Update to Alternative Specification to OCL Inductance to Control 100BASE-TX Baseline Wander

G. Zimmerman, C. Pagnanelli

Solarflare Communications

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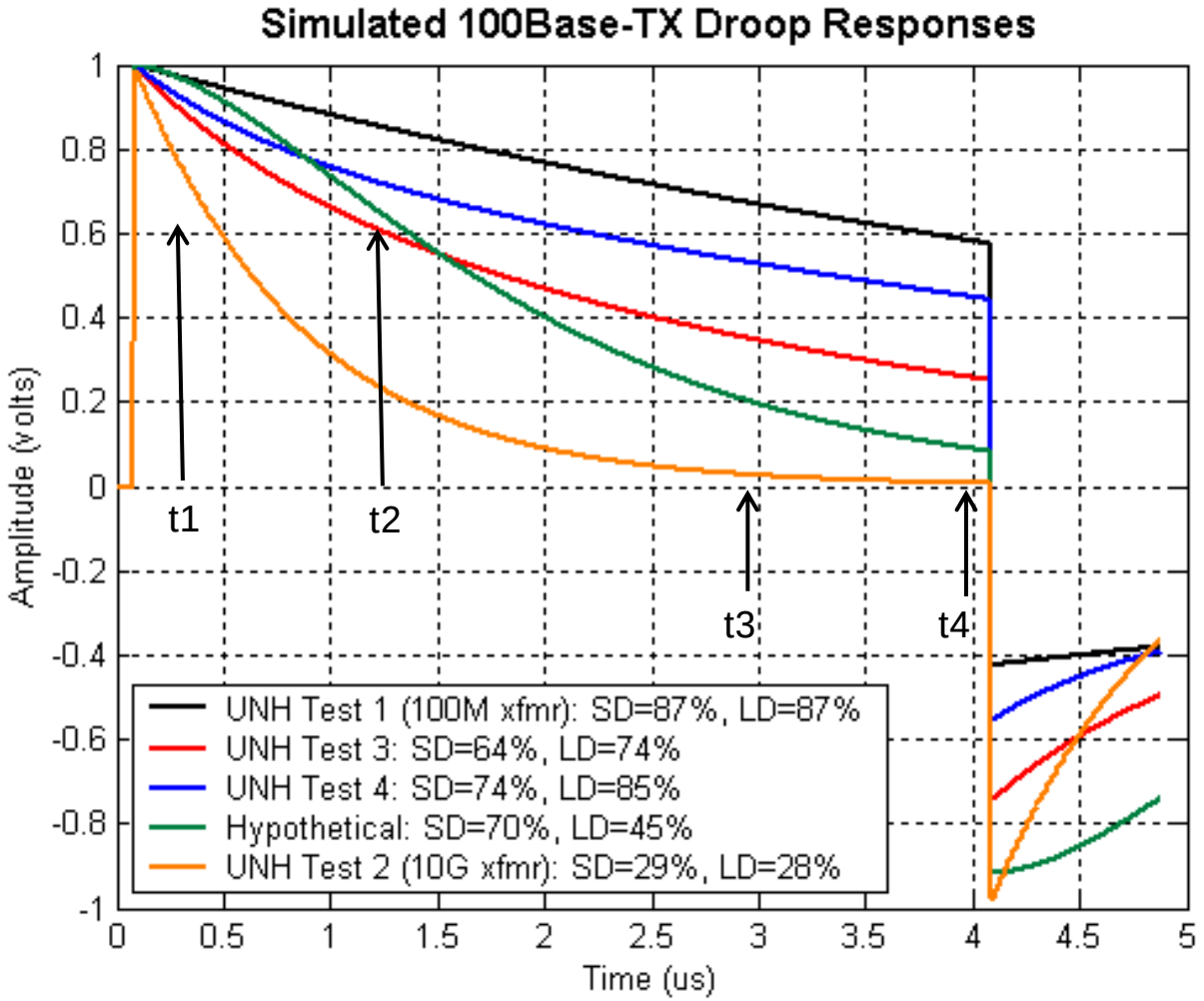
Supporters

