Technical feasibility of 25G/10G asymmetric transmission

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A single wavelength pair operating at 25/10Gbps asymmetric

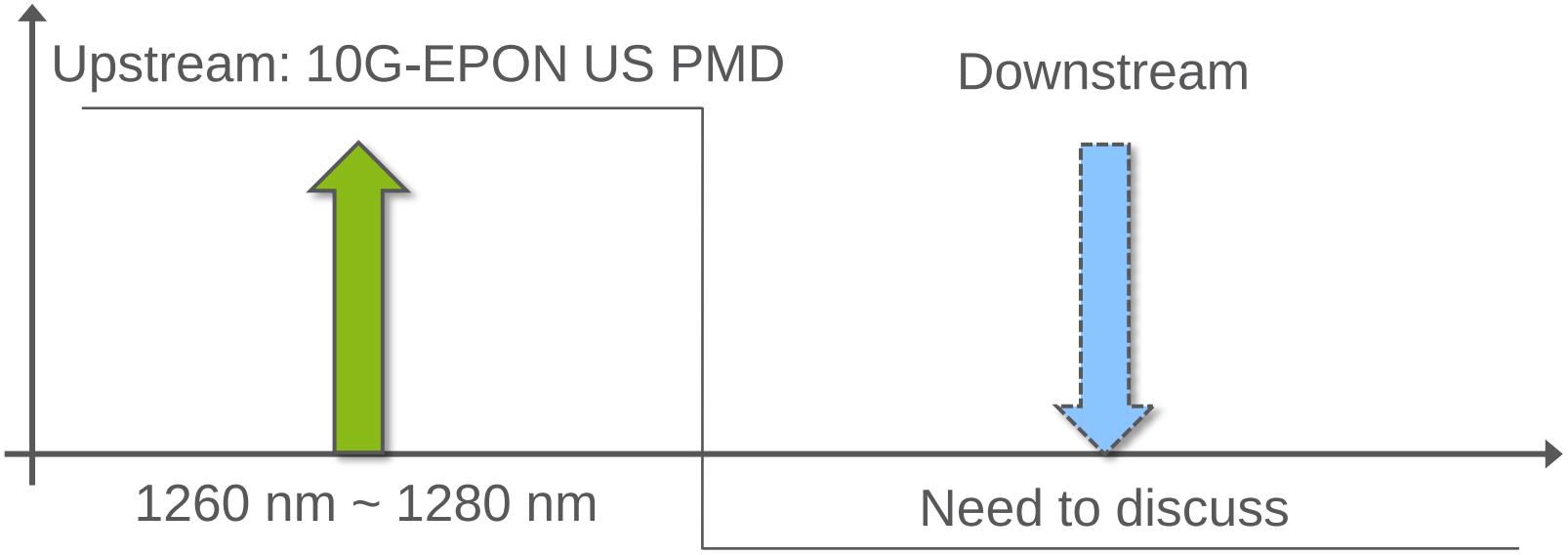
Motion #3

The P802.3ca standard shall enable an implementation using a single wavelength pair operating at 25Gbps symmetric. The P802.3ca standard shall enable an implementation using a single wavelength pair operating at 25/10Gbps asymmetric (reusing 10G-EPON US).

Moved: Jorge Salinger Seconded: Kevin Noll

For: 18 Against: 0 Abstain: 2

Technical ≥ 75% Passed



[1] minutes_unapproved_3ca_0116, Atlanta meeting, 2016

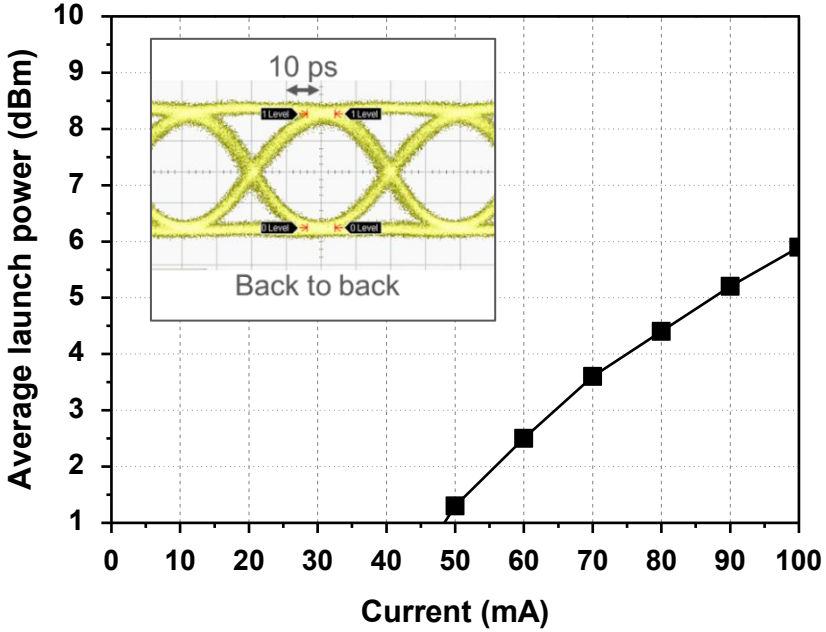
Advantages of using O-band for 25G downstream

