SUMITOMO ELECTRIC

25G NRZ Transmission

Daisuke Umeda

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Sumitomo Electric Industries, LTD.

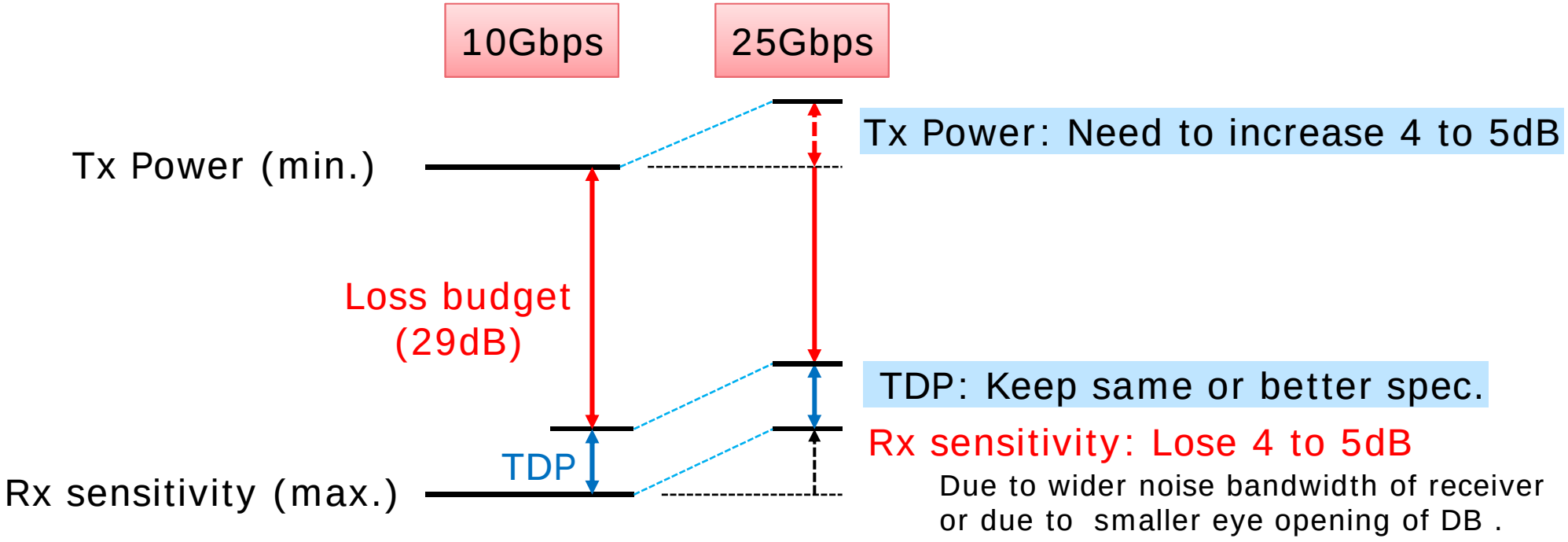
Introduction

- High power and low TDP transmitter is a key to achieve 29dB loss budget with 25Gbps/20km transmission.

- We reviewed 25.8G NRZ transmission performance of available 25G and 10G EML devices.

