Supporting presentation for comments #337 & #338

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Cisco

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Submitted Comments

Cl **185A** *SC* **185A.2.3.5** *P* **914** *L* **19** # 337

Williams, Tom Cisco

Comment Type **TR** *Comment Status* **X**

Reference equalizer misses to specify the number of taps.

A supporting presentation will be provided

SuggestedRemedy

Add a specified number of taps to the description.

Propose a 31 tap equalizer.

"... with an adaptive 31 tap T-spaced feed-forward equalizer ..."

Proposed Response *Response Status* **O**

Cl **185A** *SC* **185A.2.3.7** *P* **914** *L* **29** # 338

Williams, Tom Cisco

Comment Type **TR** *Comment Status* **X**

The purpose of ETCC is to quantify the penalty due to transmitter-only impairments. The addition of the reference post equalizer in D2.1 is proposed to compensate for a transmitter-caused penalty (IQ skew) which allows poorer transmitters to pass the test and pushing the burden to the link receiver to compensate.

It is unclear if this reference post equalizer should remain in the specification.

However, to limit the burden to the link receiver, propose to limit the Reference Post equalizer to 5 taps and only in the through paths which is sufficient to address the skew. And a seperate 1-tap phase error correction.

A supporting presentation will be provided

SuggestedRemedy

Rewrite 185A.2.3.7 to:
A reference post-equalizer for each polarization is placed after the carrier phase recovery, and used to compensate for transmit I-Q skew and transmit I-Q phase error impairments.

The I-Q phase error is corrected via a 1-tap adaptive feed forward crosstalk cancellation between I-Q pairs.

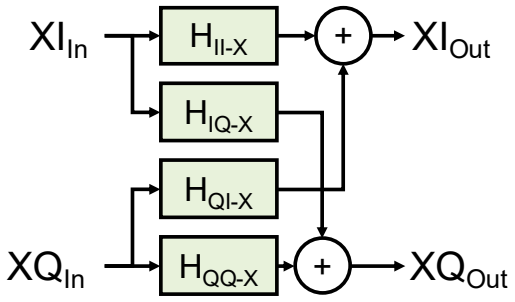
The I-Q skew is corrected via four independent 5-tap adaptive T-spaced feed forward filters for each of the XI, XQ, YI, YQ signals, where T is the symbol period.

Proposed Response *Response Status* **O**

Opening remarks

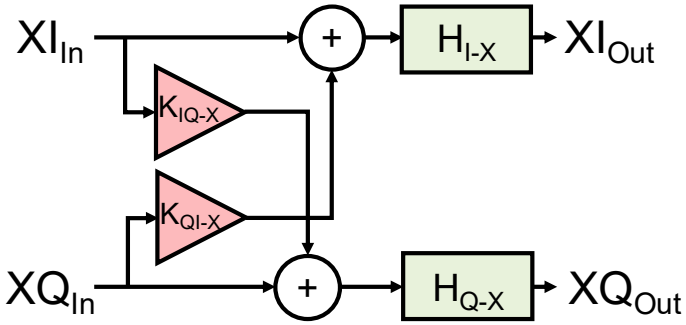
- A Reference Post Equalizer was proposed to compensate transmit I-Q skew and quadrature phase error
- The recommended 2x2 real MIMO with four T-spaced FIR filters per polarization may mask other transmitter impairments (crosstalk, frequency-dependent mismatch, etc.)
- Comment #338 proposes a simpler equalizer that achieves the same goal without any possible unwanted impairment masking

2x2 real MIMO (Current)

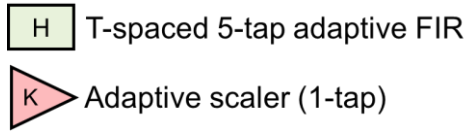


(Same for Y-pol)

2x2 lattice + FIRs (Proposed)



(Same for Y-pol)

