Noise Level in Alien Crosstalk Test

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April 2019

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Bit Error Rate and Slicer SNR

- Target bit-error rate = 10^{-12}
- Assuming the coding gain from Reed-Solomon covers for non-Gaussian noise sources such as
  - Impulse noise
  - DFE error propagation
  - EMI effects

Required SNR @ Slicer = 24 dB

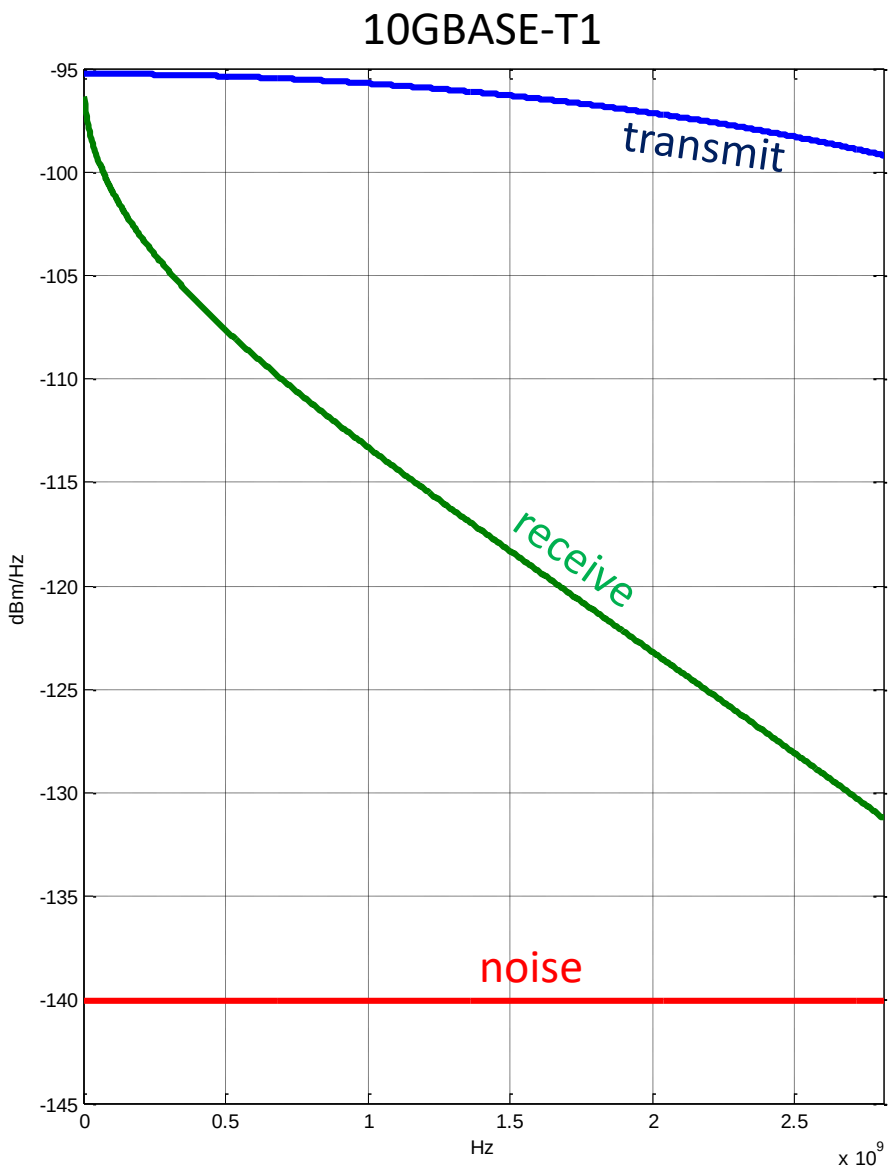
SNR and Equalization

- 10GBASE-T1 channel is colored with higher loss at higher frequencies
  - A sharp pulse is spread over multiple symbols at the end of the cable
  - Consecutive symbols overlap causing inter-symbol interference (ISI)
  - ISI is a major noise source limiting the SNR
- Equalizers eliminate the ISI to increase the SNR at slicer

- The theoretical upper bound of slicer SNR is Salz (or geometrical) SNR evaluated at the input of the equalizers
- In order to meet a target SNR at slicer, Salz SNR at the input should also meet that level

Transmit and Receive PSDs

- Transmit PSD:
  - Minimum power: -1 dBm
  - Zeroth-order hold
- Receive PSD:
  - Limit-line of insertion loss
- Noise PSD:
  - White noise to achieve 24 dB Salz SNR



SNR Margin

- Salz SNR is a theoretical bound
- Consider 6 dB margin for implementation loss for
  - Limited equalizer length and tap resolution
  - Quantization noise in signal
  - Analog imperfections
  - Clock jitter
- Sampling phase dependencies can cause SNR loss by as much as
  - 2 dB for 10 Gbps
  - 2.5 dB for 5 Gbps
  - 3 dB for 2.5 Gbps
- Consider -150 dBm/Hz for external additive background noise sources such as thermal noise

Tolerated MDI White Noise Level

Data rate (Gbps)	Noise PSD Salz Limit (dBm/Hz)	SNR Margin (dB) to account for:		Noise PSD (dBm/Hz) including:		Noise source similar to 1000BASE-T1 test setup (dBm/Hz)
		Implementation Loss	Sampling phase	margin	margin + thermal	
10	-140	6	2	-148	**-152**	-125
5	-131	6	2.5	-139.5	**-140**	-113
2.5	-124	6	3	-133	**-133**	-106
1	-115	9	3	-127	-127	-100

required margin to meet 1000BASE-T1 noise level

total alien crosstalk should be less than this level