

SOA pre-amplified upstream signal power in 100G EPON

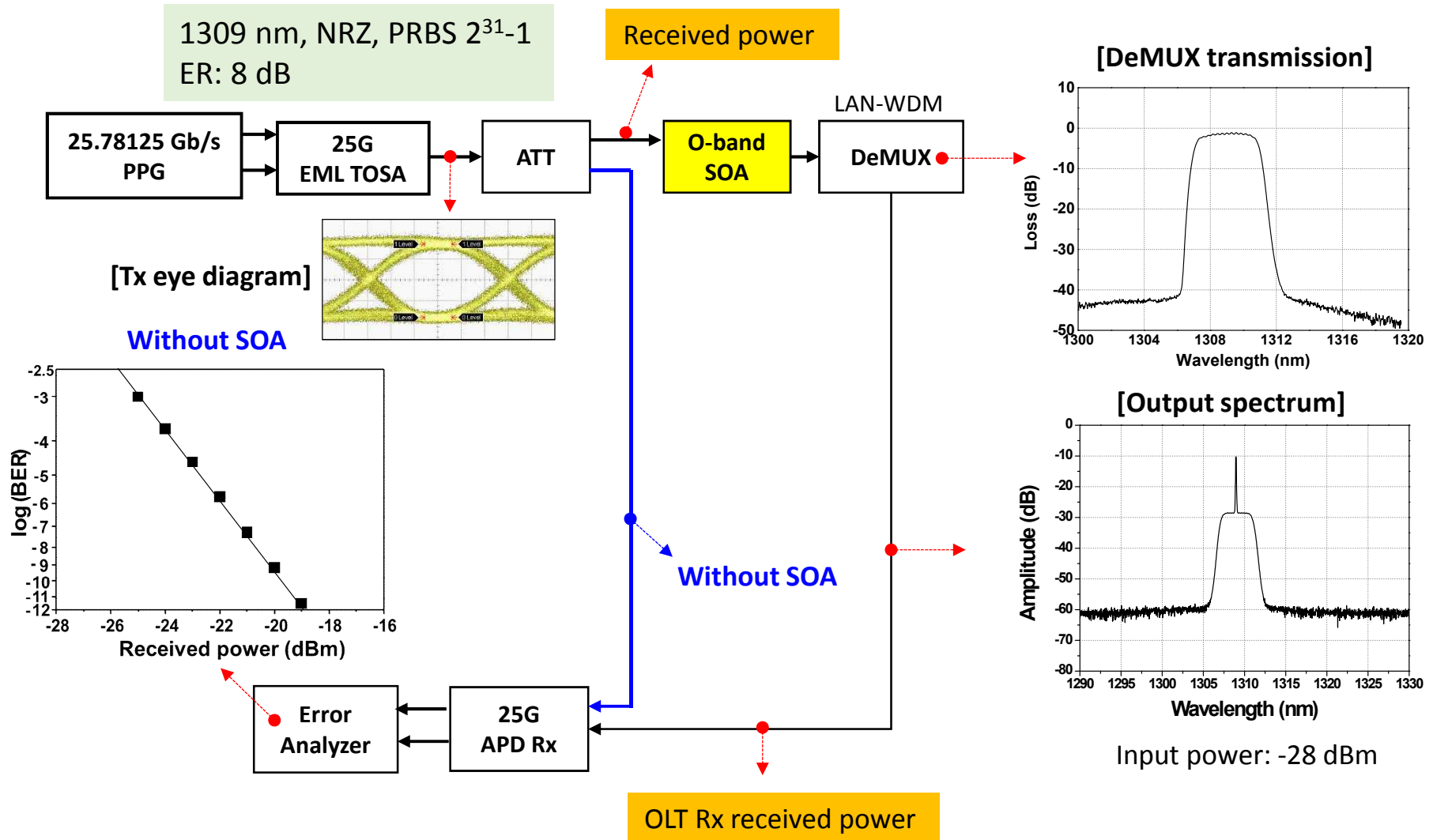
Hanhyub Lee, and Hwan Seok Chung

IEEE P802.3ca 100G-EPON Task Force
May 22-26, 2017
New Orleans, Louisiana, USA

Motivation

- 100G EPON OLT must use a pre-amplifier to compensate additional losses of optical components to configure WDM channels transmission.
- In Vancouver meeting, some contributions reported feasibility of SOA as an preamplifier. The results show that a SOA amplified receiver will be good to apply 100G EPON OLT.
 - http://www.ieee802.org/3/ca/public/meeting_archive/2017/03/liudekun_3ca_1_0317.pdf
 - http://www.ieee802.org/3/ca/public/meeting_archive/2017/03/yang_3ca_1_0317.pdf
- The previous contributions focused on improvement of a receiver sensitivity by using SOA under the small input power range.
- However, the received power of SOA can be high if an upstream signal experiences minimum channel insertion loss and a average launch power of ONU Tx is maximum.
- In this contribution, we will report experiment results when the received power of SOA is large.

Experiment setup



Channel insertion loss and average launch power of ONU Tx in 10G EPON

IEEE Std 802.3av Table 75-1—Power budgets

Description	Low Power Budget		Medium Power Budget		High Power Budget		Units
	PRX10	PR10	PRX20	PR20	PRX30	PR30	
Number of fibers	1						—
Nominal downstream line rate	10.3125						GBd
Nominal upstream line rate	1.25	10.3125	1.25	10.3125	1.25	10.3125	GBd
Nominal downstream wavelength	1577						nm
Downstream wavelength tolerance	-2, +3						nm
Nominal upstream wavelength	1310	1270	1310	1270	1310	1270	nm
Upstream wavelength tolerance	±50	±10	±50	±10	±50	±10	nm
Maximum reach ^a	≥10		≥20		≥20		km
Maximum channel insertion loss	20		24		29		dB
Minimum channel insertion loss	5		10		15		dB