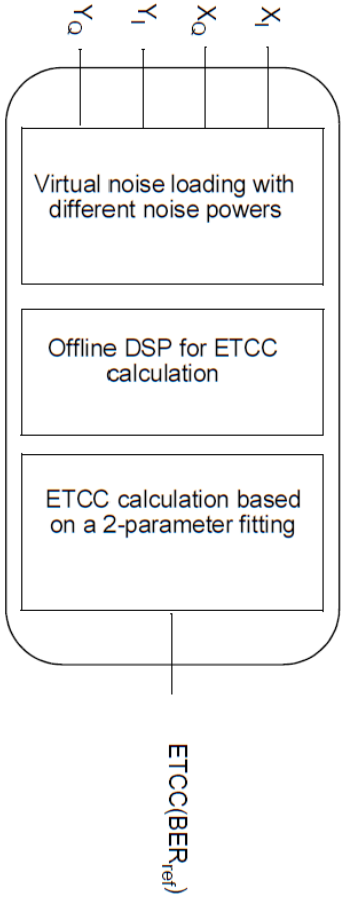


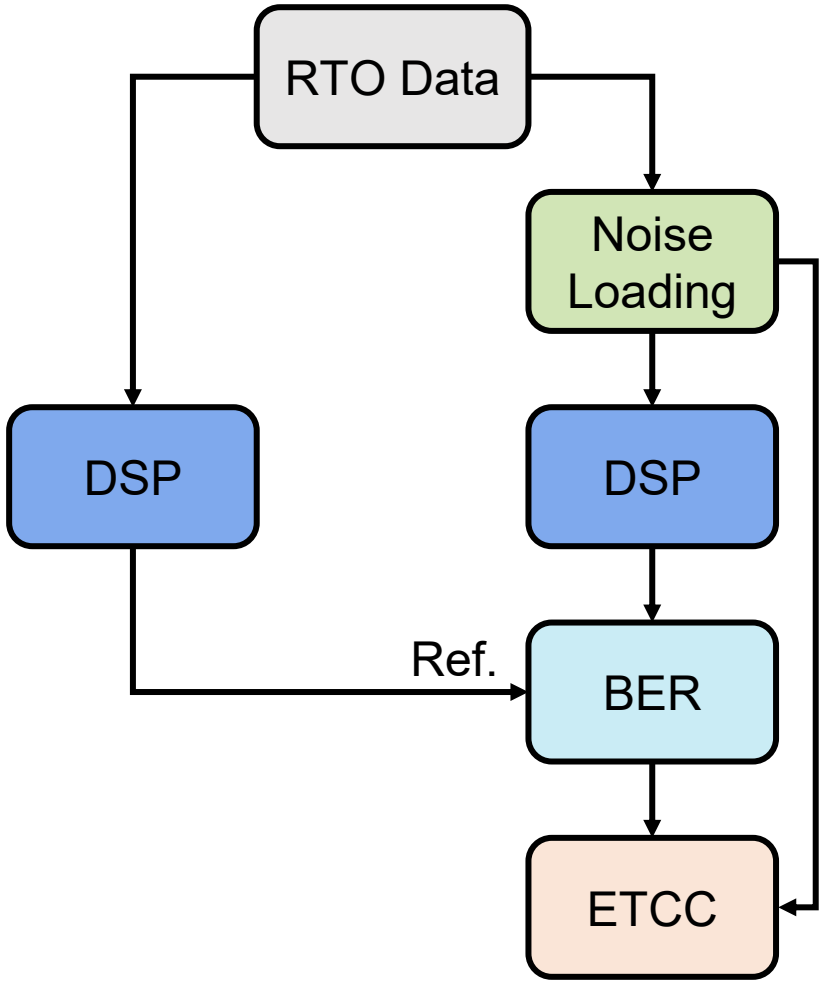
Methodology

- ETCC results are generated from an analysis on real data from publicly available OFC 2025 Plugfest 800ZR dataset from OIF [1,2]
- Tx waveforms from seven different vendors captured with a Keysight OMA/RTO
- Processing done according to ETCC calculation in IEEE P802.3dj/D2.1, Annex 185A (without receiver deembedding)

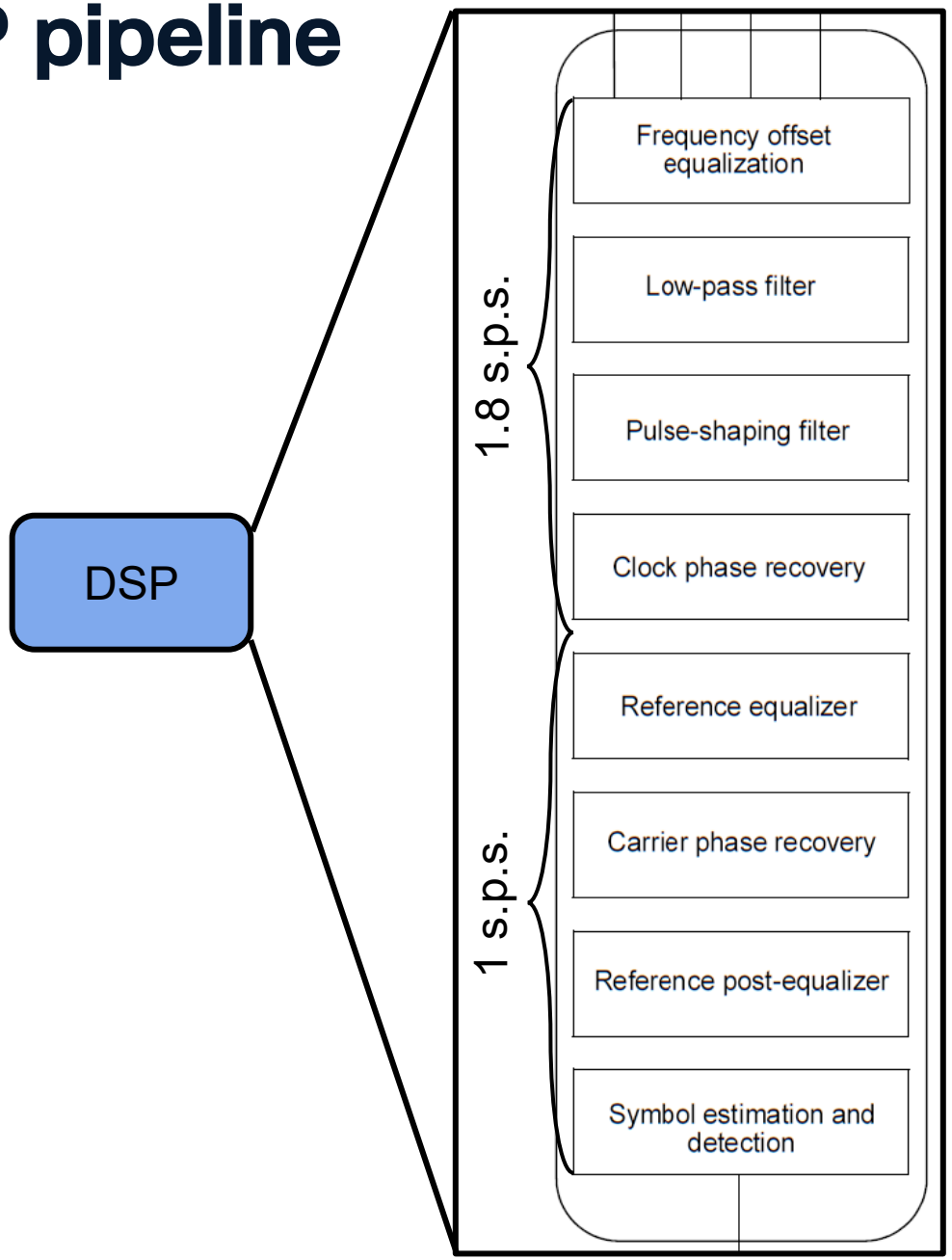
[1] OIF 400ZR and 800ZR Transmitter Quality Metric Measurements White Paper OFC 2025 Plugfest, April 2025, Pfeifle et al. (Keysight)
[2] Relevant data related to Transmitter Quality Metric development and validation

