

50G PAM4 CWDM TDP Measurements

400 Gb/s Ethernet Task Force
802.3 Interim Meeting
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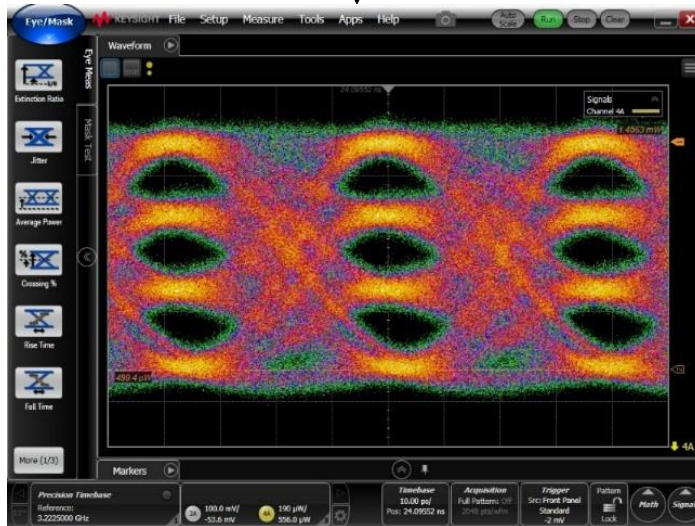
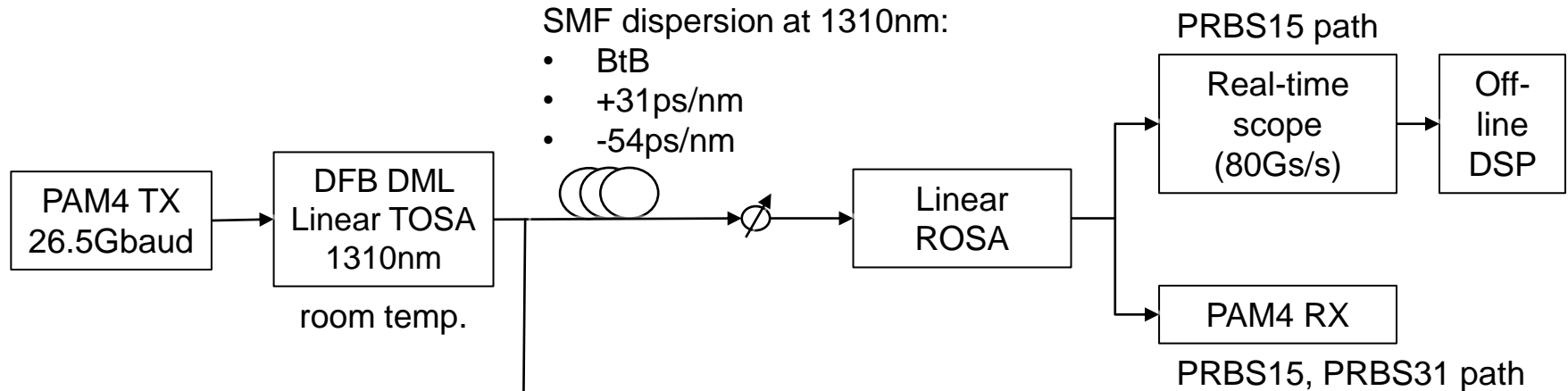
Outline

- CWDM Dispersion limits
- 50G PAM4 TDP 1310nm λ measurements
- 50G PAM4 TDP 1331nm λ measurements
- Conclusions