29dB loss budget with 25Gbps

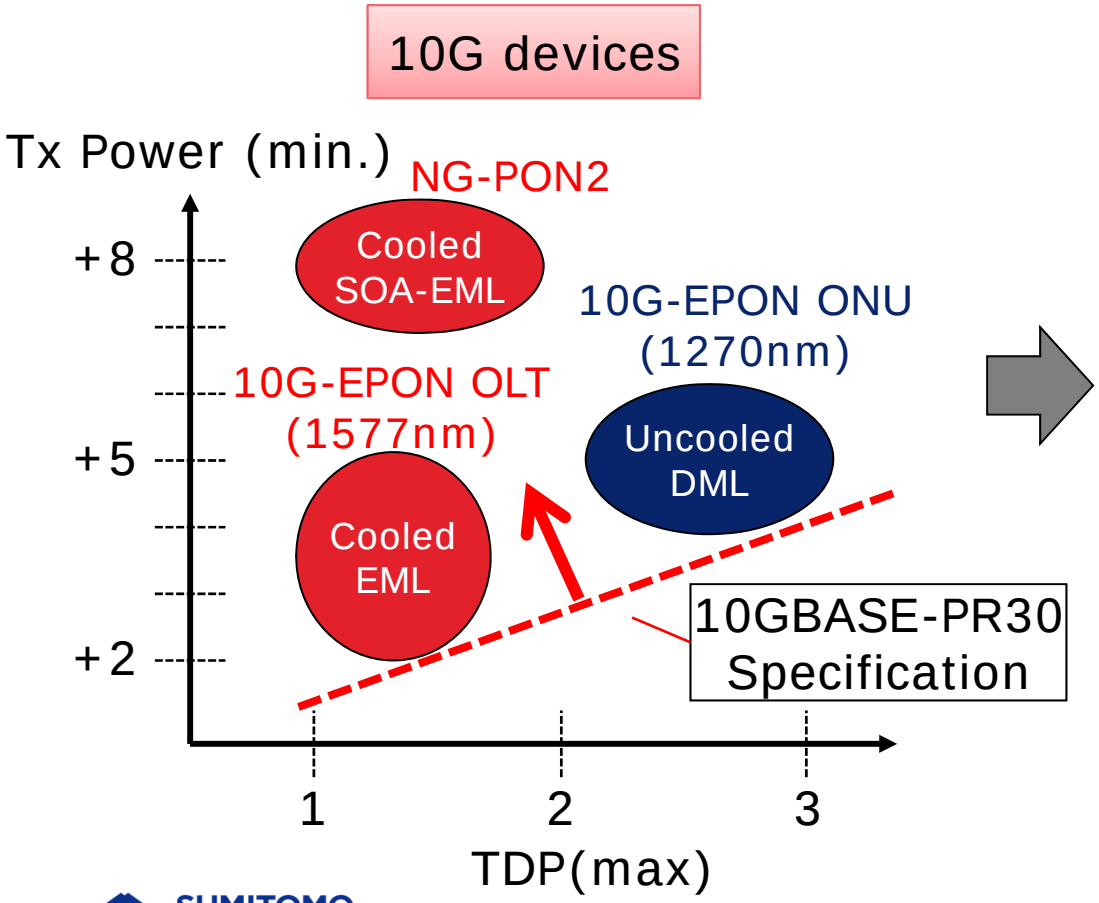
- Our target loss budget is 29dB, same as 10GBASE-PR30
- 25Gbps either NRZ or Duobinary (DB), we lose 4 to 5 dB receiver sensitivity from 10Gbps.
- We have to raise 4 to 5 dB transmitter output power and keep or reduce TDP.
  - ✓ Need high power and low TDP transmitter
  - ✓ Wavelength allocation is also important to achieve low TDP

