Transmitter and SRS test source metrics

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Tx eye quality and SRS test source metrics

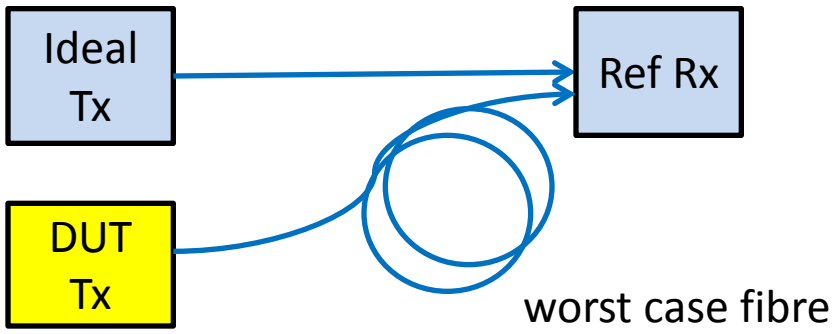
Link budgets close provided:

- the Tx eye quality measurement and the SRS test source calibration measurement use equivalent methods
  - for example, 100GBASE-SR4
- and (ideally) the source metric yields a dB value which correlates with the system penalty of an imperfect Tx.
  - i.e. the difference between the measured sensitivity, at the target BER, of a reference Rx:
    - for an ideal Tx input