- Sean Lundy, Aquantia
- Your name here

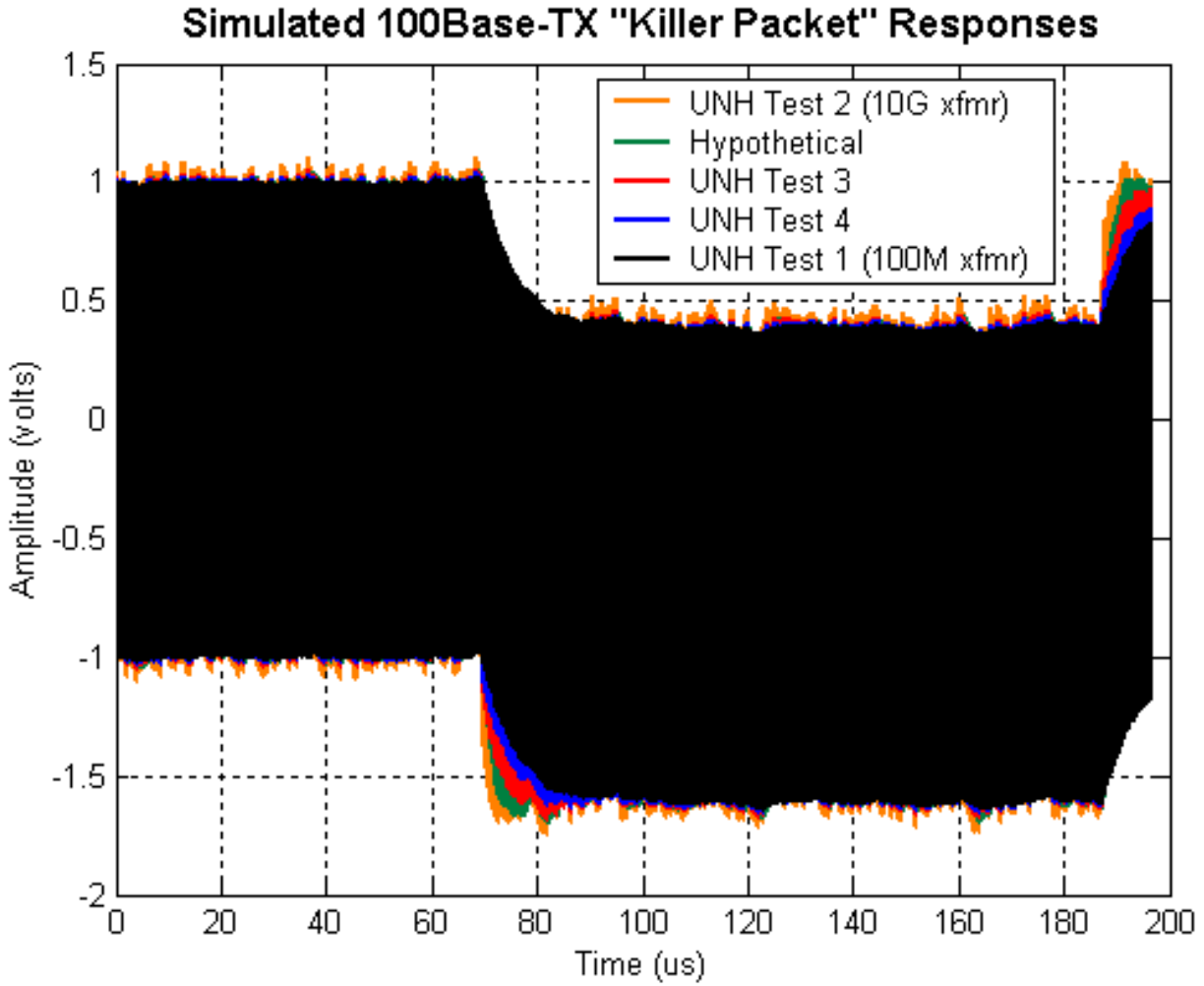
OCL Requirement in ANSI 263-1995

- ANSI 263-1995 assumes that the transformer inductance is the only control on the specification for baseline wander caused by imbalance
  - Droop can also be controlled by transmit signal conditioning, either with analog or digital components
  - Alleviates potential manufacturing and performance issues related to existing 350 uH OCL requirement
  - Result is a slowly varying dynamic response time associated with “baseline wander” that all receivers have been designed to deal with.
    - Modern receivers with “baseline wander correction” often deal with faster dynamics
- “Killer Packet” response time is closely correlated with “Long-Term” transmitter droop:
  - Short-Term Droop (SD)
    - Assuming a positive pulse, droop is the percentage voltage decay from the peak point after a rising edge transition (t0) to a specified point at some later time (t1)
  - Long-Term Droop (LD)
    - Assuming a positive pulse, droop is the percentage voltage decay from the point just preceding a falling edge transition (t4) to a specified point at some earlier time (t3)
- Proposal: produce a specification to mirrors existing behavior (e.g., baseline wander) without changing any other TP-PMD specifications
  - Now recommending identical long-term droop spec as existing 350uH for safety