Data processing flow





ETCC DSP pipeline



4th-power FFT

Bessel Thomson w/ 0.55*BR BW

Root-raised cosine w/ 0.1 roll-off

Power clock tone per polarization

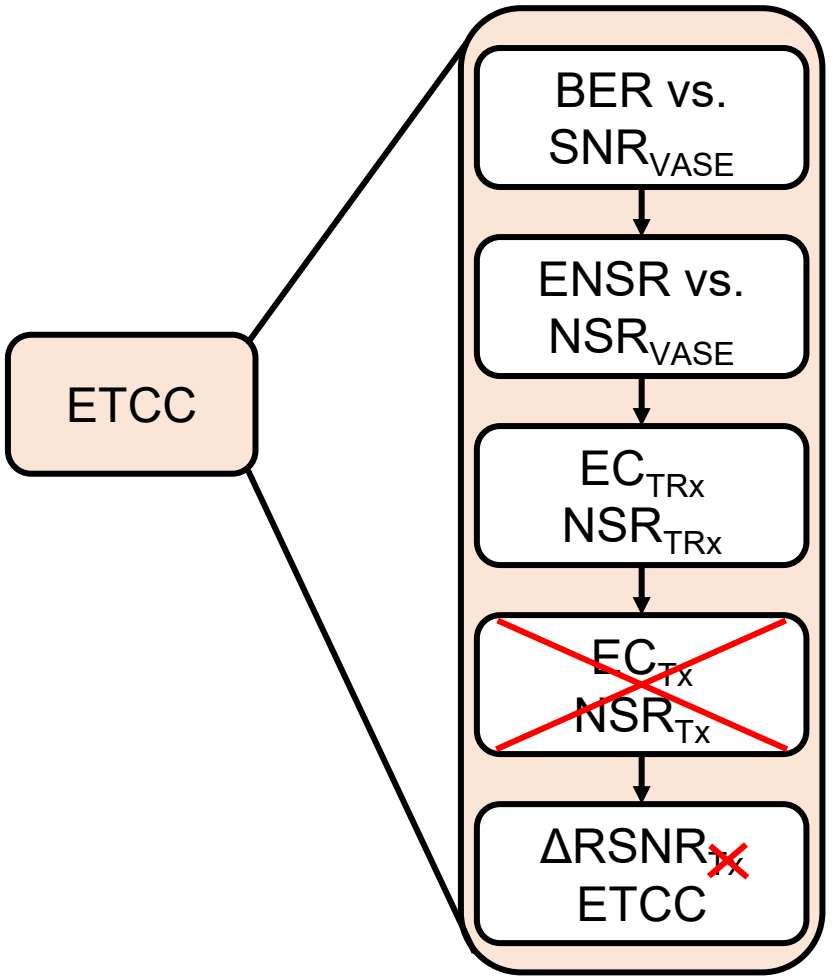
31-tap T-spaced 2x2 CMA/RDE/LMS

4th-power w/ inner & outer symbols

5-tap T-spaced 2x2 real MIMO per pol.

