

# PAM4 interference Tolerance test ad hoc report

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Charles Moore   Avago

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# Supporters.

- The following indicated support by e-mail after Dudek\_bj\_01\_1122 was sent to them.

## Support for slides 1-4

Kent Lusted

Alexander Umnov

Elizabeth Kochuparambil

Intel

Huawei

Cisco

## Support for all slides including the tentative proposal in slides 6-8

Pavel Zivny

Rich Mellitz

Rick Rabinovich

Matt Brown

Tektronix

Intel

Alcatel-Lucent

APM

# Introduction

- The ad-hoc met 3 times: October 11, October 25, November 1
- Attendees included:

|                         |          |                         |                |
|-------------------------|----------|-------------------------|----------------|
| Adam Healey             | LSI      | Mike Dudek              | QLogic         |
| Adee Ran                | Intel    | Mike Li                 | Altera         |
| Ali Ghiasi              | Broadcom | Pavel Zivny             | Tektronix      |
| Alexander Umnov         | Huawei   | Piers Dawe              | IPtronics      |
| Charles Moore           | Avago    | Rich Mellitz            | Intel          |
| Chung-jue Chen          | Broadcom | Rick Rabinovich         | Alcatel-Lucent |
| Elizabeth Kochuparambil | Cisco    | Vasudevan Parthasarathy | Broadcom       |
| Galen Fromm             | Cray     | Vittal Balasubramanian  | Brocade        |
| Jeff Slavick            | Avago    | Wheling Cheng           | Juniper        |
| Liav Ben Artsi          | Marvell  | Will Bliss              | Broadcom       |
| Matthew Brown           | APM      | Zhongfeng Wang          | Broadcom       |
| Megha Shanbhag          | TE       |                         |                |

# Discussion

Discussion topics included, but were not limited to:

- Goals for the ad-hoc
- Use of a Clause 94 transmitter as a part of the test system
- Use of COM method in defining channel or stress on the receiver
- Data patterns for test
- Including low frequency jitter tolerance test
- Use of FEC and how errors are reported
- Specify a channel which requires DFE to be equalized

# Straw polls

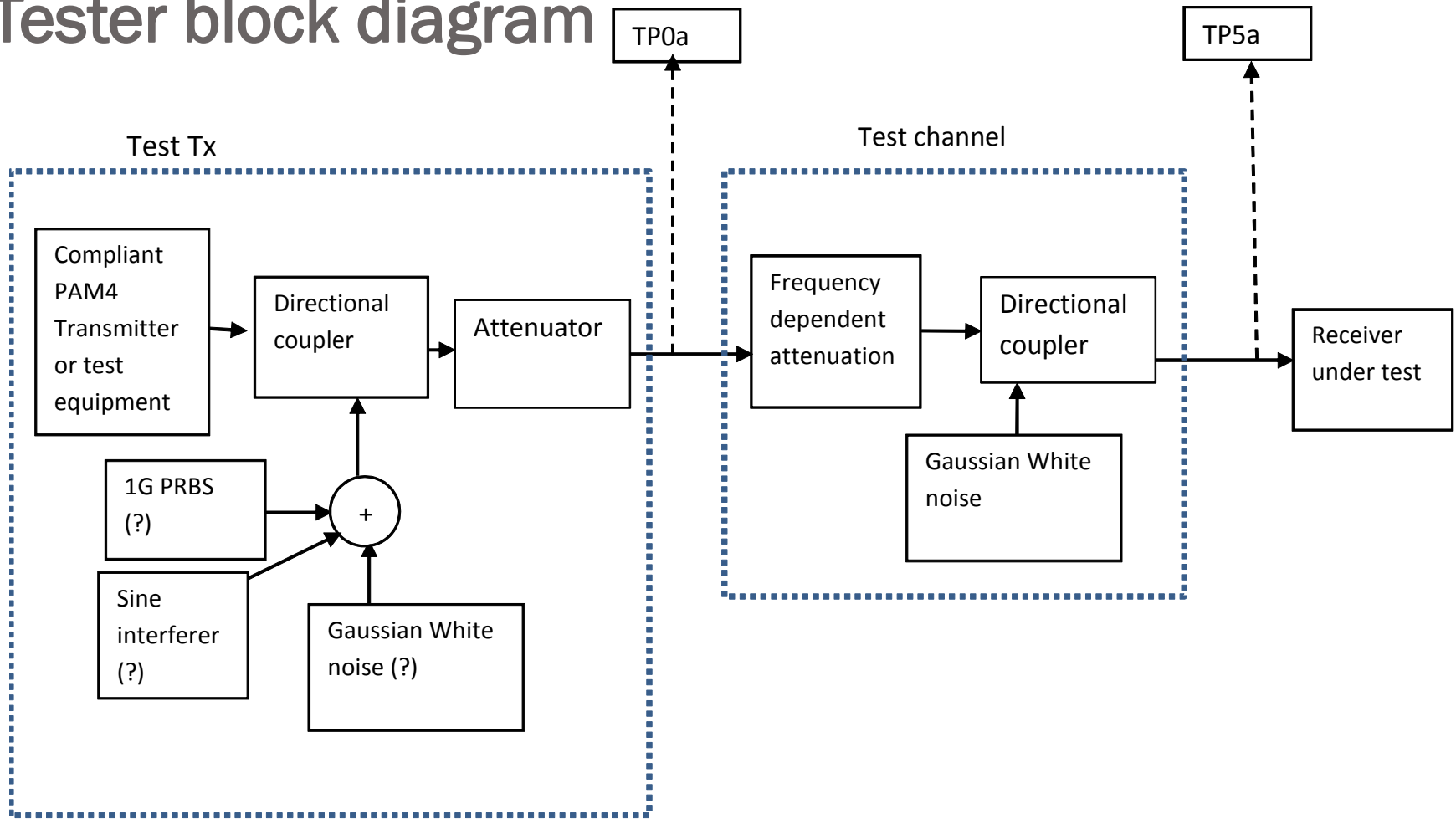
Two straw polls were taken:

1. Should the receiver interference tolerance test be normative or informative:
  - A. Normative 9
  - B. Informative 2
  
2. Do we need a piece of test equipment to provide calibrated jitter, rise time etc, or should the spec be written so the test can use a Clause 94 compliant Transmitter as a test pattern generator.
  - A. Compliant Tx or test equipment 9 (clarified as “or test equipment” in this revision).
  - B. Use test equipment only 0

# Tentative proposal

- The following proposal is based on discussions in the ad-hoc but contains additional personal suggestions from Mike Dudek that have been reviewed by a small group but not by the whole ad-hoc.

# Tester block diagram



The Frequency dependent attenuation should be at least two different channels one long, one short. It should include degradations that will require a reasonable amount of equalization. (Maybe based on a new output parameter from COM that estimates Equalized energy.)

Under discussion is whether we need (or can) add additional jitter to the compliant PAM4 Tx.

# Test Procedure.

1. The COM value of a long channel with 30.6dB attenuation at Nyquist (33dB channel loss including the min losses between TP0 and TP0a and TP5a and TP5) is measured between TP0a and TP5a and the Gaussian White Noise generator amplitude is adjusted to get a target COM value TBD. (slightly higher value than the 3dB COM value for the channel between TP0 and TP5 to account for the losses between TP0 and TP0a and between TP5a and TP5).
2. The Test Tx (with moderately low amplitudes of interference) and Receiver Under Test are connected to the channel and the Training sequence is run.
3. The Test Tx parameters are frozen and the value of the Tx SNDR is measured at TP0a. The attenuator and interferers are adjusted to give the worst case SNDR allowed from the Transmitter.
4. Steps2 (typo corrected dudek\_bj\_01\_1112 said step 3) (with the determined interference amplitudes from step 3 (typo corrected dudek\_bj\_01\_1112 said step 4 ) and step 3(typo corrected dudek\_bj\_01\_1112 said step 4) are iterated until there is no need to make adjustments to the attenuator and interferers in step 3(typo corrected dudek\_bj\_01\_1112 said step 4).
5. The pattern is set to scrambled idle and the error rate from the Receiver under test is measured. It must meet an uncorrected error rate of  $3e-4$  or an equivalent frame error ratio of  $1.7e-10$  for a complete Physical layer receiver.
6. Repeat 1-5(typo corrected dudek\_bj\_01\_1112 said step 6)with at least one other specified channel so that at least one short channel (eg 20dB loss at Nyquist) with more noise have been tested. The Noise generator should be adjusted in each case to achieve the same target COM value.
7. Although this procedure is defined in terms of using a PAM4 compliant Tx and multiple different pieces of test equipment any or all of this could be replaced by suitable test equipment that provides equivalent functionality.