100G single Lambda Optical link, experimental data

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P802.3cd task force

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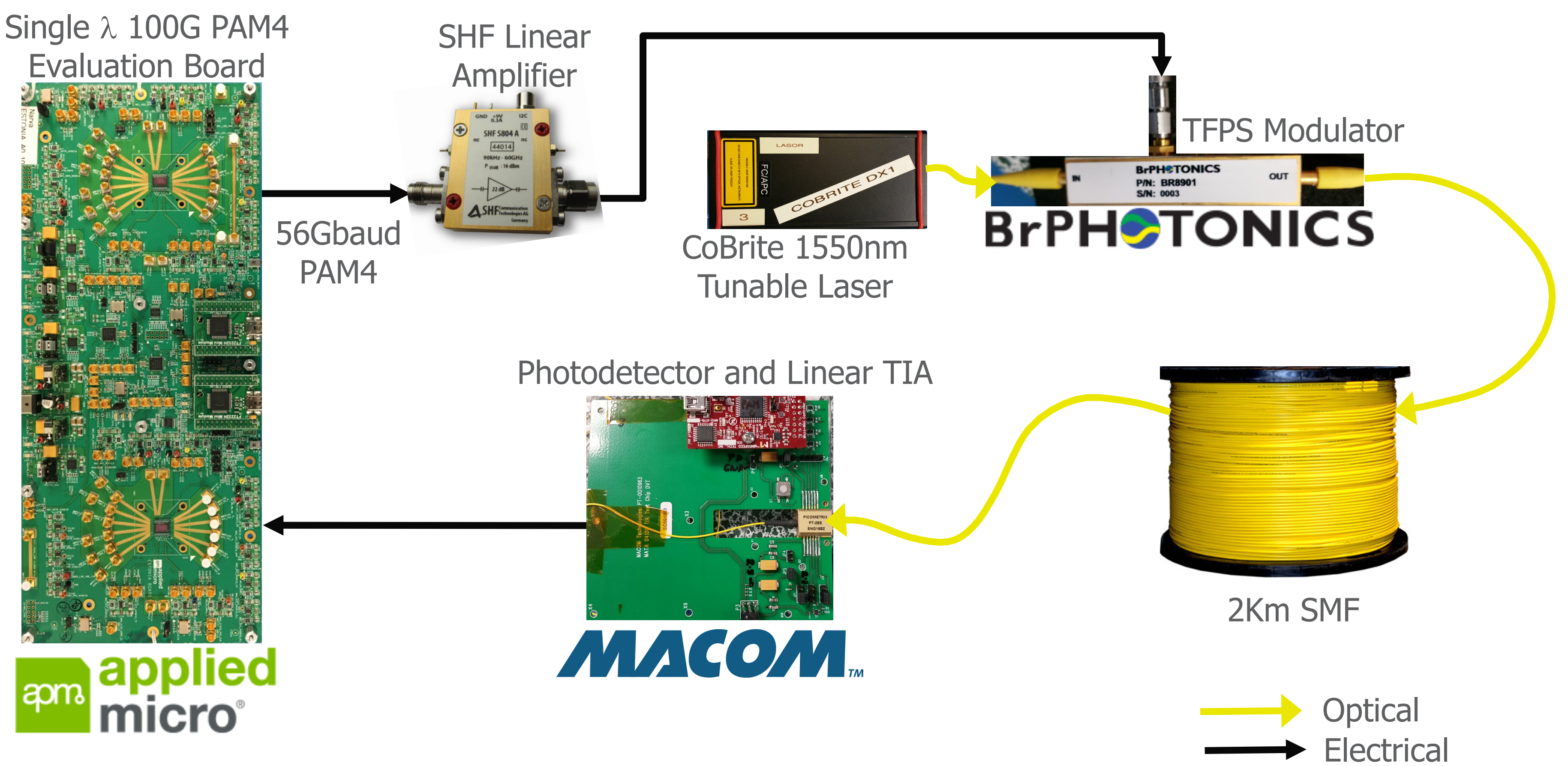
Introduction

- This presentation shows early results for a real Optical Link running PAM4 at MAC rate of 100Gbps.
- This presentation provides measured performance data to support technical feasibility for the proposed single lane 100Gbps PHY operation over duplex SMF of 500m objective.
- The optical bench uses a mix of components that are commercially available or in the various stages of R&D.
- Measurements were done at 2Km, but they are used here to indicate technical feasibility of 500m objective. Unfortunately we did not have time to collect the data again for 500m.
- This optical bench is using 1550nm Laser, it is the intent to migrate to 1310nm & 500m and present the results as soon as available.

