100G-EPON

Proposal for 25Gb NRZ PMD parameters

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Introduction

This presentation proposes initial 25G NRZ PMD parameters for PR30 budget class based on O band wavelength plan.

- To reuse 100G Ethernet components to a largest extent
- To enable a simple system implementation
- To achieve highest performance-cost ratio using available technology

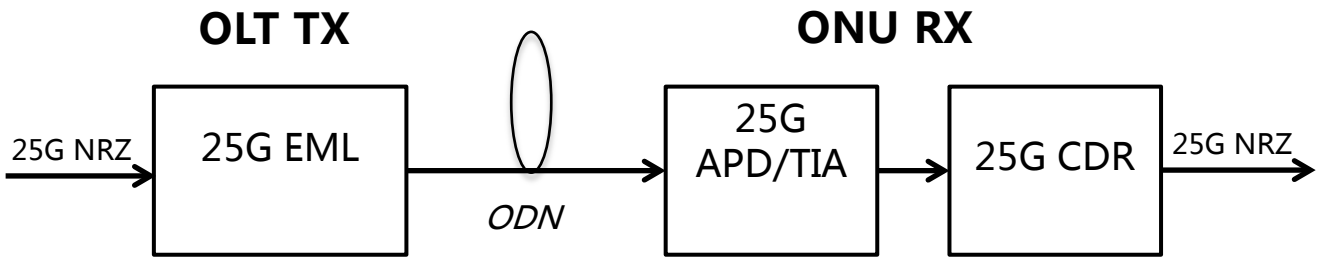
Downstream Optical Configurations

Uses wavelength above 1340nm in O+ band

- At least 800G Hz spacing in case 4 wavelengths

25G EML can be used in OLT transmitter for high ER and low TDP

25G APD can be used in ONU receiver for high sensitivity



Downstream Optical Characteristics

OLT PMD transmit		ONU PMD receive	
Extinction ratio (min)	6 dB	BER	10^{-3}
Average launch power (max)	6 dBm		
Average launch power (min)	3 dBm	Receiver sensitivity (max)	-27 dBm
Launch OMA (min)	4.91 dBm	Receiver sensitivity OMA (max)	-25.09 dBm
TDP (max)	1 dB		

- 3-6 dBm of launch power for 25G EML is achievable
- -27dBm sensitivity using 25G APD is feasible based on results from multiple contributions
- AVP_{min} and OMA_{min} are calculated for ER=9dB
- 1dB TDP for EML in O+ band is appropriate, higher TDP can be compensated by increasing the transmitter power

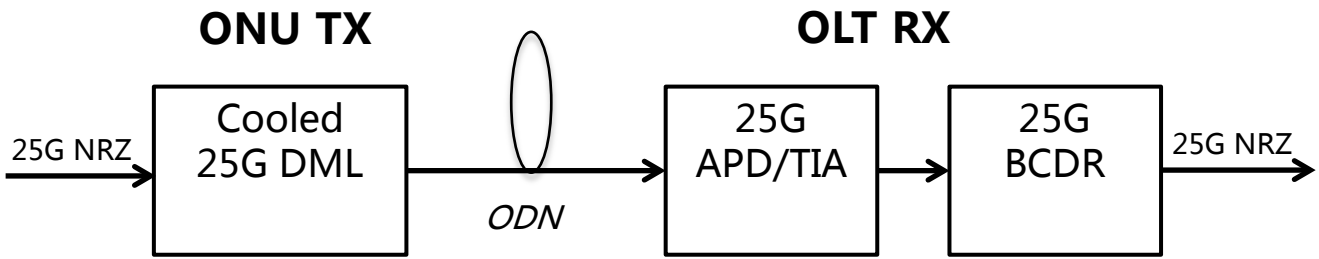
Upstream Optical Configurations

Uses wavelength near zero dispersion in O- band

- At least 800G Hz spacing in case 4 wavelengths

Cooled 25G DML can be used in ONU transmitter for low cost

25G APD can be used in OLT receiver for high sensitivity



Upstream Optical Characteristics

ONU PMD transmit		OLT PMD receive	
Extinction ratio (min)	6 dB	BER	10^{-3}
Average launch power (max)	9 dBm		
Average launch power (min)	5 dBm	Receiver sensitivity (max)	-25 dBm
Launch OMA (min)	5.78 dBm	Receiver sensitivity OMA (max)	-24.22 dBm
TDP (max)	1 dB		

- 5-9 dBm of launch power for 25G DML is achievable
- -25dBm sensitivity using 25G APD is feasible
- 1dB TDP for DML in O- band is appropriate, higher TDP can be compensated by increasing the transmitter power

Possible Improvements

In case of 100G-EPON, at least 4 dB more budgets are required because of WM insertion loss

- Enhanced FEC can further provide higher power budget
- Higher output power via high light coupling efficiency may also possible
- Receiver sensitivity can also be increased by using SOA preamplifier
- Simple equalization at receiver may help improve sensitivity
- Others?

