



ROSNR and EVM Correlation Study for 400G ZR Modules

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Background

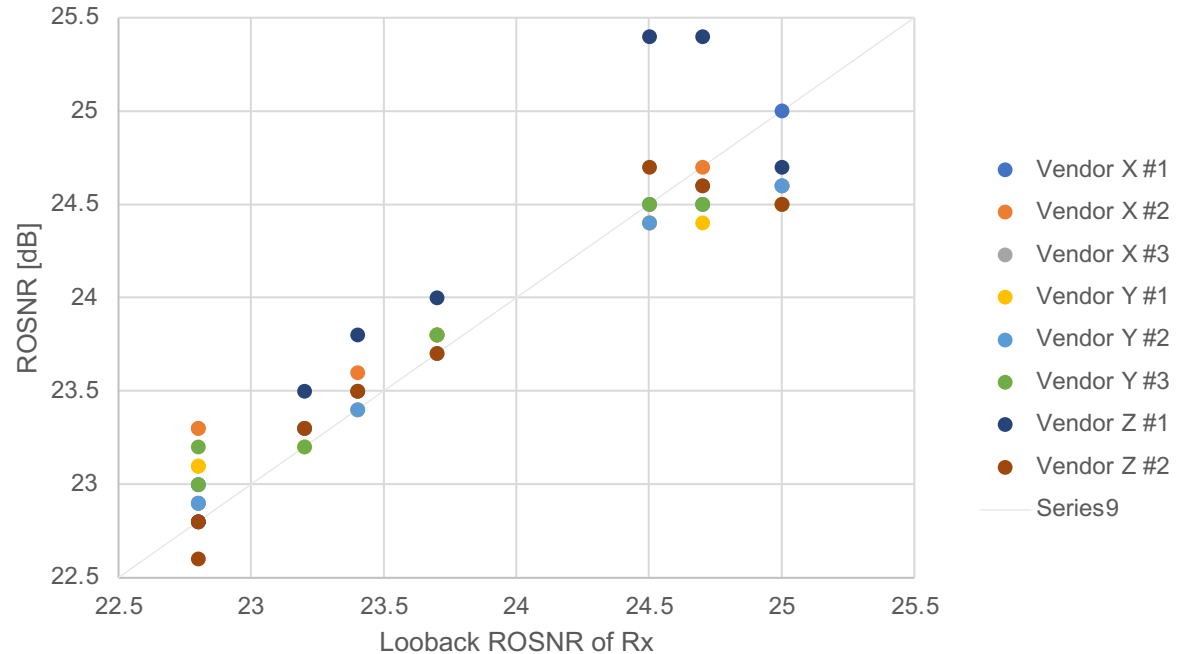
- Motivation
 - Evaluate EVM's suitability in predicting 400G ZR module interop performance
- Samples
 - A total of 8 modules from 3 vendors. All modules pass the 26.0dB ROSNR spec in loopback with > 1 dB margin
- Test conditions
 - Channel = 193.1 THz, Prx = -6 dBm, 1x400G ZR mode, CFEC
 - Tx waveform captured by Keysight N4391A OMA. Offline processing with Keysight contribution OIF2018.391.04 Matlab script
 - 7-tap equalizer, real valued, block size 1000
- ROSNR test
 - Vary the amount of ASE loading to find the threshold value where traffic is error-free for at least 120 second. 400GbE ethernet traffic is generated and checked by Viavi ONT.

