reflectance (max)	-26		dB

*: Dispersion Penalty at these two side wavelengths needs further discussion

+: Reference to 100G LAMBDA MSA

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Baseline Proposal for 100G-BR10,100G-BR20 Receiver Spec

Signaling rate (range)	53.125± 50 ppm		GBd
Modulation format	PAM4		
100GBASE-BRx-D	1264.5~1277.5	1284.5 to 1297.5/1309.1	nm
100GBASE-BRx-U	1324.5~1337.5	1304.5 to 1317.5/1304.5	nm
Damage threshold,	6.1	6.1	dBm
Average receive power,(max)	5.1	5.8	dBm
Average receive power,(min)	-9	-15.8	dBm
Receive power (OMAouter),(max)	4.4	5	dBm
Receiver reflectance (max)	-26		dB
Receiver sensitivity (OMAouter), each lane (max) for TECQ < 1.4 dB for 1.4 dB≤TECQ≤3.9 dB	-6.5	-13.6	dBm
	-7.9+TECQ	-15+TECQ	dBm
Stressed receiver sensitivity (OMAouter), (max)	-4.1	TBD	dBm
Conditions of stressed receiver sensitivity test			
Stressed eye closure for PAM4 (SECQ)	3.9	3.9	dB

Targeted Link Budget

	100G-BRx	
	10km	20km
power budget	10.7	19.4
channel IL	6.3	15
maxim discrete reflectance	-33@4connector	-35
allocation for penalties(for Max TDECQ)	4.4	4.4

Taken from 802.3cp, What was the history of this loss? Do we want to maintain this value in 802.3dk?

Summary and next Step

- This contribution has brought the wavelength choice back to consideration.
  - > When taking implementation and supply chain into account, it seems both 10km and 20km 100G Bidi objectives could make good use of the current 100G/lane CWMD4 supply chain.
  - > 10km 100G Bidi could use any two of the four CWDM wavelengths
  - > 20km 100G Bidi will need to narrow down to low dispersion wavelengths
- Based on the above analysis, this contribution proposes a set of baselines for this task force' s consideration.

- Seek input from module and component vendors about the baselines
- Work on Experimental result on 100G/lambda dispersion penalty
- Work on evaluation of 40km technology

Thank you.

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