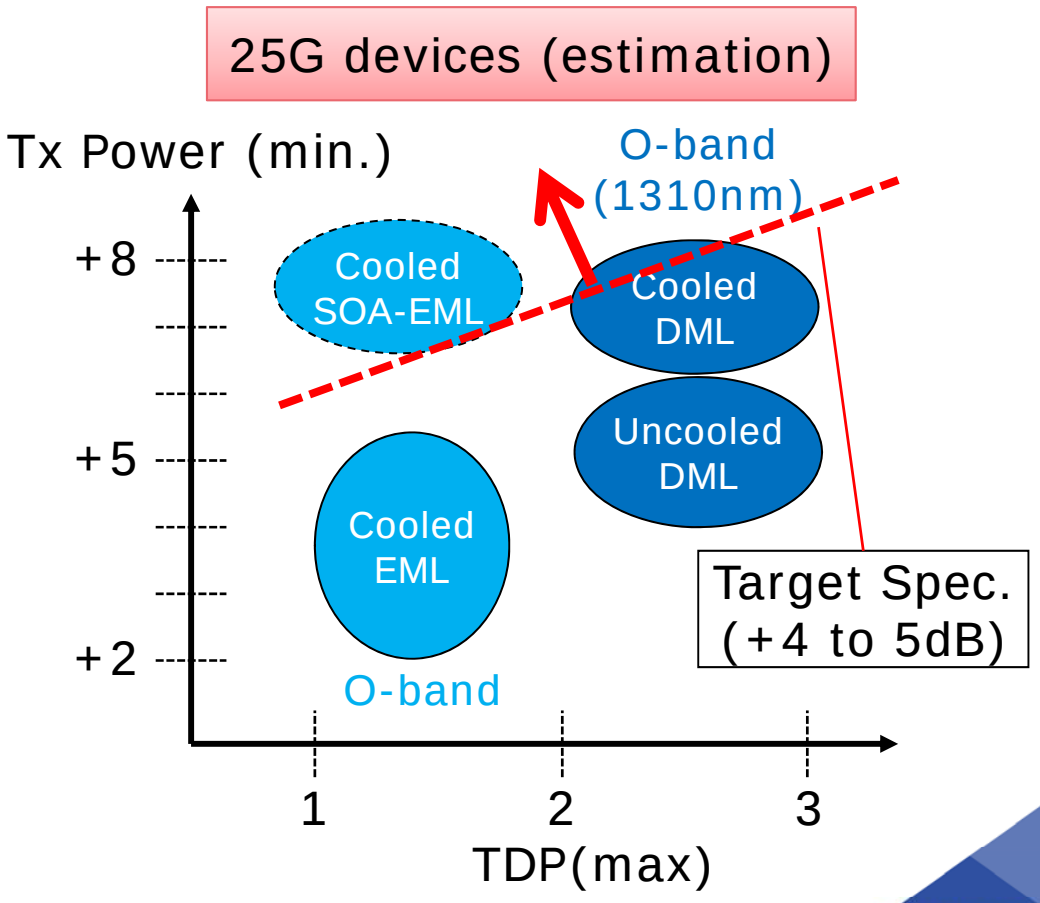


Tx Power & TDP of current Tx devices

- 10G-EPON(10Gbps) : Cooled EML (OLT) and Uncooled DML (ONU) are used.
- 100G-EPON(25Gbps) : Need higher power devices. 25G devices are in O-band now.

We reviewed 25G NRZ performance of available 10G and 25G EML devices.

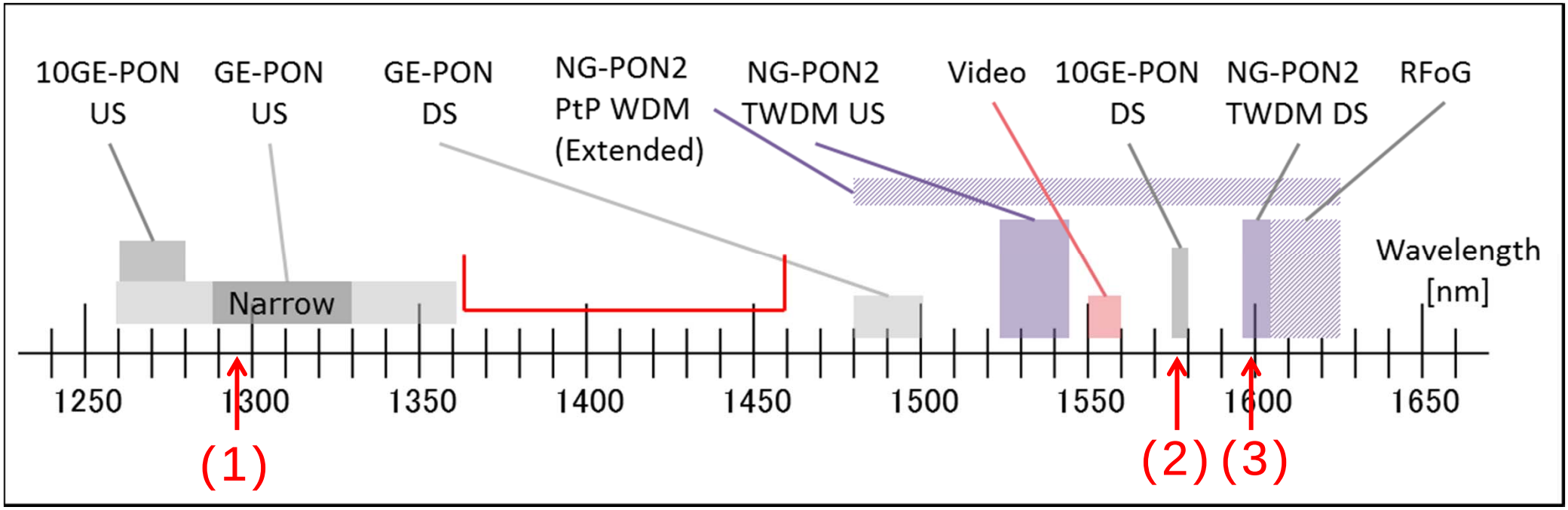




Evaluation Samples

1. 25G EML for 100G Ethernet (1295nm, LAN-WDM L0)
2. 10G EML for 10G-EPON OLT (1577nm)
3. 10G SOA-EML* for NG-PON2 OLT (1599nm)