    and
    - for the DUT Tx, after transmission through a worst case fibre link

TDP for LR

- For LR, 10G and 25G/lane NRZ , TDP is BER measurement based



DUT = Device Under Test

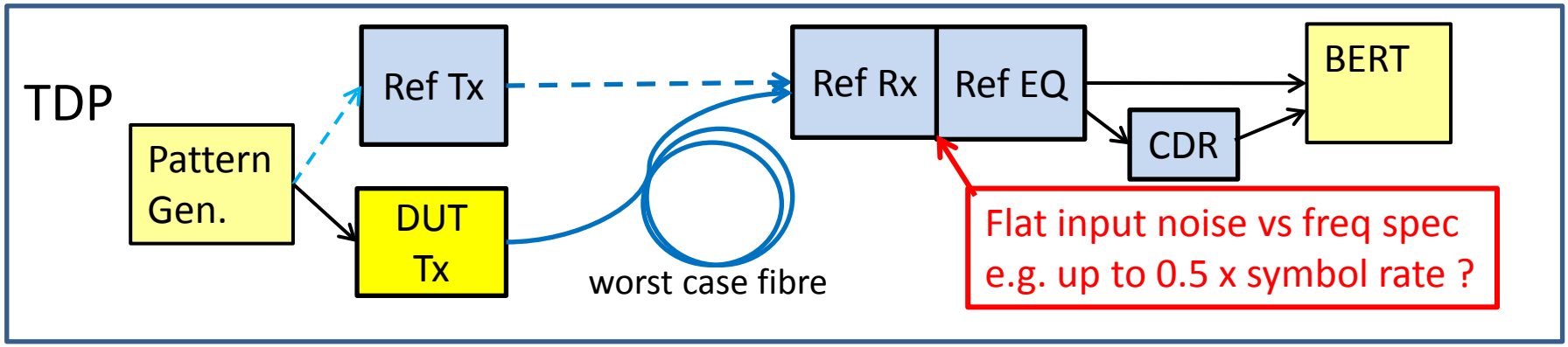
What's new now

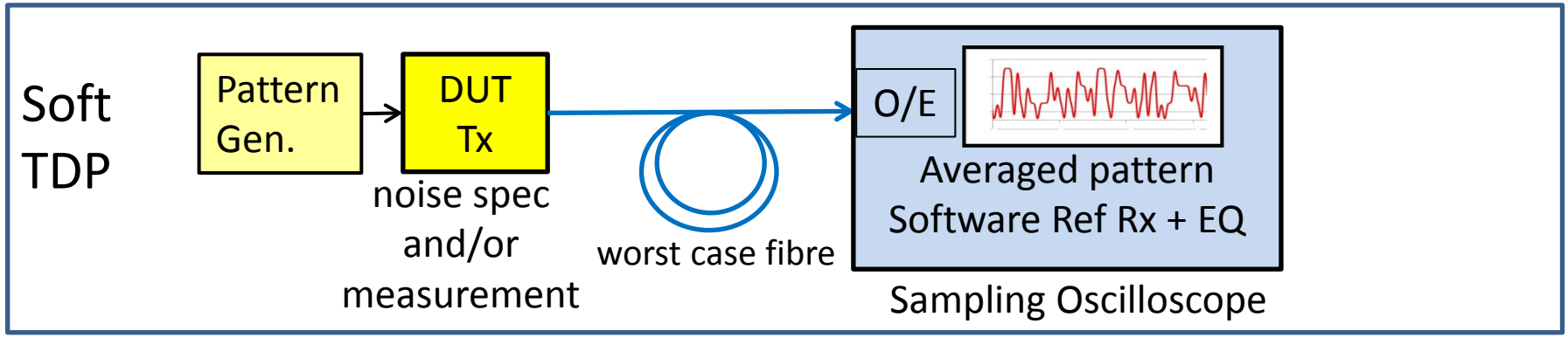
- PAM4 modulation
  - Tx and Rx likely to use equalization
  - Multiple eye openings to track
  - Eyes don't have to be open for link to close
- Suggests
  - Eye mask test no longer straightforward
    - limited value in measuring closed eyes
  - Tx quality metric should include Ref Rx and Ref EQ
    - most repeatable in software
    - hardware Rx and Eq capture long pattern effects and allows a 'real' BER test.

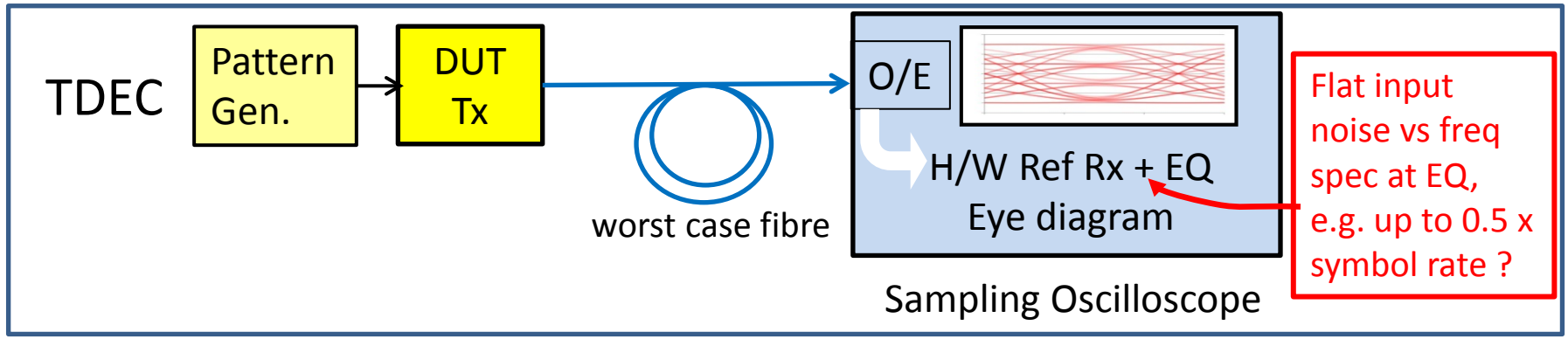
Options for 50G PAM4 Tx quality 1

	Description	Needs
'TDP'	BER measurement based DUT Tx (PRBS31) Worst case fibre H/W reference Rx and EQ	Worst case fibre H/W reference Rx + EQ Reference Tx
'Soft TDP'	'Scope **pattern** capture + post process DUT Tx (SSPR, or other short pattern) Worst case fibre S/W defined reference Rx and EQ	Oscilloscope Worst case fibre O/E (with linearity spec) Software Ref Rx + EQ Specify/measure noise of DUT Tx
'TDEC'	'Scope **eye** capture + post process DUT Tx (PRBS31) Worst case fibre Hardware O/E reference Rx and EQ Process to extract eye closure metric	Oscilloscope Worst case fibre for LR H/W reference Rx + EQ Software

