7 Challenging SI / PI Problems That Have NO Existing Solution

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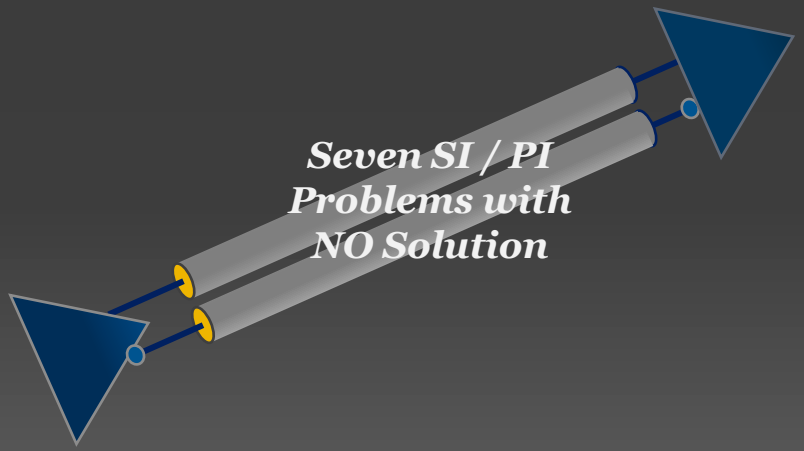
AGENDA

- Introduction
- 7 Problems
- Summary



Before We Begin

- 7 problems, no solution
- Today, sound bites, pointers
- Practical, process, products

- Maybe you know of a solution?
  - Or maybe you are the solution!

Which Skills Do You Have?

- Math 
- Lab work 
- Creativity 
- People 
- Partnering 
- Miracles 

Research skills assumed

The Seven Problems, by Skill

Ready for breakthrough

1. Standardization of template-based SerDes AMI models
2. Validated analytical solutions for conductor loss due to surface roughness / glass weave
3. Adaptation of error correction codes to address the non-random behavior of high speed serial link ISI

Long-standing problems

4. Automated and organizational solutions for interfacing SI/PI with Layout and firmware engineers

Lots of effort, but needs a fresh approach

5. Equalization, including adaptation, that targets high-speed serial link reflected noise in addition to loss
6. High bandwidth/density memory solution for memory interfacing to replace DDRx
7. Fast, efficient solution for modeling non-ideal power reference effects on signal performance

The Seven Problems

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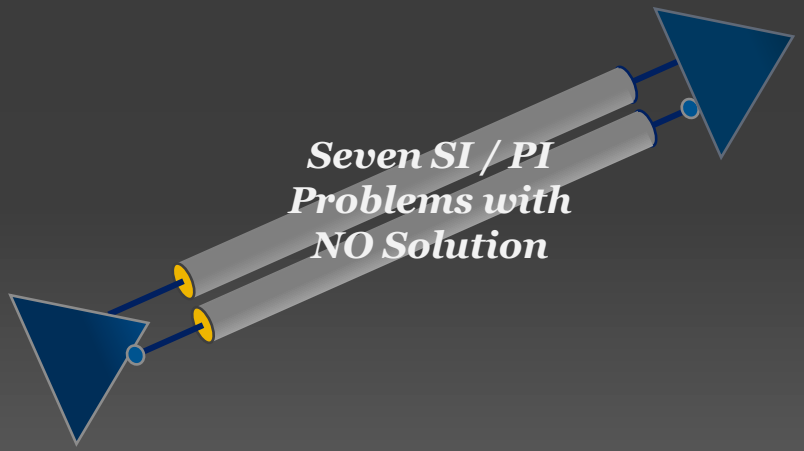
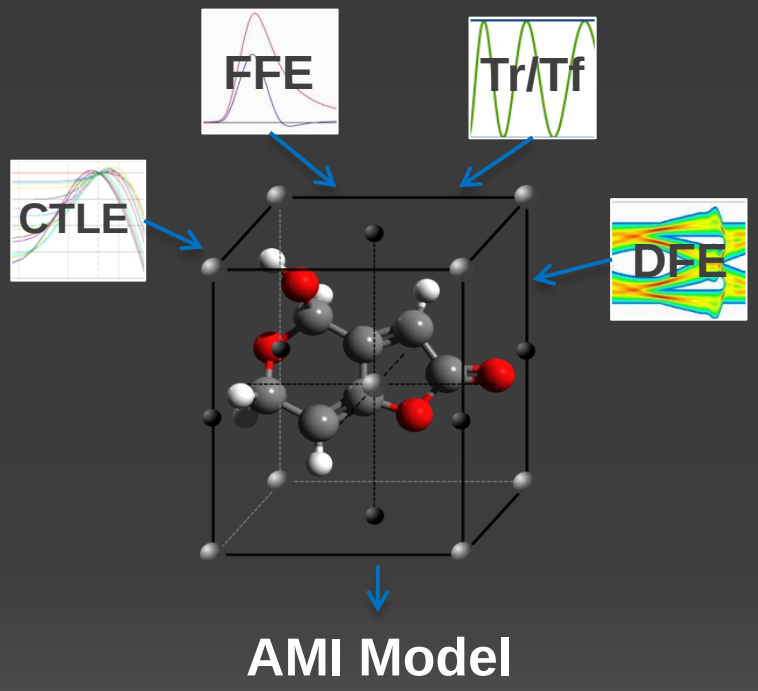