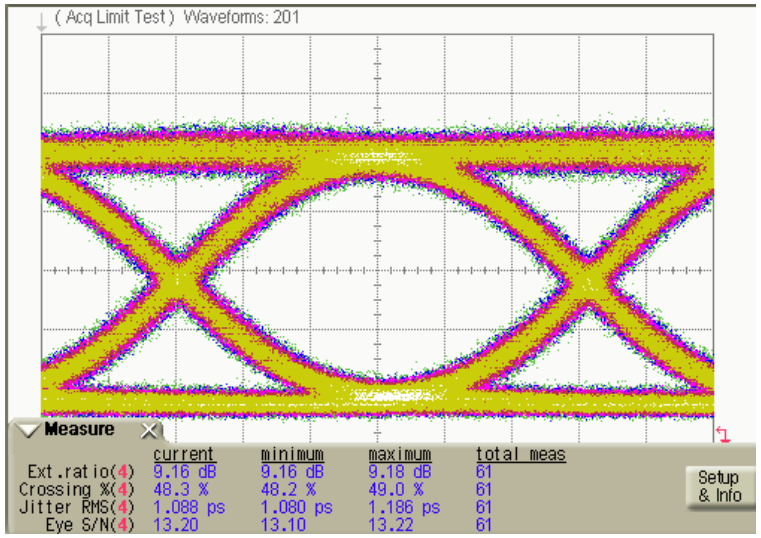
*SOA is integrated with EML. EML output is amplified by SOA.



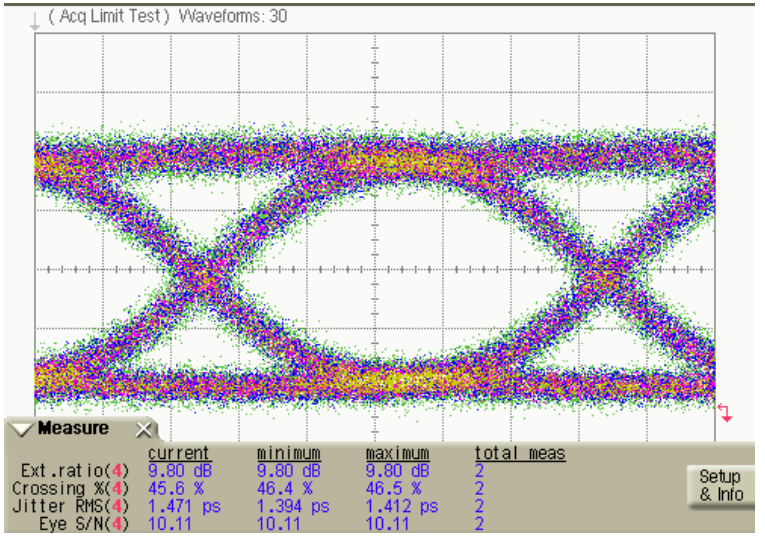
25G EML for 100G Ethernet (1295nm)

- Wavelength 1295.215nm, a high power sample
- Launch power (ave) +5.6dBm, Extinction Ratio 9.1dB
- Target launch power of +6 to +8bm is a challenge.

25.8G Optical Tx Eye (0km)



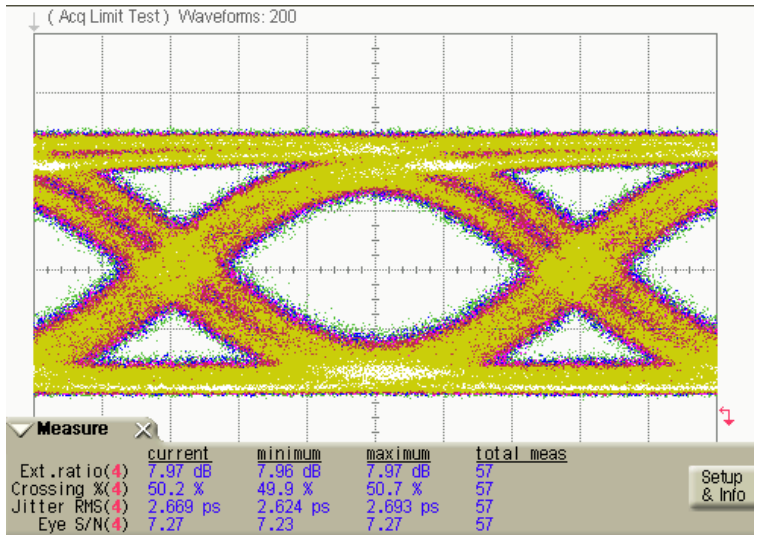
25.8G Optical Tx Eye (20km)



