Transmitter Distortion Proposal

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Supporters

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Issue

- P802.3ch draft v1.1 currently has placeholder text for a “Transmitter distortion test” but baseline text for this normative requirement is missing
- Previous Automotive PHYs also included a normative distortion test, but is it necessary for P802.3ch PHYs?
- Correlation between TX Distortion and interoperability has not been presented

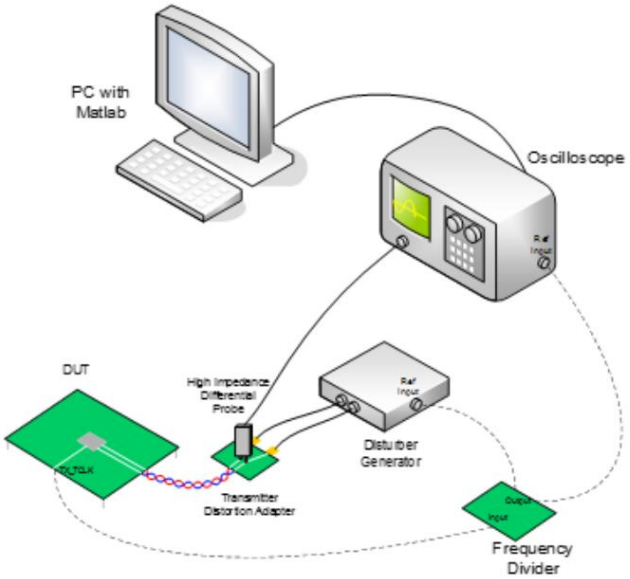
Concept of TX Distortion/Linearity

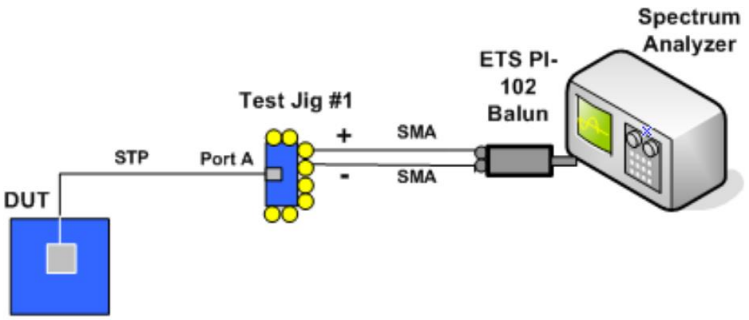
- Quantify PHY transmitter linearity in presence of “disturber” source
- Disturber comes from signals other than the PHY’s own transmitter
  - Near-end echo canceller requirements may be much stricter
  - External signal could be from the far-end link partner, e.g. on a short line, or from outside events such as an EM event
- Linear distortion in the far-end transmitter may impair reception at the near end
  - Too much TX distortion reduces probability of receiver properly decoding incoming signal

IEEE Clauses with TX Distortion/Linearity electrical requirements

PRBS + Disturber	Dual Tone SFDR
• 1000BASE-T (Clause 40) • 100BASE-T1 (Clause 96) • 1000BASE-T1 (Clause 97)	• 10GBASE-T (Clause 55) • 2.5/5GBASE-T (Clause 126)

Test Setups





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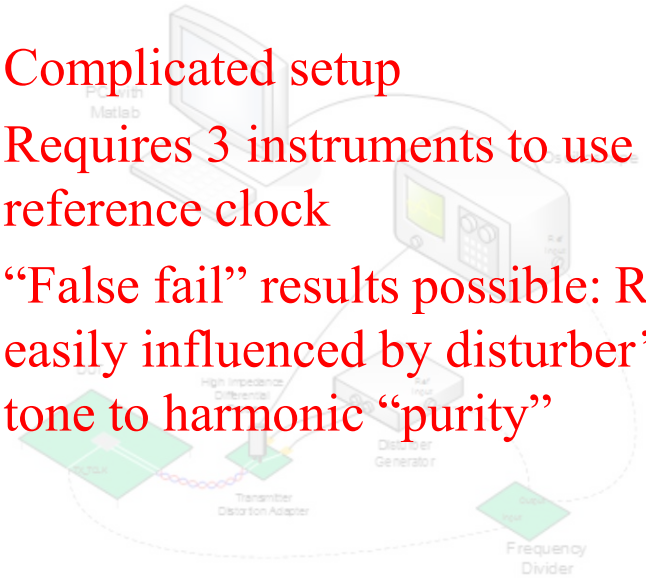
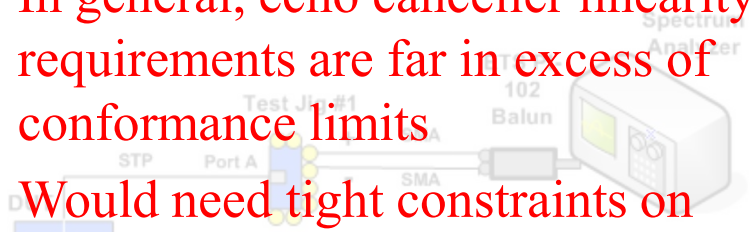
Test Setups

