100GE over SMF Using 4x10G DML and 4x25Gb/s Linear Equalizers

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Supporters

- Kai Cui, Huawei
- Frank Chang, Vitesse
- Ahmet Balcioglu, Hittite

Introduction

- The feasibility of using uncooled 1300nm CWDM 10G DML and 25G equalizer to carry 25Gb/s data is explored
- Potential for 4x25Gb/s short reach SMF (<2km) application

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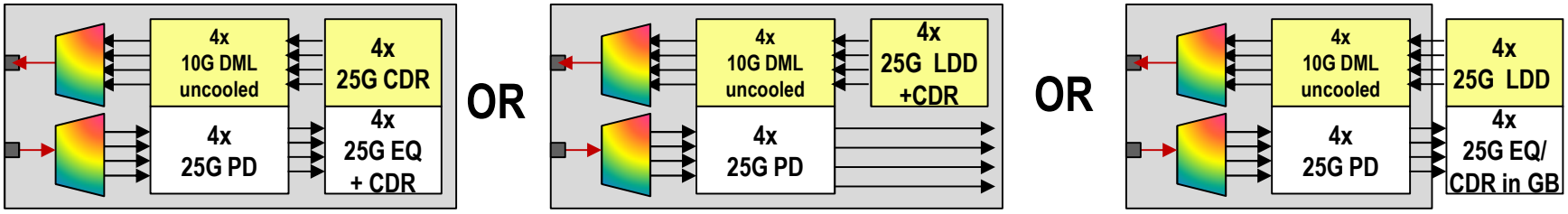
Advantages of the New Approach

- **Simple, low cost, low power consumption**
- **Reuse most of the components from today's 40GBASE-LR4 and 100GBASE-LR4**
  - CWDM mux & demux (20nm spacing)
  - 4x25Gb/s ROSAs
  - 4x25Gb/s CDRs
    - *Possible half re-timed at TX only, or un-retimed*
- **Leverage the potential volume use of 25Gb/s equalizers, which will be integrated in a CDR or a gearbox, and will be used for MMF and Cu**
- **Can fit into small modules such as QSFP or CFP2**
- **Wavelengths compatible with 40G-LR4 for dual speed operations up to 2 km**



(EQ/CDR in external gearbox)