- No need to compensate dispersion even for DML transmitter with NRZ modulation.
- O-band transmission is mature technology and available today for 100GE.
- Easy to achieve and available as laser diode from multi-vendor.
- Previous contributions proposed using O-band for the 25G downstream [1-2].

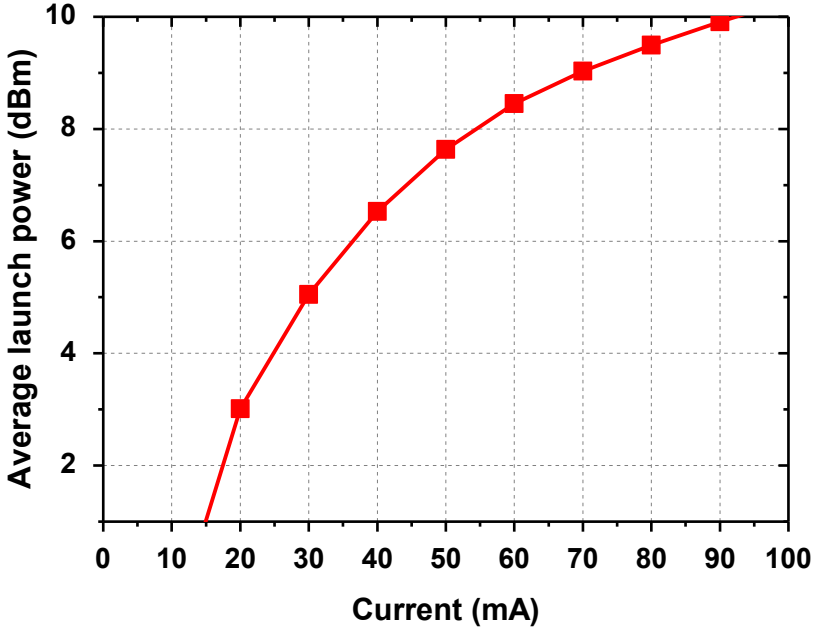
[1] Towards building a low cost 25G “base PHY” for 100G EPON, http://www.ieee802.org/3/ca/public/meeting_archive/2016/01/harstead_3ca_1b_0116.pdf
[2] O-band DWDM NRZ transmission of 100G-EPON, http://www.ieee802.org/3/ca/public/meeting_archive/2016/01/lee_3ca_01a_0116.pdf

25G downstream Tx performance

25G EML of LAN WDM



Cooled 25G DML of 1310 nm (CWDM)



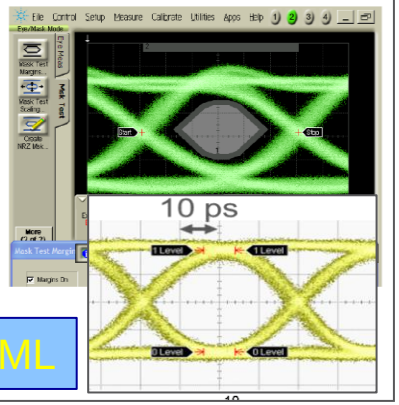
- Commercial single-channel 25G EML and DML were tested at room temperature (+25 °C).
- EML output power can be over + 5 dBm with clearly opened Eye diagram.
- DML output power shows 4 dB higher than that of EML at 100 mA operating current.