Options for 50G PAM4 Tx quality 2

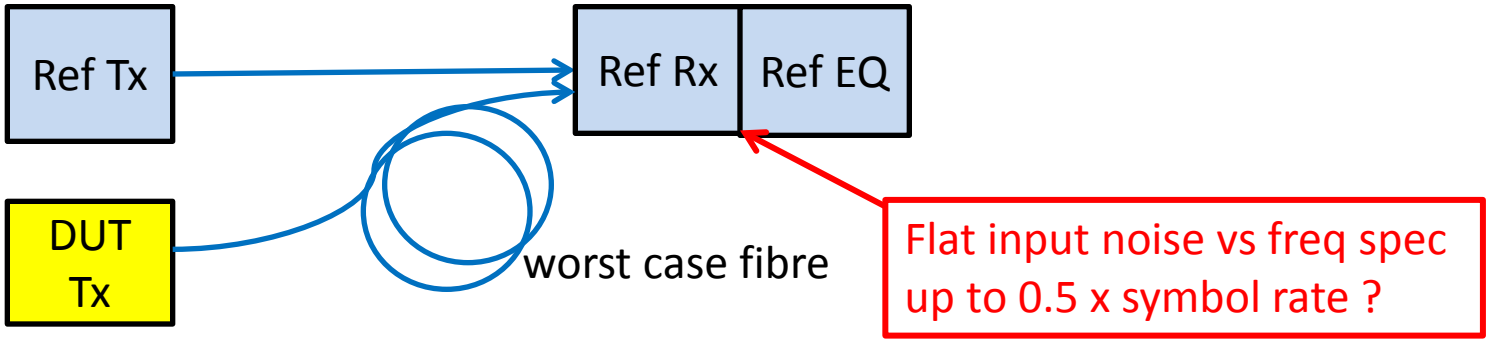






TDP for PAM4 LR, LR8

- Transmitter metric: BER measurement based with worst case chromatic dispersion fibre, reference Rx and reference EQ.
  - Reference Tx could be an NRZ source at the same symbol rate



- SRS test source metric: BER measurement based (without worst case fibre), using reference Rx and reference EQ; DUT Tx and fibre is replaced by the SRS test source.

Consequences of using TDP measurement

- Reference Tx needed to baseline TDP measurements:
  - Simplest practical ref Tx is an NRZ transmitter at the same symbol rate
    - since the ideal PAM4 modulation penalty is known
    - but reference receiver linearity must be constrained
  - For a standard
    - preferably define an NRZ ref Tx and ensure reference receiver linearity penalty is negligible
    - alternative is to use an ideal PAM4 transmitter as the reference
- Outer eye OMA can be used as a signal strength metric
- Some parameters would not need explicit specs
  - Tx RIN, ER, inner eye OMA
  - the effect of these would be captured in the TDP measured