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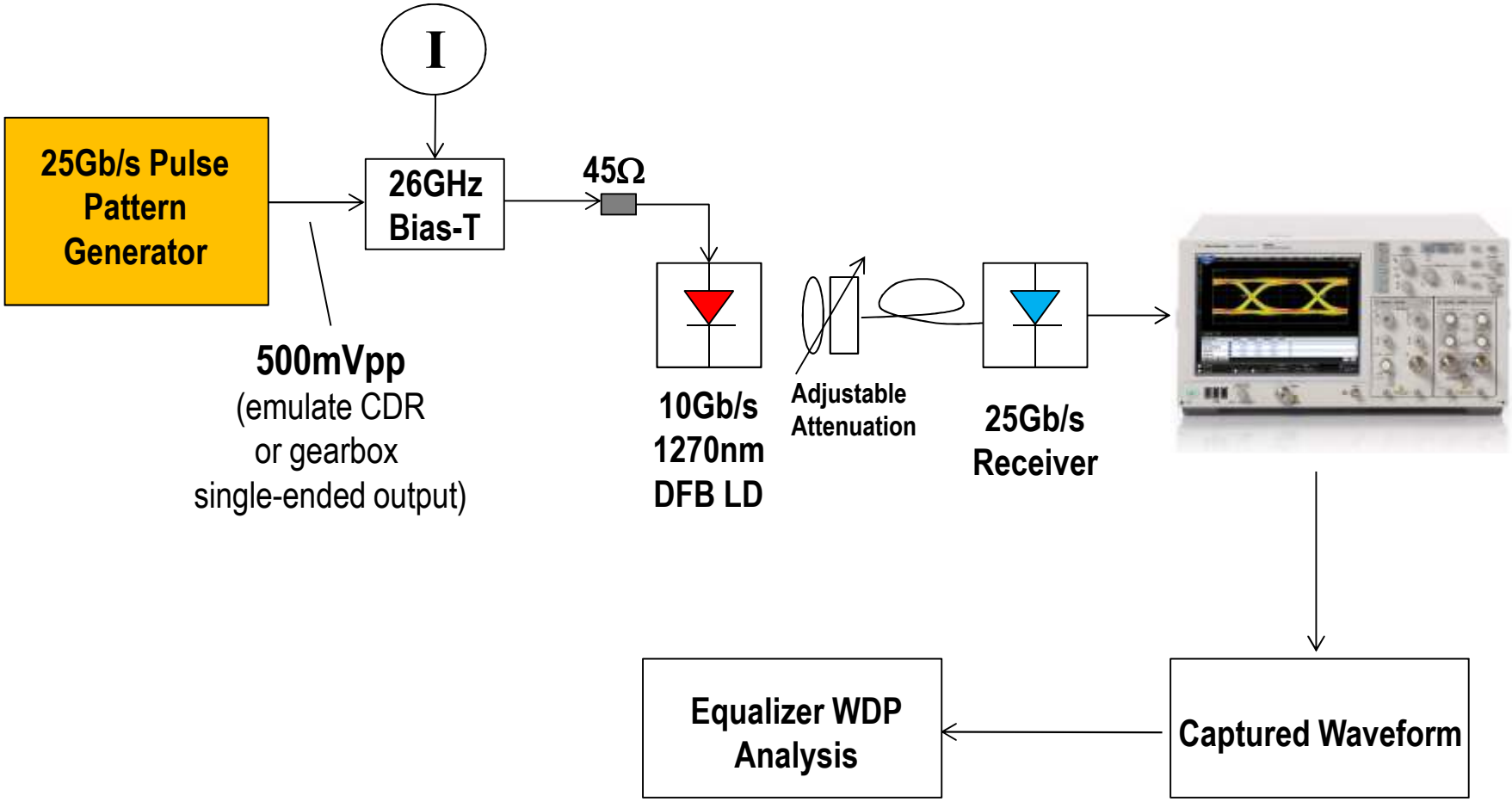
Experimental & Simulation Setup



