Enhanced WDP for 6G SAS

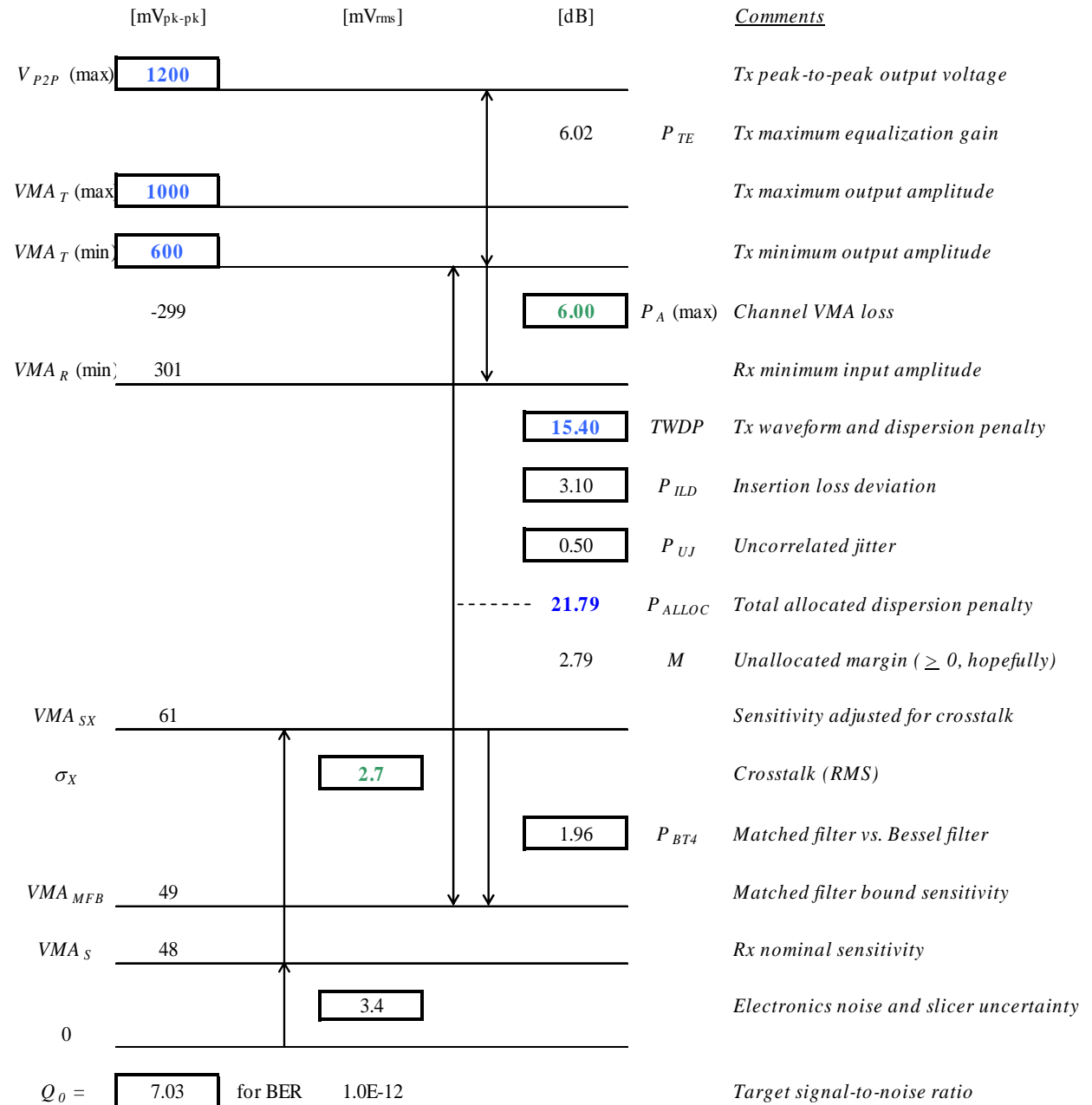## Mike Jenkins
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What are WDP, TWDP & Enhanced WDP ?

- *Waveform Dispersion Penalty (WDP)* measures how much the TX launch would need to be increased to achieve same SNR as with TX & ref RX alone (i.e., with no channel)

- *TX & Waveform Dispersion Penalty (TWDP)* measures same degradation but with TX imperfections included

- *Enhanced Waveform Dispersion Penalty* adds timing recovery to sample at the optimal point in the data eye.

Where are WDP, TWDP & Enhanced WDP ?

