

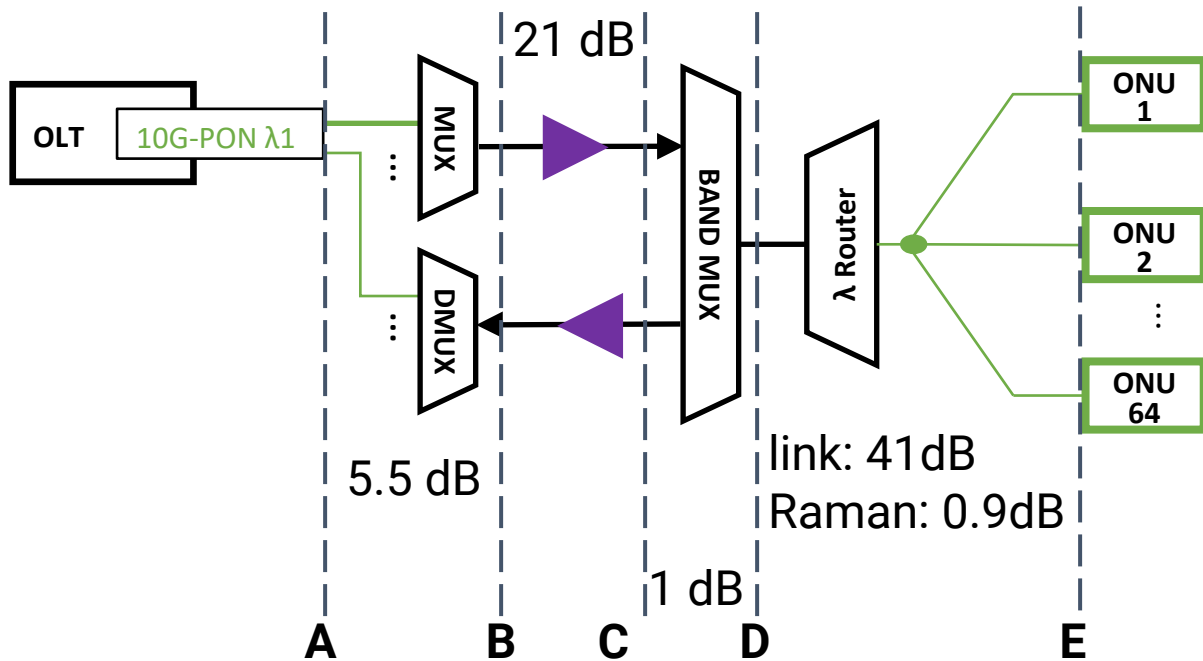
# Super-PON Draft Updates

IEEE P802.3cs, April 02, 2020  
Liang Du (Google)

# Changes to table 200-4

- For FSR set 1:
  - Change C-band 1 to downstream
  - Change L-band-1 to upstream

# Power levels - DS



Location	rel [dBm]	abs [dBm]
A	PowDS-14.5	-2.5
B	PowDS-20	-8
C	PowDS+1	13
D	PowDS	12
E	PowDS-41.9	-29.9

- OLT Tx power should be: -2.5 dBm to +1.5 dBm
- Allow for 4 dB spread between min and max
- Operator to balance the powers
- Sensitivity to be adjusted to -31 dBm to reflect the assumed gains from LDPC
- 1.1 dB for link penalty

	Required Launch powers [dBm]		
	DS	US 10G	US 2.5G
DS: L - US: C	12	7.5	3
DS: C - US: L	12	4	-0.5