Optimized thresholds

ETCC flow



Error counting

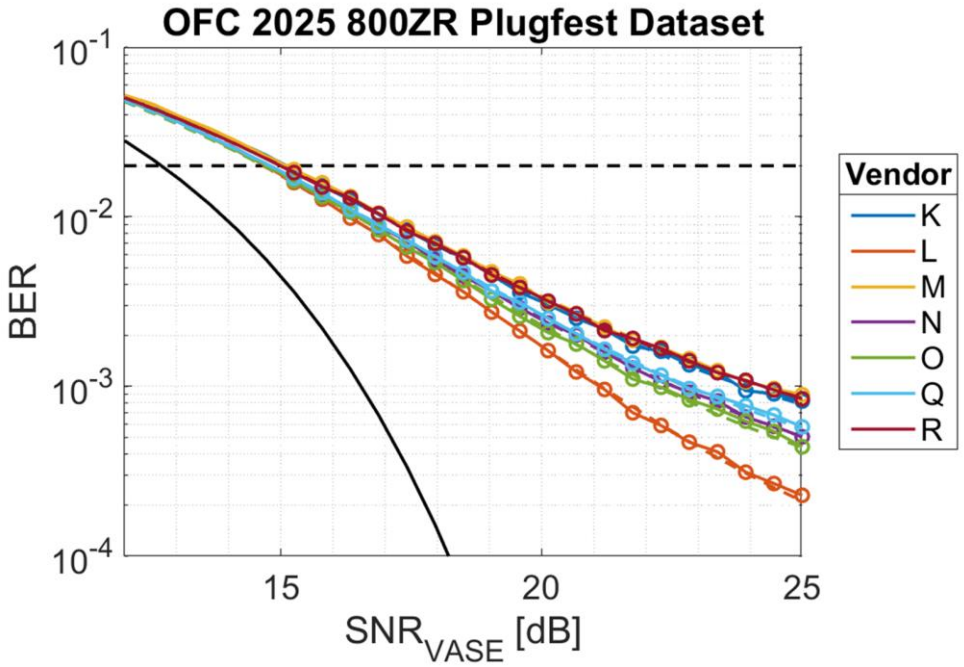
Estimation of ENSR from BER

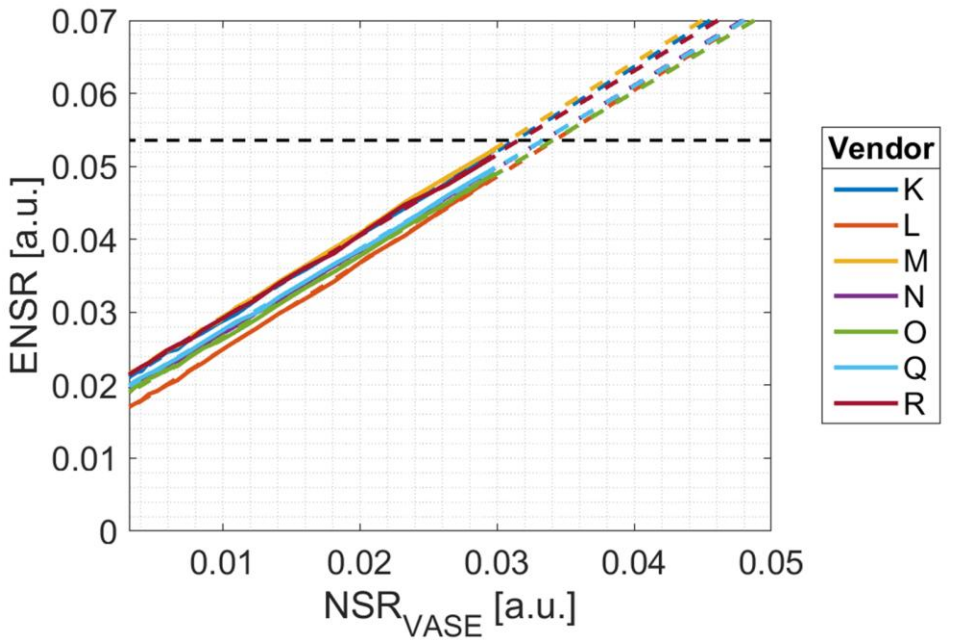
Linear fit to ENSR vs. NSR_{VASE} curve

