ITU-T G.9806AM3 UPDATE

IEEE 802.3 WORKING GROUP PLENARY

STUDY GROUP: GREATER THAN 50 GB/S BIDIRECTIONAL OPTICAL ACCESS PHYS

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Background

- ITU-T Q2/SG15 completed a series of higher speed BiDi PtP Recommendations
  - 10 Gb/s (G.9806), 25 Gb/s (G.9806Am1), 50Gb/s (G.9806Am2)
  - Continuous optical budget without gaps, to allow increased flexibility in the deployment of optics for the intended distances
  - 20/40km distance
  - PMD layer aligned with IEEE 802.3cp specifications
  - TC layer, service requirements, OAM
- ITU-T Q2/SG15 G.9806Am3 project started in 2021
  - BiDi PtP at 100 Gb/s
  - The same reaches and link budget classes as Am2 apply
- ITU-T Q2/15 formed an adhoc group to progress G.9806Am3
  - Monthly meeting started
  - Target to complete in time for consent in the next ITU-T SG15 plenary on April 2023

G.9806Am3 specifications

- Four link budget classes: continuous optical budget without gaps is important for operators to have increased flexibility in the deployment of optics for the intended distances

	Class S	Class A	Class B-	Class B
Minimum loss	0 dB	5 dB	10 dB	10 dB
Maximum loss	15 dB	20 dB	23 dB	25 dB

- Two wavelength plan options are proposed
  - 1314 ± 2 nm, 1289 ± 2 nm (aligned with G.9806Am1, Am2)
  - 1309 ± 1 nm, 1305 ± 1 nm (aligned with IEEE 100GBASE-ER4, MSA 400G-ER4-30)
- Cover system level features essential to telecom operators, e.g., silent start for the ONU modules
- Other Tx and Rx specifications are under study in the adhoc group
- **Timeline: target consent in the April 2023 SG15 Plenary**

PtP standards in 100G Lambda MSA

- Technical Specification for 100G-LR1-20 (2m-20km), 100G-ER1-30 (2m to 30km) and 100G-ER1-40 (2m-40km) PMDs (full duplex) published in June 2021

Table 2-2: 100G-LR1-20, 100G-ER1-30 and 100G-ER1-40 transmit characteristics

Description	100G-LR1-20	100G-ER1-30	100G-ER1-40	Unit
PAM4 Signaling rate (range)	53.125 ± 100 ppm	53.125 ± 100 ppm	53.125 ± 100 ppm	GBd
Wavelength (range)	1304.5- 1317.5	1304.5-1317.5[a]	1308.09-1310.19	nm
Side-mode suppression ratio (SMSR) (min)	30	30	30	dB
Average launch power (max)	6.6	5.6	7.1	dBm
Average launch power[b] (min)	-0.2	0	1.7	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (max)	6.8	6.4	7.9	dBm
Outer Optical Modulation Amplitude (OMA_{outer}) (min) for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ TDECQ (max)	2.8 1.4 + TDECQ	3.0 1.6 + TDECQ	4.7 3.3 + TDECQ	dBm dBm

Table 2-3: 100G-LR1-20, 100G-ER1-30 and 100G-ER1-40 receive characteristics

Description	100G-LR1-20	100G-ER1-30	100G-ER1-40	Unit
PAM4 Signaling rate (range)	53.125 ± 100 ppm	53.125 ± 100 ppm	53.125 ± 100 ppm	GBd
Wavelength (range)	1304.5 to 1317.5	1304.5 to 1317.5	1304.5 to 1317.5	nm
Damage threshold[a]	7.6	-2.4	-2.4	dBm
Average receive power (max)	6.6	-3.4	-3.4	dBm
Average receive power[b] (min)	-10	-14.7	-16.0	dBm
Receive power (OMA_{outer}) (max)	6.8	-2.6	-2.6	dBm
Receiver reflectance (max)	-26	-26	-26	dB
Receiver sensitivity (OMA_{outer}) (max) For TECQ < 1.4 dB For 1.4 ≤ TECQ ≤ 3.6 dB For 1.4 ≤ TECQ ≤ 3.9 dB	-7.6 -9 + TECQ	-12.5 -13.9 + TECQ	-13.8 -15.2 + TECQ	dBm
Stressed receiver sensitivity (OMA_{outer})[c] (max)	-5.4	-10.0	-11.3	dBm
Conditions of stressed receiver sensitivity test[d]:				
Stressed eye closure for PAM4 (SECQ)	3.6	3.9	3.9	dB

