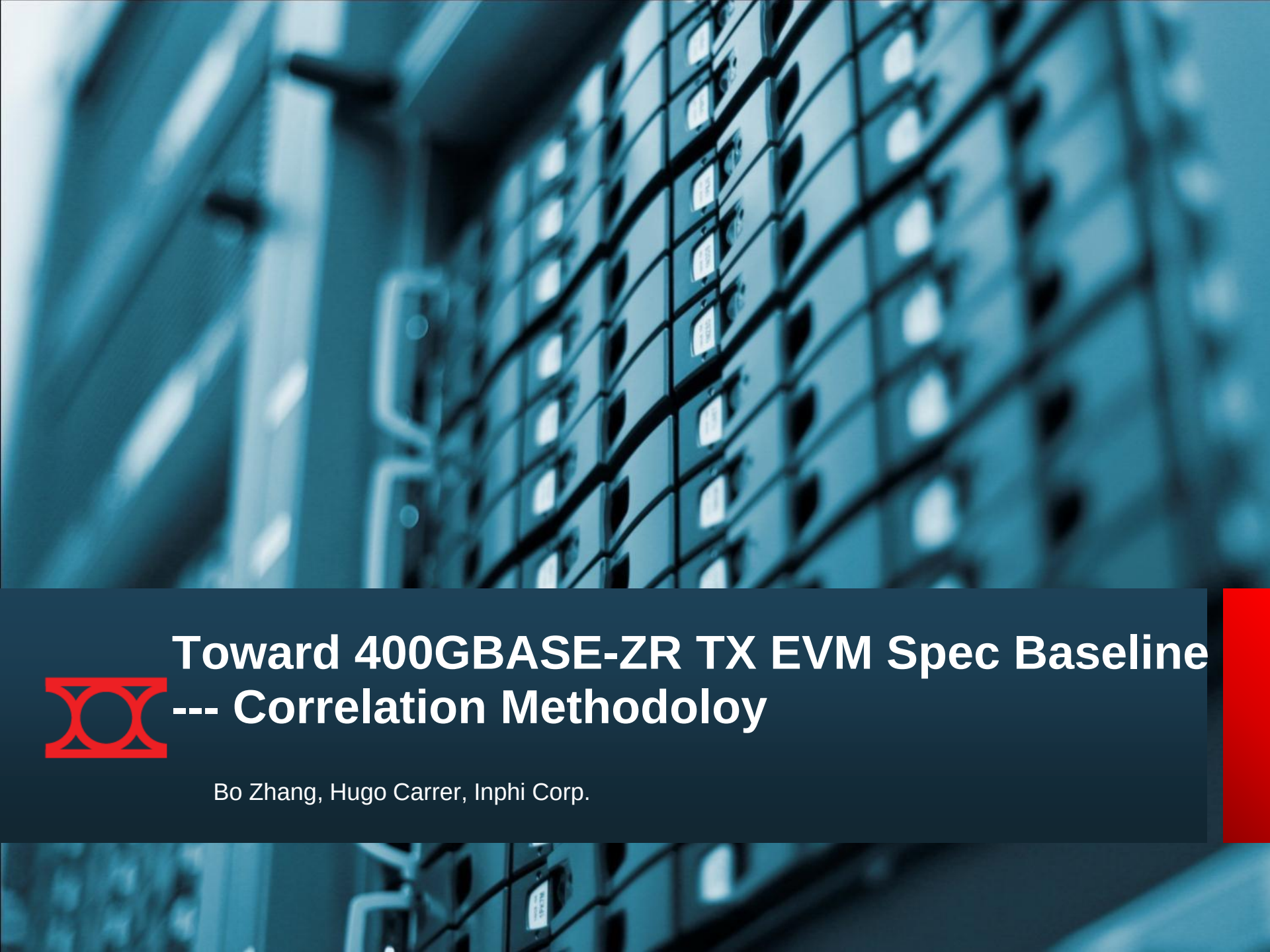

Toward 400GBASE-ZR TX EVM Spec Baseline --- Correlation Methodoloy

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Supporters

- Joerg Pfeifle, Bernd Nebendahl, Keysight

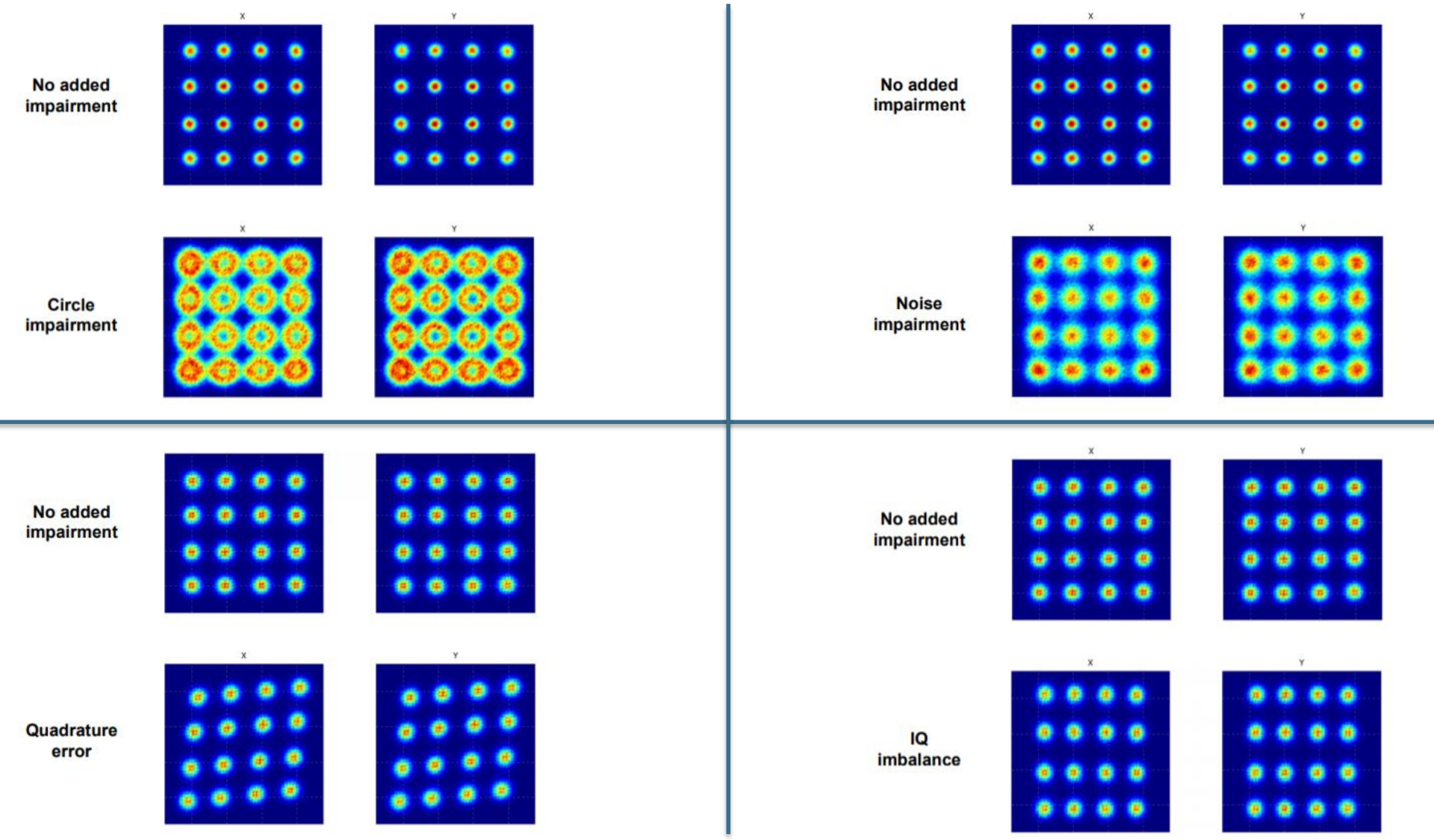
Motivation

- For P802.3ct project to succeed, the worst case DP-16QAM transmitter quality metric needs to be defined to ensure multi-supplier interoperability. EVM_{rms} is emerging as one of the most promising metrics in both IEEE P802.3ct as well as OIF 400ZR projects.