Deembed using known EC_{Rx}, NSR_{Rx}

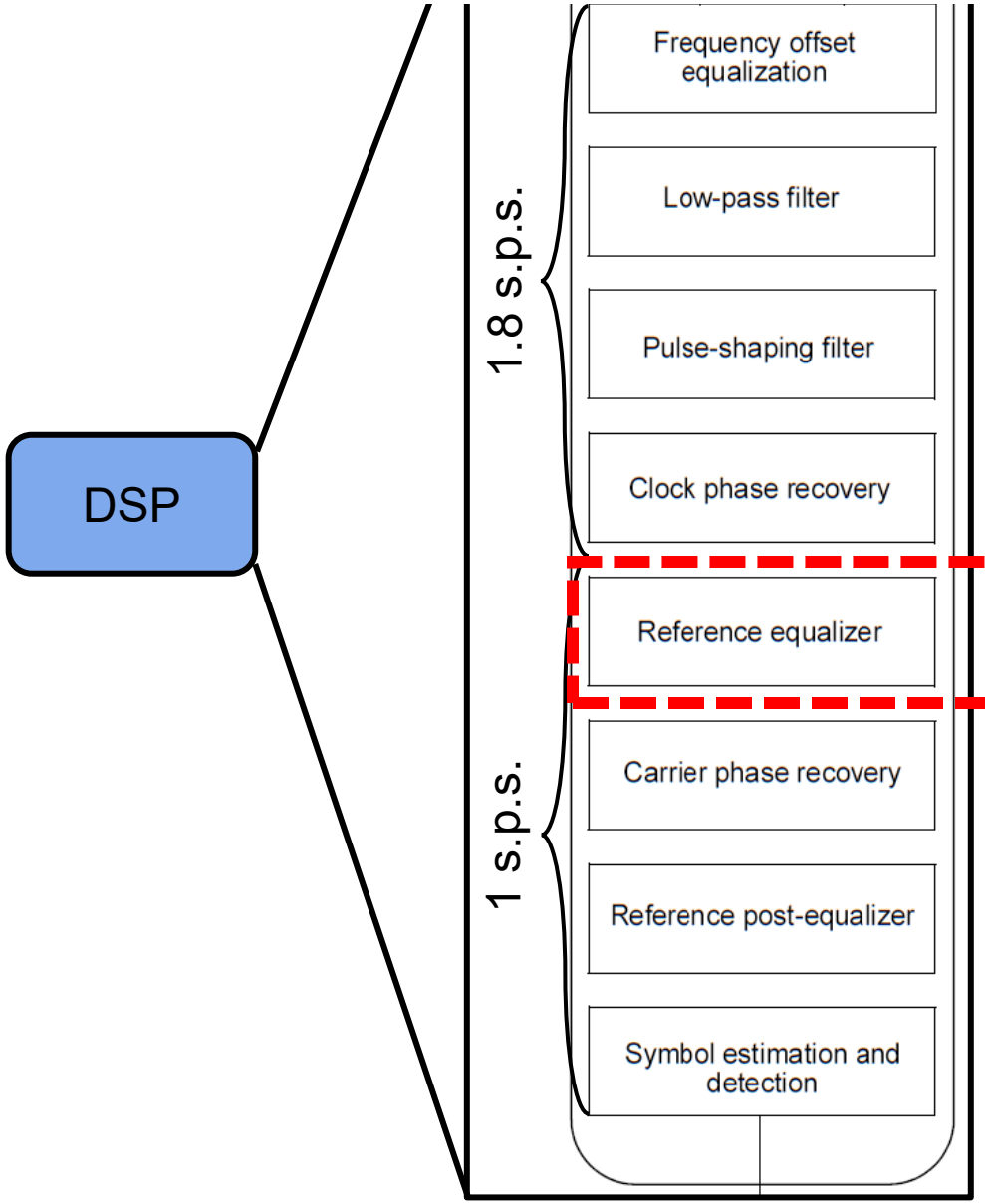
$$RSNR_{ase,tx} = ((EC_{tx} \cdot ESNR_{ref})^{-1} - NSR_{tx})^{-1}$$

$$ETCC = \Delta RSNR_{tx} = 10 \log 10\left(\frac{RSNR_{ase,tx}}{ESNR_{ref}}\right)$$





