

# **Proposal for the baseline parameters of 100GBASE-BR10, BR20, and BR40**

**Prepared by Frank Effenberger and Sisi Tan  
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# Supporters

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# Overview

- In the August meeting, 3dk\_tan\_2308\_1 proposed considerations of the baseline of optical specifications of 100GBASE-BR10, 100GBASE-BR20 based on three sources:
  - 50GBASE-BR10, 50GBASE-BR20 (clause 160, IEEE 802.3cp-2021)
  - 100GBASE-LR1 (clause 140, IEEE 802.3cu-2021)
  - ITU-T G.9806 Amd.3
- In the August meeting, there was a consensus to
  - BR10: loss budget 0 to 6.3 dB, based on 100GBASE-LR1
  - BR20: loss budget 5 to 15 dB, based on G.9806 Amd.3
  - BR40: loss budget 10 to 18 dB

# Comment on G.9806 and 100G per lambda MSA

- G.9806 was intended to be based on 802.3cp specifications
  - There was a translation effort to change the format of optical link specifications to the style used in ITU-T
  - 802.3 optical specs are more complete and cover more edge cases
  - For specifications where G.9806 remains silent, the initial assumption should be to adopt the 802.3 value, and then check to confirm its suitability
- Also, recent G.9806 work has suggested that the original “big budget” class B- (10 to 23 dB) is not feasible. Therefore, the new target is class B<sub>L</sub> (10 to 20 dB)
- 100G/lambda MSA has served as a source material for the G.9806 work and also has been proposed for reuse here
  - It should be noted that the 100GBASE-LR1 and the above MSA are two-fiber interface standards. There is a small (~0.5 dB) diplexer loss to overcome

# Presentation format

- The following slides try to present all the relevant specs side-by-side, so we may compare and contrast
- In most cases, there is very good agreement
- There are a few cases where there are small ( $<0.5$  dB) differences
- Then there are some intentional differences to achieve different loss budgets

# Table for 100GBASE-BR10 Transmitter Spec

	IEEE Std 802.3cu-2021, clause 140.6	IEEE Std 802.3dk, new clause	
Description	<b>100GBASE-LR1</b>	<b>100GBASE-BR10</b>	Unit
Signaling rate (range)	53.125 ± 100 ppm	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	-
Downstream center wavelength (range)	N/A	1308.1 to 1310.1	nm
Upstream center wavelength (range)		1303.5 to 1305.5	nm
Side-mode suppression ratio (SMSR), (min)	30	30	dB
Average launch power (max)	4.8	4.8	dBm
Average launch power (min) [1]	-1.9	-1.9	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) (max)	5	5	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) (min): for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	1.1 -0.3+TDECQ	1.1 -0.3+TDECQ	dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max))	3.4	3.4	dB
TECQ(max)	3.4	3.4	dB
TDECQ-TECQ (max)	2.5	2.5	dB
Transmitter over/under-shoot (max)	22	22	%
Transmitter power excursion (max)	2.8	2.8	dBm
Extinction ratio (min)	3.5	3.5	dB
Transmitter transition time (max)	17	17	ps
Average launch power of OFF transmitter (max)	-15	-15	dBm
RIN <sub>x,OMA</sub> (max) <sup>d</sup>	-136	-136	dB/Hz
Optical return loss tolerance (max)	15.6	15.6	dB
Transmitter reflectance <sup>e</sup> (max)	-26	-26	dB

# Table for 100GBASE-BR10 Receiver Spec

	IEEE Std 802.3cu-2021, clause 140.6	IEEE Std 802.3dk, new clause	
Description	100GBASE-LR1	100GBASE-BR10	unit
Signaling rate (range)	53.125±100ppm	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	-
Downstream center wavelength (range)	N/A	1303.5 to 1305.5	nm
Upstream center wavelength (range)	N/A	1308.1 to 1310.1	nm
Damage threshold	5.8	5.8	dBm
Average receive power (max)	4.8	4.8	dBm
Average receive power (min)	-8.2	-8.2	dBm
Receive power (OMA <sub>outer</sub> ) (max)	5	5	dBm
Receiver reflectance (max)	-26	-26	dB
Receiver sensitivity (OMA <sub>outer</sub> ), (max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ 3.4 dB	-6.1 -7.5+TECQ	-6.1 -7.5+TECQ	dBm dBm
Stressed receiver sensitivity (OMA <sub>outer</sub> ) (max)	-4.1	-4.1	dBm
Conditions of stressed receiver sensitivity test:			
Stressed eye closure for PAM4 (SECQ)	3.4	3.4	dB

# Table for 100GBASE-BR10 illustrative link power budgets

	IEEE Std 802.3cu-2021, clause 140.6	IEEE Std 802.3dk, new clause	
Description	100GBASE-LR1	100GBASE-BR10	unit
Power budget (for maximum TDECQ)	10.6	10.6	dB
Operating distance	10	10	km
Channel insertion loss	0 to 6.3	0 to 6.3	dB
Maximum discrete reflectance	-35	-35	dB
Allocation for penalties (for maximum TDECQ)	4.3	4.3	dB

The simple conclusion for BR10 is that there is only one reference for these specs. The only part we need to change from 100GBASE-LR1 are the wavelengths.