- There were good contribution and discussion at the recent IEEE Plenary meeting and prior interim meetings. See for example
  - anslow_3ct_02_0319
  - lecheminant_3cn_01_190207

- This contribution intends to clarify correlation methodology for EVM, specifically a key correlation parameter table is suggested.

Quick Review of EVM_{rms} for DP-16QAM



http://www.ieee802.org/3/ct/public/19_03/anslow_3ct_02_0319.pdf

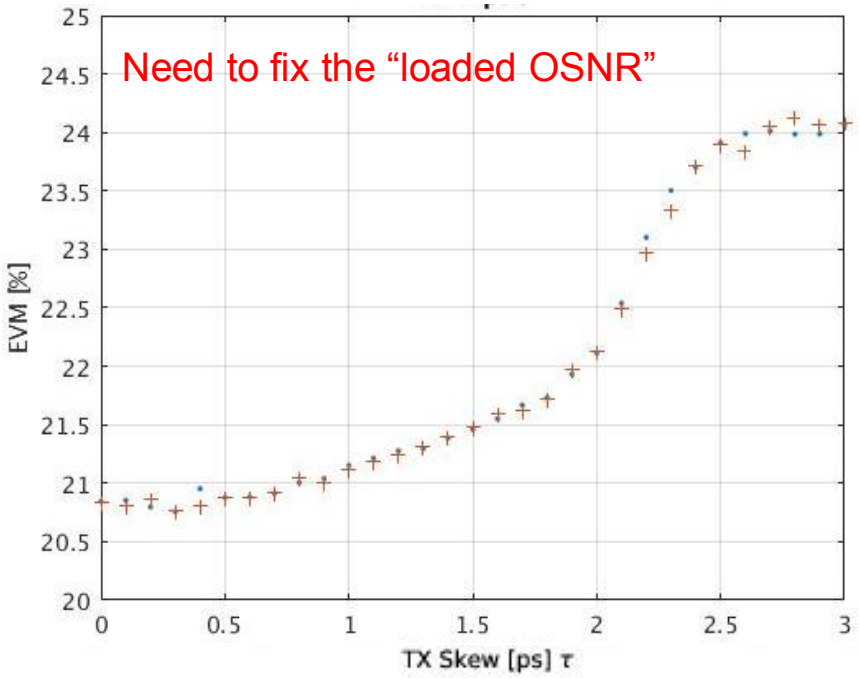
Correlation Methodology

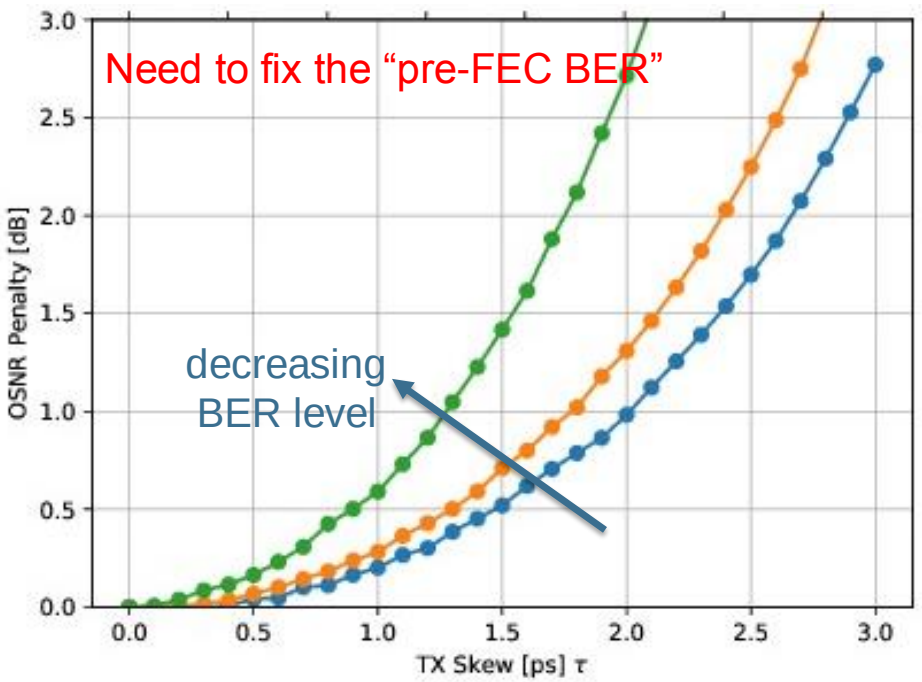
- **Need to table below parameter space before showing correlation results**
  - Baud rate for DP-16QAM
  - Pre-FEC BER level for reporting OSNR penalty (Loaded **Optical OSNR**)
  - Loaded **Digital OSNR (Dig OSNR)** level in script for reporting EVM
  - EVM data from ADC capture or Real-Time (RT) scope
  - *any other items?*

