# Improved SSPRQ pattern for testing optical transmitters

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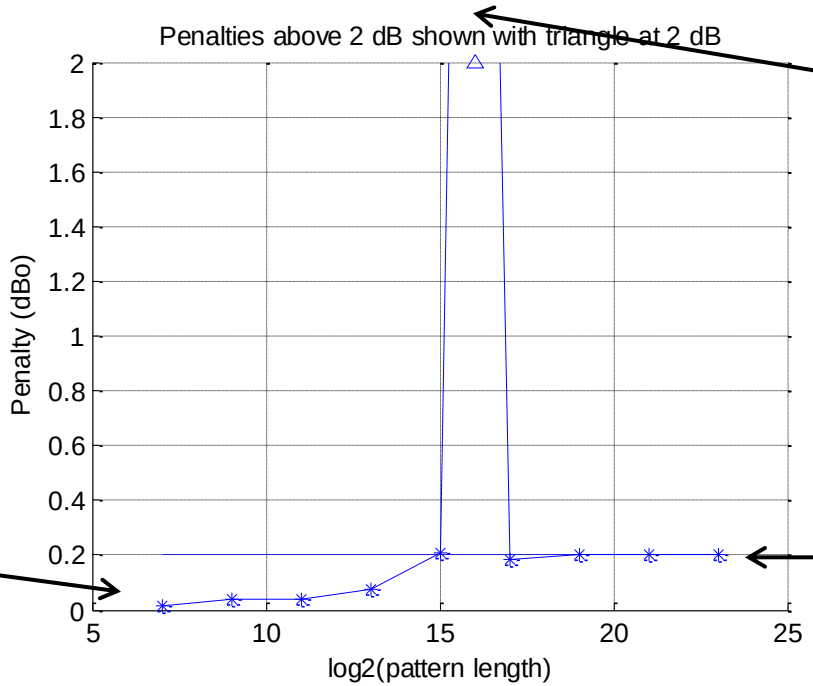
# Introduction

- Recent optical transmitter and receiver specs in 802.3 are defined with long scrambled signals. Measurements are representative of links in use
- But for qualifying PAM4 optical transmitters, we use a pattern (SSPRQ) no longer than 2^16 = 65,536 PAM4 symbols so that a soft equalizer in a scope can be used. Receivers are measured with long scrambled signals but the stressed receiver test signal is calibrated with SSPRQ. Discrepancy arises
- Measurements with the SSPRQ in the draft would report much higher penalties than is representative
  - Product transmitters must be much better than normal in some ways: cost and power wasted
  - Stressed receiver test signals reported as worse than they are so receivers will be under-stressed in the test: "hole in the spec"
- This presentation proposes an improved SSPRQ that is accurate enough for stressed receiver calibration and TDECQ testing yet still fails bad transmitters