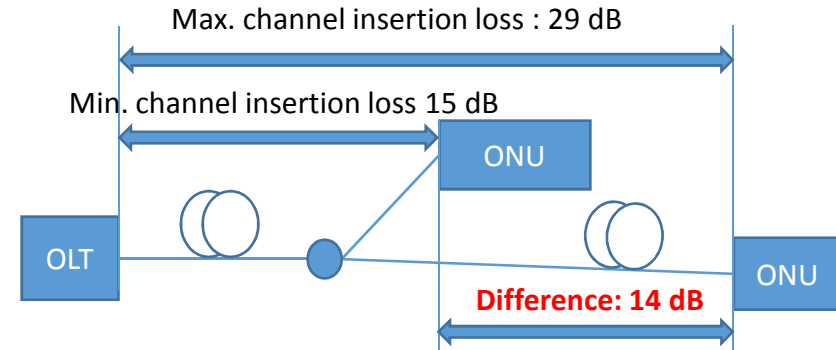
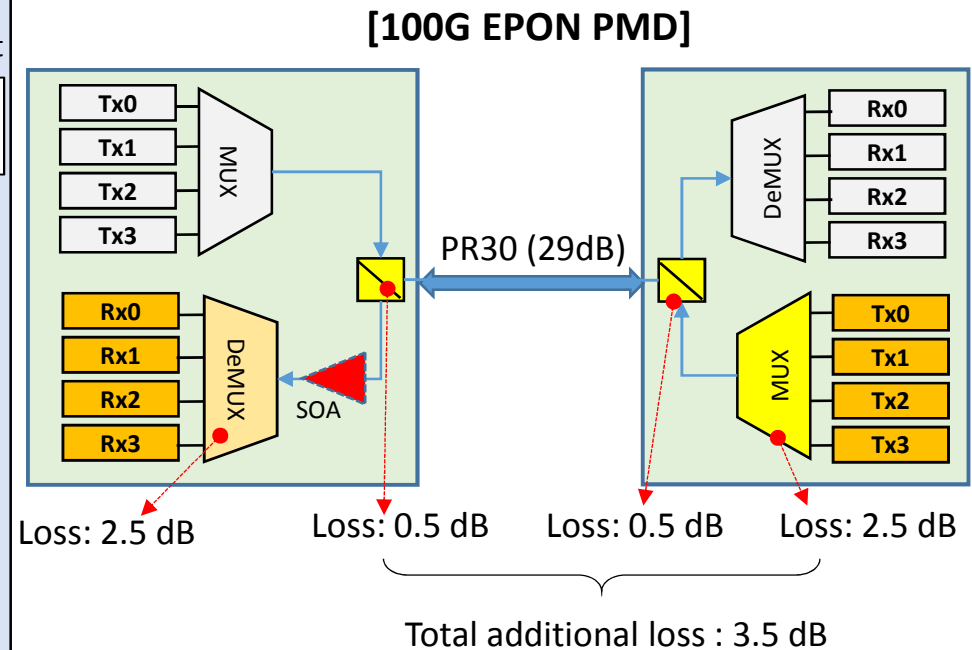
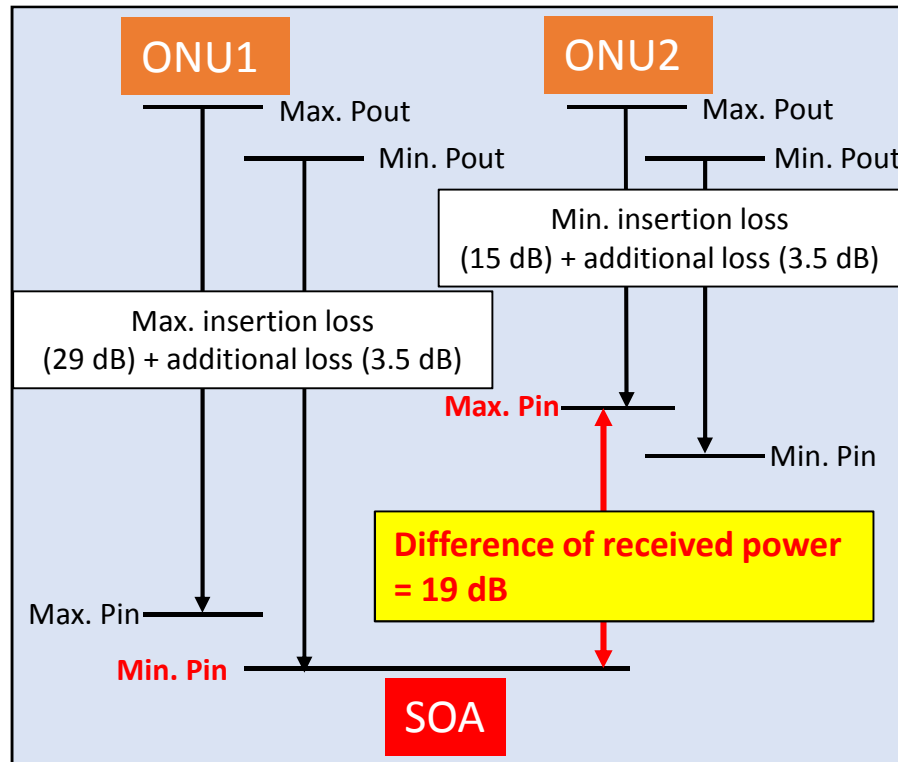


Table 75-8—PR type ONU PMD transmit characteristics

Description	10GBASE-PR-U1	10GBASE-PR-U3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1280	1260 to 1280	nm
Side Mode Suppression Ratio (min) ^a	30	30	dB
Average launch power (max)	4	9	dBm
Average launch power (min) ^b	-1	4	dBm
Average launch power of OFF transmitter (max)	-45	-45	dBm
Extinction ratio (min)	6	6	dB