Example: Key Correlation Parameter Table

	Value	Note
Baud Rate	60GBd	DP-16QAM
PreFEC BER for reporting OSNR penalty	1.25 E-2	CFEC cliff
Digital OSNR in script	30dB	See next few slide
EVM data from …	ADC captures or RT scope captures	Might need to detail key differentiating params

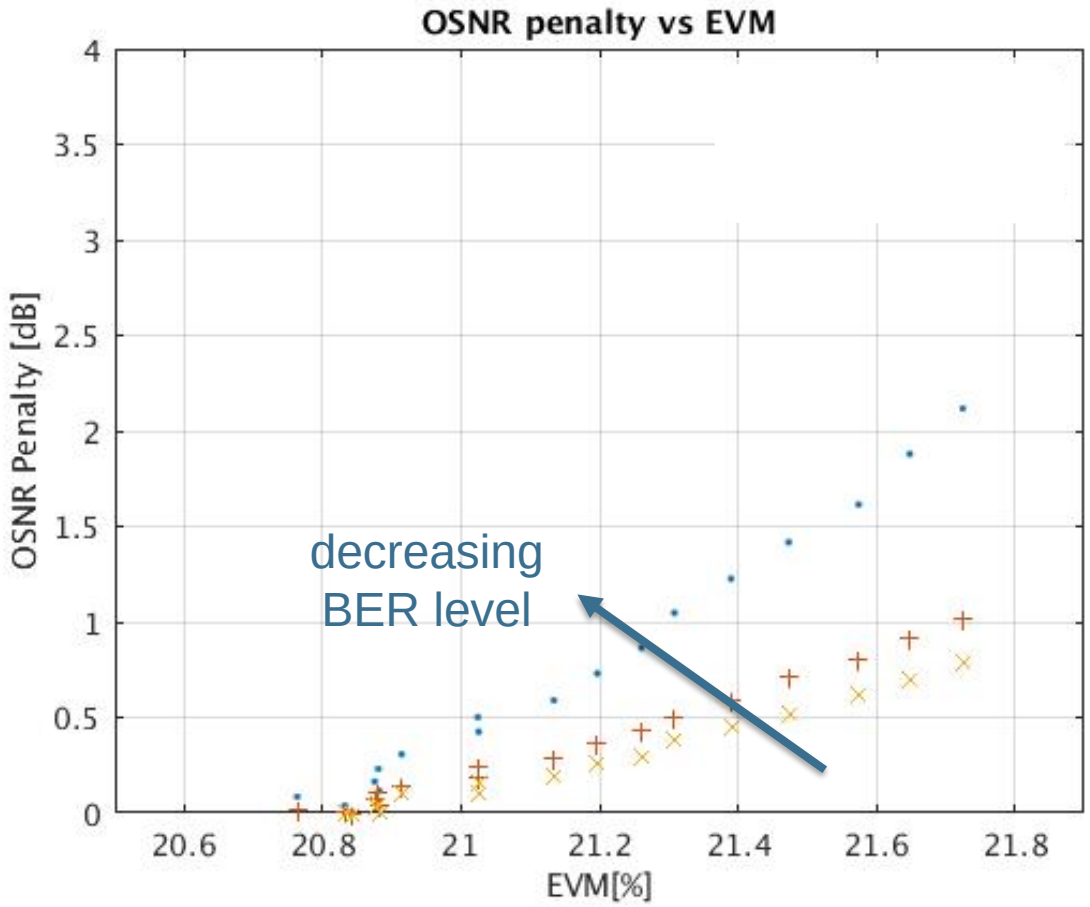
How to correlate EVM with OSNR penalty?