CWDM Dispersion Limits

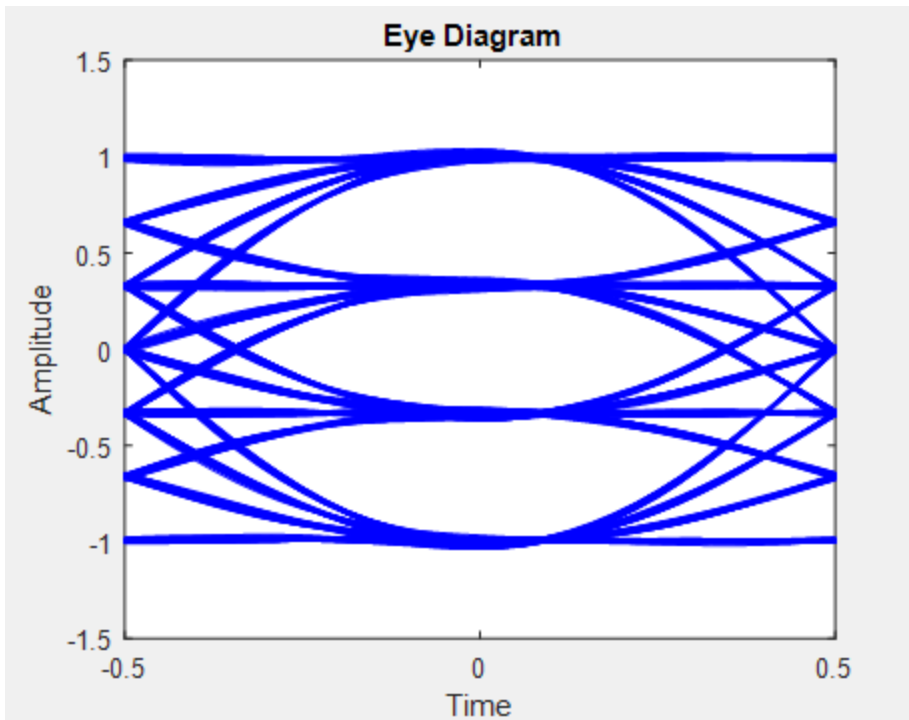
- L0 Wavelength: 1271nm (1264.5 to 1277.5nm)
 - Dispersion at 1264.5nm w/ 1324nm ZD: -5.93ps/nm-km
 - G.652 A, B, C, D SMF theoretical worst case
 - 10km dispersion: -59.3ps/nm
- L3 Wavelength: 1331nm (1324.5 to 1337.5nm)
 - Dispersion at 1337.5nm w/ 1300nm ZD: 3.34ps/nm-km
 - G.652 A, B, C, D SMF theoretical worst case
 - 10km dispersion: 33.4ps/nm
 - Dispersion at 1337.5nm w/ 1304nm ZD: 3.0ps/nm-km
 - realistic field SMF worst case
 - 10km dispersion: 30ps/nm
 - Dispersion at 1337.5nm w/ 1310nm ZD: 2.5ps/nm-km
 - 10km dispersion: 25ps/nm