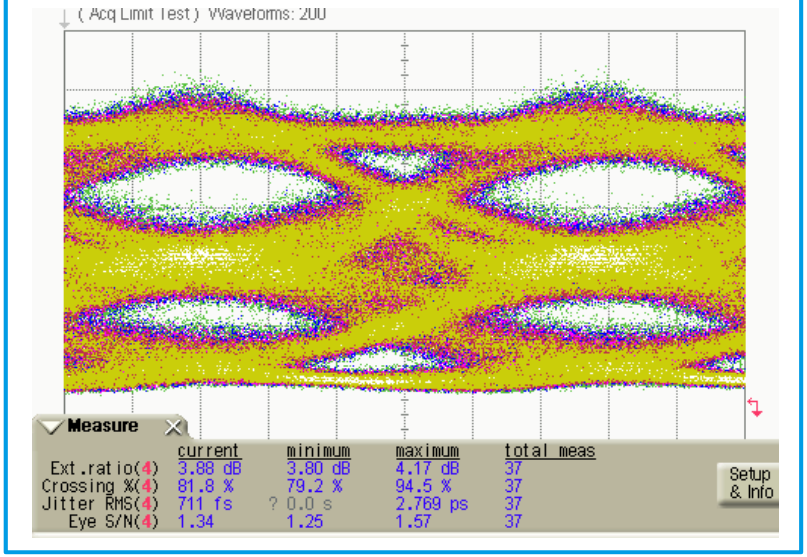
10G EML for 10G-EPON OLT (1577nm)

- Wavelength 1576.832nm
- Launch power (ave) +6.4dBm, Extinction Ratio 8.0dB
- 10G EML works at 25.8Gbps. The bandwidth is limited by the package. Need to optimize the package design.
- NRZ/20km transmission at 1577nm is a challenge.

25.8G Optical Tx Eye (0km)



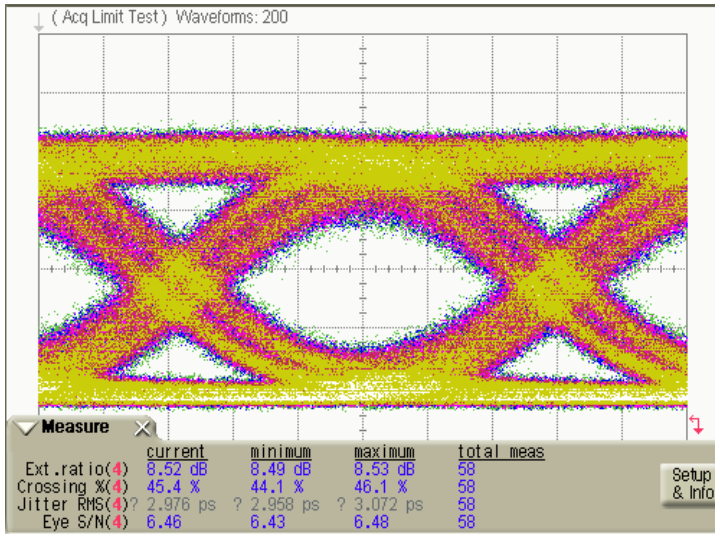
25.8G Optical Tx Eye (20km)



