Feasibility Of 400GBASE-LR4 Using EML Transmitters On CWDM Grid Over 10 km (6.3 dB Channel Loss) of Single Mode Fiber

Kohichi Tamura, CIG

Takanori Suzuki, CIG

Hirofumi Nakagawa, CIG
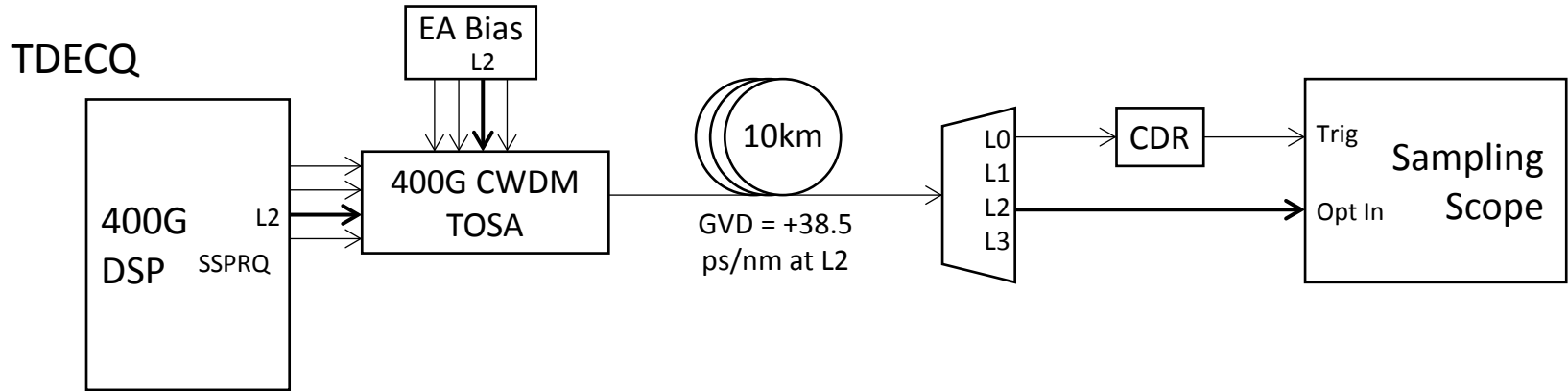
David Lewis, Lumentum

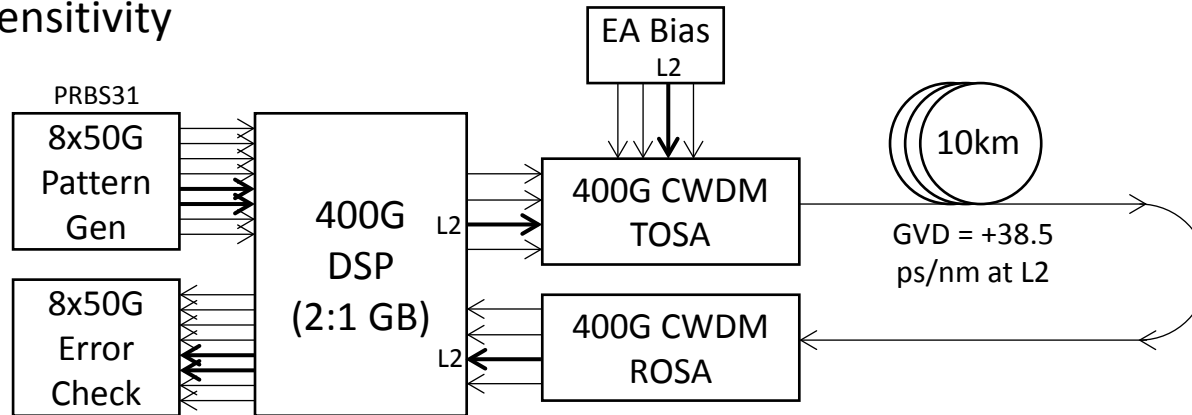3 September 2019

Supporters

Brian Welch, Cisco

Introduction

- Data is presented that demonstrates the feasibility of 53.125 Gbaud PAM4 optical transmission over 10 km of single mode fiber with chromatic dispersion that exceeds the worst case value.
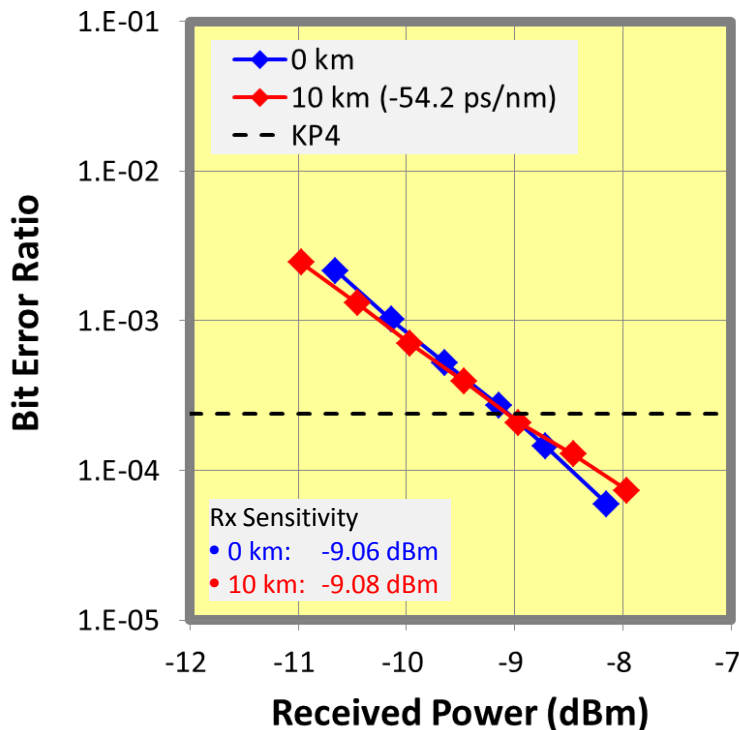
Experimental Configuration