Comment 337. Reference Equalizer Taps



4th-power FFT

Bessel Thomson w/ 0.55*BR BW

Root-raised cosine w/ 0.1 roll-off

Power clock tone per polarization

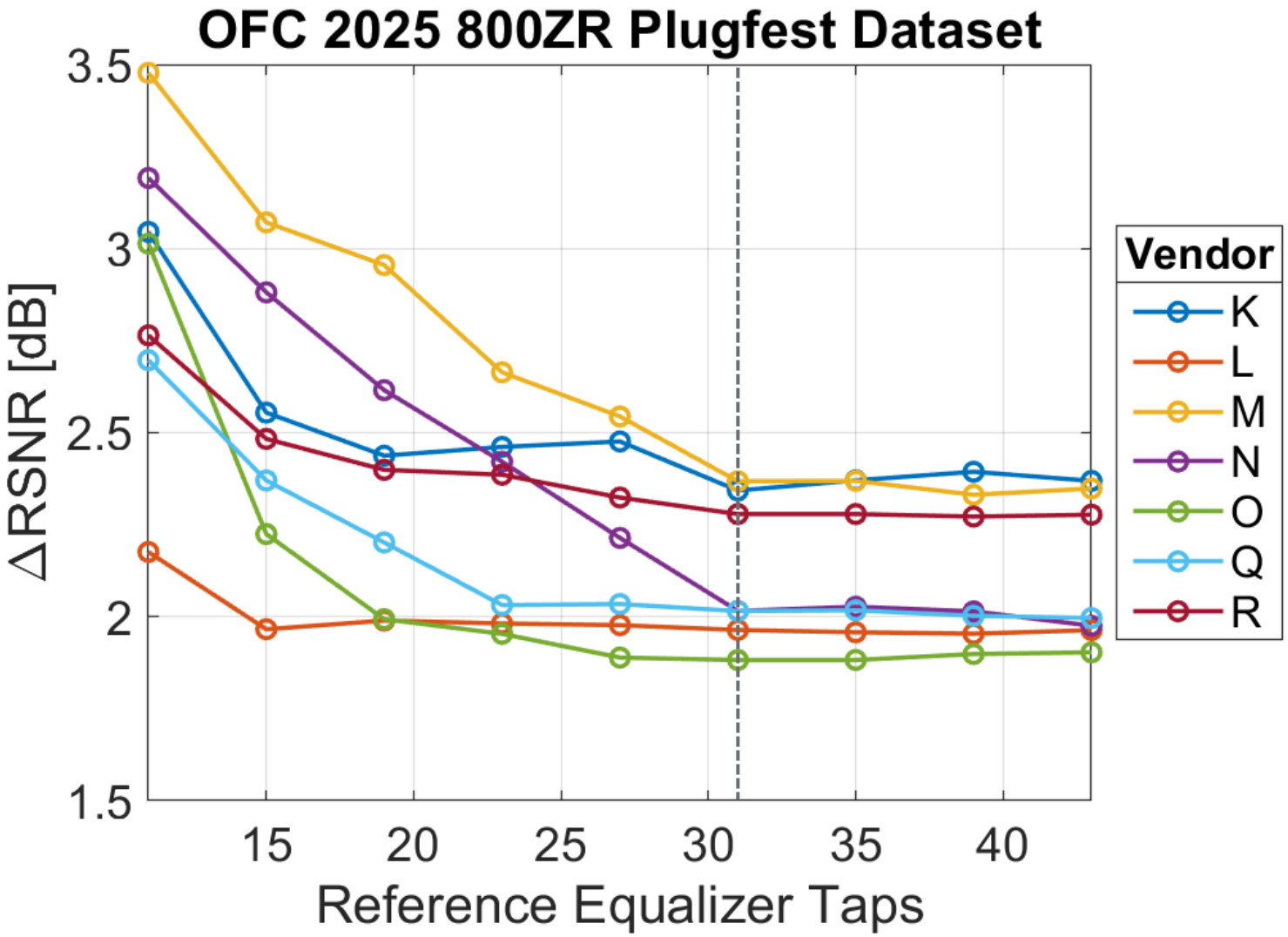
N-tap T-spaced 2x2 CMA/RDE/LMS

4th-power w/ inner & outer symbols

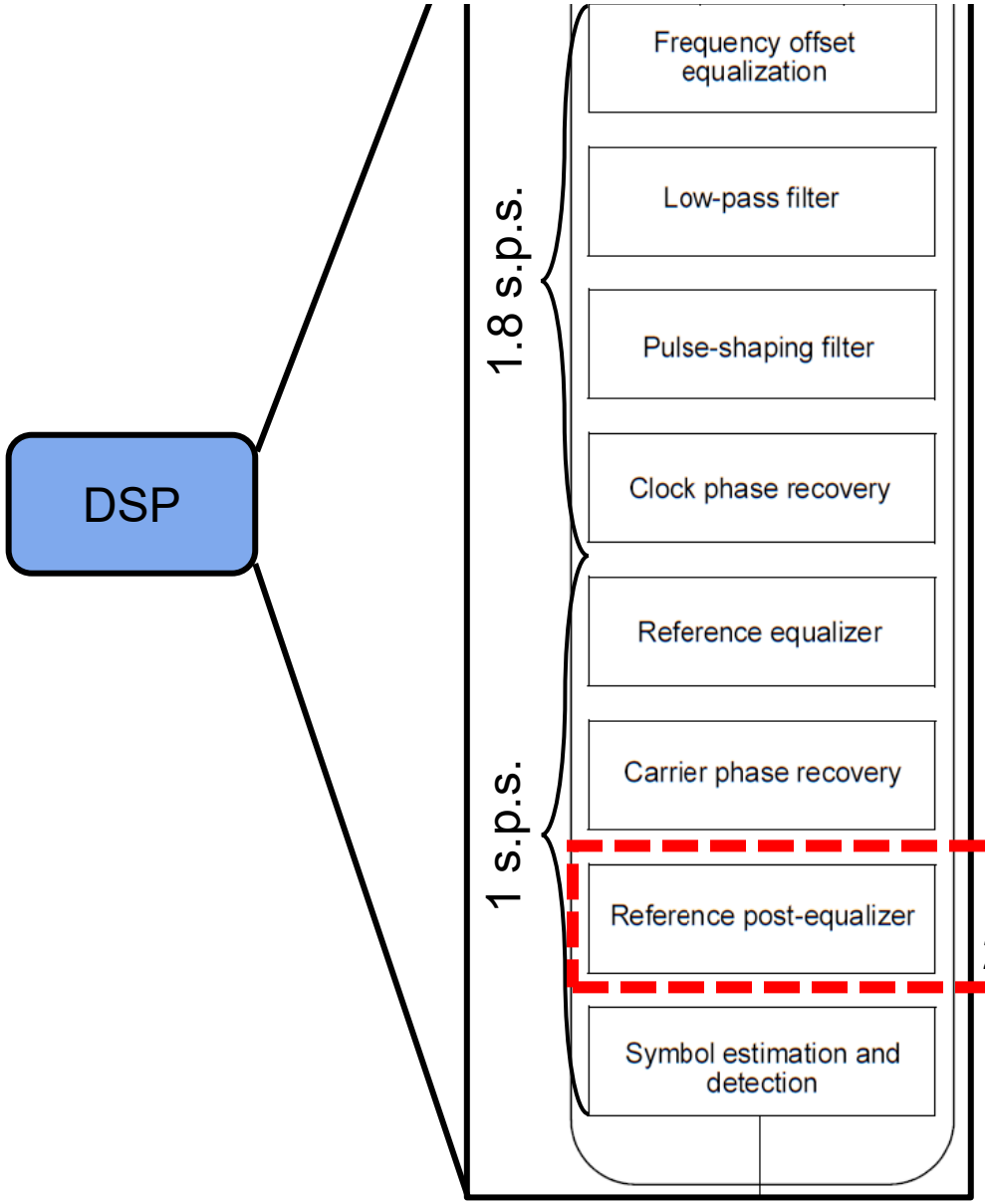
5-tap T-spaced 2x2 real MIMO per pol.