1310nm λ Measurement Set-up

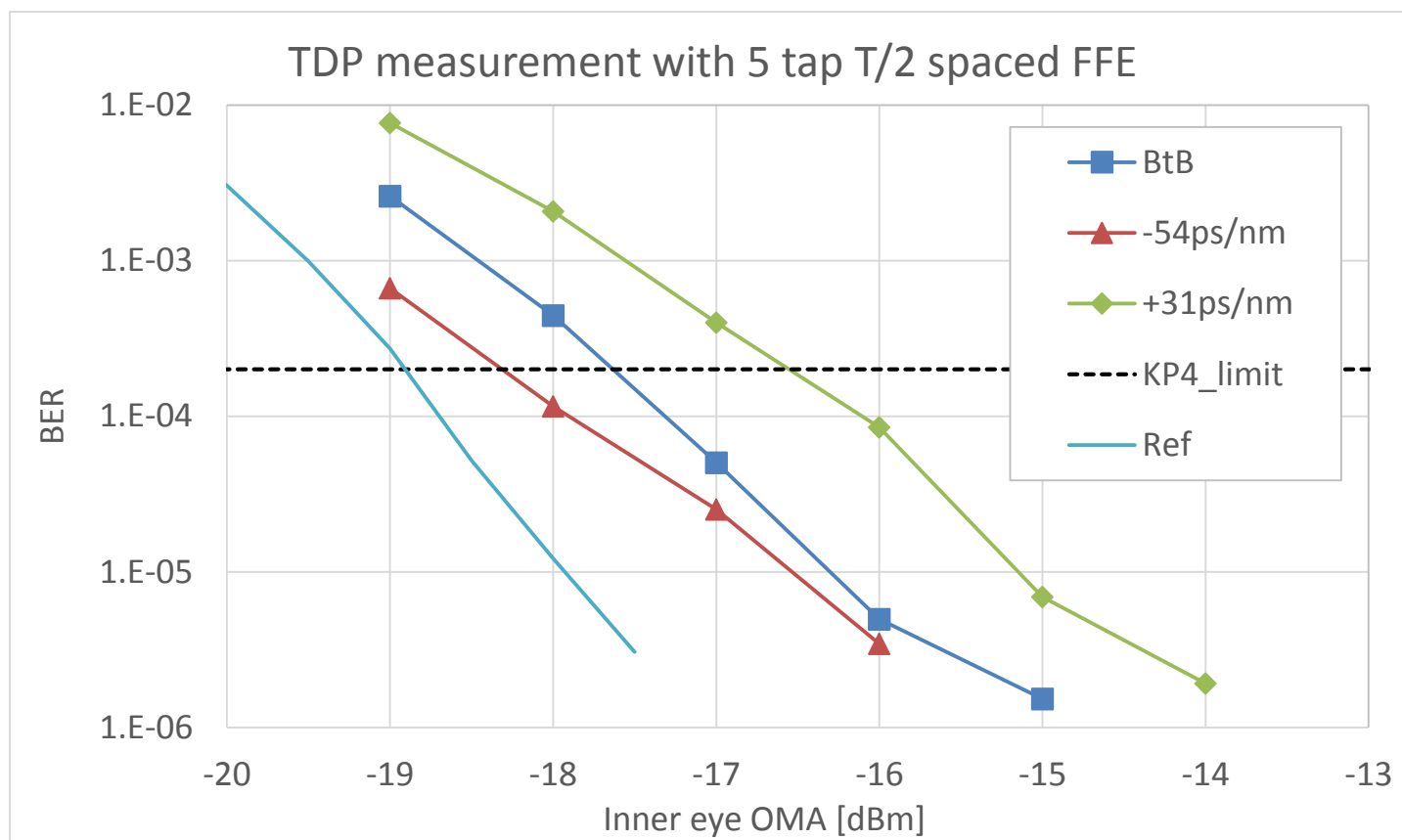


Off-line DSP RX Reference (Ref.)

- 19.5GHz BW
- 0.8 A/W responsivity
- 12.5pA/sqrt(Hz) input referred noise
- DSP reference signal eye diagram (no noise):