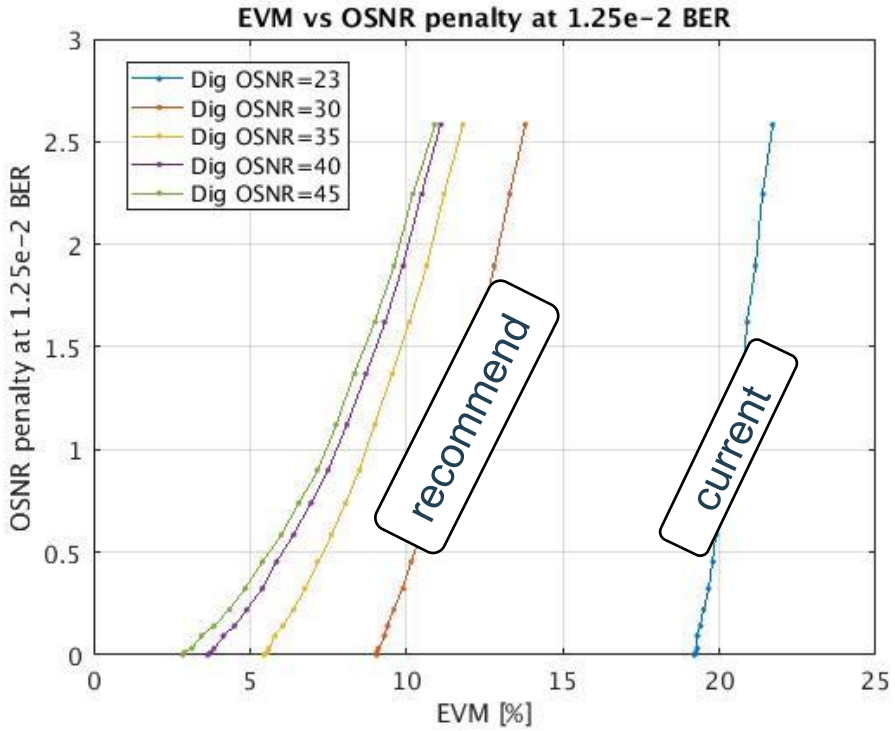
- As an illustrative example (Tx IQ skew as the one impairment), above shows how one can correlate EVM with OSNR penalty
  - Left figure: when Digital OSNR loaded in script is set to 23dB, how EVM degrades as one increases Tx IQ skew
  - Right figure: for a fixed Pre-FEC BER, how OSNR penalty increases as one increases Tx IQ skew
- Based on these two independent measures, one can then plot EVM on X axis and OSNR penalty on the Y axis (see next slide)