#1: Standardize AMI Template

- IBIS is a template
  - AMI is not (yet)
- All EDA vendors have
  - proprietary AMI templates
- Need standard syntax
  - Propose with IBIS “BIRD”
- Match on dynamite



- Resource (DesCon 16):
  - “Building IBIS-AMI Models from Datasheet Specifications”

#2: Conductor Roughness

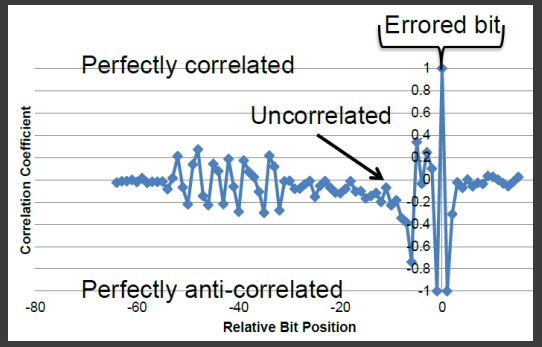
- Dielectric Loss
  - Djordjevic, Sarkar, et. al.
- Conductor Roughness Loss
  - Who to believe?
  - Difficult to get data
- The physics involved
  - Surface roughness or chemistry?

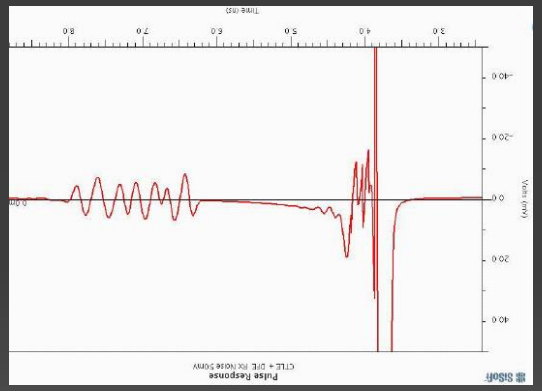
Model	Description
Hammerstad	Statistical variation of conduction path length
Huray	“Snowball” model of variation of conduction path length
Koledintseva et. al.	Thin layer of lossy dielectric on surface of conductors.

- Resources (DesCon 16):
  - “Effect of conductor profile structure on propagation in transmission lines” Horn, LaFrance, et. al.
  - “A Material World” Nwachukwu, Shlepnev, McMorrow

#3: Adapt FEC for Links

- Existing FEC
  - Pattern independent
- But serial link errors
  - Pattern dependent
- Or, remove bad patterns
  - Self-correcting





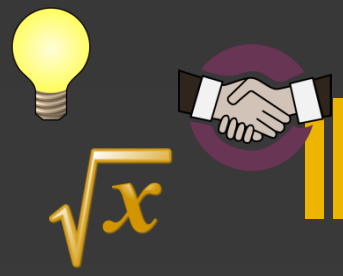
- Resources:
  - Michael Steinberger, msteinb@sisoft.com
  - "A Brief Tour of FEC", DesignCon '15, Lin, Liu, et. al.

#4: SI Automation / Hand-offs

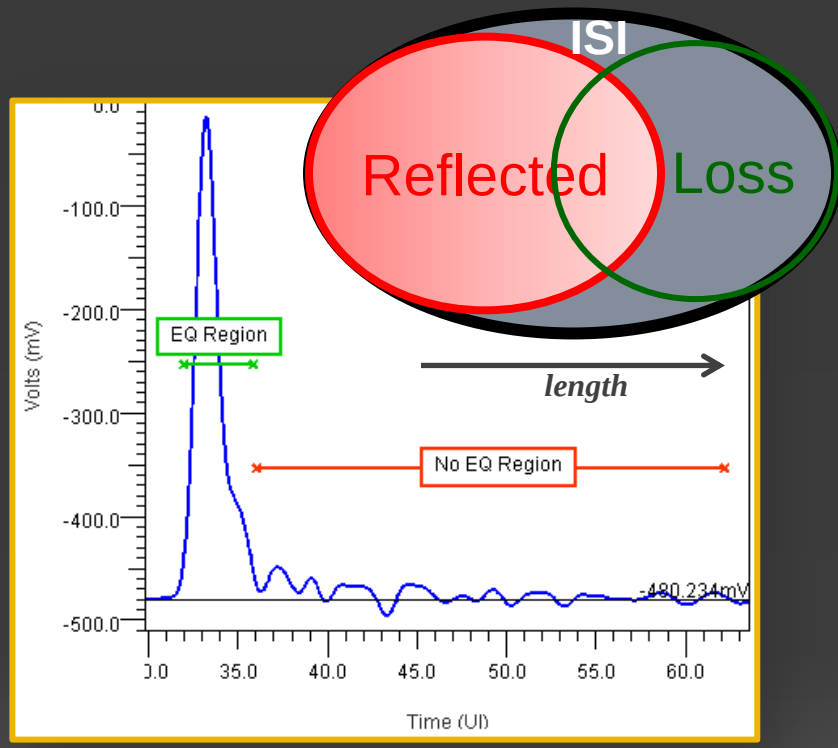
- SI / PI Rules
  - Must get implemented
- Optimal equalization
  - Must get implemented
- Little/no automation exists
  - Big source of SI problems