# Table for 100GBASE-BR20 Transmitter Spec

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
Description	100G - ER1 – 30 (9~15dB)	Class S <sub>U</sub> (5~15dB)	100GBASE-BR20 (5~15dB)	Unit
Signaling rate (range)	53.125 ± 100 ppm	53.125	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	PAM4	-
Downstream center wavelength (range)	N/A	1309.1 ± 1 nm	1308.1 to 1310.1	nm
Upstream center wavelength (range)	N/A	1304.6 ± 1 nm	1303.6 to 1305.6	nm
Side-mode suppression ratio (SMSR), (min)	30	30	30	dB
Average launch power (max)	5.6	4.8	4.8	dBm
Average launch power (min) [1]	0		-0.3	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) (max)	6.4		6.1	dBm
Outer Optical Modulation Amplitude(OMA <sub>outer</sub> ) (min): for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.9 dB	3.0 1.6+TDECQ	N/A		dBm dBm
Outer Optical Modulation Amplitude(OMA <sub>outer</sub> ) (min): for TDECQ < 1.6 dB for 1.6 dB ≤ TDECQ ≤ 3.4 dB	N/A	2.7 1.1 + TDECQ	2.7 1.1 + TDECQ	dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max))	3.9	3.4		dB
TECQ(max)	3.9		3.9	dB
TDECQ-TECQ (max)	2.7	2.5	2.7	dB
Transmitter over/under-shoot (max)	22		22	%
Transmitter power excursion (max)	3.9		3.9	
Extinction ratio (min)	5	5	5	
Transmitter transition time (max)	17		17	
Average launch power of OFF transmitter (max)	-15	-20	-15	
RIN <sub>X</sub> OMA (max) <sup>d</sup>	-136		-136	
Optical return loss tolerance (max)	15	14	15	
Transmitter reflectance <sup>e</sup> (max)	-26		-26	

# Table for 100GBASE-BR20 Receiver Spec

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
Description	100G - ER1 - 30	Class S <sub>U</sub> (5~15dB)	100GBASE-BR20	unit
Signaling rate (range)	53.125±100ppm	53.125	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	PAM4	-
Downstream center wavelength (range)	N/A	1304.6 ± 1 nm	1303.6 to 1305.6	nm
Upstream center wavelength (range)	N/A	1309.1 ± 1 nm	1308.1 to 1310.1	nm
Damage threshold	-2.4	1.0	1.0	dBm
Average receive power (max)	-3.4	0.0	0.0	dBm
Average receive power (min)	-14.7		-15	dBm
Receive power (OMA <sub>outer</sub> ) (max)	-2.6		1.1	dBm
Receiver reflectance (max)	-26	-14	-26	dB
Receiver sensitivity (OMA <sub>outer</sub> ), (max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ 3.4 dB	-12.5 -13.9+TECQ	N/A		dBm dBm
Receiver sensitivity (OMA <sub>outer</sub> ), (max) for TECQ < 1.6 dB for 1.6 dB ≤ TECQ ≤ 3.6 dB	N/A	-12.8 -14.4 + TECQ	-12.8 -14.4 + TECQ	
Stressed receiver sensitivity (OMA <sub>outer</sub> ) (max)	-10.0		-10.8	dBm
Conditions of stressed receiver sensitivity test:				
Stressed eye closure for PAM4 (SECQ)	3.9		3.9	dB

## Table for 100GBASE-BR20 illustrative link power budgets

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
<b>Description</b>	<b>100G - ER1 - 30</b>	<b>Class S<sub>U</sub> (5~15 dB)</b>	<b>100GBASE-BR20</b>	<b>unit</b>
Power budget (for maximum TDECQ)	19.4			dB
Operating distance	30	20	20	km
Channel insertion loss	9 to 15	5 to 15	5 to 15	dB
Maximum discrete reflectance	-35			dB
Allocation for penalties (for maximum TDECQ)	4.4			dB

For BR20, there are small differences (0.3 dB) in the sensitivity values, and the minimum loss budget is quite difference (9 vs. 5). Since the lower speed BR20 loss budgets were 0 to 15 dB, the loss range of 5 to 15 is a closer fit. Hence, we largely reuse the values from G.9806