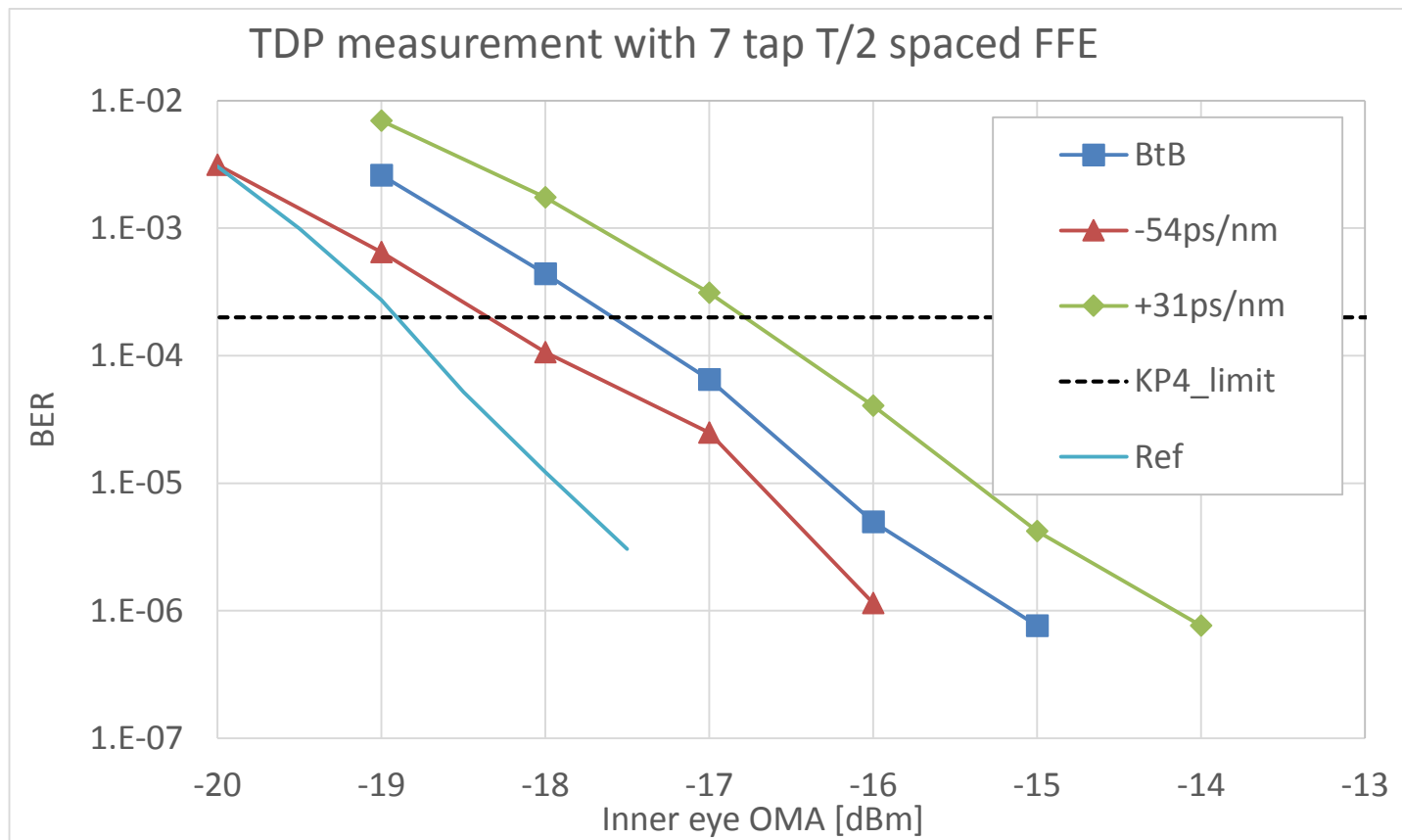


Off-line DSP TDP: 5-tap T/2 FFE



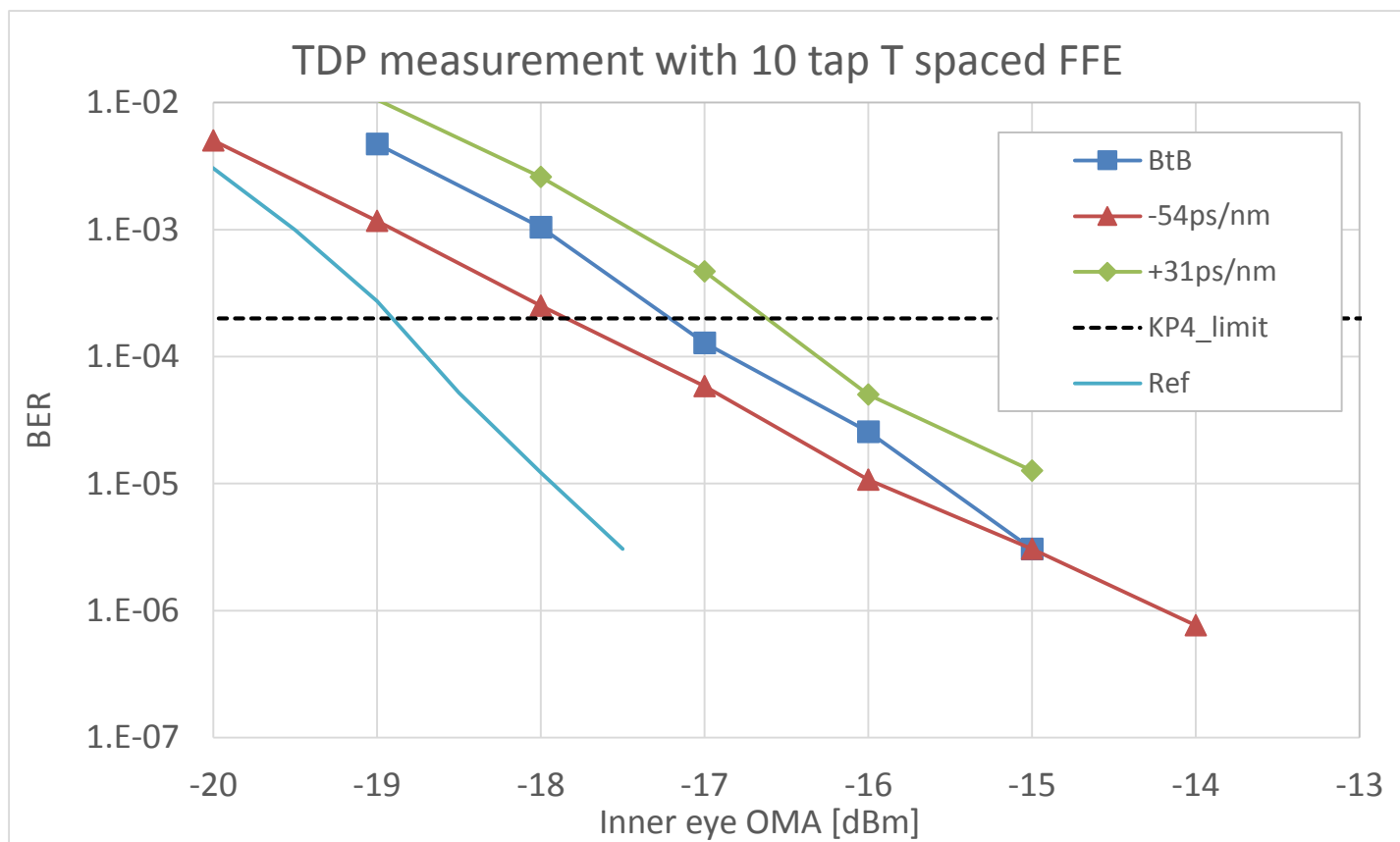
Dispersion	TDP (dB)	DP (dB)
+31ps/nm	2.3	1.0
-54ps/nm	0.6	-0.7

