Analysis of SNR, TWDP and Implementation penalty vs. measured waveforms

Finite EQ lengths

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General analysis notes

- Waveforms from LRM private area (pre-processed)
- Plotted results are based on finite EQ lengths
  - 2 configurations: 14,5 and 10,3, FF @T/2, FB @T
- Implementation penalty (IP) = SNR\text{\tiny infinite} – SNR\text{\tiny finite} (dBo)
- Stressors ~4.5 dB PIE-D from recent Ewen set
  - < 2 dB IP budget for EQ length
  - SNR > 8.5 dB…
- OMA & OMSD for TWDP scaling determined via SW waveform analysis
- Vertical scales in dBo
- Semi-analytic method & MMSE adaptation
- Work in progress…
Measured waveforms for following analyses
Next 2 plots show that pre-cursor fiber is almost always most stressful to shorter length EQs

- Not surprising…
- Not always true for very long lengths, but differences are small (not plotted)
- Differences greatest for pre-emphasized waveforms
  - Shape not optimized for pre-cursor

IP results are from OMA & OMSD scaled waveforms

- Little difference
- FYI, unscaled waveform IPs tend in the same direction as actual power
IP vs. waveform* for pre, symmetrical, and post cursor channels; 14,5 EQ

*Additional waveforms tested here, beyond those displayed on slide 3.
IP vs. waveform* for pre, symmetrical, and post cursor channels; 10,3 EQ

*Additional waveforms tested here, beyond those displayed on slide 3.
Slicer SNR

- 3 SNR traces vs. LRM reference Rx
  - Unscaled optical power
  - Scaled to match OMSD to OMSD of ideal reference Tx
    - Waveform has same MFB SNR at TP2 as reference (14.97 dB)
  - Scaled to match OMA to OMA of ideal reference Tx
    - Waveform has same OMA at TP2 as reference (-4.5 dBm)
- Actual power has direct effect on SNR
  - Scaling hides effect of actual power
- Waveshape also has strong effect on SNR
  - Effect of IP is secondary
- Pre-emphasized waveforms show advantage when scaled via OMA
  - But, is it real? More to come…
- As expected, 14,5 EQ shows higher SNR & lower IP than 10,3
SNR & IP vs. waveform for pre-cursor channel; 14,5 EQ
SNR & IP vs. waveform for pre-cursor channel; 10,3 EQ
Is current pre-emphasis advantage real?

- Unscaled SNR (blue) changes as expected per eyes
  - Eye powers are to same scale
- Slicer SNR has similar trends as input OMSD and OMA
  - Better tracking of OMSD than OMA
- With constant input power at TP2
  - Constant OMSD results in ~constant SNR; this is not surprising as MFB SNRs at TP2 are all the same
  - Constant OMA does not result in constant SNR
  - Neither scaling method predicts actual SNR
    - Direct effect of power on SNR is removed by scaling
- With current pre-emphasis method
  - Better TWDP_{OMA} does not relate to better SNR or finite length IP
  - IP tends in same direction as TWDP_{OMSD}
TWDP & IP vs. pre-emphasized waveforms for pre-cursor channel; 14,5 EQ
TWDP & IP vs. pre-emphasized waveforms for pre-cursor channel; 10,3 EQ
• 2 traces
  – OMSD scaling
  – OMA scaling
    • Per D2.0
• Impact to TWDP dominated by channel waveshape
  – Effect of IP is secondary
  – Scaling removes effect of actual power
• Pre-emphasized waveforms show advantage when scaled via OMA
  – But, from above, it may not be real with current method
• As expected, 14,5 EQ shows lower TWDP & IP scores than 10,3
TWDP & IP vs. waveform for pre-cursor channel; 14,5 EQ
TWDP & IP vs. waveform for pre-cursor channel; 10,3 EQ
Summary

• Pre-cursor channel most challenging for finite EQ
• Actual optical power has direct effect on slicer SNR
  – Scaling, if used, hides effect of actual power
• Waveshape has strong effect on SNR & TWDP
  – Effect of finite length IP is secondary
• Pre-emphasized waveforms show advantage when scaled via OMA
  – But, better TWDP_{OMA} does not result in better SNR or finite length IP for current method
  – Scaling with OMSD results in better tracking among SNR, TWDP, and IP
  – Current pre-emphasis not optimum for pre-cursor
Need other IP mechanisms to test

• EQ length being done
• Others readily implemented in TWDP-like code
  – Threshold
  – Timing
  – Rx bandwidth
• More?