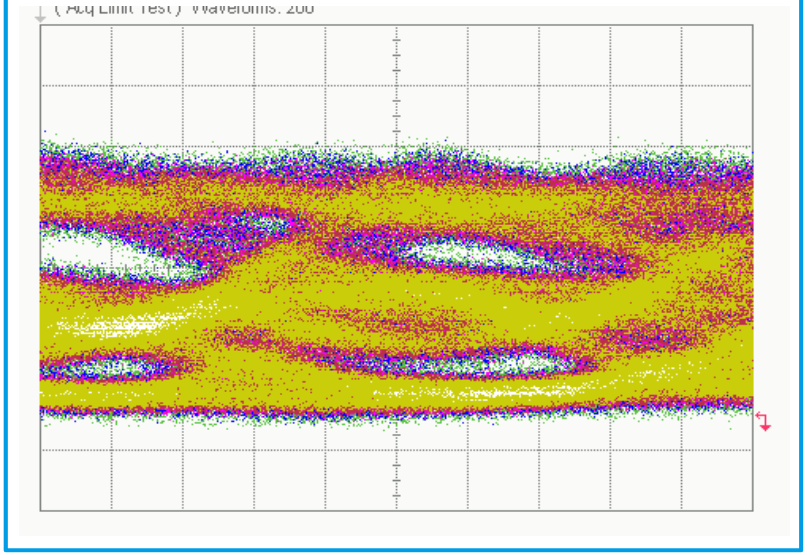
10G SOA-EML for NG-PON2 OLT (1599nm)

- Wavelength 1598.738nm
- Launch power (ave) **+9.3dBm**, Extinction Ratio 8.5dB
- SOA-EML works at 25.8Gbps and the power is good. Need to optimize the package.
- SOA-EML is a candidate for high power transmitter.

25.8G Optical Tx Eye (0km)

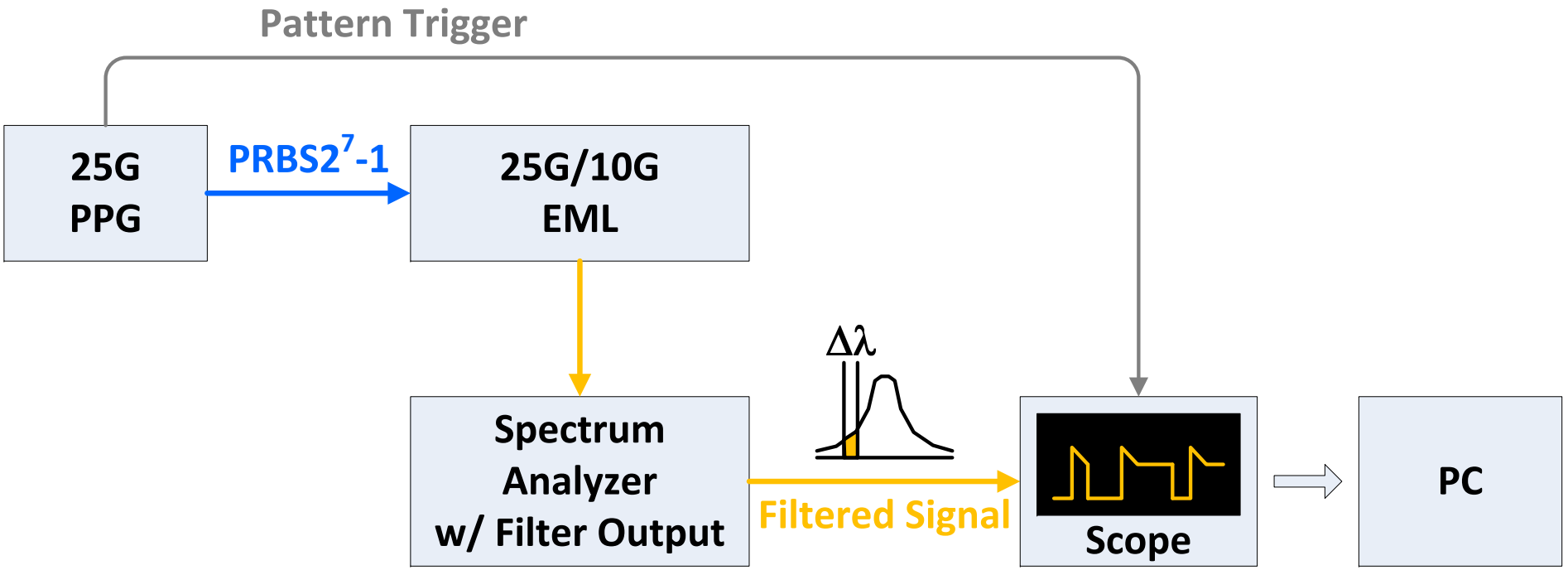


25.8G Optical Tx Eye (20km)



Time Resolved Chirp (TRC)

- TRC is a method to estimate TDP based on chirp measurement.
- Measure the time variation of the intensity and the frequency of a transmission by monitoring the filtered signal and simulate the waveform after transmission.
- It's possible to estimate TDP in other wavelengths.