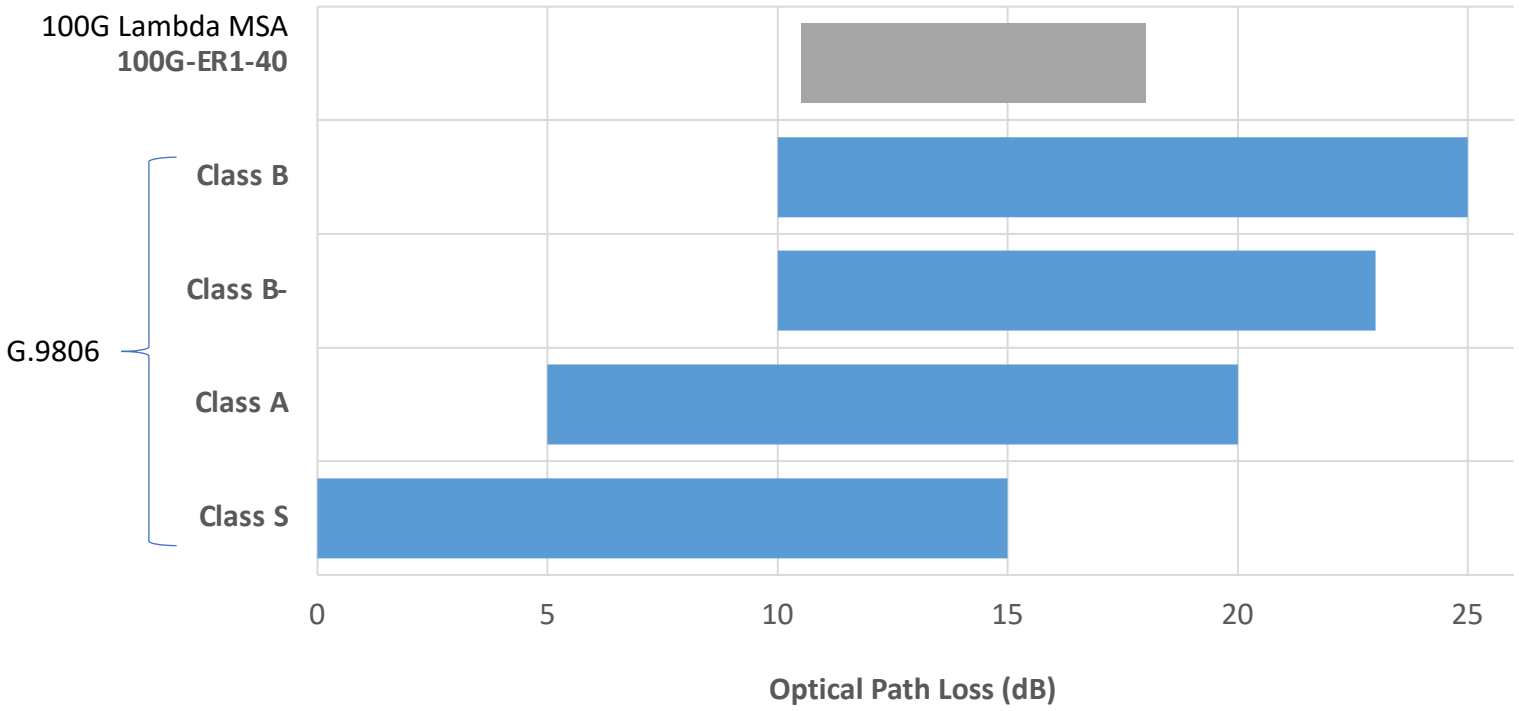
Table 2-4: 100G-LR1-20, 100G-ER1-30 and 100G-ER1-40 illustrative power budget

