

# Importance and Issues in Background Noise Measurement

Contribution to IEEE 802.3: 40G-BASE-T Task Force

George Zimmerman, Ph.D.  
CME Consulting/Aquantia & Commscope

# Supporters

---

# Overview

---

- Contributions to PHY Baseline Proposal Ad Hoc highlighted a strawman proposal to analyze and the need for background noise measurements
- Follow on discussion with parties indicated a range of views on these measurements
- This contribution attempts to recognize some of the issues facing us

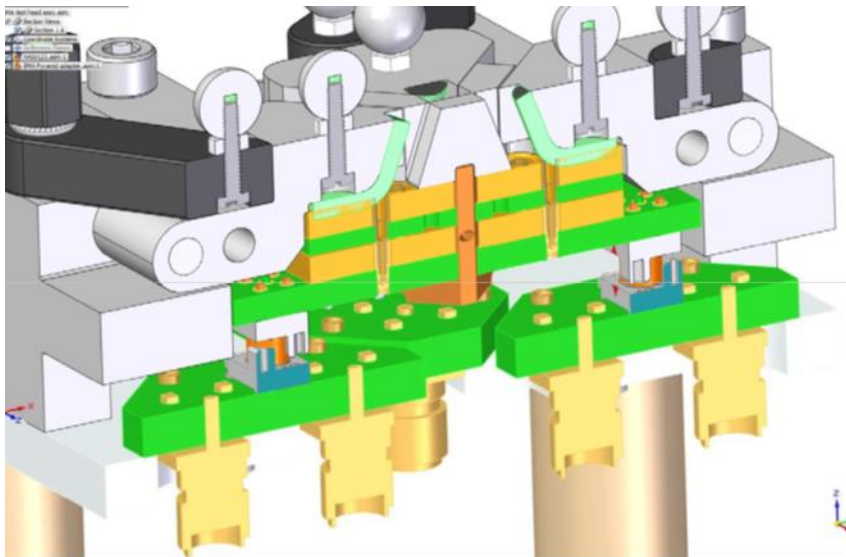
# Background Noise Background

---

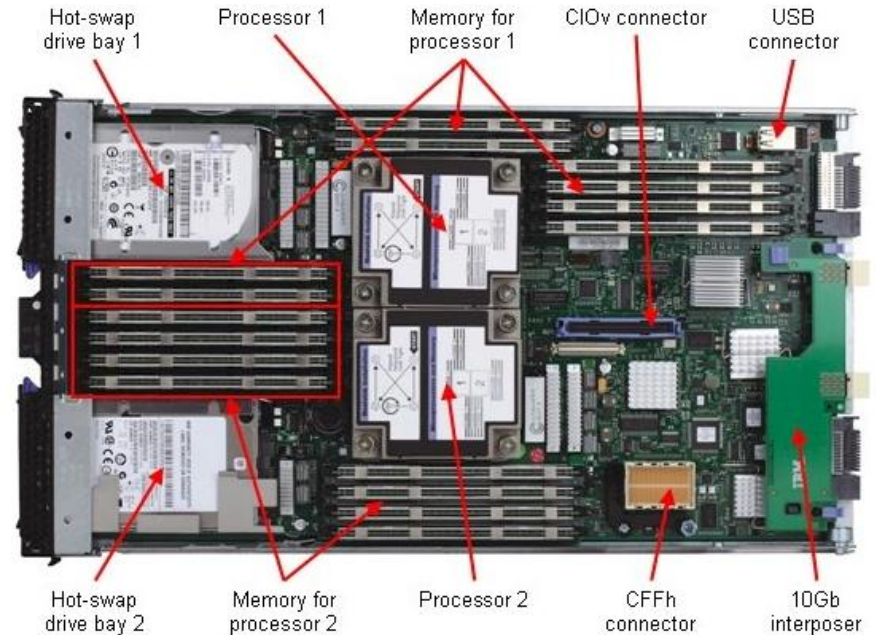
- Cancellation of internal impairments and low-noise AFE receivers make background noise the limit on TX power
- Past PHYs have focused on Cabling background noise, e.g., alien crosstalk & EM pickup
  - 40GBASE-T cabling has improved shielding to this!
- Cabling groups are now wrestling with measurements limited by test equipment
- 10GBASE-T PHY design levels initially stressed noise isolation on systems boards, adding cost & delaying designs