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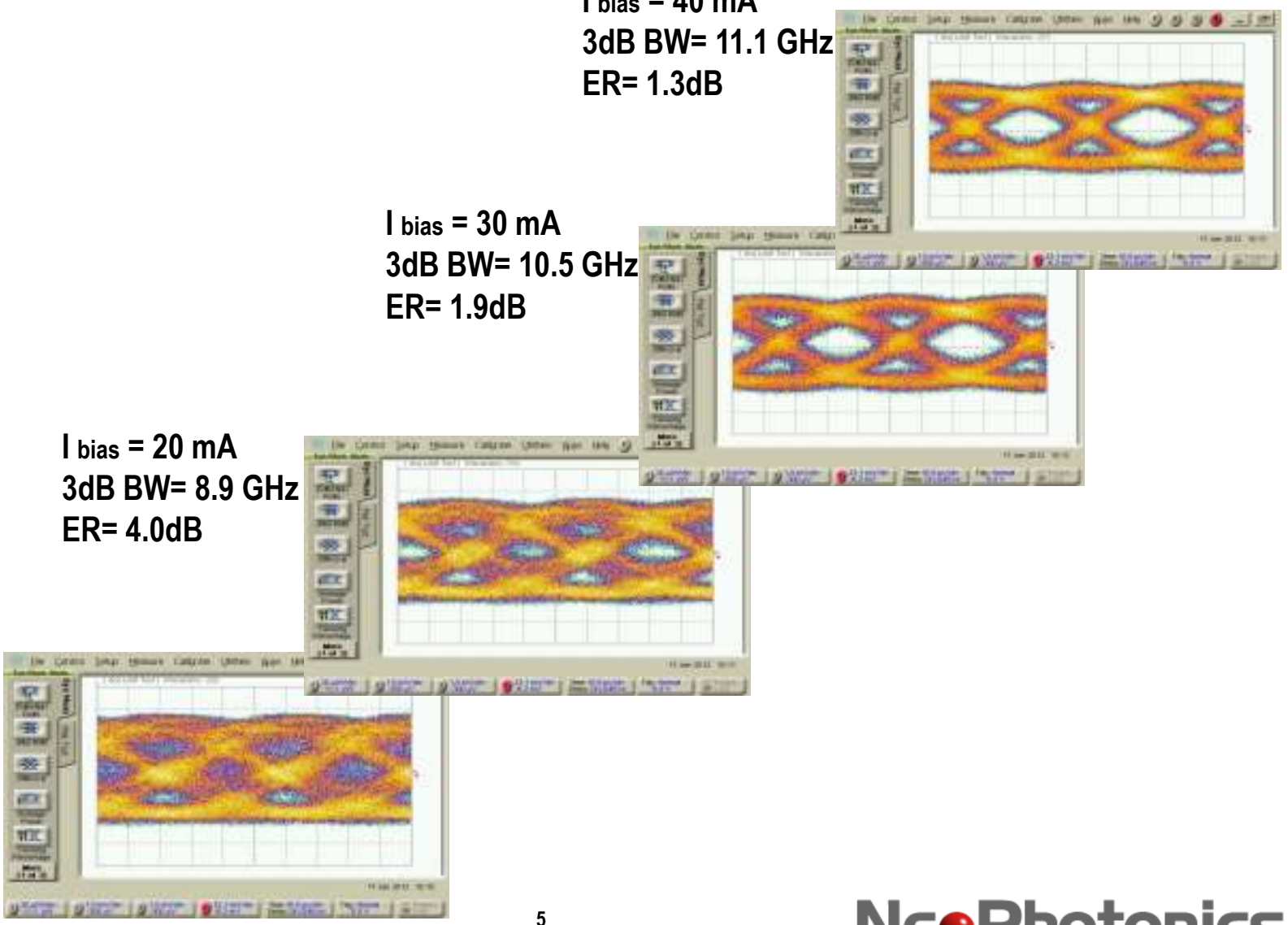
Eye Diagrams at Different Bias Levels