ROSNR Study: Correlation with average for module's Tx or Rx

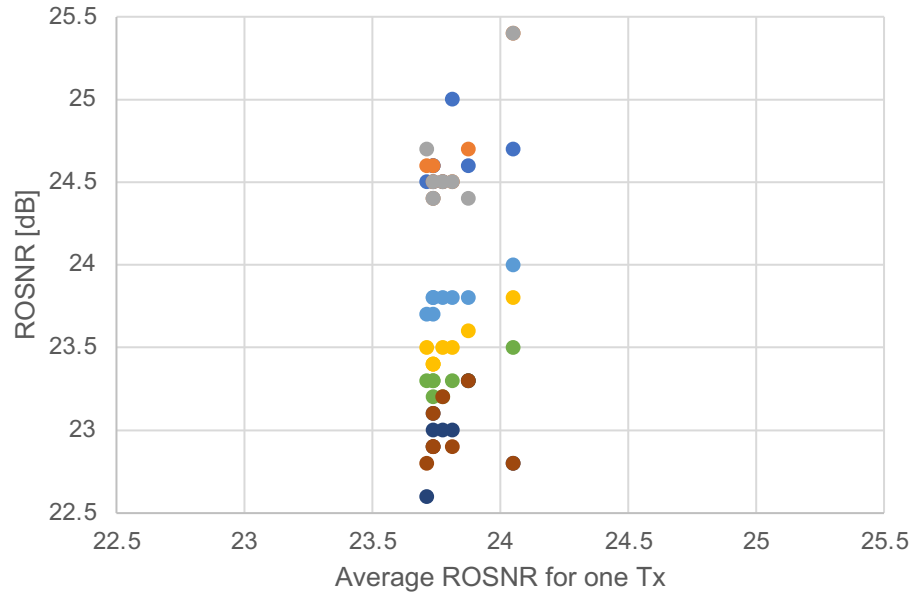
		Transmitter ⇨	Vendor X #1	Vendor X #2	Vendor X #3	Vendor Y #1	Vendor Y #2	Vendor Y #3	Vendor Z #1	Vendor Z #2
Receiver ↓	Average ROSNR for this Rx ↓	Average ROSNR for this Tx ⇨								
Vendor X #1	24.6		25	24.6	24.6	24.5	24.6	24.5	24.7	24.5
Vendor X #2	24.6		24.5	24.7	24.5	24.4	24.6	24.5	25.4	24.6
Vendor X #3	24.6		24.5	24.4	24.5	24.4	24.4	24.5	25.4	24.7
Vendor Y #1	23.5		23.5	23.6	23.4	23.4	23.4	23.5	23.8	23.5
Vendor Y #2	23.8		23.8	23.8	23.8	23.8	23.7	23.8	24	23.7
Vendor Y #3	23.3		23.3	23.3	23.3	23.2	23.3	23.2	23.5	23.3
Vendor Z #1	23.0		23	23.3	22.9	23.1	23	23	22.8	22.6
Vendor Z #2	23.0		22.9	23.3	22.9	23.1	22.9	23.2	22.8	22.8
EVM [No Filter]			11.1%	11.2%	10.9%	11.2%	11.2%	11.3%	10.1%	9.9%
EVM [RRC 0.2 Filter]			9.1%	9.0%	8.7%	10.1%	10.1%	10.2%	8.9%	8.6%

ROSNR: compare with loopback ROSNR

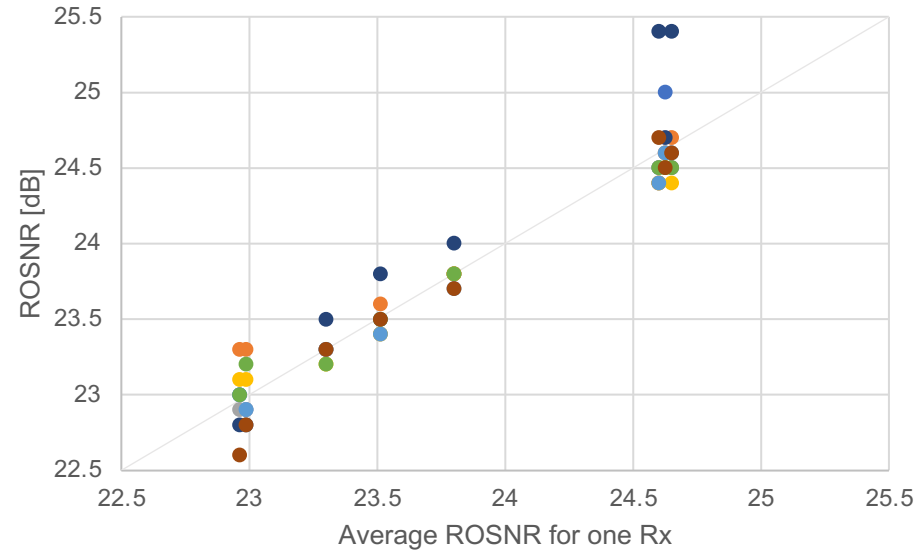
- ▶ Loopback ROSNR of receiver is a good predictor of paired ROSNR
 - Average 0.04 dB offset
 - Standard deviation of 0.26 dB