SIMULATED DROOP RESPONSES



SIMULATED “KILLER PACKET” RESPONSES

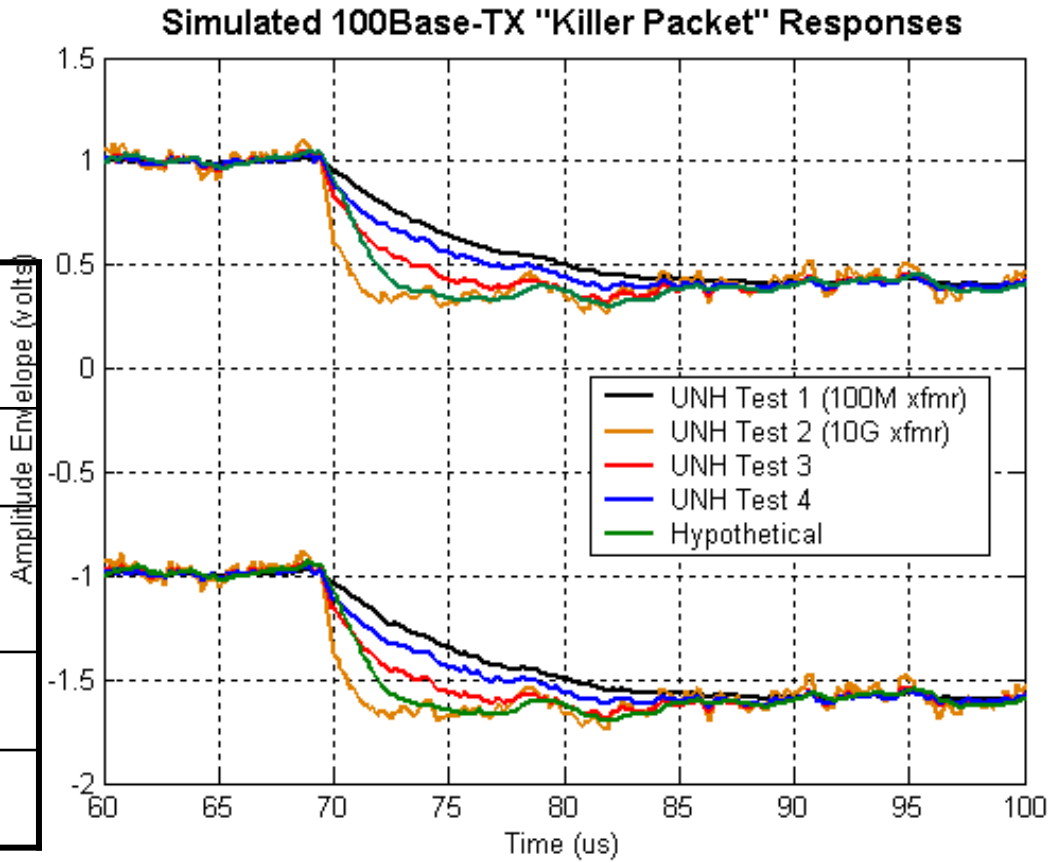


Close Up of Baseline Wander Dynamics

- Waveform with similar long-term droop behavior closely matches behavior of existing 350uH OCL specification

Comparison vs. UNH#1,
1 V signal amplitude,
dB relative to signal

Test Case	Max Difference (V)
UNH Test 2	.498 (-6dB)
UNH Test 3	.231 (-13 dB)
UNH Test 4	.107 (-19 dB)
Hypothetical	.350 (-9 dB)



UNH Baseline Wander Test Results

- Standard Fast-Ethernet Baseline Wander tests conducted by the UNH IOL indicate that the droop waveforms labeled “Test 1”, “Test 3”, and “Test 4” produce acceptable performance on both legacy and modern 100Base-TX PHYs
  - 0%, 25%, 50% and 100% Worst-case channels, 3ns & 5ns rise times, 16 DUTs
  - DUT responses are monitored to establish an effective packet loss rate for “Killer Packet” events
  - Test 1: waveform based on ~350 uH OCL (100Base-TX requirement – the “Gold Standard”)
  - Test 2: waveform based on 40uH OCL without compensation, produces unacceptable baseline wander performance
  - Test 3: waveform with Long-term Droop equivalent to ~170 uH OCL, but using 40uH OCL, works equivalent to Test 1 with most, but not all exceptions
  - Test 4: waveform with Long-term Droop equivalent to ~310 uH OCL, but using 40uH OCL, works equivalent to Test 1
- Detailed UNH report submitted to David Law for posting
- Detailed review of results showed Test 3 (170uH equivalent) has an exceptional case with more errors, therefore recommend going with 87% droop, exactly the same as 350uH OCL waveform (Test 1).