Reported results of 25G DML lasers

25Gb/s DML Lasers Status [1]

- **Requirements**
  - 25Gb/s Directly modulated DFB
  - Uncooled operation (-5C to +85C)
  - Low drive current
- **Current status – two vendors have samples available now:**
  - 18~22% Eye Margin at 25°C
  - 15~20% at 50°C
  - Good eyes up to 85°C
- **Ongoing work**
  - Improve slope efficiency
  - Improve high temp performance

25°C 60mA bias
2^{31}-1 PRBS

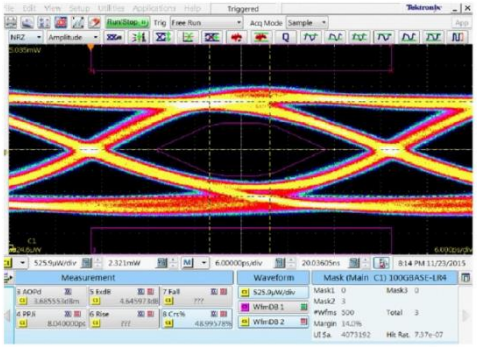


EML

Test result [2]

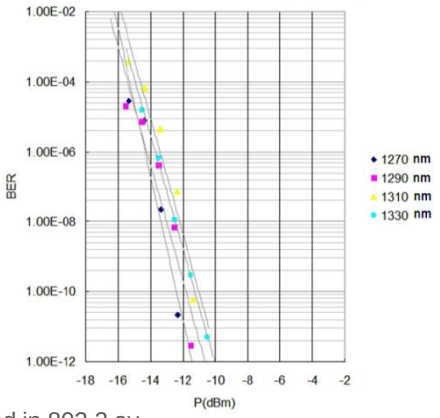
◆ Test results of DML+PIN scheme

DML Transmitter Eye Diagram(70°C)



OMA: 3.68dBm
ER: 4.64dB
Mask margin>14%

PIN Receiver Sensitivity (70°C)



*6 dB ER is required in 802.3 av.

: about -10dBm

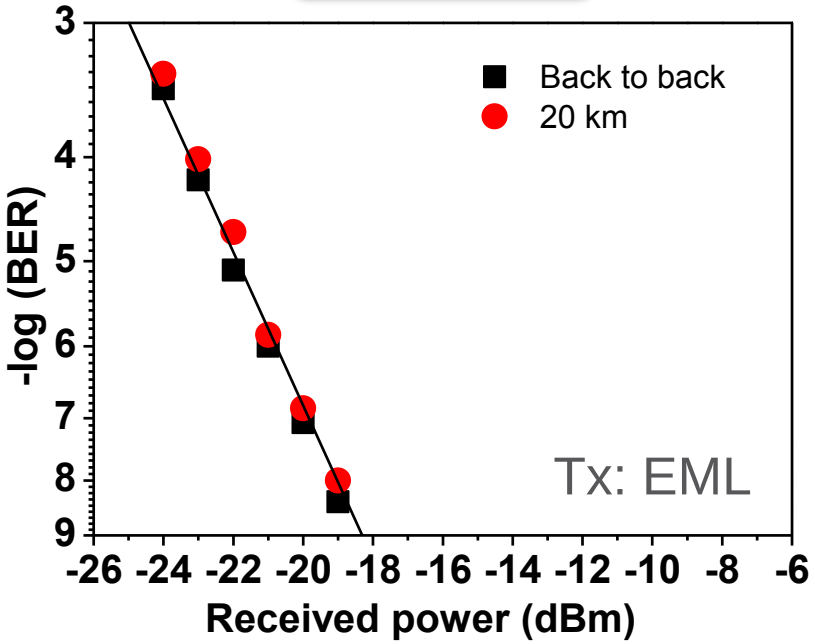
6

- Using 25G DML (CWDM) for 100GE application was proposed at IEEE 100GE TF since cost of laser diode, packaging, and IC is lower than that of EML.
- Reported DML modulation performances such as ER, rising time and falling time, jitter are not better than them of EML.
- But, usage of DML for OLT has its own advantages such as low power consumption and high output power.

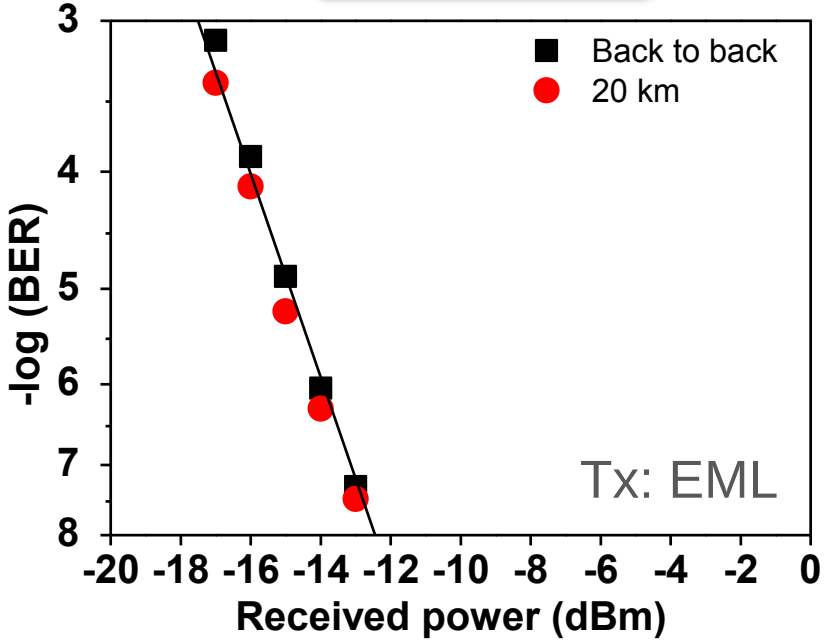
[1] Low Cost Component Feasibility for 100GBASE-CWDM CFP4, http://www.ieee802.org/3/bm/public/jul13/wli_01_0713_optx.pdf
[2] 25Gb/s Single Lane SMF 10km PMDs Technical Feasibility, http://www.ieee802.org/3/25GSMF/public/1601_Atlanta/cao_25gsmf_01_0116.pdf