Summary

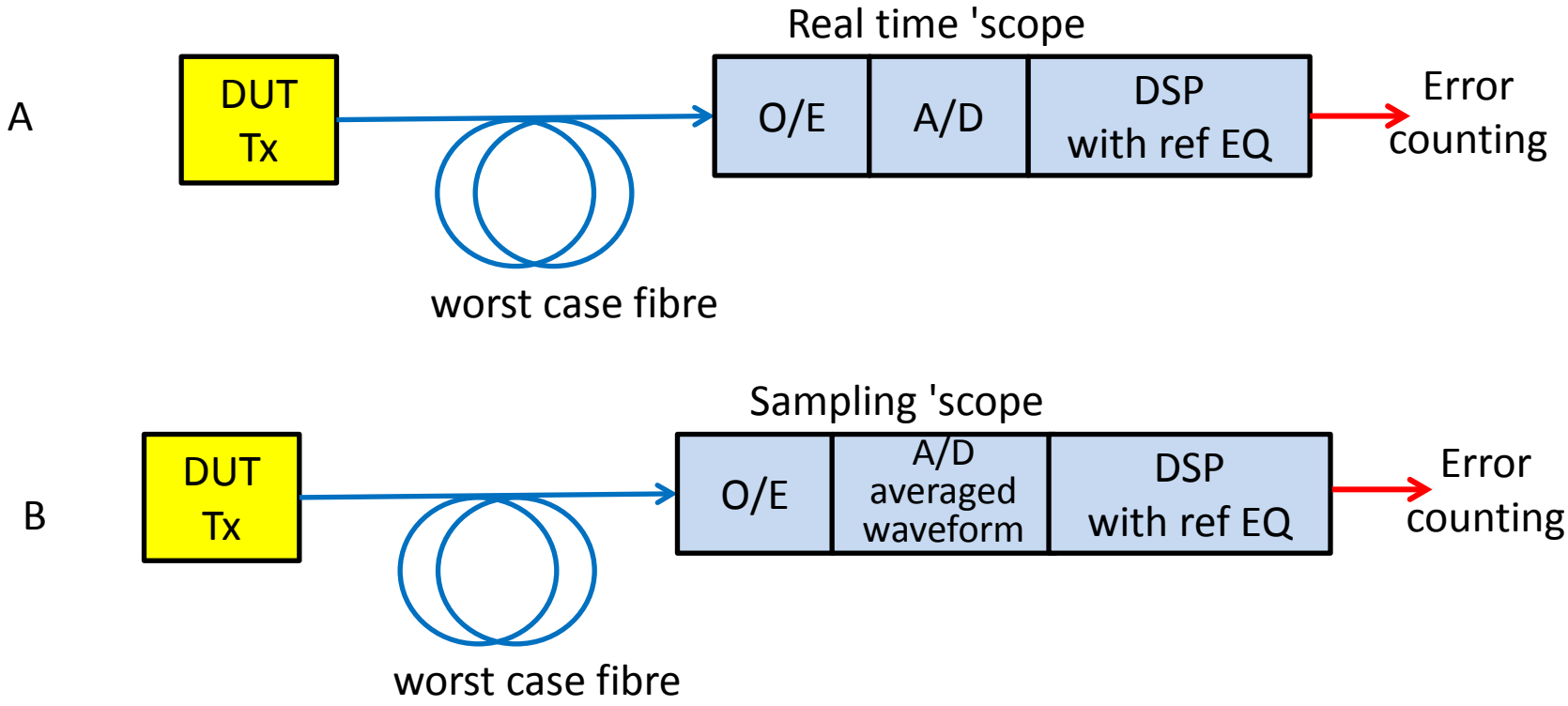
- Using equivalent methods for Transmitter metric and SRS test source metric ensures link closure
- A reference receiver and reference equalizer should be included in the measurement definition
  - e.g. 0.8 x symbol rate bandwidth, 5 tap T/2 spaced FFE.
- A TDP measurement would allow several Tx parameters to be captured in the TDP value
  - should allow the largest design/implementation space for PAM4 transmitters

- Many details to be worked out….

Back up

'Scope based alternative TDP tests

- Hardware options



- **Option A** is the equivalent of a real -time BER test, but might be too costly for production testing
- **Option B** needs a noise spec and/or measurement on Tx, and a test to ensure that low probability events (which might cause error floors) are not being averaged out. Could be simple Tx – Rx BER test
  - E.g. laser mode -hops, or other low probability timing or amplitude instabilities.