Optical Bench Setup

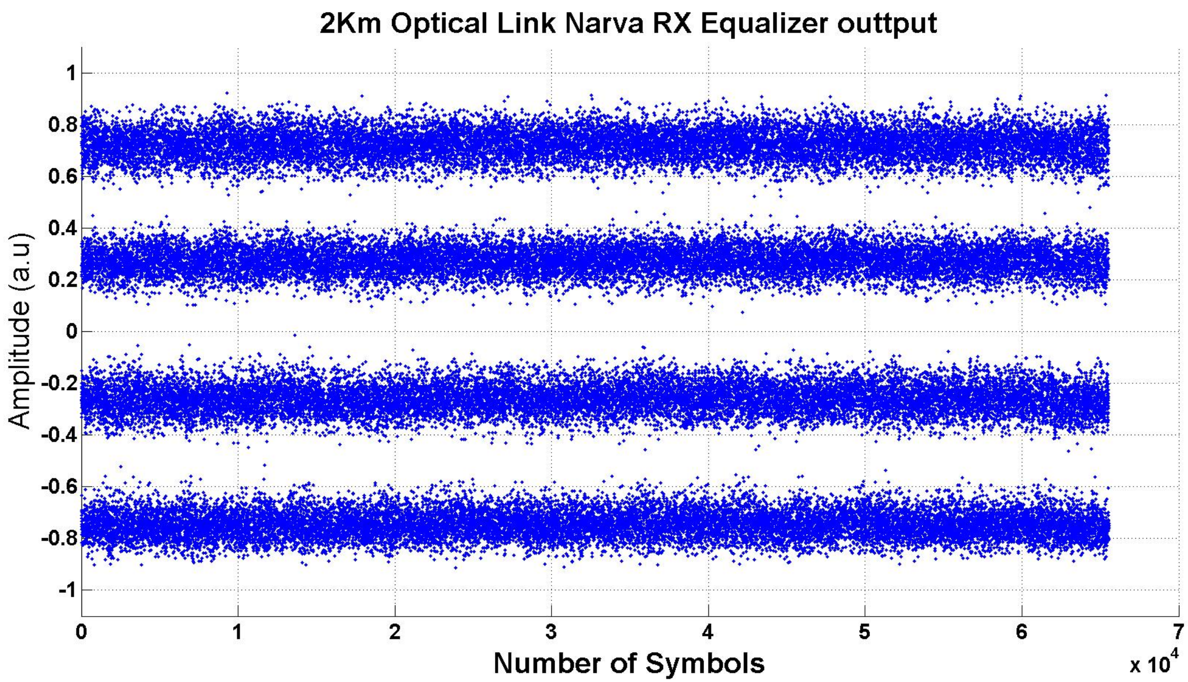
- 3 test configurations and results are shown here:
  - Optical back-to-back with offline receiver processing
  - Optical fiber transmission with offline receiver processing
  - Optical fiber transmission with real 16nm Test Chip ADC/DSP Receiver and simple TX, 2 bit level driver with FIR .
- The aim of the test was to characterize the performance of APM's 100G Transceiver PAM4 DSP Test Chip in an optical link, where the optical signal generation was performed by a TFPS (Thin Film Polymer on Silicon) 53GHz MZM modulator and receiver used Macom TIA & PD.
- The offline captures were taken by receiving the 100G PAM4 signal at the photodetector output into a real time DSO (LeCroy LabMaster 10-65Zi), where it was stored and processed using a offline DSP algorithm.

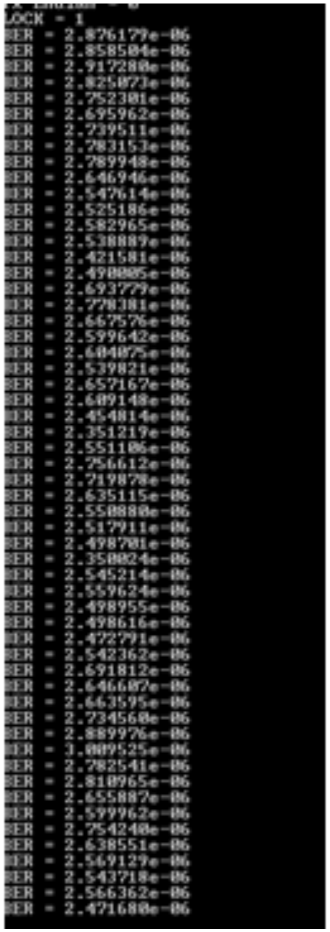
100G Per Lambda – 2Km Optical Link
16nm ADC/DAC/DSP Test Chip