# Present SSPRQ gives inaccurate results

*This penalty has to come out of the TDECQ limit (2.2 to 2.5 dB)*




Far too high

Too low

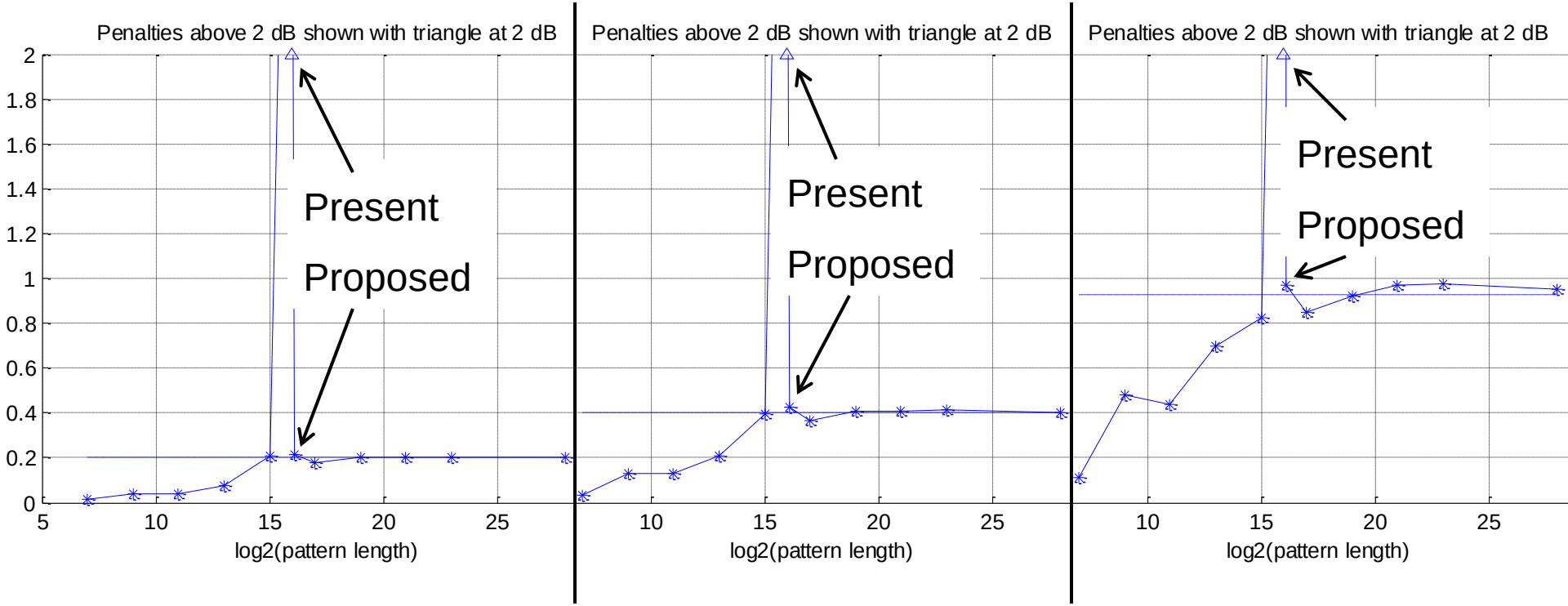
Correct

- In this example, a transmitter has 0.2 dB baseline wander penalty with a random sequence (dashed line) and is otherwise compliant (TDECQ would be 2.5 dB)
- PRBS13Q (at 13 on x-axis) under-estimates the penalty
- Present SSPRQ (at 16 on x-axis) grossly over-estimates the penalty
- PRBS19Q, PRBS21Q and PRBS23Q measure this transmitter correctly but they are too long for use with TDECQ
- A compliant transmitter could be like this; a practical stressed receiver compliance signal might have ~0.1 dB of baseline wander penalty that would hardly be noticed

# Search for a better SSPRQ

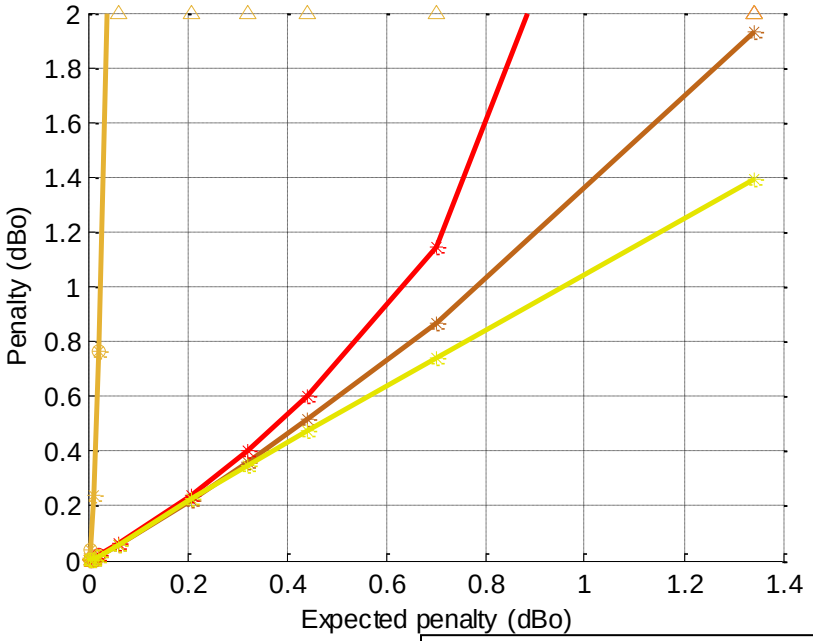
- The first seed in Table 120-2, SSPRQ bit sequence A, was varied until a pattern was found that gave representative penalties
- Modifying SSPRQ like this is a very minor change, both in the draft and in hardware
  - In Table 120-2, SSPRQ bit sequence A, change the first seed from 0x00000002 to 0x022A0ED0
- Result is shown on next slide
- Pattern is supplied in a separate csv file

# Present and improved SSPRQ




- Three cases with different baseline wander penalties
- New point (at 16.1 on x axis) for proposed revised SSPRQ, reports a very slightly high penalty

# Improved SSPRQ gives almost the penalty as for random data




- Brown PRBS15Q
- Red PRBS21Q
- Orange Present SSPRQ
- Yellow Proposed SSPRQ

*Yellow is representative: good for SRS calibration*

*Brown is too challenging*

*An alternative SSPRQ in between, e.g. similar to the red, could be generated*

*What do we want?*

# Conclusion

- Today's SSPRQ is useful as a challenge pattern but too inaccurate to use for transmitter testing or stressed receiver test calibration
- Changing the first seed in Table 120-2, SSPRQ bit sequence A, fixes this
- Pattern is supplied in a separate csv file