Off-line DSP TDP: 7-tap T/2 FFE



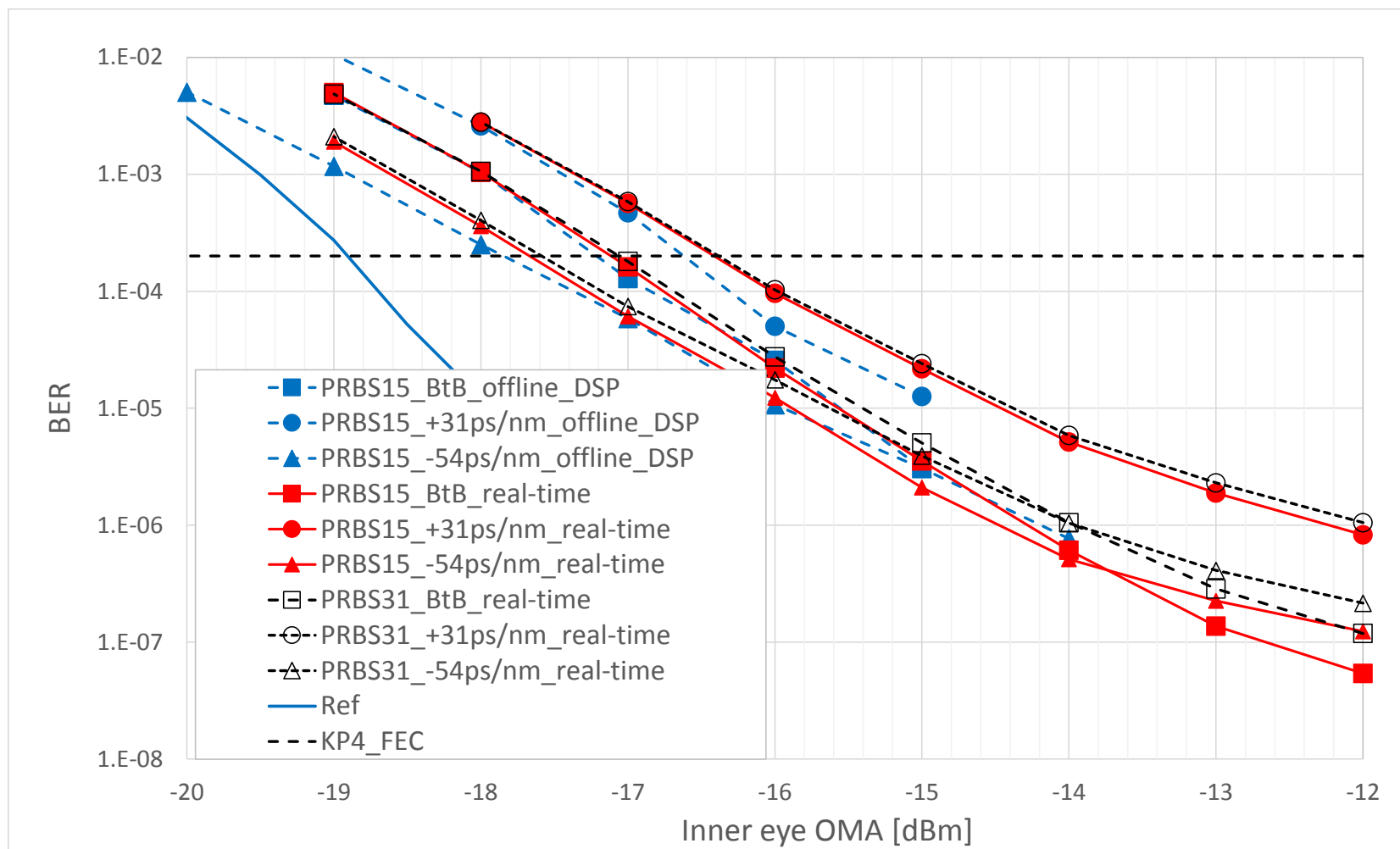
Dispersion	TDP (dB)	DP (dB)
+31ps/nm	2.1	0.8
-54ps/nm	0.6	-0.7