Optimized thresholds

Comment 337. Reference Equalizer Taps



Comment 338. Post Reference Equalizer Implementation



4th-power FFT

Bessel Thomson w/ 0.55*BR BW

Root-raised cosine w/ 0.1 roll-off

Power clock tone per polarization

31-tap T-spaced 2x2 CMA/RDE/LMS

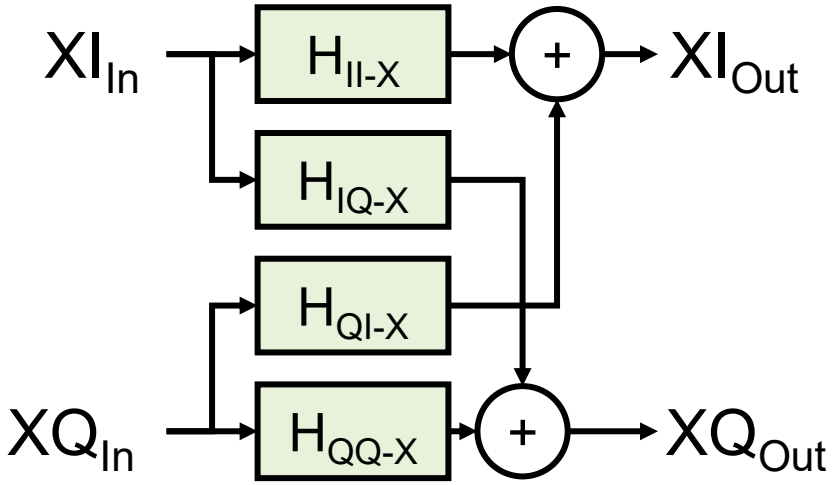
4th-power w/ inner & outer symbols

~~**5-tap T-spaced 2x2 real MIMO per pol.**~~
2x2 Lattice + 2x1 5-tap T-spaced FIR per pol.

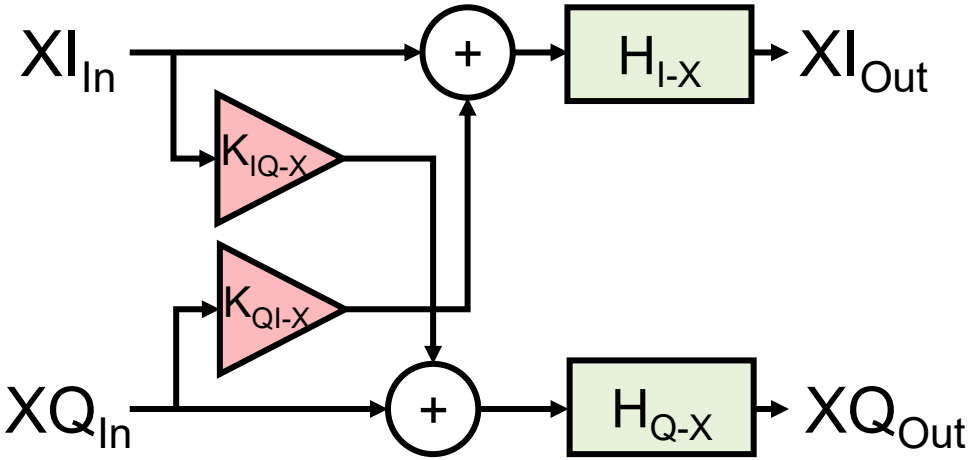
Optimized thresholds

Comment 338. Post Reference Equalizer Implementation

2x2 real MIMO (Current)



2x2 lattice + FIRs (Proposed)