TDECQ

Receiver Sensitivity

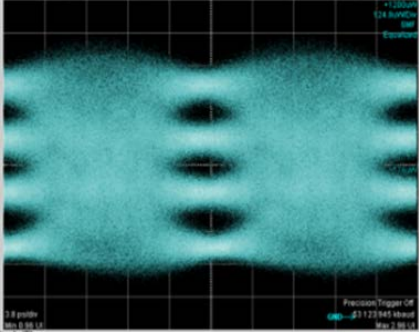# Dispersion Penalty In Negative Dispersion Regime Small For EML
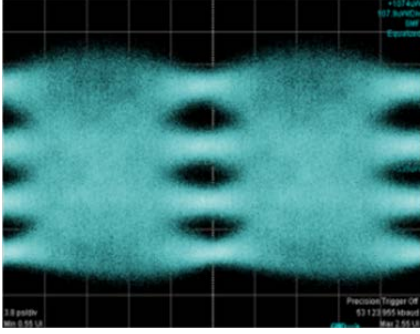
L0 Results
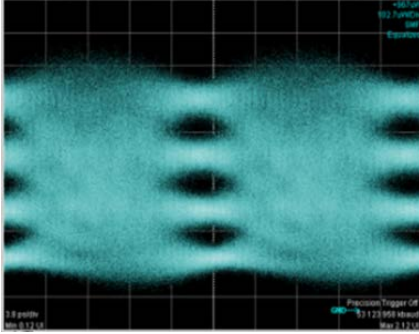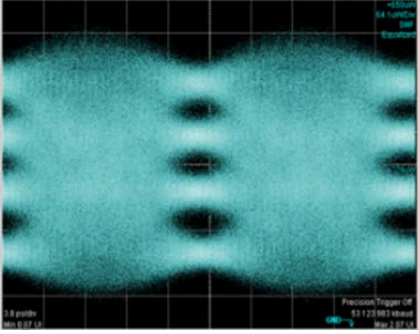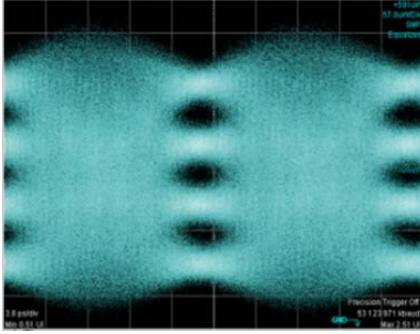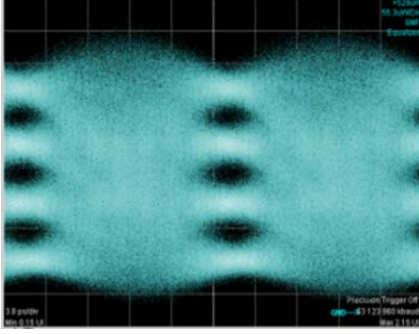

Note: Maximum negative dispersion is -59.5 ps/nm for 10 km SMF channel (see Table 87-14).

- For EML, 10 km dispersion penalty small for maximum negative dispersion, so can focus on maximum positive dispersion for worst-case dispersion penalty.

Optical Eye Before/After Maximum Positive Dispersion

	Case 1 • Optimum linearity and TDECQ back-to-back (default).	**Case 2** • Adjust inner eye levels for best linearity at 10 km (+38.5 ps/nm).	**Case 3** • Increase extinction ratio and adjust inner eye levels for best linearity at 10 km (+38.5 ps/nm).
0 ps/nm	 EA Bias: -1.52 V TDECQ: 2.30 dB Outer ER: 5.0 dB RLM: 0.99	 EA Bias: -1.52 V TDECQ: 2.16 dB Outer ER: 5.0 dB RLM: 0.92	 EA Bias: -1.72 V TDECQ: 2.86 dB Outer ER: 6.2 dB RLM: 0.91
+38.5 ps/nm	 EA Bias: -1.52 V TDECQ: 3.66 dB Outer ER: 4.9 dB RLM: 0.93	 EA Bias: -1.52 V TDECQ: 3.31 dB Outer ER: 5.0 dB RLM: 0.99	 EA Bias: -1.72 V TDECQ: 3.31 dB Outer ER: 6.2 dB RLM: 0.98

BER and Rx Sensitivity Before/After Maximum Positive Dispersion

	Case 1	Case 2	Case 3
	• Optimum linearity and TDECQ back-to-back (default).	• Adjust inner eye levels for best linearity at 10 km (+38.5 ps/nm).	• Increase extinction ratio and adjust inner eye levels for best linearity at 10 km (+38.5 ps/nm).
BER			
Rx Sens (dBm) 0 ps/nm	-9.15	-8.87	-7.81
Rx Sens (dBm) +38.5 ps/nm	-7.51	-8.00	-7.82
Penalty (dB)	1.64	0.87	-0.01

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Summary / Conclusions

■ Dispersion penalty investigated for 53.125 GBd PAM4 EML transmitters over SMF channel with dispersion exceeding maximum of allowed positive dispersion (> +33.5 ps/nm).

■ Operating point (extinction ratio, linearity) at 0 km can be set to minimize dispersion penalty.

■ Results support feasibility of 400GBASE-LR4 specification using CWDM grid, where single mode fiber channel has reach of 10 km, maximum loss of 6.3 dB, and maximum positive dispersion of +33.5 ps/nm.

■ Dispersion penalty at maximum negative dispersion is small for EML, so only maximum positive dispersion needs examination.

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