Summary

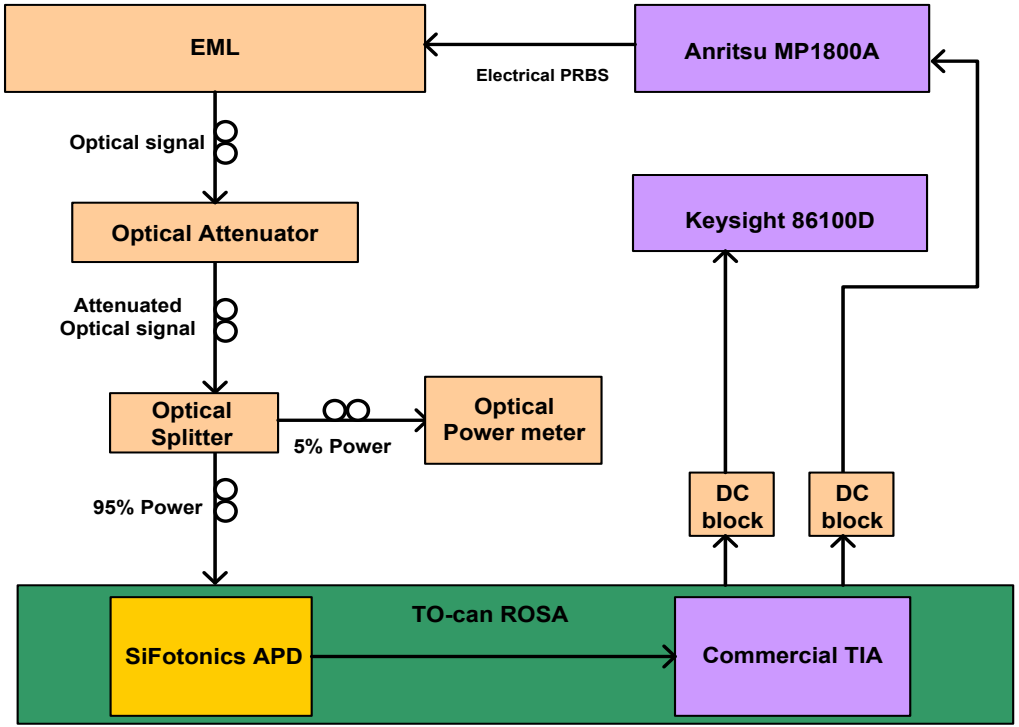
Initial 25G NRZ PMD parameters are proposed