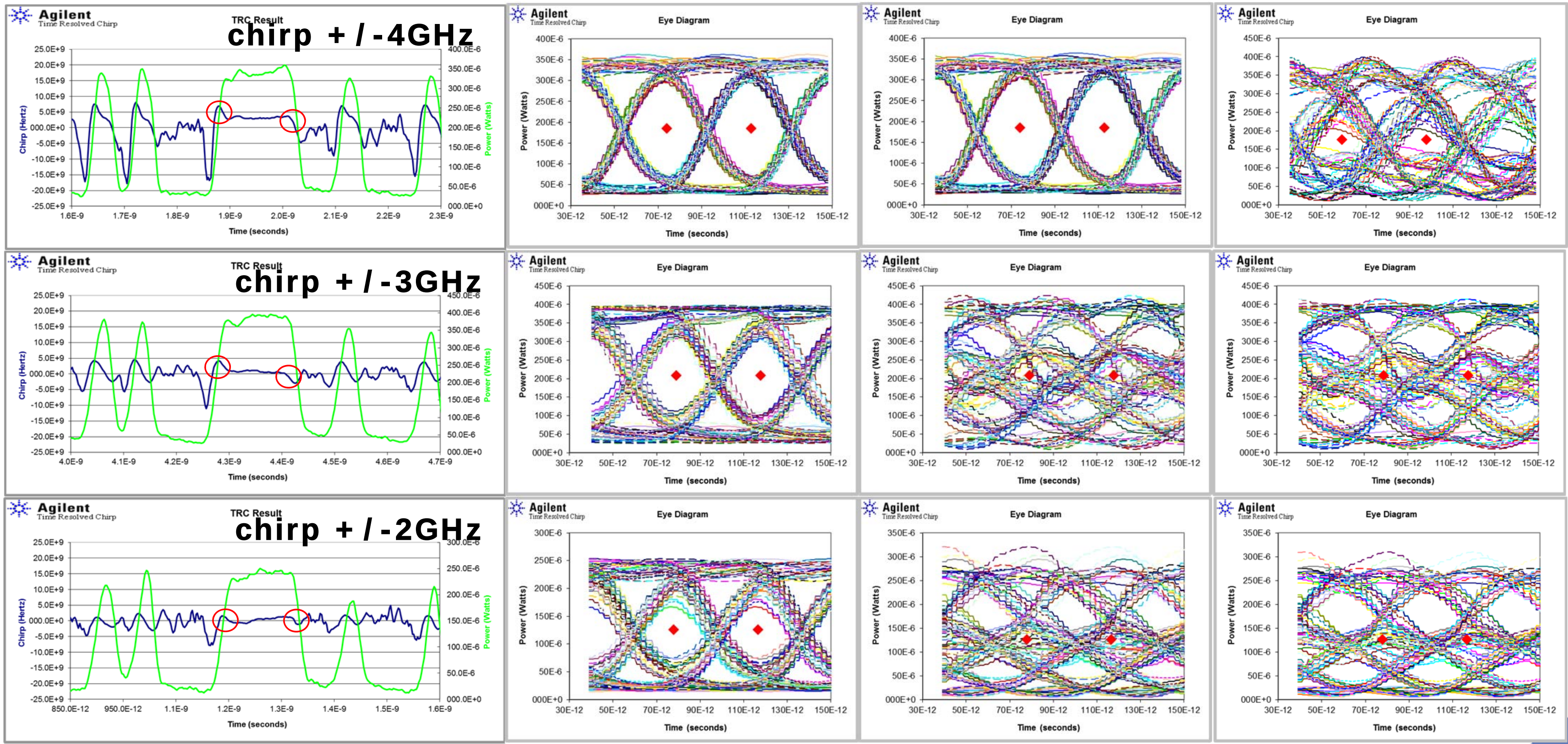


TRC Results

- Measured transient chirp is +/-4GHz to +/-2GHz.
- SOA-EML achieves high power with reasonable chirp.