I_{bias} = 40 mA
3dB BW= 11.1 GHz
ER= 1.3dB

I_{bias} = 30 mA
3dB BW= 10.5 GHz
ER= 1.9dB

I_{bias} = 20 mA
3dB BW= 8.9 GHz
ER= 4.0dB

I_{bias} = 18 mA
3dB BW= 8.1 GHz
ER= 5.2dB



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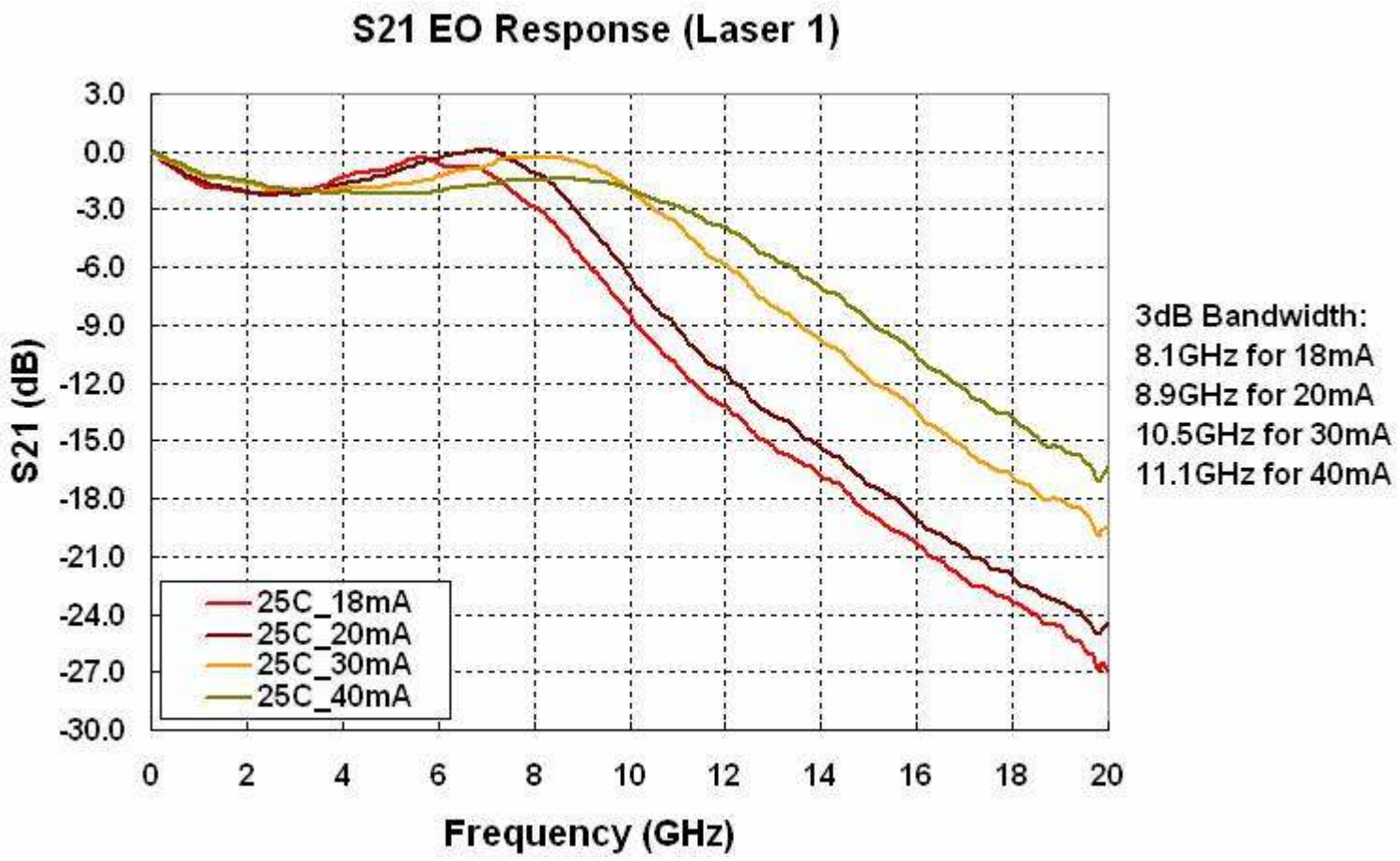
1270nm 10G DML Frequency Response