Plot ROSNR value against each module's average

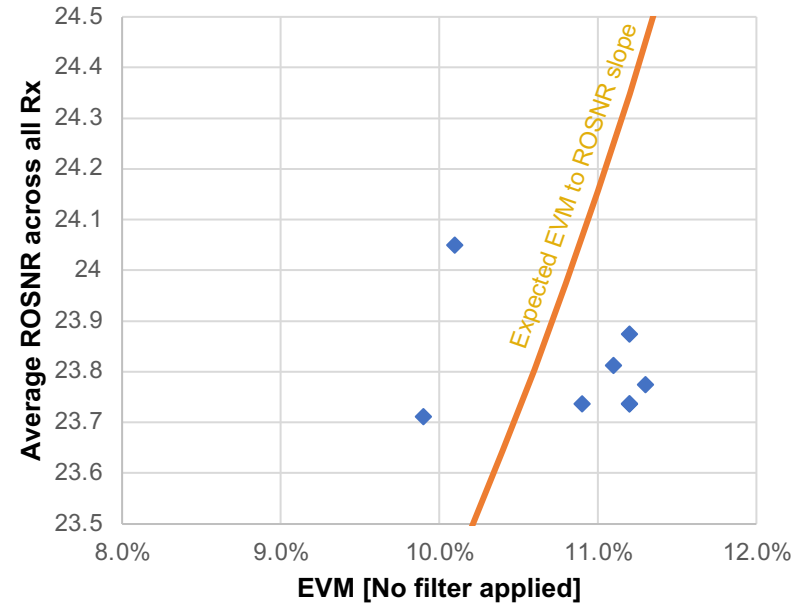
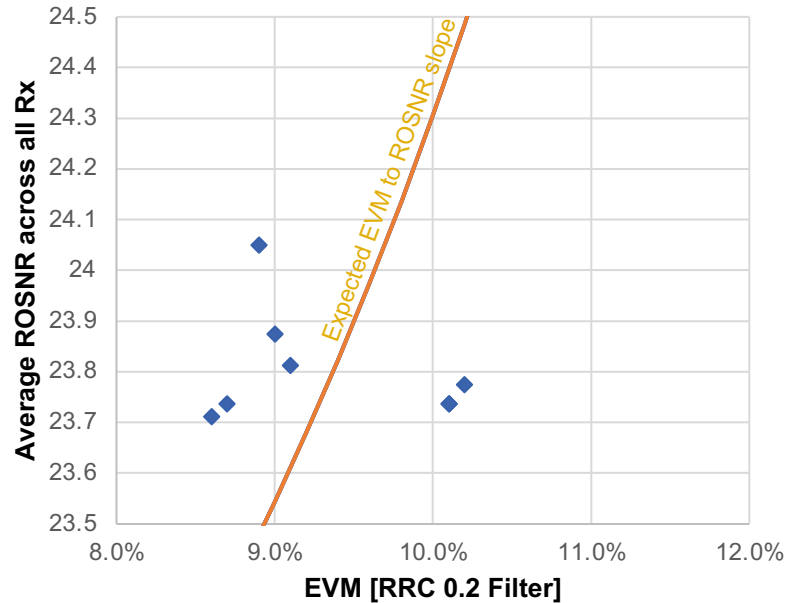


● Vendor X #1 ● Vendor X #2 ● Vendor X #3 ● Vendor Y #1
● Vendor Y #2 ● Vendor Y #3 ● Vendor Z #1 ● Vendor Z #2



● Vendor X #1 ● Vendor X #2 ● Vendor X #3
● Vendor Y #1 ● Vendor Y #2 ● Vendor Y #3
● Vendor Z #1 ● Vendor Z #2 — Series9

ROSNR and EVM Correlation



$$ROSNR = -10\log_{10}\left(10^{-\frac{ROSNR_{MIN}}{10}} - 10^{-\frac{SNR_{EVM}}{10}}\right) + 10\log_{10}\left(\frac{f_{baud}}{12.5}\right)$$
$$SNR_{EVM} = -2.55 - 20\log_{10}(EVM)$$

Observations

- ▶ All transmitters have similar average ROSNR across different receivers
 - Impressive achievement to have so much consistency across 3 vendors
 - But: this makes for a poor dataset for evaluating EVM utility
- ▶ Loopback ROSNR is a good predictor of how a given receiver will operate with other vendors
- ▶ ROSNR values show little correlation with EVM
 - EVM spread as measured by modulation analyzer should map to significant ROSNR spread
- ▶ Compared with previous contribution:
 - Updated modules for vendor Z with better spec compliance

Thank you!