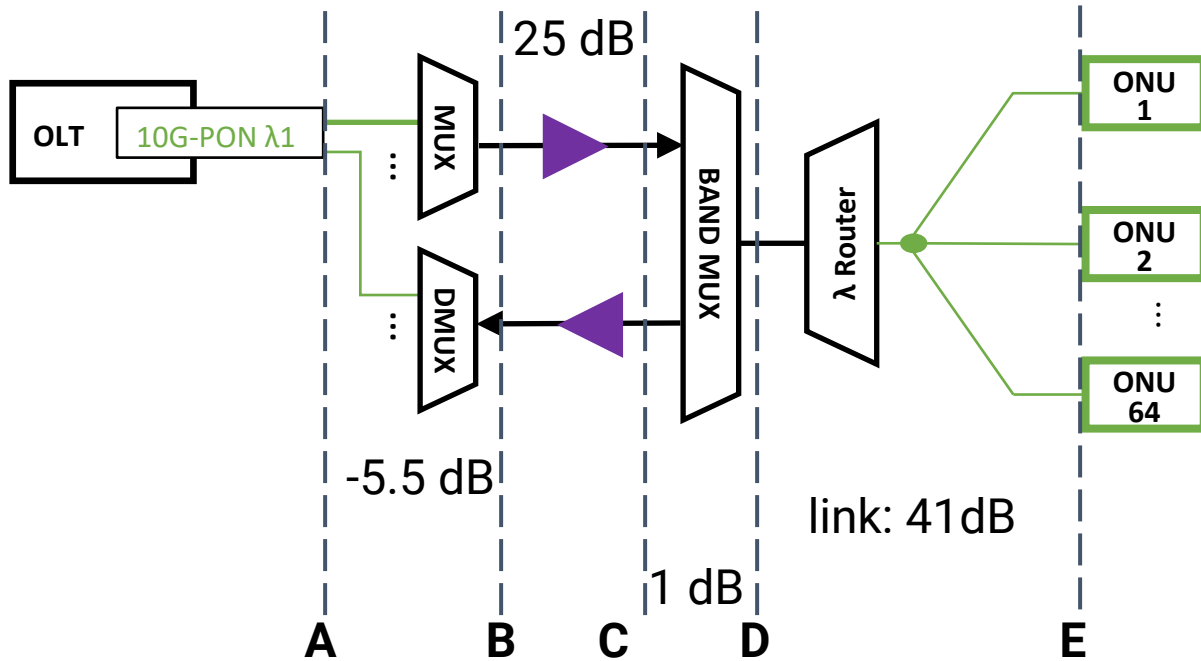
# OLT transmit

	<b>Current draft values</b>	<b>Updated values for next draft</b>	
<b>Parameter</b>	<b>10GBASE-SP1-Dx 10/2.5GBASE-SP1-Dx</b>	<b>10GBASE-SP1-Dx 10/2.5GBASE-SP1-Dx</b>	<b>Unit</b>
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Channel center frequencies	L-band 1 (downstream)	C-band 1 (downstream)	THz
Maximum spectral excursion	± 12.5	± 12.5	GHz
Maximum mean channel output power	2	1.5	dBm
Minimum mean channel output power	-3	-2.5	dBm
Minimum side-mode suppression ratio (SMSR)	35	35	dB
Minimum channel extinction ratio	8.2	8.2	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	UI
Transmitter and dispersion penalty (TDP) @ 0 to 1000 ps/nm residual CD	0*	0*	dB
RIN <sub>15</sub> OMA (max)	-120	-120	dB/Hz
Average launch power of OFF transmitter (max)	-39	-39	dBm
Optical return loss tolerance (max)	15	15	dB

# ONU receive

	<b>Current draft values</b>	<b>Updated values for next draft</b>	
<b>Parameter</b>	<b>10GBASE-SP1-Ux 10/2.5GBASE-SP1-Ux</b>	<b>10GBASE-SP1-Ux 10/2.5GBASE-SP1-Ux</b>	<b>Unit</b>
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Channel frequency range	187.600 to 189.092	191.990 to 193.510	THz
Bit error ratio (max)	10 <sup>-3</sup>	10 <sup>-2</sup>	
Maximum mean input power	-8	-8	dBm
Minimum mean input power	-29	-31	dBm
Minimum OSNR	+22	+30	dB (0.1 nm)
Receiver OSNR tolerance	+20	+28	dB (0.1 nm)
Receiver reflectance (max)	-12	-12	dB
Damage Threshold	-2	-2	dBm
Signal detect threshold (min)	-44	-44	dBm