3dB Bandwidth:
8.1GHz for 18mA
8.9GHz for 20mA
10.5GHz for 30mA
11.1GHz for 40mA

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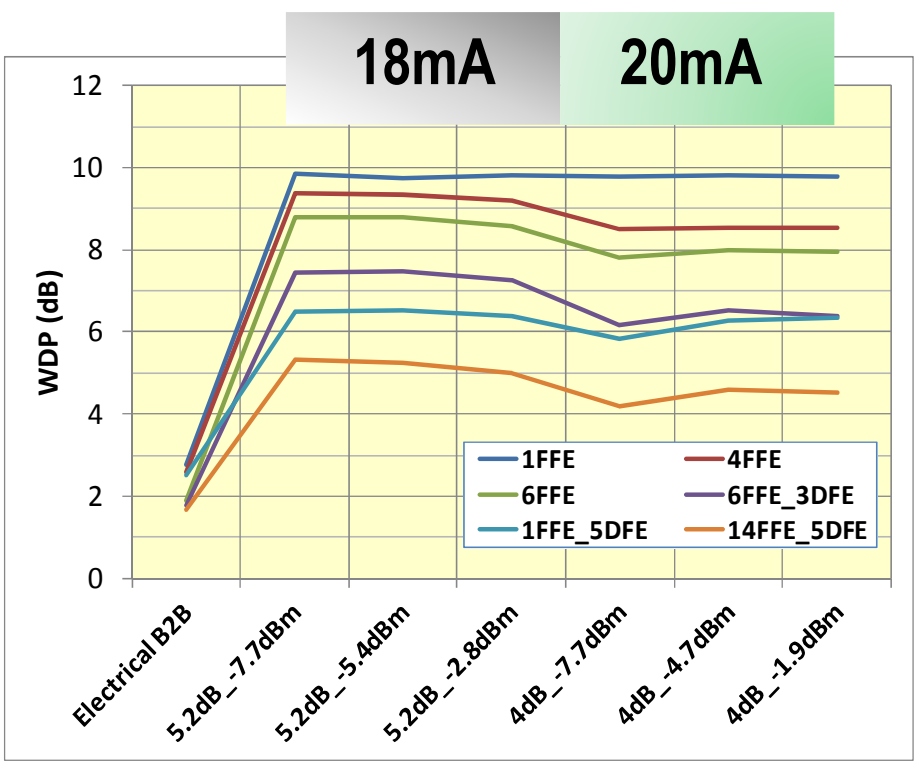
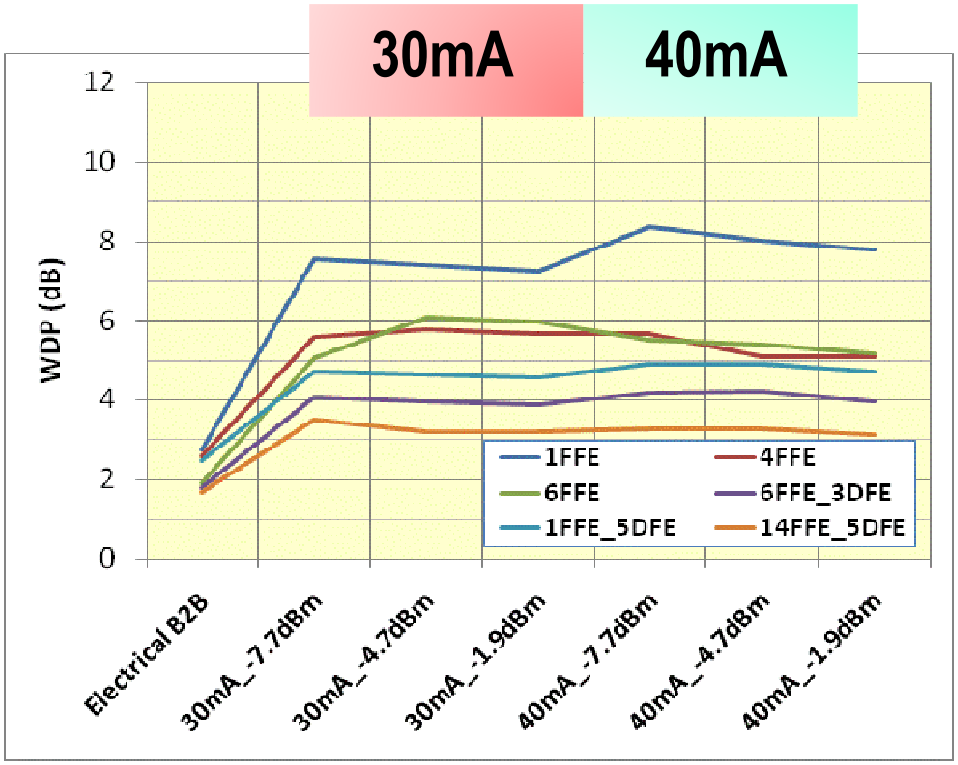
Calculated WDP for Measured Waveforms (P_{Alloc}=5dB)





- At low bias levels (18, 20mA), WDP for a realizable equalizer is >5dBo
- At high bias levels (30, 40mA), WDP for a realizable equalizer is <5dBo
- At high bias levels, WDP remains fairly constant (1FFE+5DFE, 6FFE+3DFE) within the received power range of 5.8dB (channel insertion loss budget for 2km SMF is 4dB, which includes 2dB connector/splice loss)