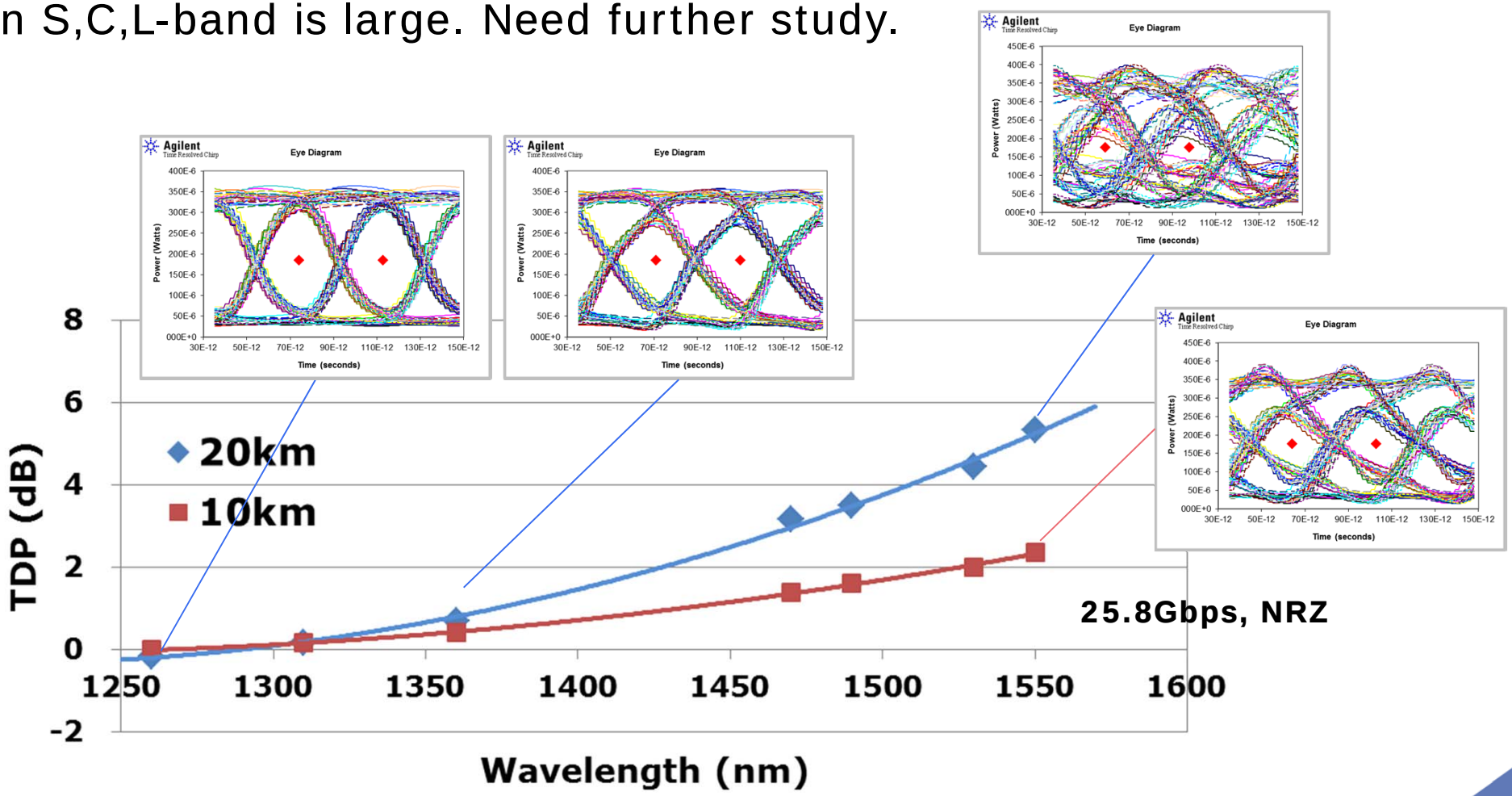
Transient **Power** and **Chirp** | Measured Eye (0km) | Sim. Eye (20km) | Sim. Eye (1550nm,20km)

Rows: 25G EML (1295nm); 10G-EPON OLT EML (1577nm); 10G SOA-EML (1599nm)



Simulated TDP with 25G NRZ

- Simulated TDP at 20km and 10km based on measured 25G-EML chirp
- TDP in O-band is enough low. (<1dB)
- TDP in S,C,L-band is large. Need further study.



Summary

- SOA-EML is a good candidate for 25G NRZ transmission to achieve 29dB budget.
- TDP with 25G NRZ is low in O-band. Need efficient use of O-band.
- TDP with 25G NRZ in S,C,L-band is challenging. Need further study to compensate dispersion.

Thank you