Early testing is showing better than 1.0E-5 BER for PRBS31 running PAM4 @ 53.125GBaud

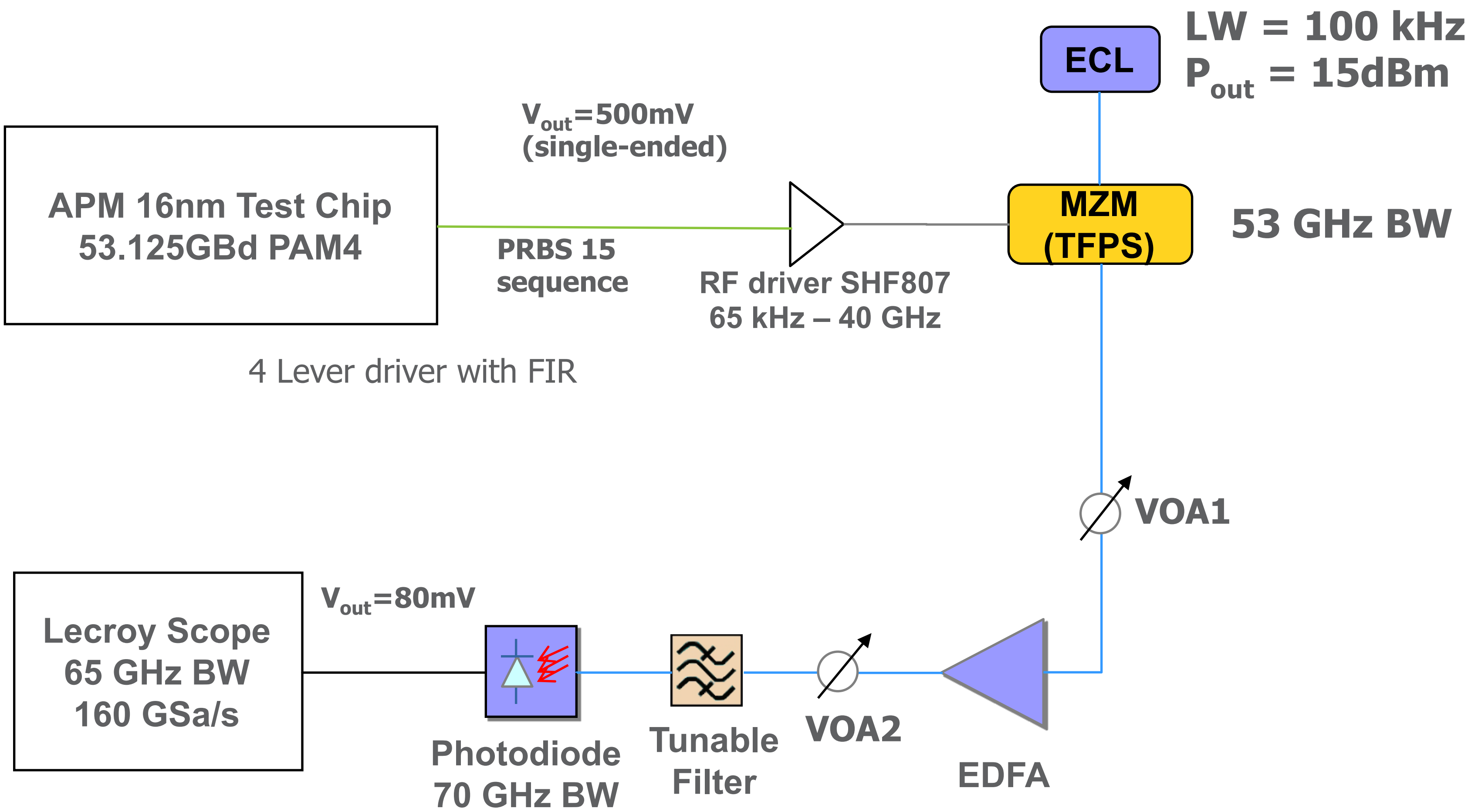
2Km Optical Link – 16nm Test Chip Optical Equalizer Output