# Table for 100GBASE-BR40 Transmitter Spec

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
Description	100G - ER1 - 40	Class B <sub>L</sub> (10~20 dB)	100GBASE-BR40	Unit
Signaling rate (range)	53.125 ± 100 ppm	53.125	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	PAM4	-
Downstream center wavelength (range)	1309.1 ± 1 nm	1309.1 ± 1 nm	1308.1 to 1310.1	nm
Upstream center wavelength (range)	1304.6 ± 1 nm	1304.6 ± 1 nm	1303.6 to 1305.6	nm
Side-mode suppression ratio (SMSR), (min)	30	30	30	dB
Average launch power (max)	7.1	8.6	6.6 ~ 7.1	dBm
Average launch power (min) [1]	1.7		TBD	dBm
Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) (max)	7.9		TBD	dBm
Outer Optical Modulation Amplitude(OMA <sub>outer</sub> ) (min): for TDECQ < 1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	4.7 3.3+TDECQ	N/A	TBD	dBm dBm
Outer Optical Modulation Amplitude(OMA <sub>outer</sub> ) (min): for TDECQ < 1.6 dB for 1.6 dB ≤ TDECQ ≤ 3.4 dB	N/A	7.0 5.4 + TDECQ	TBD	dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ) (max))	3.9	3.4	3.9	dB
TECQ(max)	3.9		3.9	dB
TDECQ-TECQ (max)	2.7	2.5	2.7	dB
Transmitter over/under-shoot (max)	22		22	%
Transmitter power excursion (max)	5.4		5.4	
Extinction ratio (min)	5	5	5	
Transmitter transition time (max)	17		17	
Average launch power of OFF transmitter (max)	-15	-20	-15	
RIN <sub>xOMA</sub> (max) <sup>d</sup>	-136		-136	
Optical return loss tolerance (max)	15	14	15	
Transmitter reflectance <sup>e</sup> (max)	-26		-26	

# Table for 100GBASE-BR40 Receiver Spec

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
Description	100G - ER1 - 40	Class B <sub>L</sub> (10~20 dB)	100GBASE-BR40	unit
Signaling rate (range)	53.125±100ppm	53.125	53.125 ± 100 ppm	GBd
Modulation format	PAM4	PAM4	PAM4	-
Downstream center wavelength (range)	1304.6 ± 1 nm	1304.6 ± 1 nm	1303.6 to 1305.6	nm
Upstream center wavelength (range)	1309.1 ± 1 nm	1309.1 ± 1 nm	1308.1 to 1310.1	nm
Damage threshold	-2.4	- 0.4	TBD	dBm
Average receive power (max)	-3.4	- 1.4	TBD	dBm
Average receive power (min)	-16.0		TBD	dBm
Receive power (OMA <sub>outer</sub> ) (max)	-2.6		TBD	dBm
Receiver reflectance (max)	-26	-14	-26	dB
Receiver sensitivity (OMA <sub>outer</sub> ), (max) for TECQ < 1.4 dB for 1.4 dB ≤ TECQ ≤ 3.4 dB	-13.8 -15.2+TECQ	N/A	TBD	dBm dBm
Receiver sensitivity (OMA <sub>outer</sub> ), (max) for TECQ < 1.6 dB for 1.6 dB ≤ TECQ ≤ 3.6 dB	N/A	-13.5 -15.1 + TECQ	TBD	
Stressed receiver sensitivity (OMA <sub>outer</sub> ) (max)	-11.3		TBD	dBm
Conditions of stressed receiver sensitivity test:				
Stressed eye closure for PAM4 (SECQ)	3.9		3.9	dB

## Table for 100GBASE-BR40 illustrative link power budgets

	100G/lambda MSA	G.9806 Amd.3 100G line rate	IEEE Std 802.3dk, new clause	
Description	100G - ER1 - 40	Class B <sub>L</sub> (10~20 dB)	100GBASE-BR40	unit
Power budget (for maximum TDECQ)	22.4			dB
Operating distance	40	40	40	km
Channel insertion loss	10.5 to 18	10 to 20	10 to 18	dB
Maximum discrete reflectance	-35		-35	dB
Allocation for penalties (for maximum TDECQ)	4.4		4.4	dB

For BR40, there are (again) small differences (0.3 dB) in the sensitivity values, and the maximum loss budget is quite difference (18 vs. 20). Since the lower speed BR40 loss budgets were 10 to 18 dB, the MSA is a closer fit. However, more work is needed to reconcile the exact values

## Suggested way forward

- It seems there is consensus for moving forward with the optical specifications for the 100 Gb/s bidirectional optics as given above
  - With the proviso that there are small differences in some values that need to be resolved
- It is suggested that we make motions to tentatively accept the specifications above, and to begin drafting the new 100G bidi clause
  - If there are particular specifications that still have doubts, we can mark those as “TBD”. The main objective is to start the draft

# Motion #X

- Move to appoint Sisi Tan as editor

## Motion #Y

- Move to direct the editor to prepare a draft 0.1 of the 100G bidi clause, beginning with existing clause 140 as the base and then adopting the specifications as given in this presentation as tentative baseline values

# Thank you

Any questions?