Off-line DSP TDP: 10-tap T FFE



Dispersion	TDP (dB)	DP (dB)
+31ps/nm	2.1	0.6
-54ps/nm	1.0	-0.6

Off-line DSP & Real-time TDP: 10-tap T FFE



- Small differences between PRBS15 and PRBS31

1310nm λ TDP Summary (Off-line DSP)

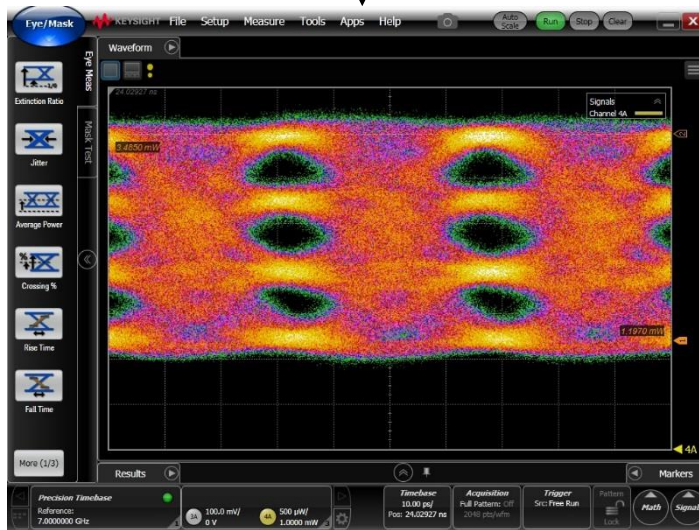
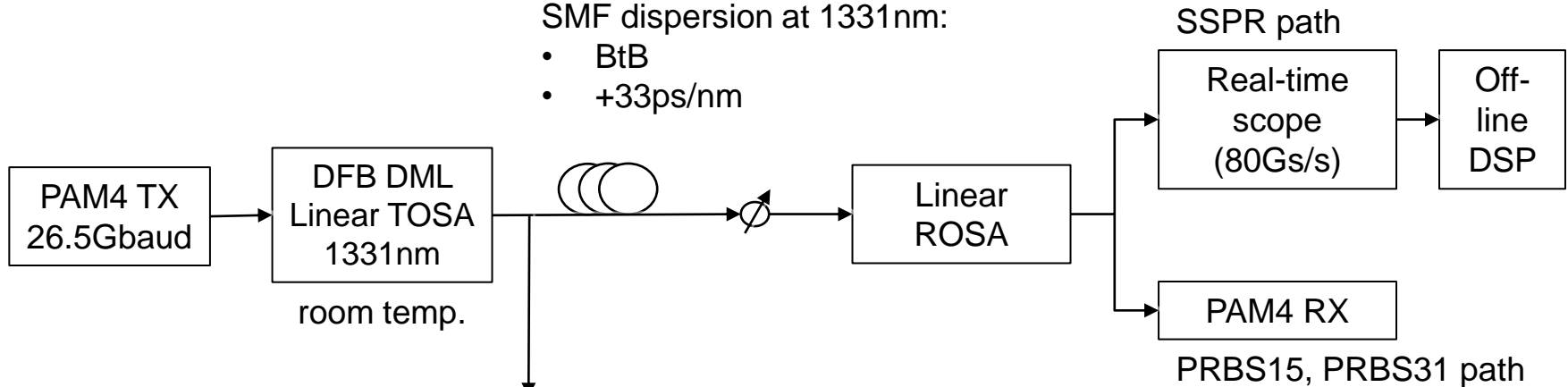
DML TX	TDP (dB)		DP (dB)	
RX FFE	+31ps/nm	-54ps/nm	+31ps/nm	-54ps/nm
5-tap T/2	2.3	0.6	1.0	-0.7
7-tap T/2	2.1	0.6	0.8	-0.7
10-tap T	2.1	1.0	0.6	-0.6