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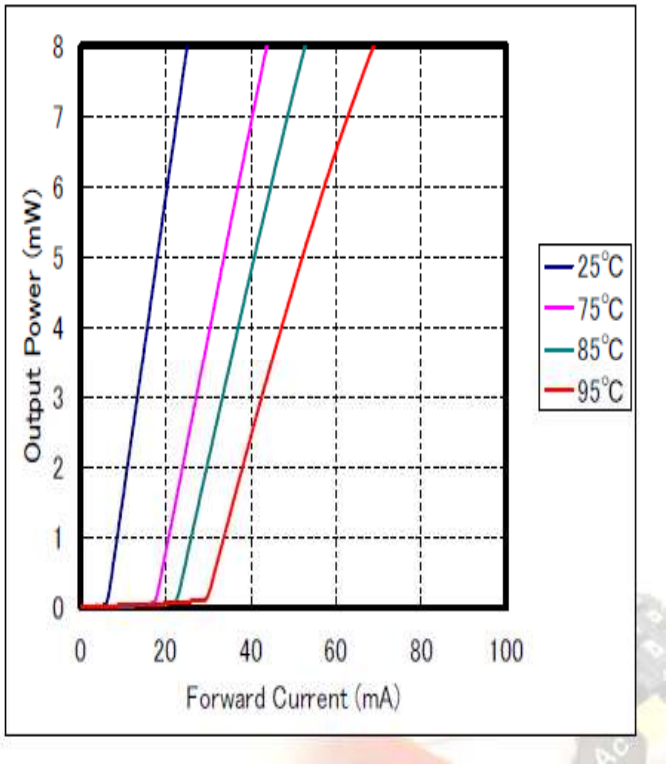
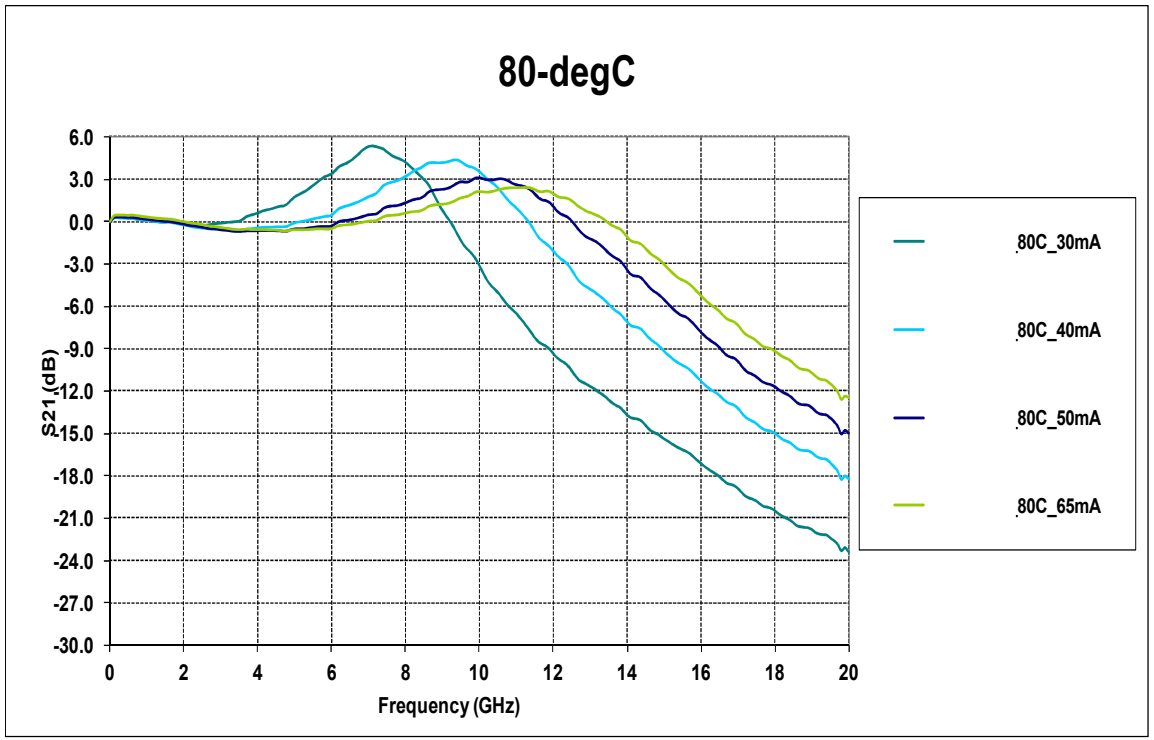
AlGaInAs–InP 10Gbps DFB Lasers-
High Bandwidth, High Temperature Operations