Description	100G-LR1-20	100G-ER1-30	100G-ER1-40	Unit
Power budget (for max TDECQ)	14.0	19.4	22.4	dB
Operating distance	20	30	40	km
Channel insertion loss (max)[a]	9.8	15	18	dB
Channel insertion loss (min)	0	9	10.5	dB

http://100glambda.com/specifications/summary/2-specifications/11-100g-lr1-20-er1-30-er1-40-technical-specs-rev-1p1

Comparison of power budget classes

G.9806 specifies continuous optical budget without gaps, to allow increased flexibility in the deployment of optics minimize inventory for the intended distances



Comparison of wavelength plans

Source	PMD	Wavelength Range (nm)	Operating Distance (km)	Channel Insertion Loss (dB)	Power Budget (dB)	Min Dispersion (ps/nm)	Max Dispersion (ps/nm)
100G Lambda	400G-LR4-10	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5	10	6.3	11	-59.4	33.4
100G Lambda	100G-ER1-30	1304.5 to 1317.5	30	15	19.4	-55.6	47.9
100G Lambda	100G-ER1-40	1308.09 to 1310.19	40	18	22.4	-60.3	37.5
G.9806 IEEE 802.3cp	**10G**	1260 – 1280 (US) 1320 – 1340 (DS)	20, 40				
G.9806Am1 G.9806Am2 IEEE 802.3cp	**25G, 50G**	1281 – 1297 (US) 1306 – 1322 (DS)	20, 40				
G.9806Am3	**100G**	1) 1314 ± 2, 1289 ± 2 or 2) 1309 ± 1, 1305 ± 1	20. 40				

Depending on loss budget classes

Reference: johnson_nea_01_220223

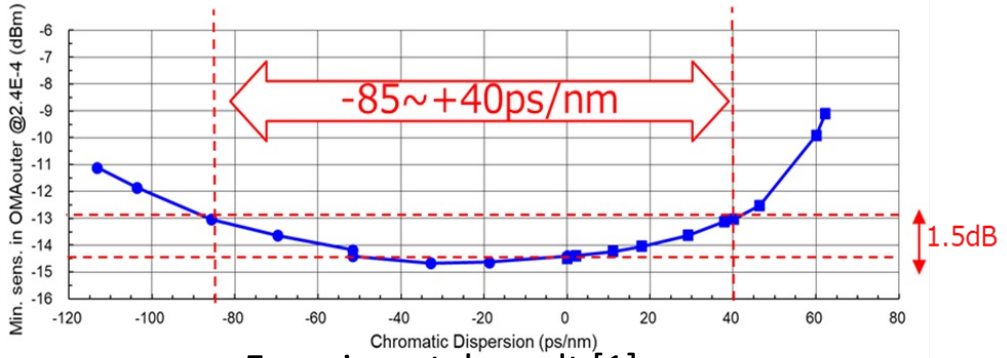
100G BiDi PtP adhoc group

- Summary of previous contributions in ITU-T Q2/15

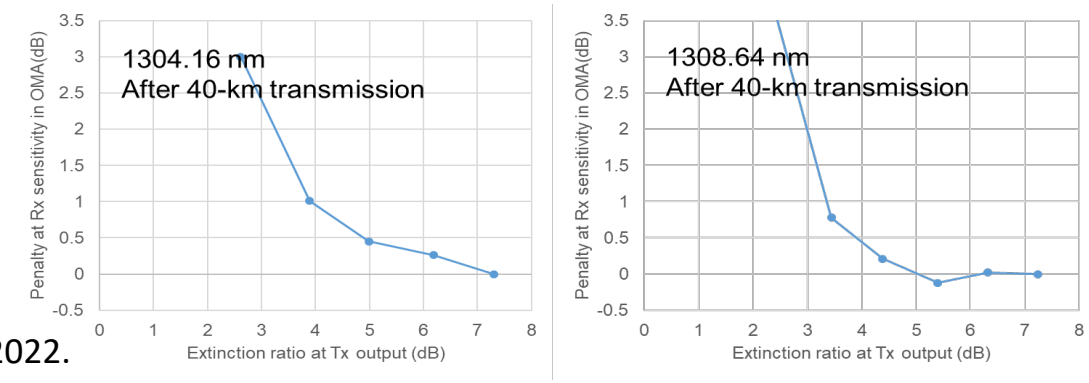
- Wavelength allocation
  - 1304.6/1309.1 ±1 nm for 40 km
  - Employed L2 and L3 in 800GHz-grid LAN-WDM for market sharing