- Transmitter using EML or MZ will result in lower TDP

1331nm λ Measurement Set-up

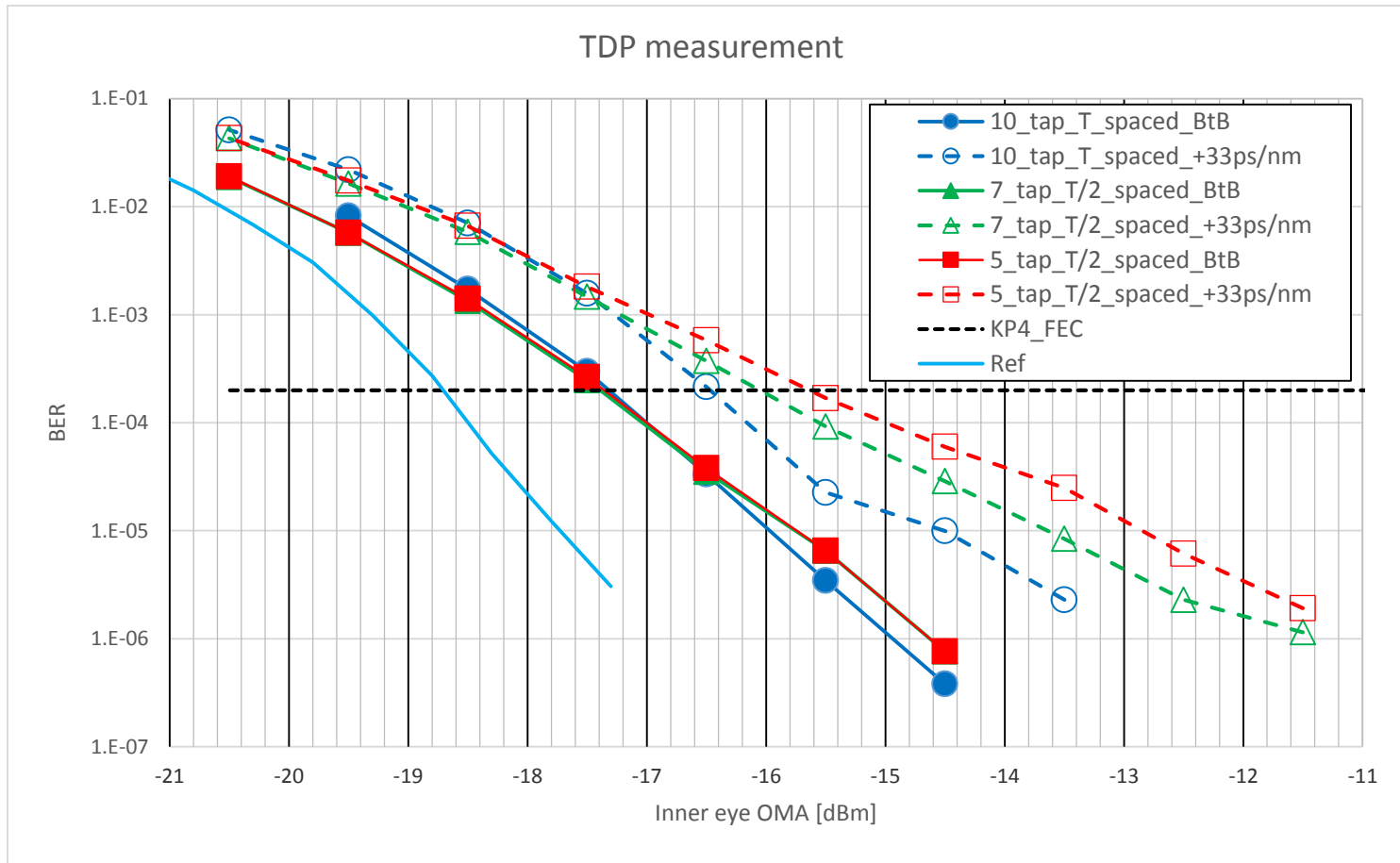
SMF dispersion at 1331nm:

- BtB
- +33ps/nm

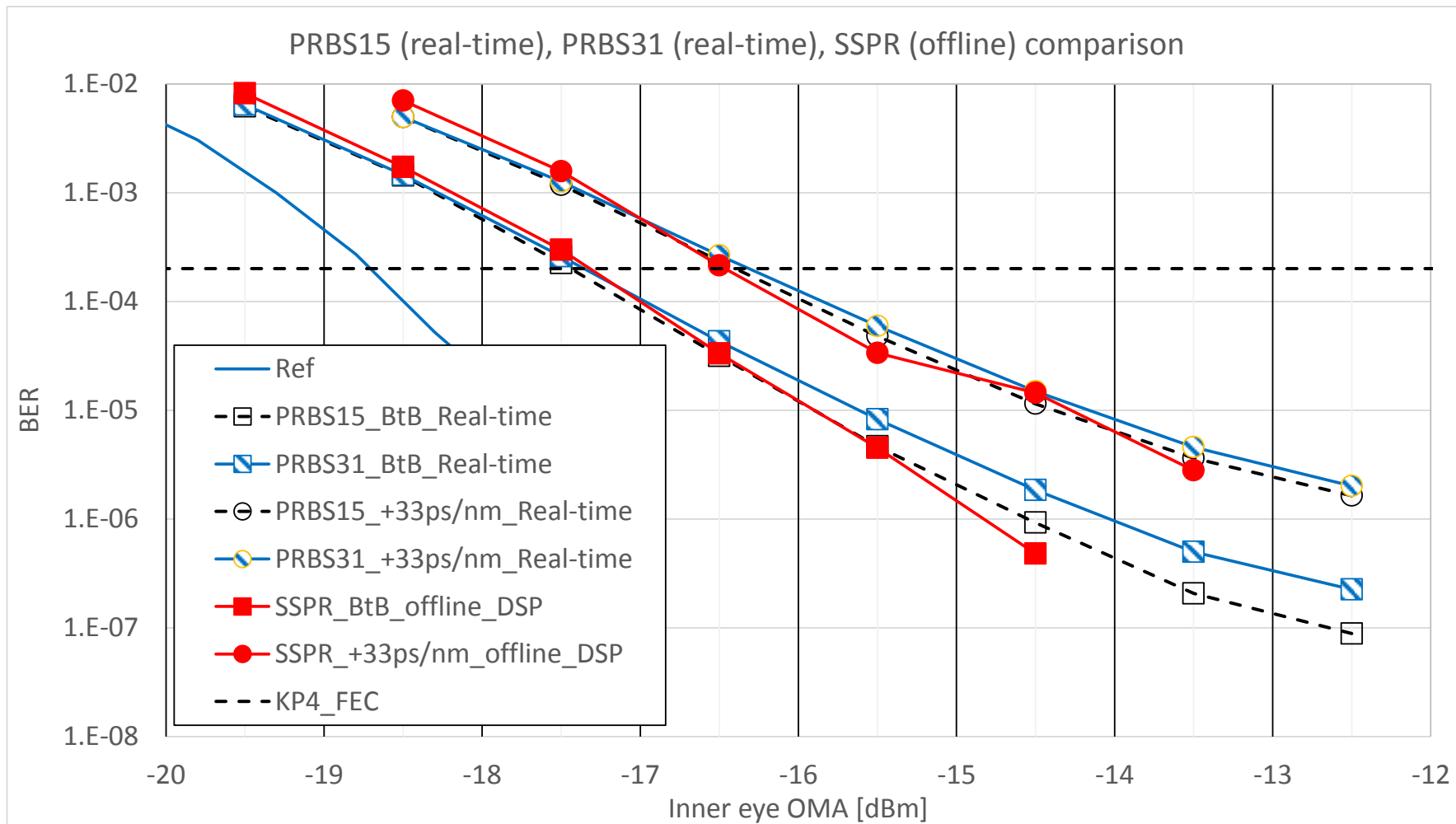


- 1331nm eye significantly worse than 1310nm eye

Off-line DSP TDP: 5, 7-tap T/2, 10-tap T FFE



Off-line DSP & Real-time TDP: 10-tap T FFE



- Small differences between SSPR and PRBS15, PRBS31

1331nm λ TDP Summary (Off-line DSP)

DML TX	TDP (dB)	DP (dB)
RX FFE	+33ps/nm	+33ps/nm
5-tap T/2	3.0	1.6
7-tap T/2	2.6	1.2
10-tap T	2.2	0.8

- Transmitter using EML or MZ will result in lower TDP

Conclusions

- Measurements to date support feasibility of CWDM grid for 200GBASE-LR4 10km application
- Improved transmitter is expected to have additional margin
- Real deployment will also have additional margin because actual SMF dispersion is lower than the theoretical worst case

50G PAM4 CWDM TDP Measurements

Thank you