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Electronic Components for 10G

- Driver amplifiers: 3dB bandwidth > 19GHz
- 4x10G package: 3dB bandwidth > 17~18GHz

Summary

- Technical feasibility of using 4x25G 1300nm CWDM DML and 4x25G linear equalizer (to be integrated in a CDR) for short reach (<2km) SMF is studied via experiment and simulation
- Due to the replacement of 25G DML or EML by a 10G DML, and the elimination of 25G laser drivers, there will be a significant cost reduction
- This low cost and low power approach can use a small module such as QSFP or CFP2

Next Steps

1. Test packaged AlGaInAs–InP 10Gbps DFB Lasers at high temperature through 2km SMF, with or without driver amps

2. Compare the performance differences between un-retimed and re-timed configurations

Backup Slide

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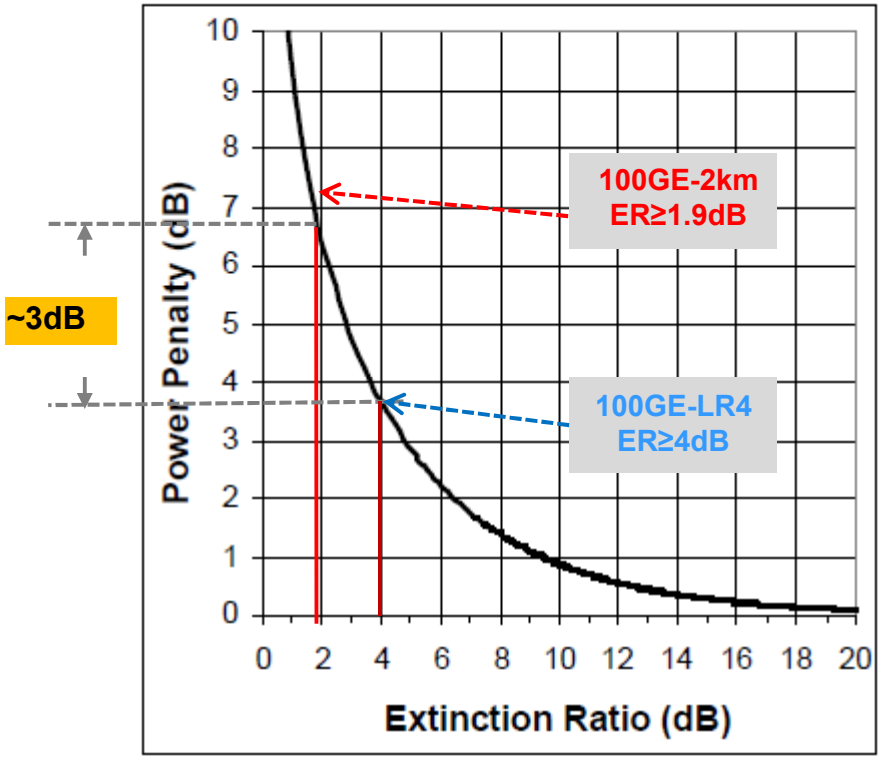
Extra Penalty Due to Smaller ER



0.47dB/km x (10km – 2km)= 3.76dB

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