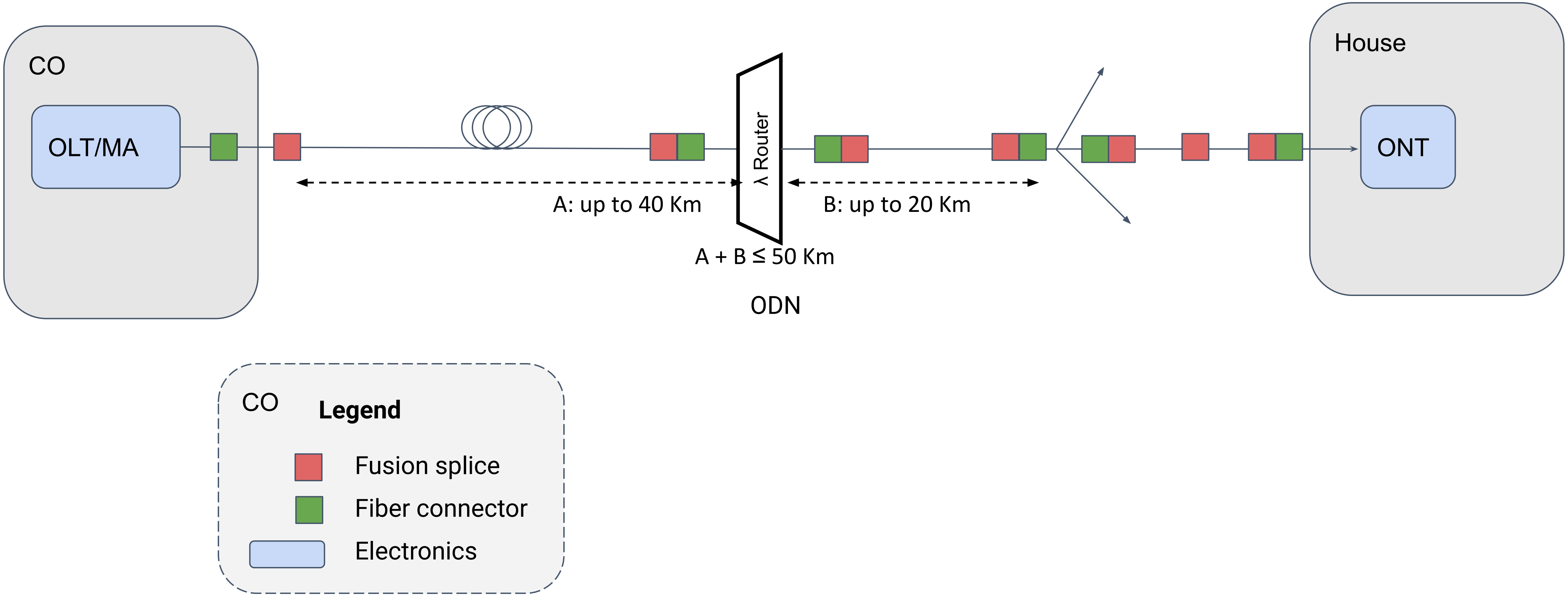
Super-PON linear fit for US power

IEEE P802.3cs, January 2020

Liang Du (Google)

Google Fiber

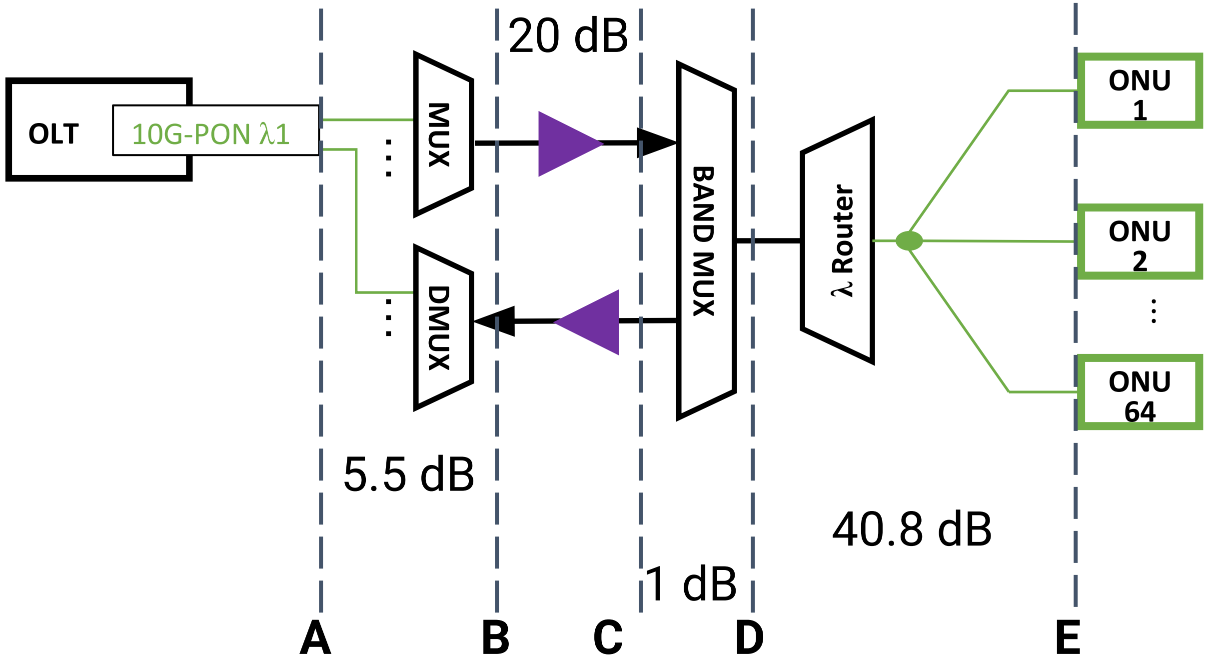
Loss of ODN Components (from last cycle)