# Power levels - US



- 10G ONU Tx power: >4 dBm @ 6dB ER
- 2.5G ONU Tx power: -0.5 dBm to 4.5 dBm
- OLT sensitivity needs to be better than -20.6 dBm to account for 2.1 dB of TDP

Location	rel [dBm]	abs [dBm]
A	PowUS-22.5	-18.5
B	PowUS-17	-13
C	PowUS-42	-38
D	PowUS-41	-37
E	PowUS	4

	Required Launch powers [dBm]		
	DS	US 10G	US 2.5G
DS: L - US: C	12	7.5	3
DS: C - US: L	12	4	-0.5

# ONU transmit

Parameter	Current draft values		Updated values for next draft		Unit
	10GBASE-SP1-U <sub>x</sub>	10/2.5GBASE-SP1-U <sub>x</sub>	10GBASE-SP1-U <sub>x</sub>	10/2.5GBASE-SP1-U <sub>x</sub>	
Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	10.3125 ± 100 ppm	2.578125 ± 100 ppm	GBd
Channel center frequencies	C-band 1 (upstream)		L-band 1 (upstream)		THz
Maximum spectral excursion (after turn-on time)	± 15		± 15		GHz
Maximum mean channel output power		6	8	4.5	dBm
Minimum mean channel output power		1	see equation xx	-0.5	dBm
Minimum side-mode suppression ratio (SMSR)	38		38		dBm
Minimum channel extinction ratio		6	see equation xx	6	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		UI
Maximum transmitter (residual) dispersion OSNR penalty -400 to +200 ps/nm residual CD -400 to +1000 ps/nm residual CD	1	0.5	2.1	1.1	dB
Average launch power of OFF transmitter (max)	-45		-45		dBm
RIN <sub>15</sub> OMA (max)	-128		-128		dB/Hz
Turn-on time (max)	512		512		ns
Turn-off time (max)	512		512		ns

# OLT receive

Parameter	Current draft values		Updated values for next draft		Unit
	10GBASE-SP1-Dx	10/2.5GBASE-SP1-Dx	10GBASE-SP1-Dx	10/2.5GBASE-SP1-Dx	
Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	10.3125 ± 100 ppm	2.578125 ± 100 ppm	GBd
Channel frequency range	191.990 to 193.510		187.600 to 189.092		THz
Bit error ratio (max)	10 <sup>-3</sup>		10 <sup>-2</sup>		
Maximum mean input power	-6		-6		dBm
Minimum mean input power	-23	-26	-20.6	-25.1	dBm
Minimum OSNR			15	10.5	dB (0.1 nm)
Receiver OSNR tolerance			12.9	8.4	dB (0.1 nm)
Receiver reflectance (max)	-12		-12		dB
Damage Threshold	-5		-5		dBm
Signal detect threshold (min)	-45		-45		dBm
Treceiver settling (max)	800		800		ns