- Complicated setup
- Requires 3 instruments to use same reference clock
- "False fail" results possible: Result easily influenced by disturber's tone to harmonic "purity"



- Straight forward setup
- In general, echo canceller linearity requirements are far in excess of conformance limits
- Would need tight constraints on tone amplitude, frequency, and phase generation



Does testing for Distortion Compliance help the industry (promote interoperability)?

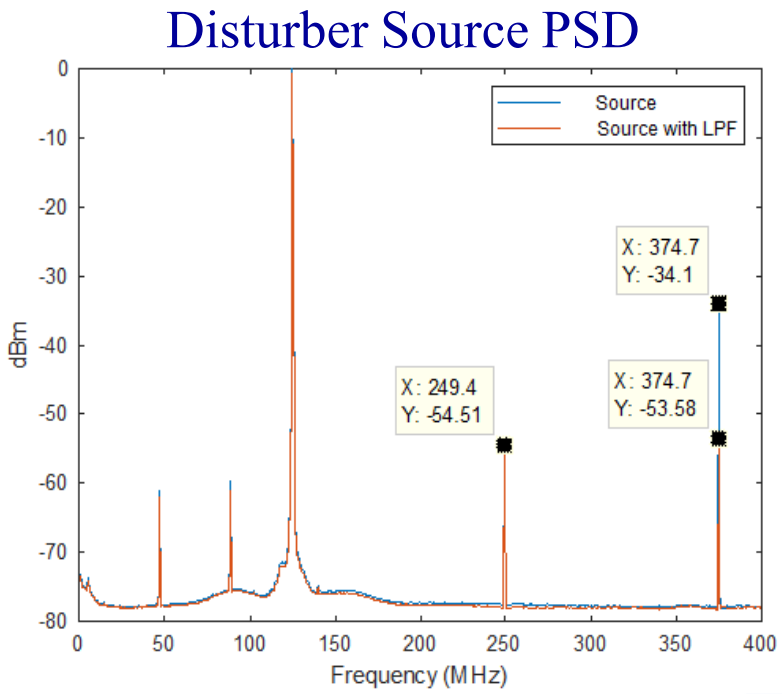
- UNH-IOL has been testing electrical conformance for 1000BASE-T for 20 years
  - Never witnessed strong correlation between Distortion fail and interoperability issues (afaik such a study has never been performed anywhere)
- Performing Distortion testing for Automotive Ethernet PHYs
  - Most observed fails are a product of improperly calibrated test equipment, or lack of capability of PHY to tie to common reference clock of test equipment
  - **More on next slides**
- Due to repeatability issues, much of the T&M community question value of distortion setup

UNH-IOL BASE-T1 TX Distortion Results

- Reviewed 33 PMA reports from last 2+ years
  - 33 unique PHYs (could be retest of silicon with different initialization settings)
  - From 8 companies
- Conformance Result Summary
  - TX Distortion: 32 Passes / 1 Fail
- Notes on 1 Fail
  - TX_TCLK was not available for clock domain synchronization in test setup
  - DUT did not exhibit interop/BER failures

UNH-IOL BASE-T1 TX Distortion Results

“False Fail” scenario



		Measured Maximum TX Distortion
Disturber	"Source" (-34dB @ 374 MHz)	**30.1 mV**
	"Source with LPF" (-53dB @ 374 MHz)	**13.9 mV**

Conclusion

- Discuss/demonstrate intention of TX Distortion conformance requirements
- TX Distortion/interop correlation study has not been presented previously
- Presented BASE-T1 distortion results collected at UNH-IOL
  - 97% of testing in last 2+ years has observed passing Distortion
  - Showed evidence of proper setup difficulty (“false fail”)

Suggested Proposal

Remove normative requirements for Transmitter distortion as follows:

- Change Table 45-155e value of “Test mode 4” to “Reserved”
- Remove “transmitter distortion” from 149.5.1 on page 151, lines 34-35
- Change 5th row of Table 149-12 from

100	Test Mode 4 – Transmit distortion test.

to

100	Reserved.

- Remove two sentences regarding Test mode 4 in 149.5.1 on page 152, line 44
- Remove Editor’s note in 149.5.1 on page 152, lines 41-42
- Remove Figure 149-34
- Remove subclause 149.5.2.2

Thank you!