Loss of ODN Components with low-loss AWG

Component	count	typical loss [dB]	worst case loss [dB]	Total loss [dB]	comments
Fiber [km]	50	0.24	0.24	12	Revised numbers from Vince (Corning)
Connectors	6	0.2	0.5	1.5	Count from last meeting
Splices	17	0.05	0.2	1	7 for components/cable changes, 10 for inline
AWG	1	4.8	4.8	4.8	Using Broadex values
Splitter (x64)	1	21.5	21.5	21.5	Assumes 3.5 dB per 2x
Total				**40.8**	

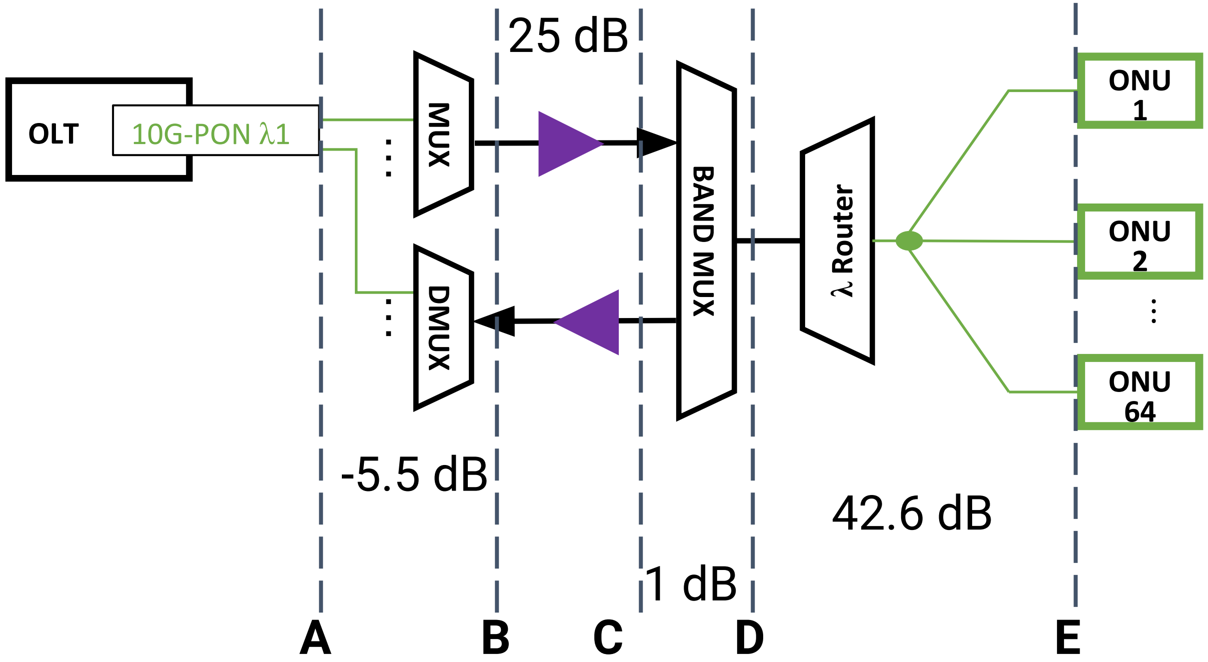
Downstream power levels



Location	DS/WL [dBm]	DS total [dBm]
A	-2.2	
B	-4.1	4.3
C	12.3	24.3
D	11.3	23.3
E	-29.5 PR40	

- Class 3 laser is needed to close the DS link budget
- Close to powers of inline amplifiers