- WDP was developed to characterize the optical channels in 802.3aq

- Enhanced WDP is being adopted to measure TXs, channels(?) & set up RX tests for 8G Fibre Channel

Loss Budget

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[mVpk-pk]	[mVrms]	[dB]		Comments
V_{P2P} (max) 1200				Tx peak-to-peak output voltage
		6.02	P_{TE}	Tx maximum equalization gain
VMA_T (max) 1000				Tx maximum output amplitude
VMA_T (min) 600				Tx minimum output amplitude
-299		6.00	P_A (max)	Channel VMA loss
VMA_R (min) 301				Rx minimum input amplitude
		15.40	TWDP	Tx waveform and dispersion penalty
		3.10	P_{ILD}	Insertion loss deviation
		0.50	P_{UJ}	Uncorrelated jitter
		21.79	P_{ALLOC}	Total allocated dispersion penalty
		2.79	M	Unallocated margin (≥ 0, hopefully)
VMA_{SX} 61				Sensitivity adjusted for crosstalk
σ_X	2.7			Crosstalk (RMS)
		1.96	P_{BT4}	Matched filter vs. Bessel filter
VMA_{MFB} 49				Matched filter bound sensitivity
VMA_S 48				Rx nominal sensitivity
	3.4			Electronics noise and slicer uncertainty
0				
$Q_0 =$ 7.03	for BER 1.0E-12			Target signal-to-noise ratio

Jitter Budget

[mUI]

|	NC-DDJ (pk-pk)	BUJ (pk-pk)	RJ (pk-pk)	RJ (RMS)	UJ (RMS)	TJ (pk-pk)	Comments
TX		35	140	10	**20**		*Tx output jitter*
	316						*Tx waveform and dispersion*
	90						*Insertion loss deviation*
				9			*Crosstalk*
RX							
		200	140	10			*Rx clock and data recovery*
Total	406	235	235	17		876	*Total jitter ($\leq$ 1 UI, hopefully)*
						946	*What if RJ = UJ (e.g. BUJ = 0)?*

$f_s =$ 6.000   GBd

Effect of DFE
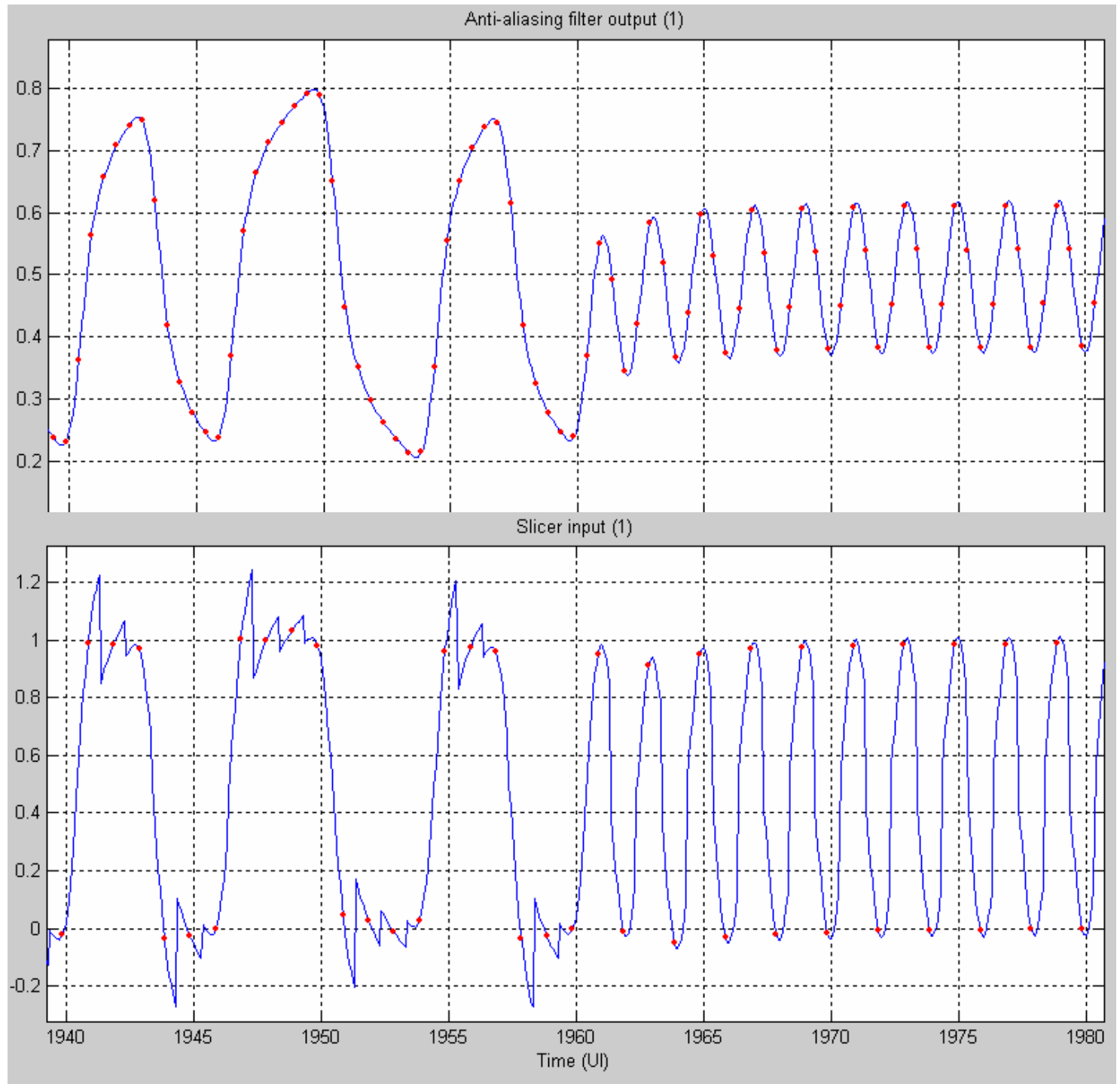
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TX Waveform and Dispersion Penalty (TWDP)