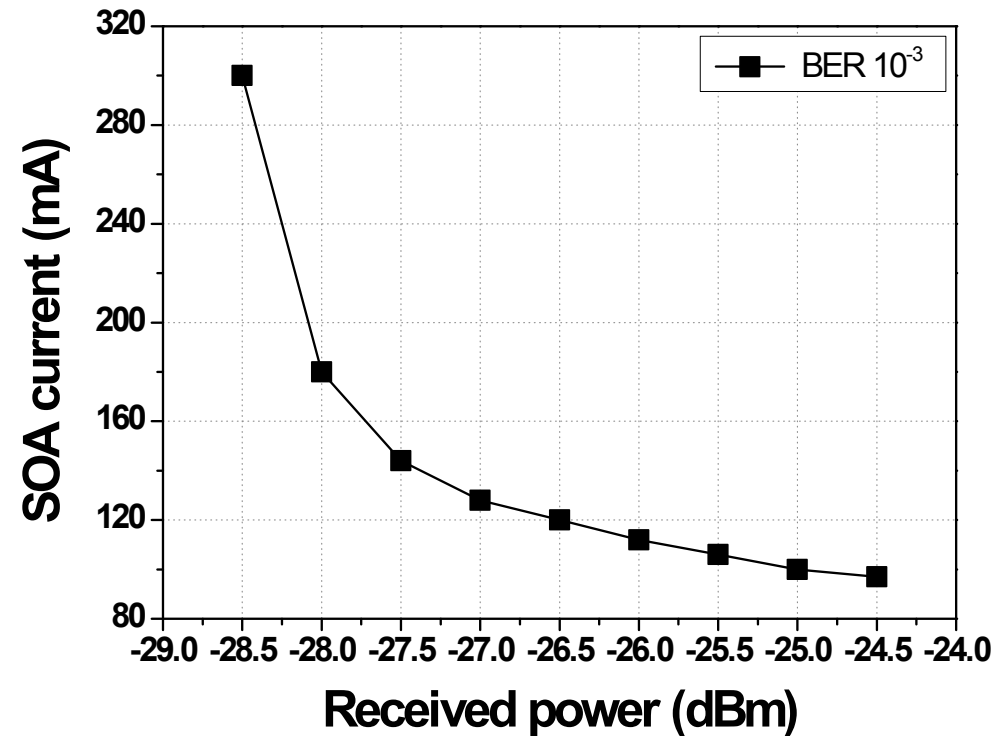
- 802.3av defined 14-dB difference of channel insertion loss between the max. channel insertion loss (29 dB) and the min. channel insertion loss (15 dB) to support flexible deployment on PON.
- It seems that 100G EPON PMD should allow the same difference of channel insertion loss to ensure co-existence with 10G EPON.
- 10G EPON ONU PMD transmit defined 5-dB difference of upstream signal power between the average launch power(max) and the average launch power(min).