# What we want – Broad Market PCBs

**NOT THIS!**



**THIS!!!**



# 10GBASE-T Experience

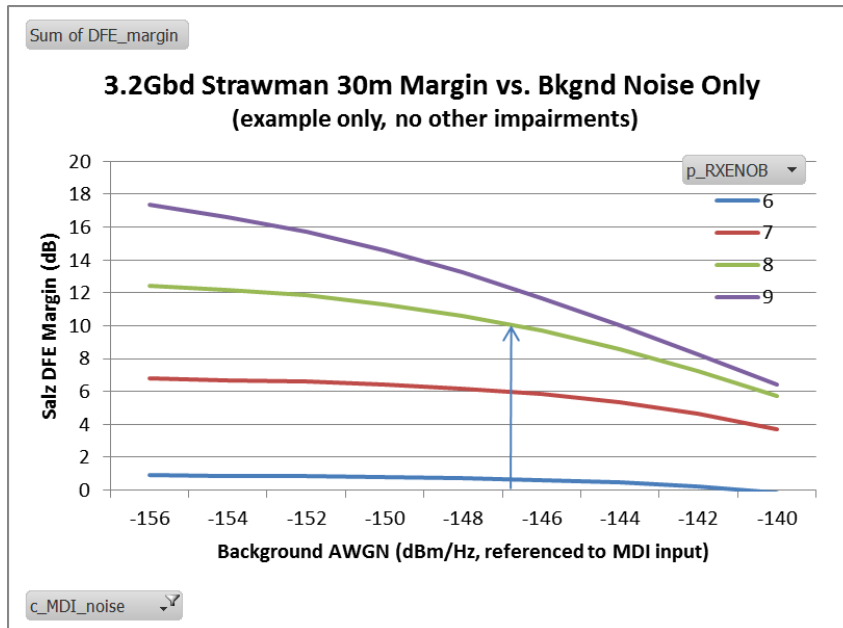
---

- 10GBASE-T Alien Crosstalk test: -142 dBm/Hz
  - Salz DFE margin <6 dB in that scenario
    - (we want more!)
  - Addition of ANEXT budgeted for ~1dB margin loss
    - Board background < -148 dBm/Hz
    - Stressed initial designs to multilayer isolation
- Below -150dBm/Hz is difficult ground
  - 150dBm/Hz =  $10\text{nV} / \sqrt{\text{Hz}}$  (100 $\Omega$ )
  - 2 nanoWatts power in 2GHz
  - 0.45 mV rms (100 $\Omega$ )

# Impact on PHY Baud Selection

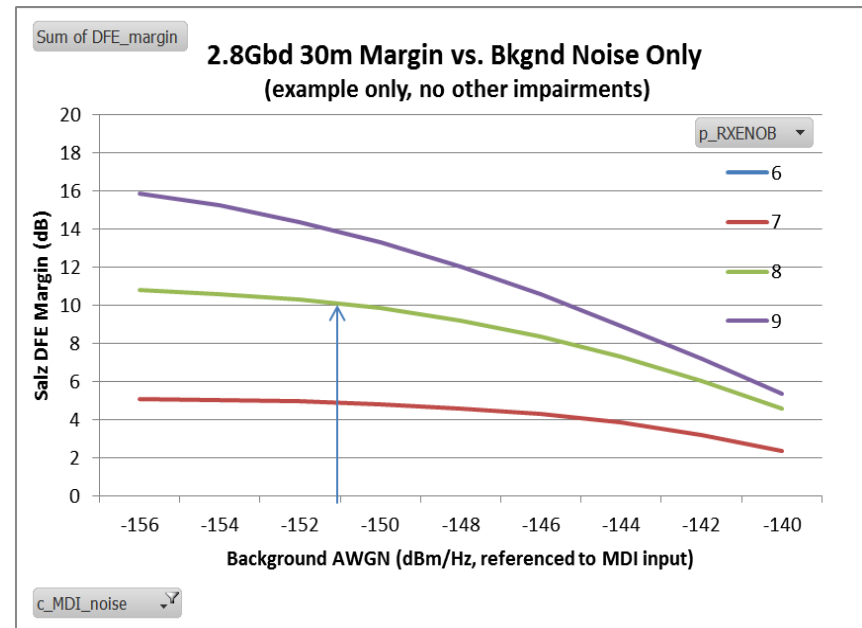
## 3.2 Gbaud Strawman:

- 0dBm launch

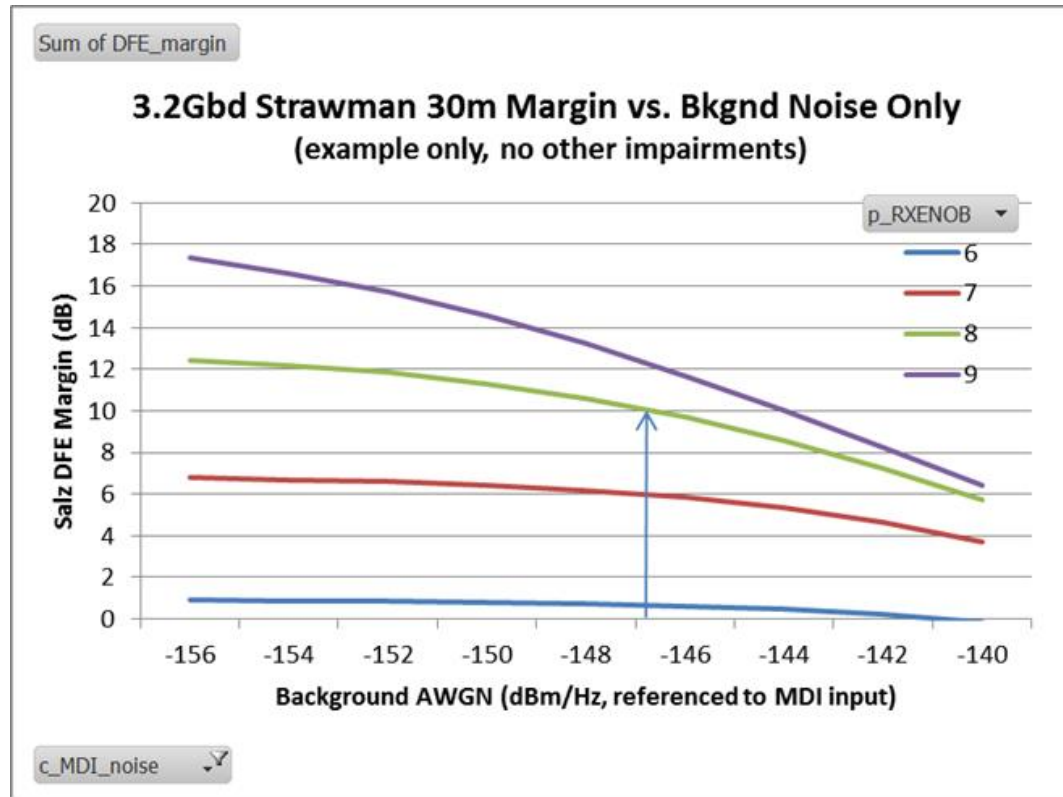


## 2.8 Gbaud Strawman:

- 0dBm launch
- needs ~4dB lower noise



# Impact on PHY TX power



- Decreasing TX power moves background knee 1dB/dB  
-150dBm/Hz level would limit to -3dBm TX power

*Each dB lower buys us transmit power savings*



# Impact on PHY Coding

---

- 10GBASE-T-like uncoded bits are vulnerable to impulse noise
  - Is this a thing of the past with shielded cable?
  - If we lower TX power, is board-generated impulse noise the new culprit?

# Measurements Environment

---

- Live, operating systems
  - Servers running bus, memory, storage applications
  - Preferably with a 10GBASE-T port on a motherboard or daughter card
    - Not an isolated NIC or eval board
  - No network activity (not even autoneg) on 10GBASE-T port (port in PCS or other loopback with TX disabled preferred)
    - No need for connected cabling
  - Adjacent 10GBASE-T ports active is desirable
- Measurement as close to chip RX input as practical
  - Differential measurement, pref. referenced to PHY end of PCB model from Channel ad hoc

# Measurements

---

- Spectrum analyzer measurement of background for level & freq content, out to 3GHz
  - Extra BW needed for Anti-aliasing filters
- Impulse height distribution, from counter or time-domain
  - Need to check impulsive sources for coding
- On multiple systems & types would be good!

# Discussion

---

- What else?