DFE objective is to adjust all positive samples (red dots) to 1 & all negative samples to 0

TWDP measures how much TX VMA would have to be increased to get same SNR as TX+RX with no channel

For ref TX (1000mVpp with 2dB de-emphasis and 10 meter cable, TWDP = 13.41 dB (15.4 dB allocated)

Slicer input eye (1)

Normalized amplitude

Time (UI)
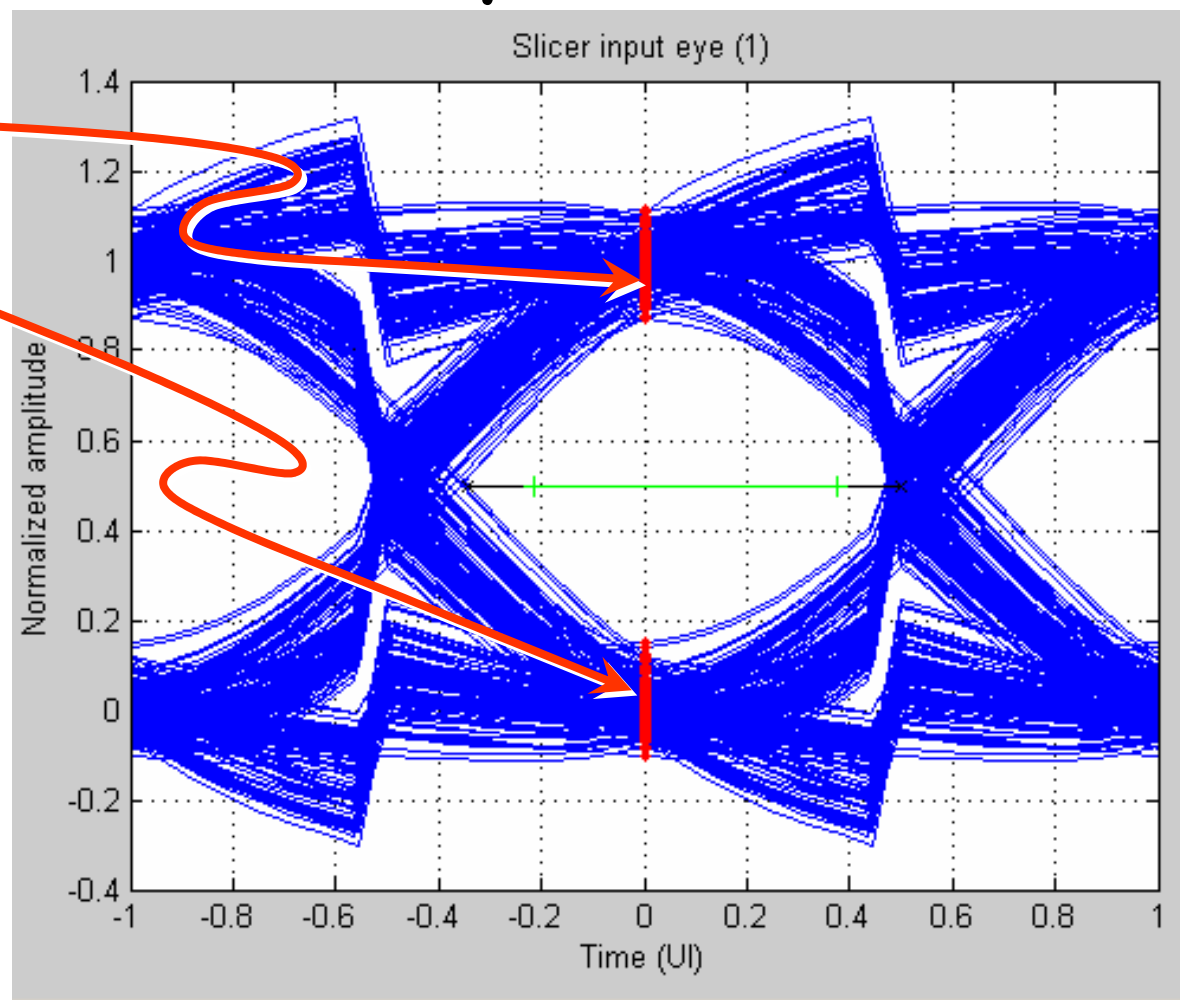
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Summary

- Enhanced WDP provides a technique to validate TX, channel & RX hardware

- Enhanced WDP provides a simulation method to validate ref TX+channel+RX

- Enhanced WDP shows more vertical eye opening than Stateye, but is expected to correlate to Stateye v5 with 8B10B