- Extinction ratio
  - Between 4 and 5 dB based on 40-km transmission experiments at 1304 and 1309 nm

	Distance (km)	Solution	Wavelength(nm)			
IEEE 100GBASE-ER4	40	4 x 25 Gbps 800GHz LAN-WDM	1295.6	1300.1	1304.6	1309.1
MSA 400G-ER4-30	30	4 x 100 Gbps 400GHz LAN-WDM	1304.6	1306.9	1309.1	1311.0
MSA 100G-ER1-40	40	1 x 100 Gbps	1308.9 - 1310.9			
MSA 100G-ER1-30	30	1 x 100 Gbps	1304.5 – 1317.5			



Experimental result [1]



Experimental result [2]

[1] 220125_D10_G.9806_15min_NTT_WLplan.docx, ITU-T Q2/SG15 interim meeting, Jan. 2022.
[2] 220524_D08_G.9806_15min_NTT_Proposal_v3.docx, ITU-T Q2/SG15 interim meeting, May 2022.

100G BiDi PtP adhoc group -work plan-

- Study by simulation (VPI) [3,4]
  - TDECQ-TECQ
  - Min launch power OMA and max Rx sensitivity OMA
  - 100G BiDi PtP adhoc group needs realistic parameter values on VPI simulations for more specific discussion
  - To achieve a budget class for supporting 40 km, optical amplifiers, such as SOA, may be needed. Discussions based on simulations and/or experiments are required to determine whether amplification should be applied to a Tx or a Rx.
- Finalize specifications
  - Loss budget
  - Tx and Rx specifications

[3] T22-SG15-C0184, ITU-T Q2/SG15 Plenary meeting, Sep. 2022.
[4] NTT_10min_VPI simulation for 100G-Bidi.pptx, 100G BiDi PtP adhoc meeting, Oct. 2022.

100G BiDi PtP adhoc group -time plan-

Seven conference calls are planned. All are held at 14:00- 15:00 CEST (Geneva Time)

Two calls have been held on 2022.9.9 (Fri.) and 2022.10.13 (Thu.)

Upcoming calls:

3. 2022.11.22 (Tue.)
4. 2022.12.8 (Thu.)
5. 2023.1.12 (Thu.)
6. 2023.2.9 (Thu.)
7. 2023.3.2 (Thu.)

	Oct.	Nov.	Dec.	Jan. 2023	Feb.	Mar.	Apr.	May
ITU-T	▲ ITU interim 25th-27th Oct.	▲ ITU interim End of Nov.			▲ ITU interim Feb.	▲ ITU interim Mar.	▲ ITU Plenary	
100G Bidi adhoc	▲ 2nd 10/13	▲ 3rd 11/22	▲ 4th 12/8	▲ 5th 1/12	▲ 6th 2/9	▲ 7th 3/2		
IEEE		▲ Plenary 2nd week in Nov.		▲ Interim 2nd week in Jan.		▲ Plenary 2nd week in Mar.		▲ Interim 2nd week in May

Summary

- Development of 100 Gb/s would benefit from the synergy with the ongoing ITU-T G.9806Am3 project and 100G Lambda MSA specifications
- Time is of essence: G.9806Am3 target consent in the April 2023 SG15 Plenary
- Requests to IEEE 802.3 participants
  - Prioritize working on the 100G objectives over 200G
  - Prioritize working on important parameters, e.g., wavelength plan, power budget, penalties
  - IEEE 802.3 participants are encouraged to join the ITU-T 100G BiDi PtP adhoc group. Contact Dr. Hirotaka Nakamura hirotaka.nakamura.by@hco.ntt.co.jp
  - Share information and baselines by regular liaisons with Q2/15
  - Target to reach 100G baseline consensus by the end of Feb. 2023

THANK YOU