Further suggestions are expected

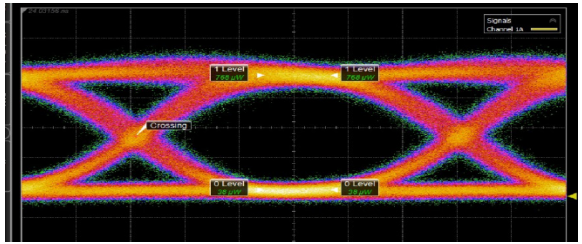
Thank you

Back up

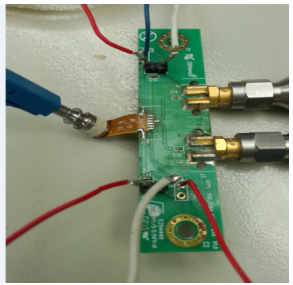
25G APD TO-can ROSA + LA for 25G PON



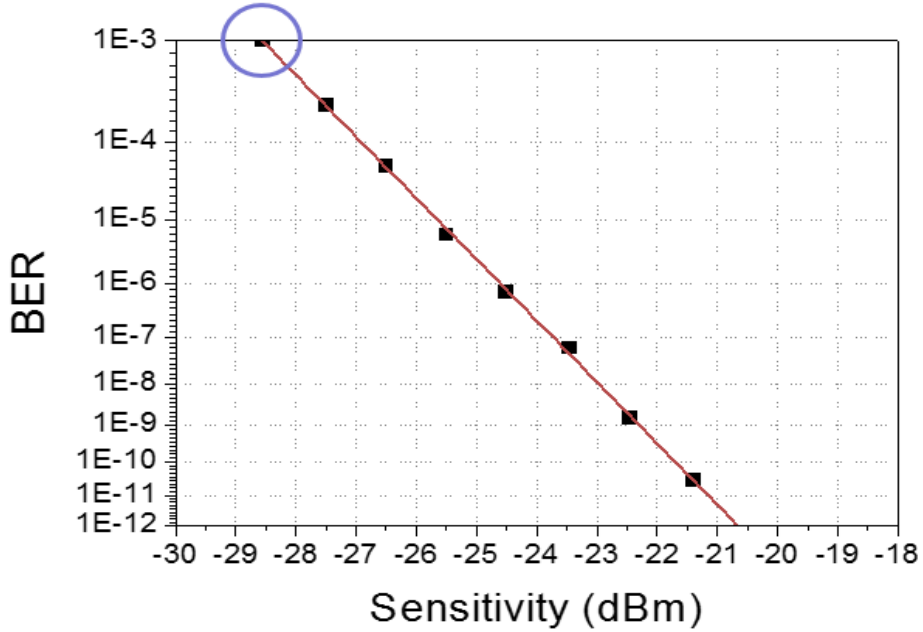
Tx optical eye-diagram



TO-can APD ROSA on EVB

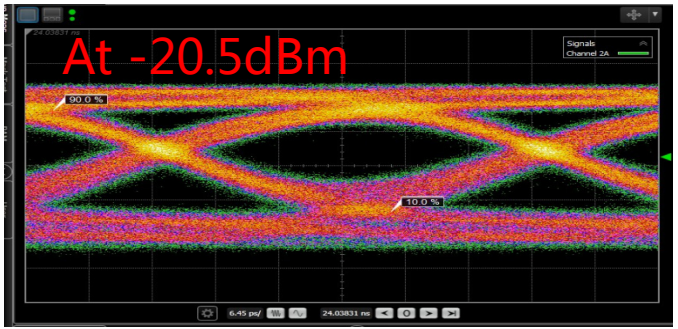


TO-can type 25G APD ROSA sensitivity and output eye-diagram



Back-to-back sensitivity of Ge/Si APD TO-can ROSA (λ=1309.14nm, ER=9.5dB, 25.78Gbps, 2^31-1, NRZ, w/o CDR, 25ºC)

Rx electrical eye-diagram



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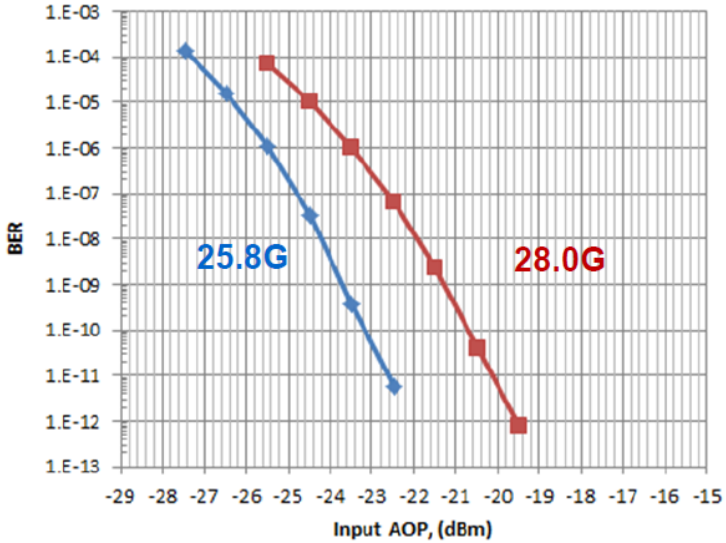
EML TX, APD RX BER



BtB Input AOP @ 5e-5 BER	
25.8G	28.0G
-27.0dBm	-25.4dBm

- λ = 1310nm
- TX ER = 10.7
- MM = 38%

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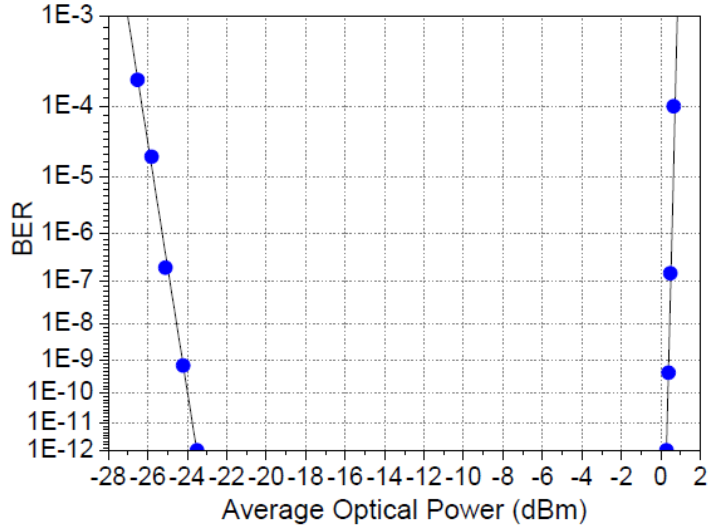
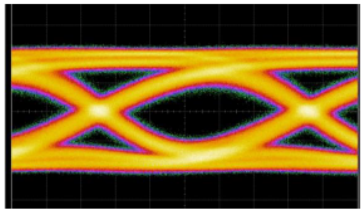
Sensitivity and Overload