PROPOSED DROOP SPECIFICATION

- Add Maximum Output Droop specification to 100Base-TX to ensure next generation Fast Ethernet PHYs comply with baseline wander capabilities of legacy 100Base-TX PHYs with respect to “Killer Packet” response
- Droop specification is similar to existing requirements for 1000Base-T and 10GBase-T PHYs
- Requires simple test waveform consisting of less than 1K samples that can be generated using integer divider on FBAUD clock (125 MHz)
- Uses same test equipment and test fixtures required for verifying compliance with existing rise time, fall time, pulse symmetry, and “transmit eye template” requirements
- Alleviates potential manufacturing and performance issues related to existing 350 uH OCL requirement

PROPOSED DROOP SPECIFICATION

- Wording is based on 1000Base-T droop requirement (40.6.1.2.2)
- Addition to Clause 25.4, Specific Requirements and Exceptions:

25.4.x Alternative to 9.1.7 Worst case droop of transformer

A PHY that does not meet the OCL requirement of paragraph 9.1.7 of ANSI 263-1995 shall meet the following maximum output droop requirement. The magnitude of the positive voltage of the transmit droop test waveform at point B, as defined in Figure X–X, shall be greater than 87% of the magnitude of the positive voltage of the waveform at point A. These measurements are to be made while transmitting the droop test pattern and observing the differential signal output at the MDI. Point A is defined as the point exactly 1 us before point B. Point B is defined as the point just prior to where the waveform undergoes a negative transition in voltage as indicated in Figure X–X.

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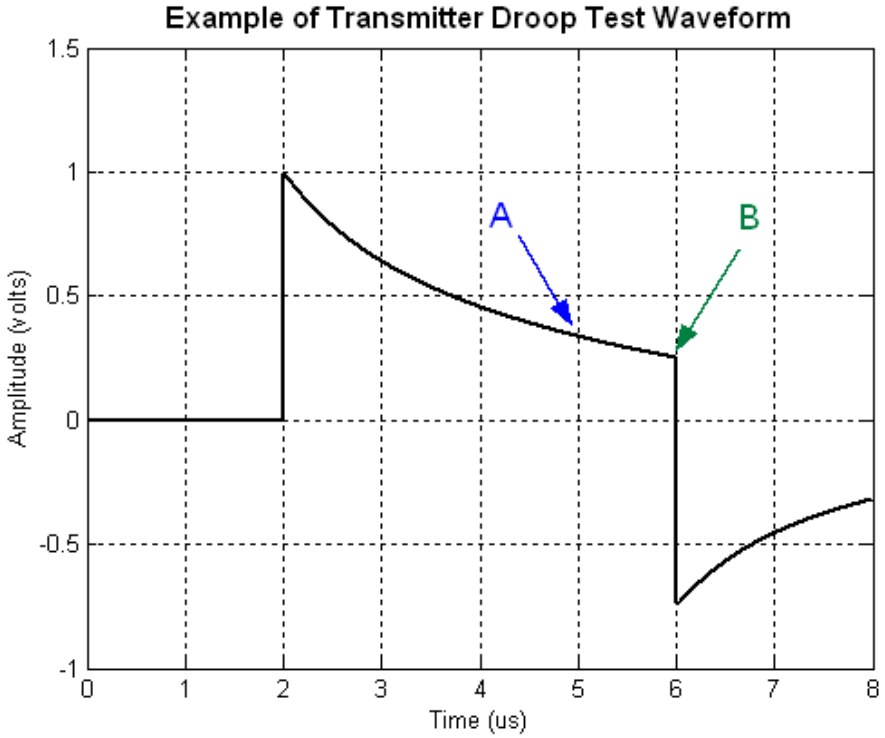
PROPOSED DROOP SPECIFICATION

- Droop Test Waveform

  When the 100Base-TX transmit droop test pattern is enabled, the PHY shall transmit the following sequence of data symbols:

  {{250 -1 symbols}, {500 +1 symbols}, {250 -1 symbols}}

(note: Droop Test Waveform produces a 125 kHz square wave that can be generated from FBAUD using a divide-by-1000 frequency counter, and has been validated by at least one magnetics vendor)



CONCLUSIONS

- Recommendation to 802.3: specify Long-term Droop behavior mirroring existing 350uH specification, amending Clause 25.4
  - UNH Tests show equivalent packet-error behavior to 350uH OCL waveforms, even with much lower OCL
  - Recommend same 87% long term droop as 350uH OCL
    - Tests show less (70%) can be tolerated, but perhaps not in all conditions by all receiving devices
    - Resulting waveforms closely match existing dynamics
- Specifically, add an alternative to measuring the OCL to Clause 25.4
  - All other TP-PMD specifications are untouched
  - Existing specification still stands, keeping legacy devices compliant
  - Provides a specification for 802.3at to reference to define the capabilities of either “new” devices with baseline wander correction, or to compensate transceivers to work with higher imbalance current at their transmitters + midspan PSE & “old” devices
- Additionally aids production of lower cost, small footprint, and high-performance magnetics