Upstream power levels

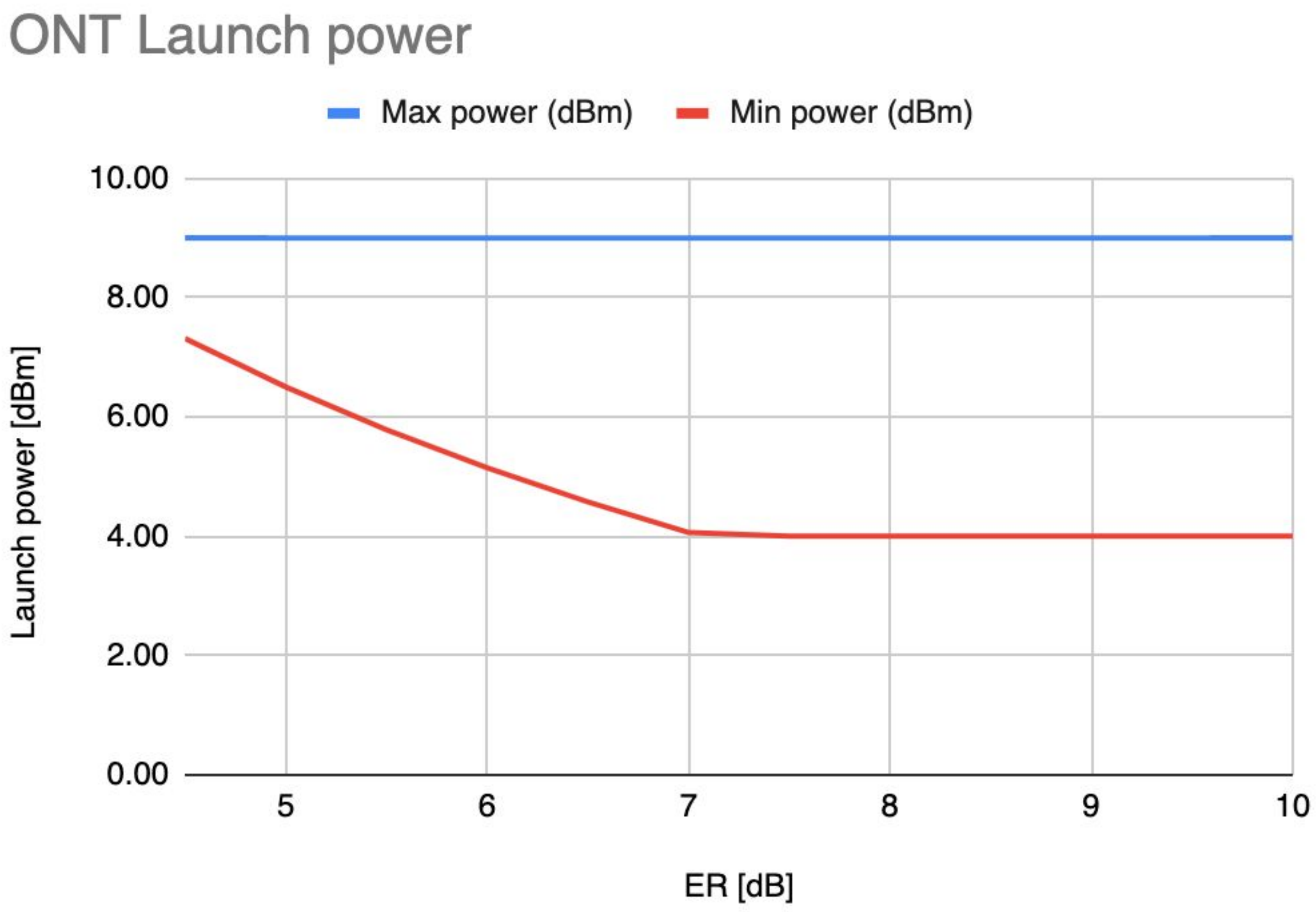


Location	US/WL [dBm]	US total [dBm]
A	-19.5	
B	-14	0
C	-39	-25
D	-38	-26
E	2.8	

- 2.8 dBm ONT launch power is required at 8.5-dB ER

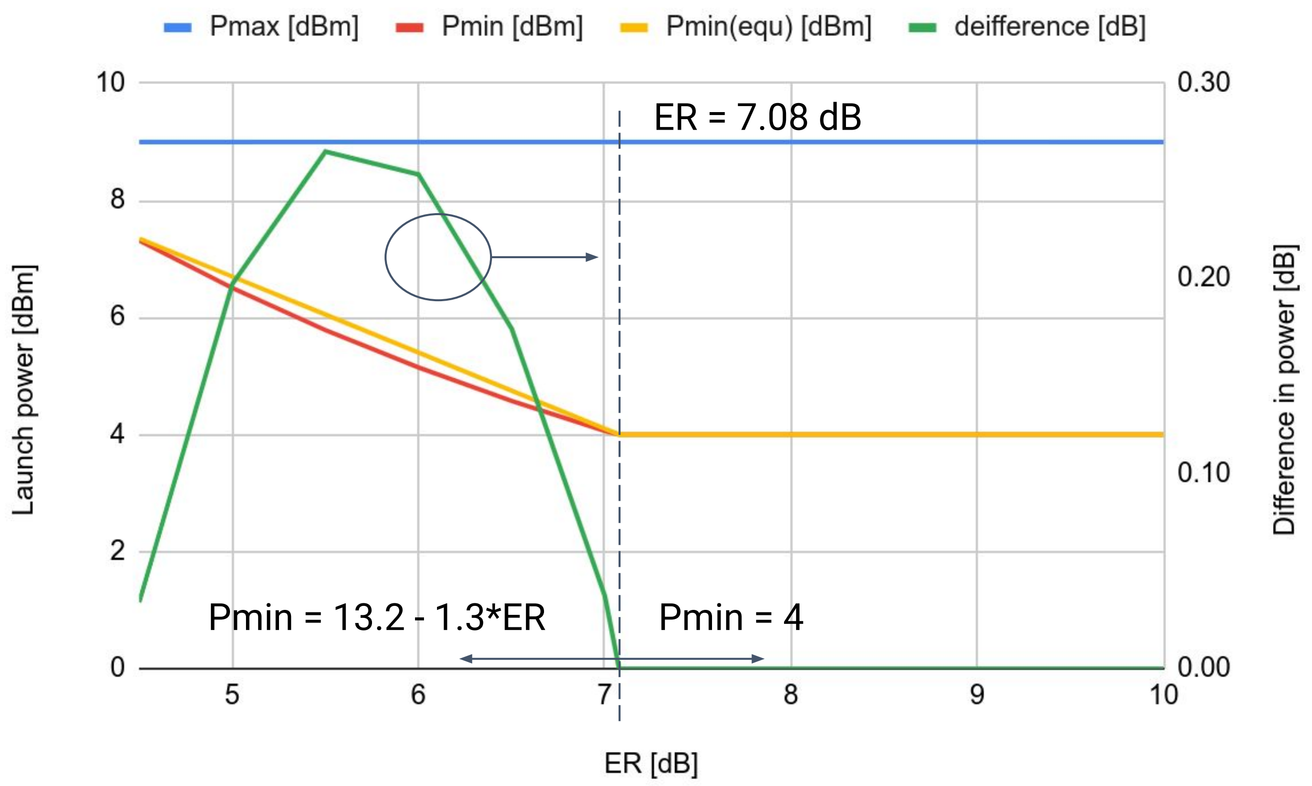
ONT launch power 10-Gb/s US with low-loss AWG (with max 5-dB DR)

ER (dB)	Max power (dBm)	Min power (dBm)
10	9.00	4.00
9.5	9.00	4.00
9	9.00	4.00
8.5	9.00	4.00
8	9.00	4.00
7.5	9.00	4.00
7	9.00	4.06
6.5	9.00	4.58
6	9.00	5.15
5.5	9.00	5.78
5	9.00	6.50
4.5	9.00	7.32



ONT launch power 10-Gb/s US with low-loss AWG (with max 5-dB DR)

ER (dB)	Pmax [dBm]	Pmin [dBm]	Pmin(equ) [dBm]	deifference [dB]
10	9.00	4.00	4	0.00
9.5	9.00	4.00	4	0.00
9	9.00	4.00	4	0.00
8.5	9.00	4.00	4	0.00
8	9.00	4.00	4	0.00
7.5	9.00	4.00	4	0.00
7	9.00	4.00	4	0.00
6.5	9.00	4.06	4.1	0.04
6	9.00	4.58	4.75	0.17
5.5	9.00	5.15	5.4	0.25
5	9.00	5.78	6.05	0.27
4.5	9.00	6.50	6.7	0.20



Pmin(ER) = 13.2 -1.3*ER, where ER < 7.08 dB

Linear approximation

- Very little difference between the theoretical limit and the linear equation if the right end points are used
  - Maximum difference of 0.25 dB for the US powers proposed in 20191112-Du_3cs_01a
- The shape of the curve means the linear estimate is conservative, forcing solutions with an ER in the middle to have slight high launch power, thus ensuring they would work
- Propose to use a linear curve to govern US power and ER
  - New data to be presented in 20200121-Du_3cs_02 will require a different US launch power than that proposed in 20191112-Du_3cs_01a, which is used in this analysis

Thank you