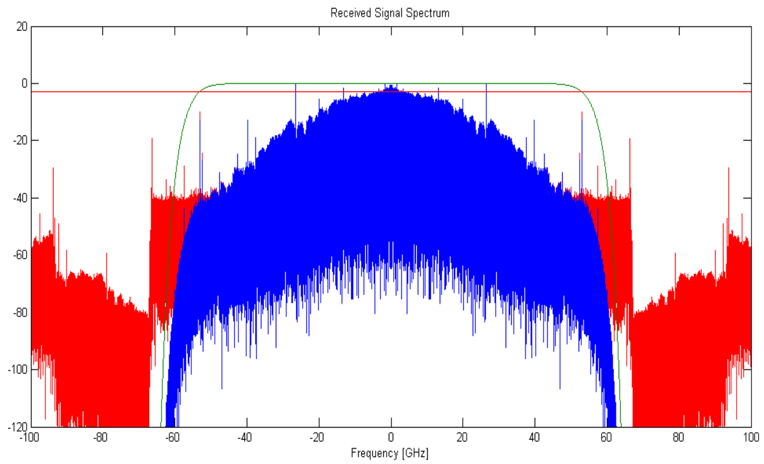


Early testing is showing better than 1.0E-5 BER for PRBS31 running PAM4 @ 53.125GBaud

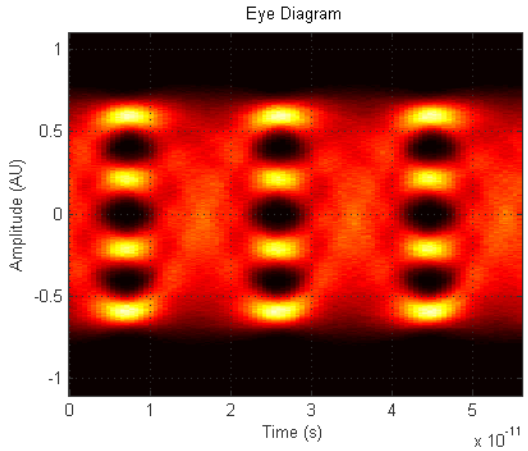
Setup – Optical B2B for Offline Processing



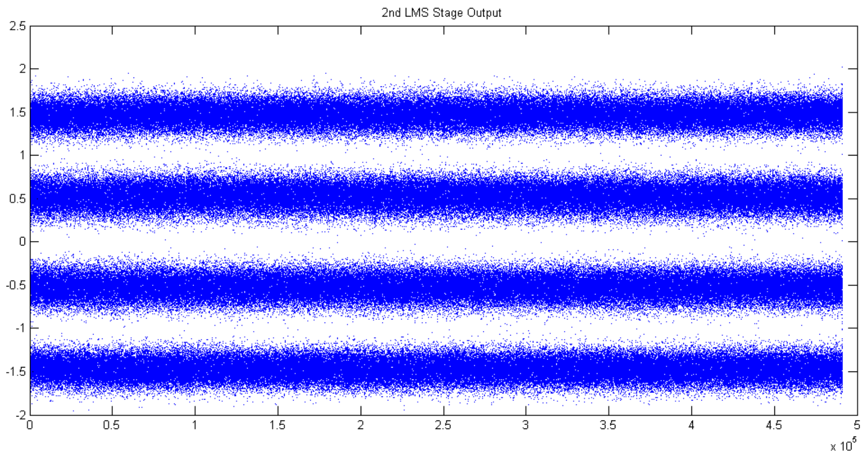
Results – 53.125GBd Optical B2B Offline



Received spectrum (red: before Gaussian filter blue: after Gaussian filter)