Importance of Pre-FEC BER Level Set



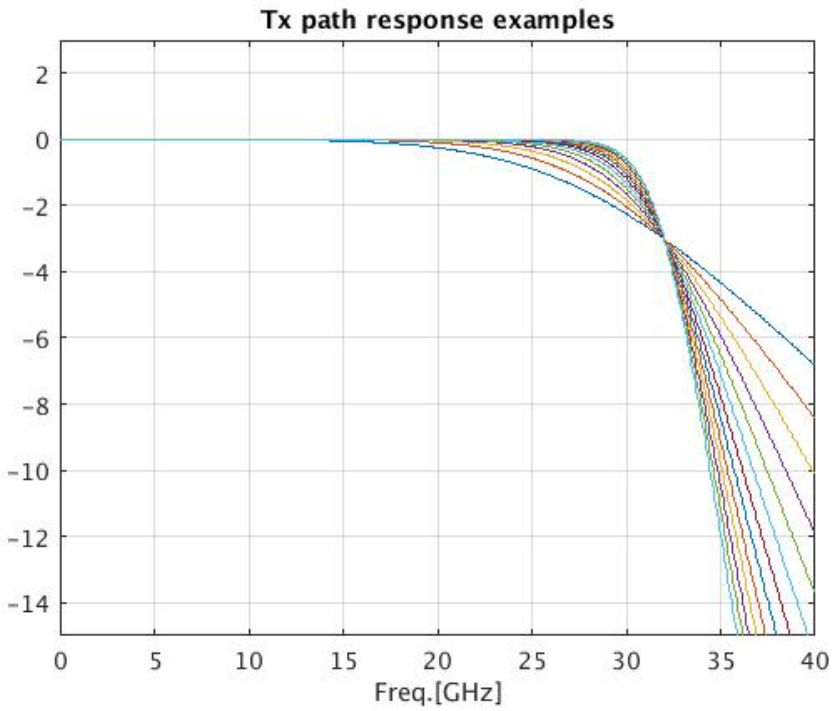
Importance of Loaded Digital OSNR

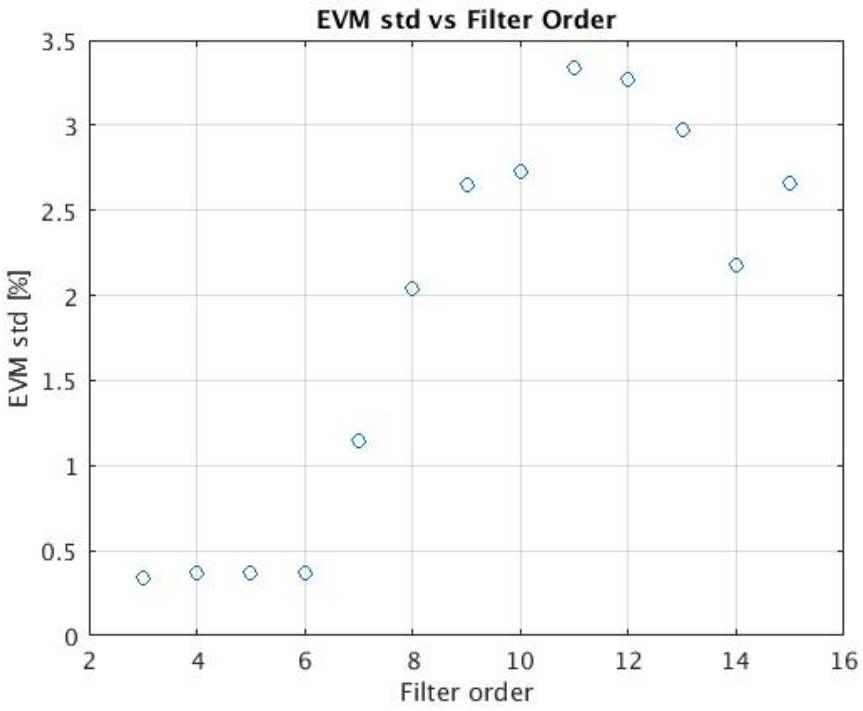
```
% some initial values
demuxPolarization = 1;    % do you want MIMO processing done
demuxBlockCount = 10;     % number of retiming blocks for demultiplexing

retimeBlockCount = 10;    % number of EVM blocks used for retiming

blockSize = 1e3;          % blocksize for impairment and EVM measurement and removal --> 1000

numTaps = 7;              % number of equalizer taps (must be an odd number) --> 7

OSNR = 23;                % OSNR(193.6) at reference point R_s (table in Clause 8)
                          % used to calculate signal-to-noise-ratio used to calculate the amount of
                          % additional white gaussian noise added to
                          % the signal prior to finding the equalizer taps
                          % the EVM is then calculated with the original
                          % signal after noise adding
```



EVM variability observed

- Using a Butterworth filter on the transmit path we swept the roll-off to by increasing the filter order to compare the EVM variability for 200 different 1k sample blocks





- Keysight is being notified on this EVM variability and they are currently working on it for a possible solution