25G downstream Rx performance

APD receiver



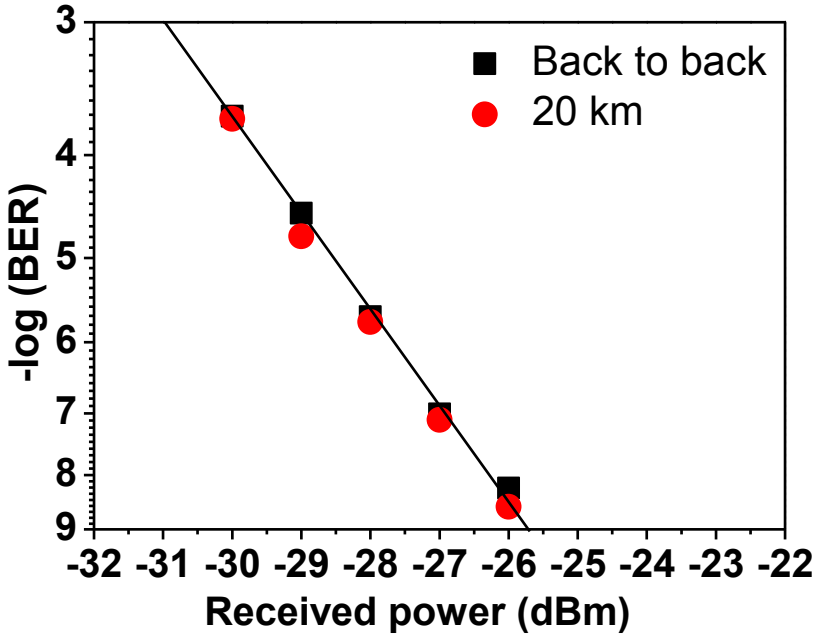
pin PD receiver



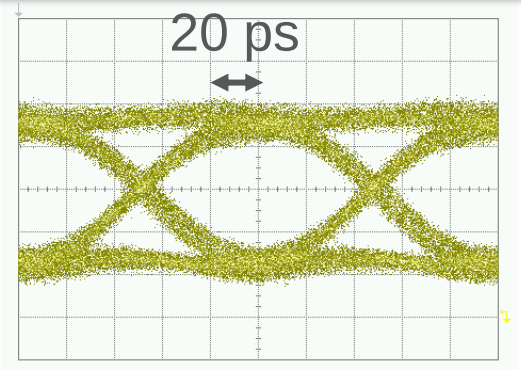
- Power penalties were negligible over 20 km transmission in O-band for both ADP and pin PD cases.
- PON Link budget is 30 dB with using EML Tx at OLT and APD Rx at ONU.

Parameter	Value	Unit
Tx wavelength	1309.08	nm
Tx output (P_{avg})	5	dBm
Tx ER	7	dB
Rx sensitivity (BER =10^{-3})	APD : -25	dBm
	Pin PD : -17.5	dBm

10G upstream performance



10G ONU burstmode DML



Back to back

- Power penalty of 10G BM upstream was negligible over 20 km transmission in O-band.
- Link budget will be over 30 dB with using DML Tx at ONU and APD Rx at OLT.

Parameter	Value	Unit
Tx wavelength	1270	nm
Tx output (P_{avg})	4	dBm
Tx ER	6	dB

Conclusions

- To archive PR30 (29dB) link margin without using an amplifier a scheme of 25G EML at OLT and 25G APD at ONU can be one of good solutions.
- DML has a merit of low cost that is important for PON system.
- Further discussion about link power penalty, required ER etc. should be needed.

Thank you!