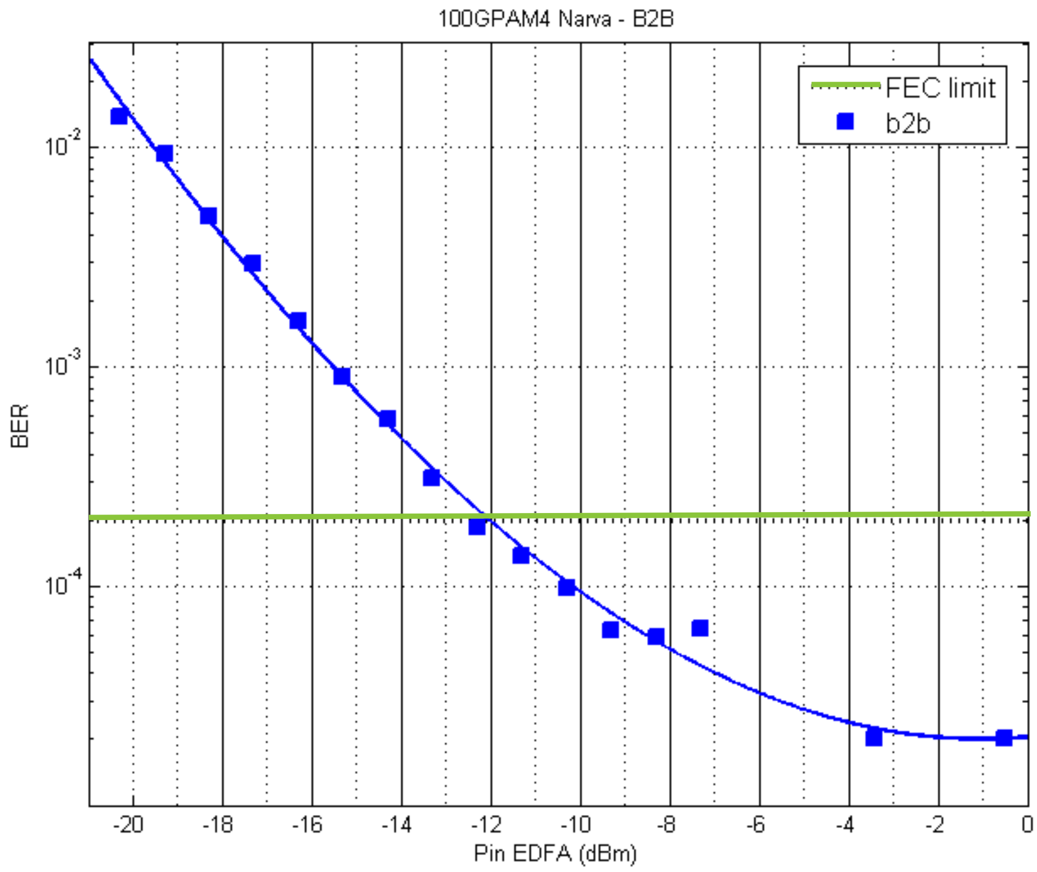
Digital Eye Diagram at Mid Stage of DSP Output