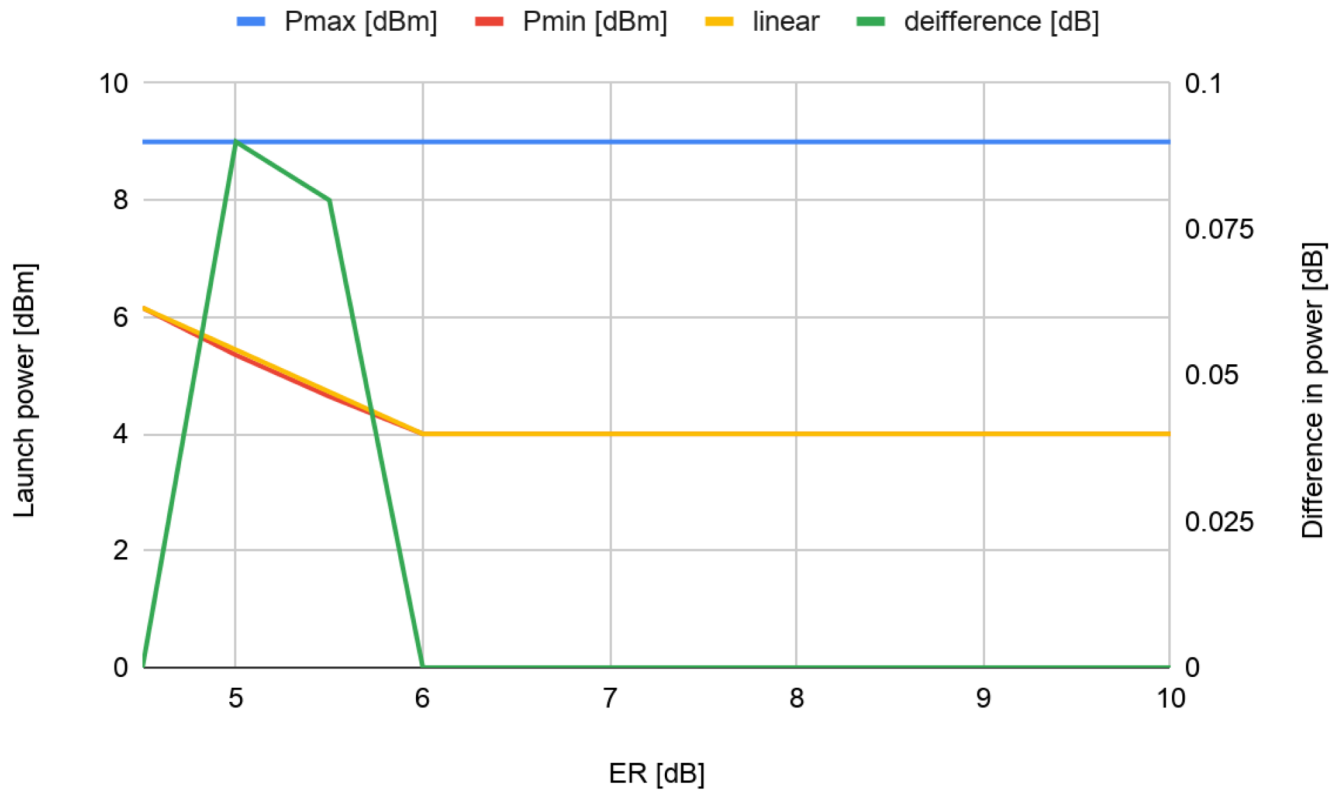


# OSNR values

- DS OSNR
  - Not limited by OSNR
  - Set to a readily achievable value that will not affect the ONU receiver sensitivity
  - Propose 30 dB
- US OSNR
  - Limited by OSNR
  - $\text{OSNR} = 58 + P(\text{fiber input}) - \text{NF} - L(\text{span}) - \log(\#\text{spans})$   
 $\text{OSNR} = 58 + 4 - 6 - 41 - 0$   
 $\text{OSNR} = 15 \text{ dB}$