Difference of received power to SOA



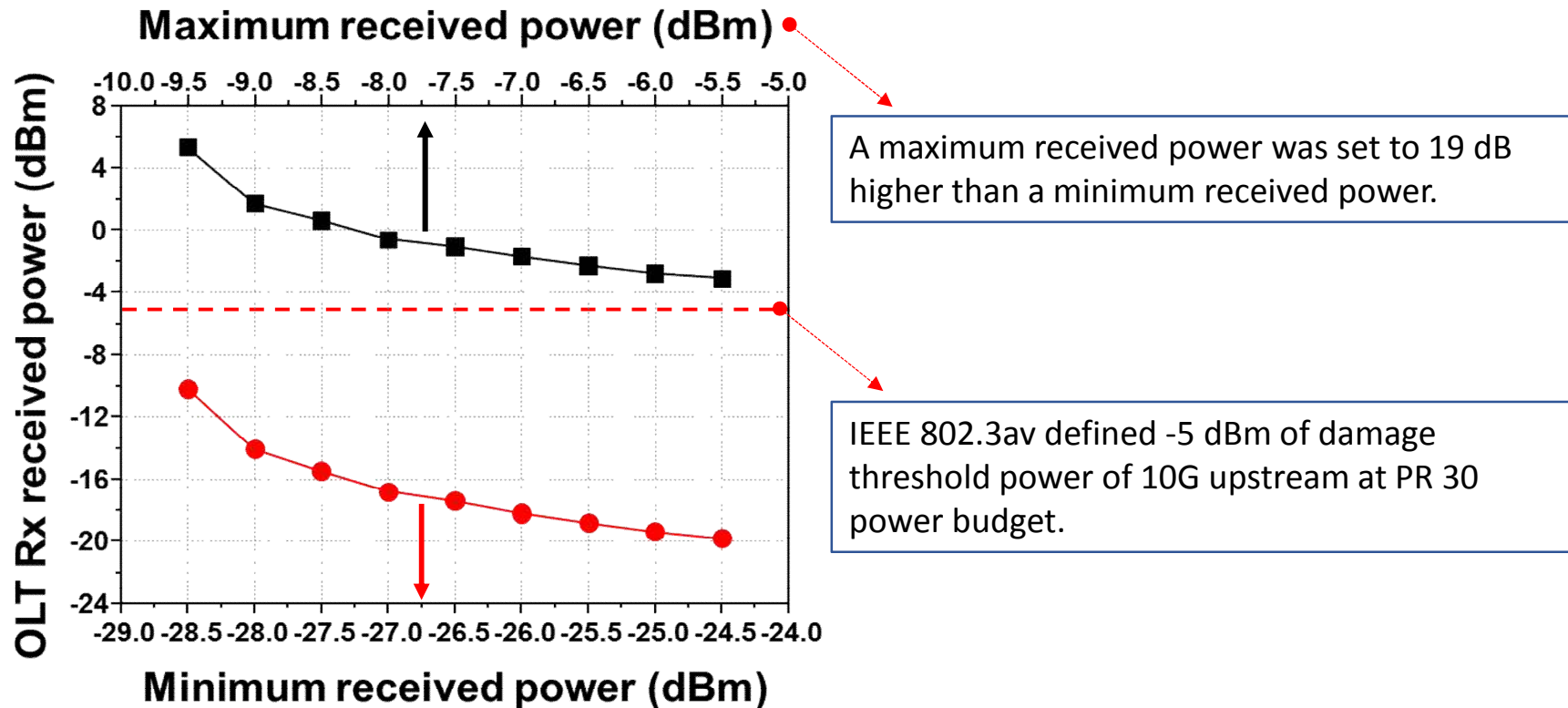
- Max. Pout - Min. Pout = 5 dB (as same as 802.3av PMD spec.)
- Min. Pin to SOA = Min. Pout of ONU – Max. insertion loss (29 dB) – Additional loss (3.5 dB) = Min. Pout of ONU – 32.5 dB
- Max. Pin to SOA = Max. Pout of ONU – Min. Insertion loss(15 dB) – Additional loss (3.5 dB) = Max. Pout of ONU – 18.5 dB
- Difference of received power to SOA = Min. Pin to SOA – Max. Pin to SOA = 19 dB

Minimum received power @ BER of 10^{-3}



- We investigated received powers and SOA operating current to archive BER of 10^{-3} by decreasing a received power to SOA.
- **-28.5 dBm is the minimum received power** with 300 mA of SOA operating current. We can not archive BER of 10^{-3} when the received power was smaller than -28.5 dBm due to a limited optical signal to noise ratio (OSNR).
- -28.5 dBm of minimum received power is corresponding to **+4 dBm of average launch power (min) of ONU Tx** considering 29 dB of maximum channel insertion loss and 3.5 dB of additional loss.

OLT Rx received power



- We measured OLT Rx received power after OLT DeMUX when SOA input power is a minimum received power or a maximum received power. Here, an operating current of SOA was set to the optimum current for each minimum received power.
- Measured OLT Rx received powers were over -4 dBm within measurement range of maximum received power from -28.5 dBm to -24.5 dBm. It will be harmful to OLT Rx considering overload power of APD based receiver.

Conclusion

- SOA amplified receiver is good for 100G EPON OLT even the upstream received power is lower than -28.5 dBm.
- However, the output power of SOA can be over overload power of 25G APD Rx when the upstream signal experiences the minimum channel insertion loss and average launch power of ONU is maximum.
- Further discussion is needed to reduce the output power of SOA.