APD receiver output eye-diagram at -22.5dBm



Test conditions: back-to-back, 1300nm, ER=9.5dB, 25.78Gb/s, NRZ, PRBS=2^31-1

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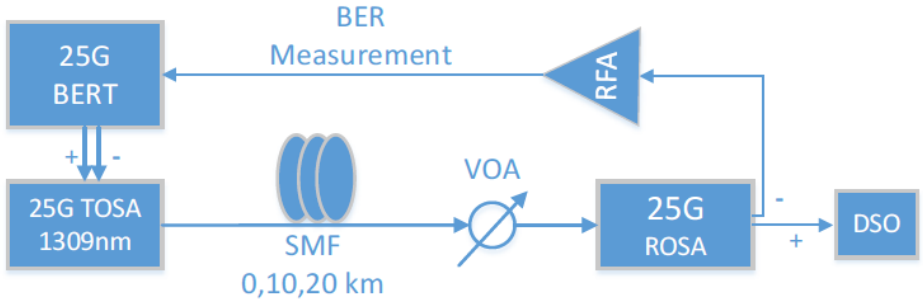
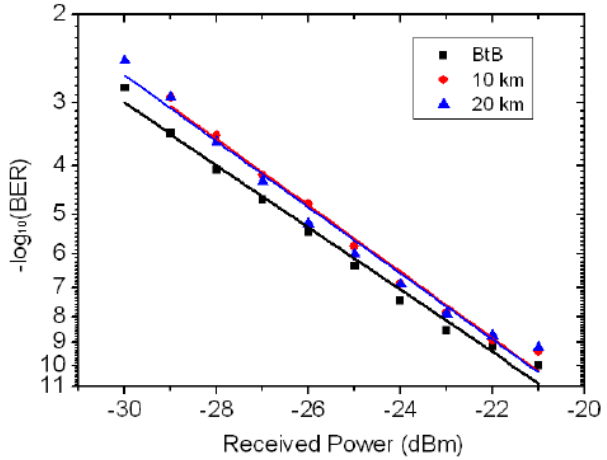
Experimental setup & results of 25G EML & 25G APD





- 25G EML TOSA at 1309nm,
- Detect by 25G APD/TIA ROSA
- DSO for eye monitoring
- BER is measured by 25Gb BERT

Performance of 25G APD is good enough that you really don't want to miss it!

APD chip is ready for commercial!

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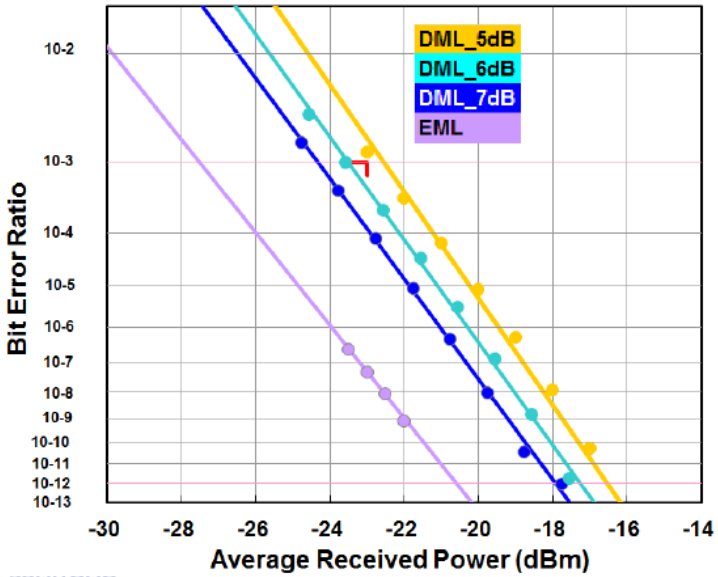
Measured BER with APD Rx

- Min. sensitivity -23.5dBm @1e-3 BER with DML (ER is tuned to 5.9dB)
- Min. sensitivity -27.5dBm @1e-3 BER with EML (ER is 10.0dB)

Notes; Sensitivity would be improved 1.5dB from this result by ROSA assembly optimization or simple equalization.



Measured at room temperature

5dB worse than 10G w/DML