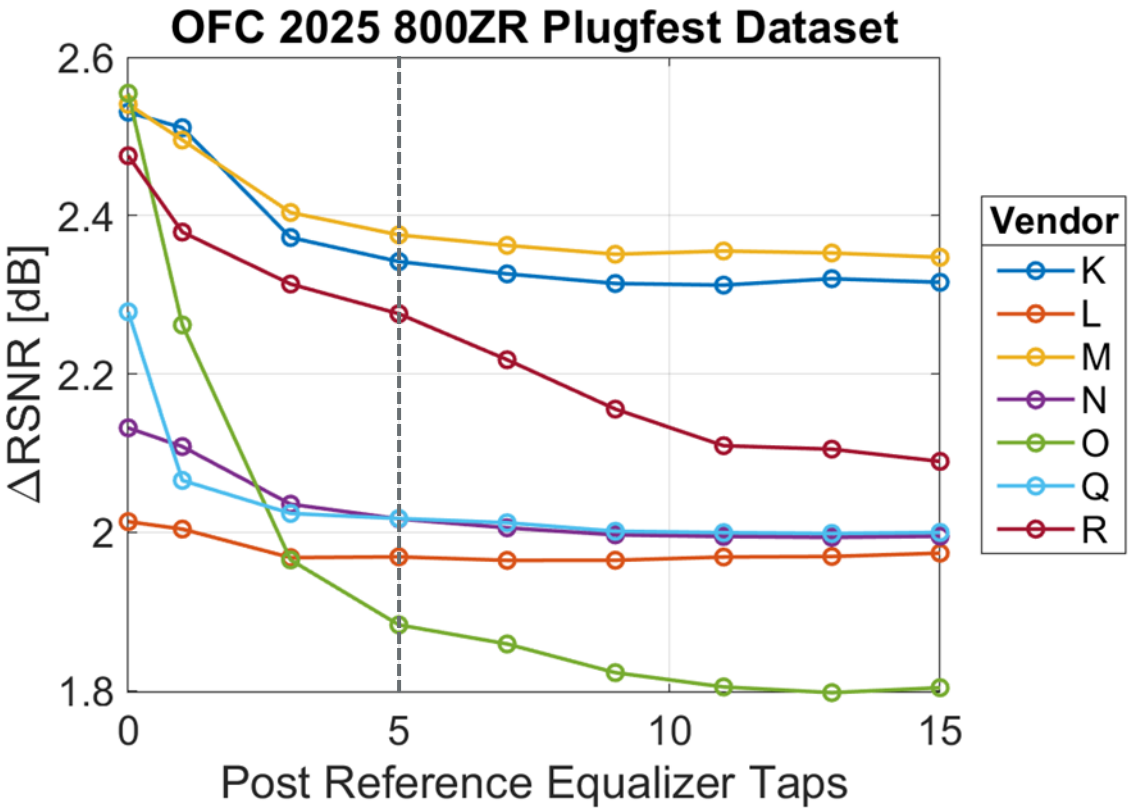


H — T-spaced 5-tap adaptive FIR

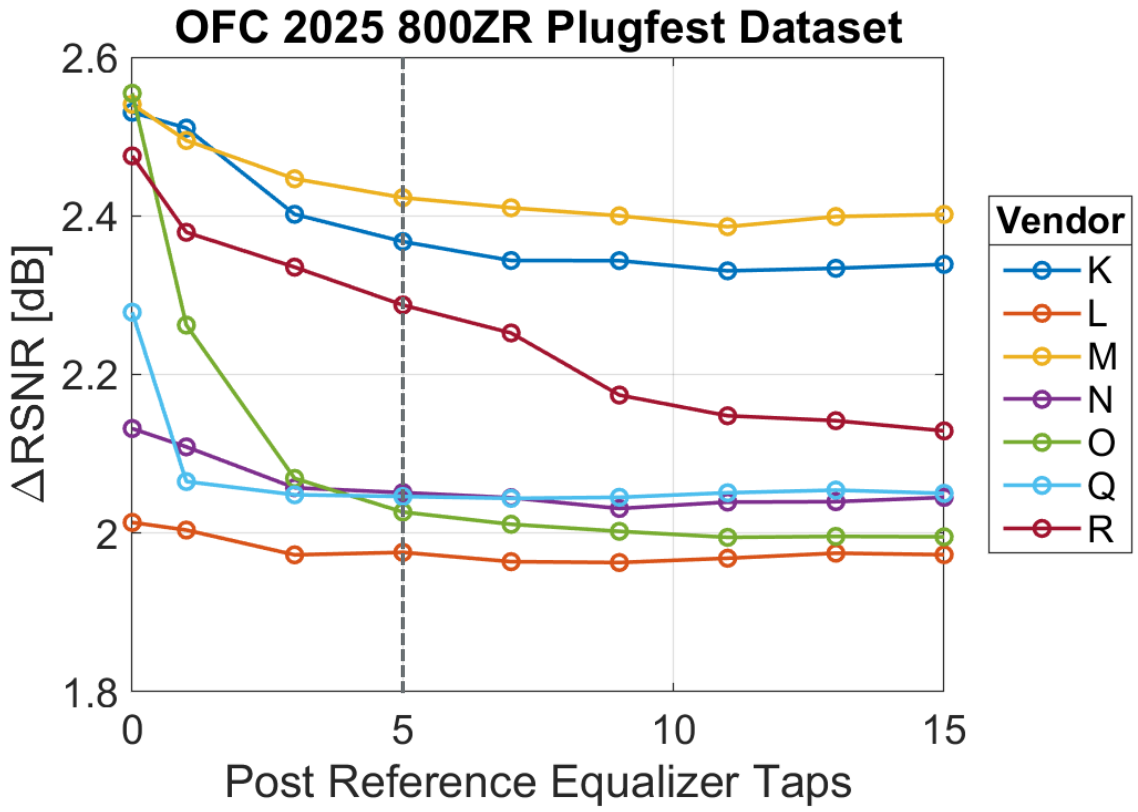
K — Adaptive scaler (1-tap)

Comment 338. Post Reference Equalizer Implementation

2x2 real MIMO (Current)



2x2 lattice + FIRs (Proposed)



Thank you – questions?