# Power vs ER curves

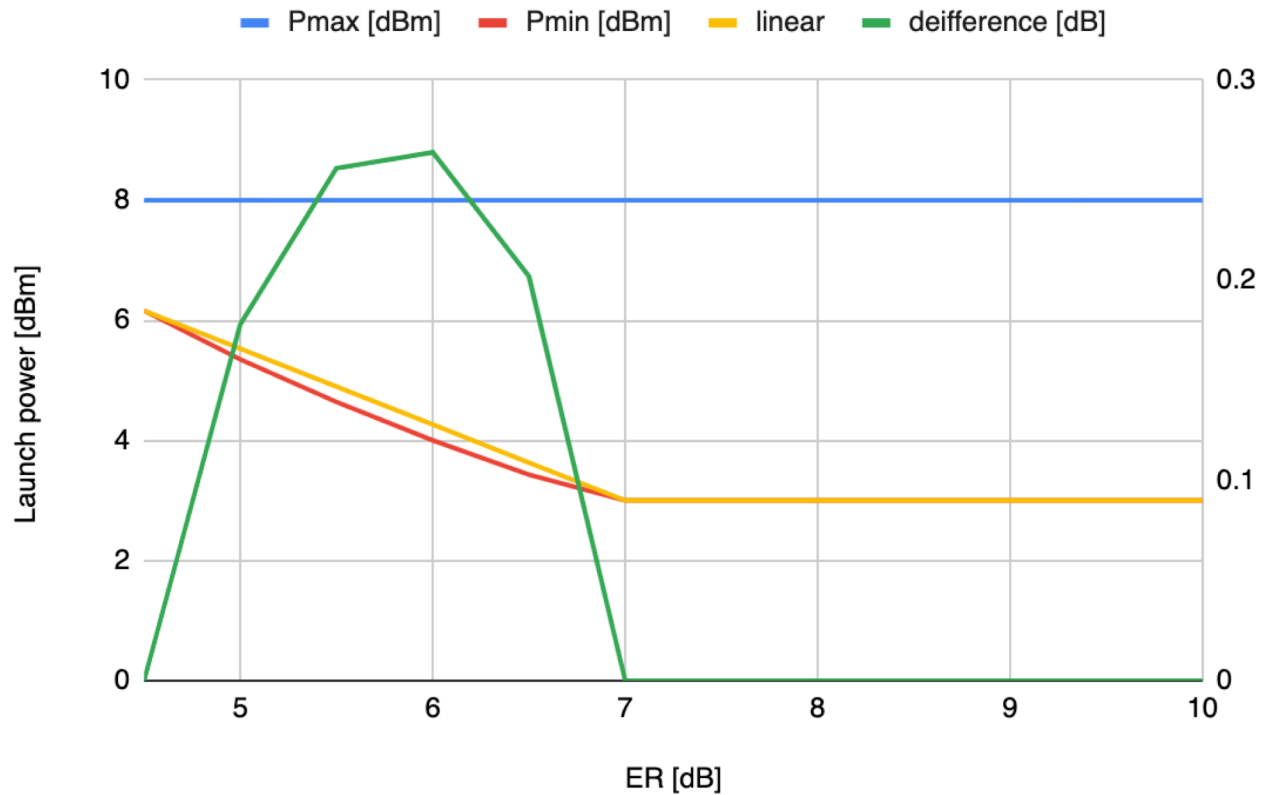
- Max power of 9 dBm
- Does not allow any power reduction for ER >6 dB



ER (dB)	Pmax [dBm]	Pmin [dBm]	linear
10	9.00	4	4
9.5	9.00	4	4
9	9.00	4	4
8.5	9.00	4	4
8	9.00	4	4
7.5	9.00	4	4
7	9.00	4	4
6.5	9.00	4	4
6	9.00	4	4
5.5	9.00	4.64	4.72
5	9.00	5.35	5.44
4.5	9.00	6.16	6.16

# Power vs ER curves

- Max power of 8 dBm
- Allows for 3 dBm at ER  $\geq 7$  dB ----> Better for EML ONUs



ER (dB)	Pmax [dBm]	Pmin [dBm]	linear
10	8	3	3
9.5	8	3	3
9	8	3	3
8.5	8	3	3
8	8	3	3
7.5	8	3	3
7	8	3	3
6.5	8	3.43	3.632
6	8	4	4.264
5.5	8	4.64	4.896
5	8	5.35	5.528
4.5	8	6.16	6.16

# Linearized Min Power (Max power of 8 dBm)

- Equation xx:
  - $P_{\min} = -1.44 * ER + 12.64$  for  $4.5 \leq ER \leq 6$
  - $P_{\min} = -ER + 10$  for  $6 \leq ER \leq 7$
  - $P_{\min} = 3$  for  $ER \geq 7$

Thank you