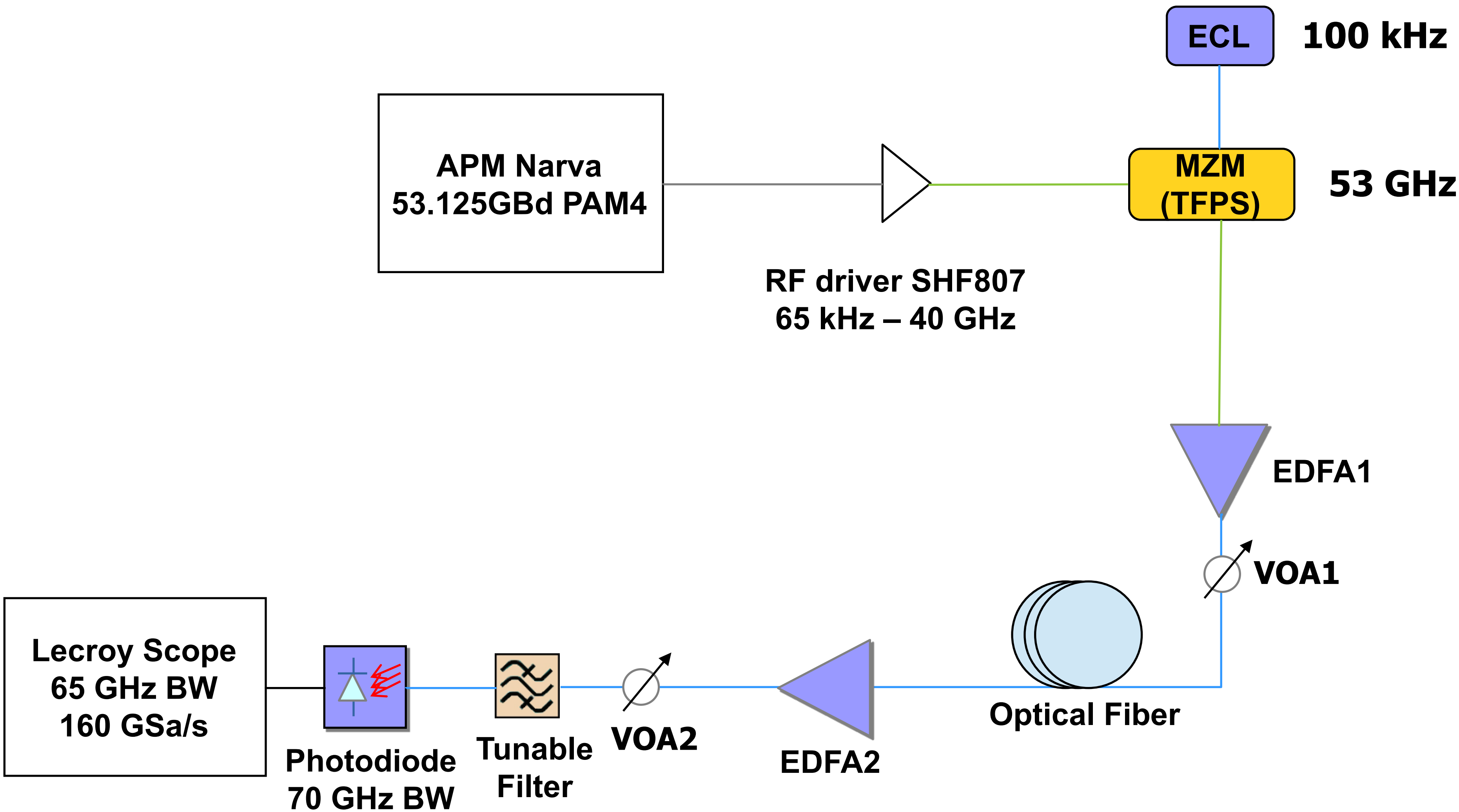
DSP Output

Results – 53.125GBd Optical B2B Offline

- OSNR was varied by changing the input optical power to the EDFA, using the first variable optical attenuator (VOA1)
- After the EDFA, the second optical attenuator (VOA2) was used to maintain the voltage swing at the PD output constant

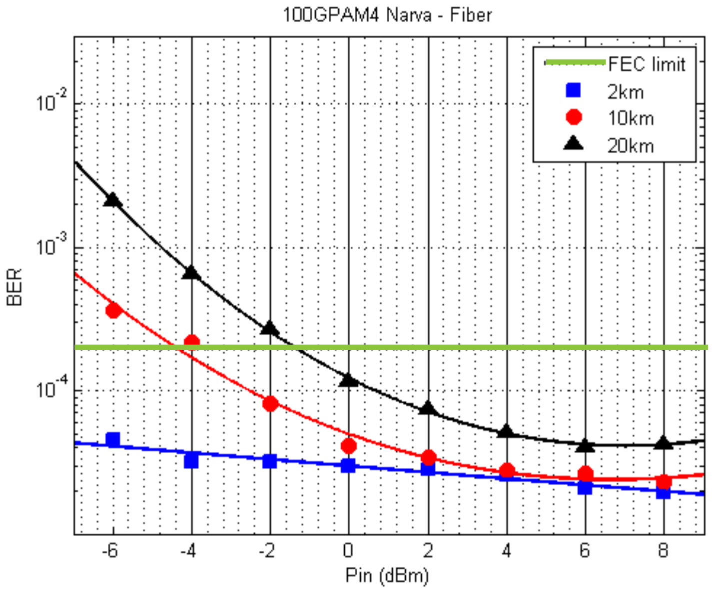


Setup – Fiber Transmission Offline



Results – Fiber Transmission Offline

- Three different link lengths were tested: 2km, 10 km and 20 km
- With 10 km and 20 km, the use of a tunable dispersion compensating module (TDCM) was required
- Optical power at the fiber input was varied using the first variable optical attenuator (VOA1)
- To compensate for link losses, a second EDFA was used to pre-amplify the signal before detection
- After EDFA2, the second optical attenuator (VOA2) was used to maintain the voltage swing at the PD output constant



Note that 500m is the Target. Measurements at other link lengths were taken to show where the limits might be.

Conclusions

- The complexity of the Receiver DSP algorithm seems to be in line with the Power Envelop target set by QSFP form factor.
- Measured results for Back-to-back and with transmission media show that pre-FEC BER at the receiver would be acceptable.
- Early testing seems to indicate technical feasibility for the proposed single lane 100 Gb/s PHY for operation over duplex SMF with lengths up to at least 500 m objective.
- More data will be collected and shared as soon as available.

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