- Resources:
  - EDA-specific files/formats (e.g., Cadence topology files)
  - Rules Augmented Interconnect Layout – IBIS initiative

#5: EQ for Reflected ISI



- Existing EQ targets loss
  - Problem on longer links
- Links also fail due to noise
  - Problem on shorter links
- What can be done?
  - UIs 5 to 45, adaptation too



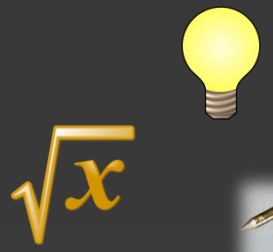
- Resources:
  - S. Quan, F. Zhong, W. Liu, P. Aziz et al, "A 1.0625-to-14.025Gb/s Multimedia Transceiver with Full-rate Source-Series-Terminated Transmit Driver and Floating Tap Decision Feedback Equalizer in 40nm CMOS", *Digest of Technical Papers, IEEE Intl. Solid States Circuits Conf.*, pp. 348-349, Feb, 2011.
  - "Ripple Analysis, Identify and Quantify Reflective Interference…" SPI 2016, Allred, Katz, Furse
  - A SerDes Balancing Act: Co-Optimizing Tx and Rx EQ (SiSoft webinar)

#6: Next-Gen Memory

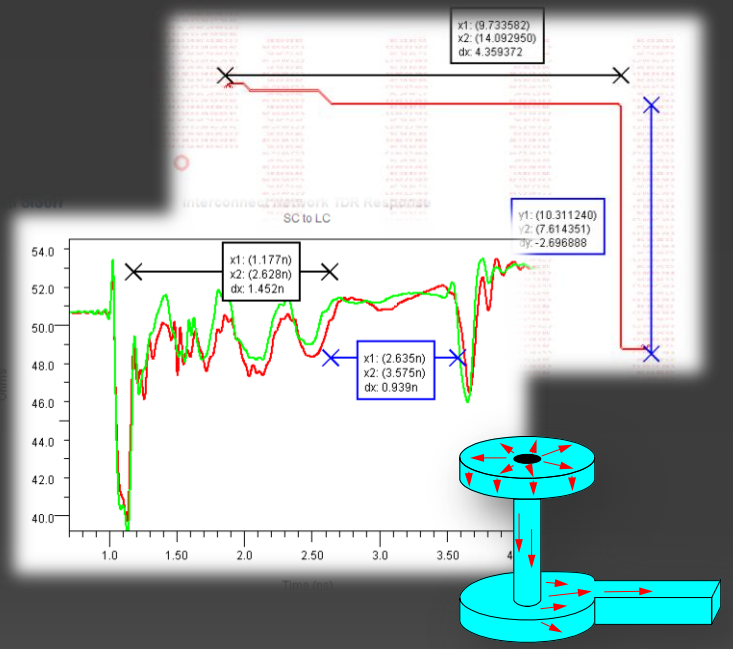
- Memory standards driven by density
  - Not SI / PI
- SI is overly complex and fragile
  - Tolerance is major issue
- When will it end?

- Resources:
  - HMC-Hybrid Memory Cube, HBM-High Bandwidth Memory, Wide I/O
  - devabpro.sandia.gov

#7: Non-ideal Reference



- Generalized solutions are slow
  - To configure and solve
- Approximation /= Bad
- Missing metal
  - Raises L, lowers C
- Simplify?



- Resources:
  - Fast, efficient, and accurate: via models that correlate to 20 GHz
  - <your name here>

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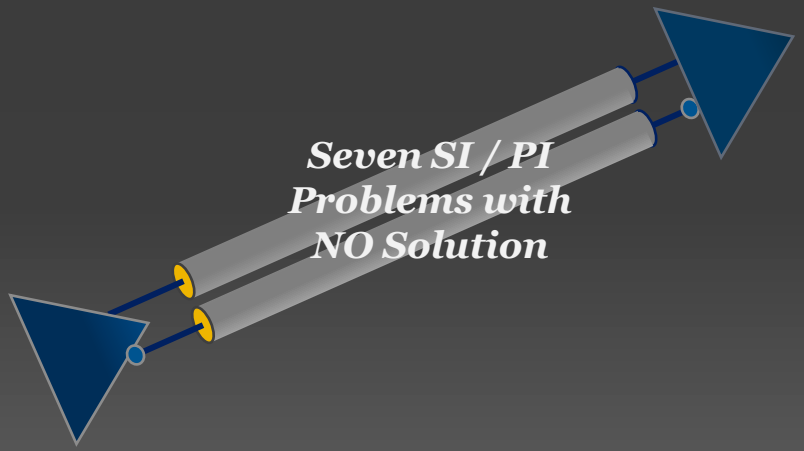
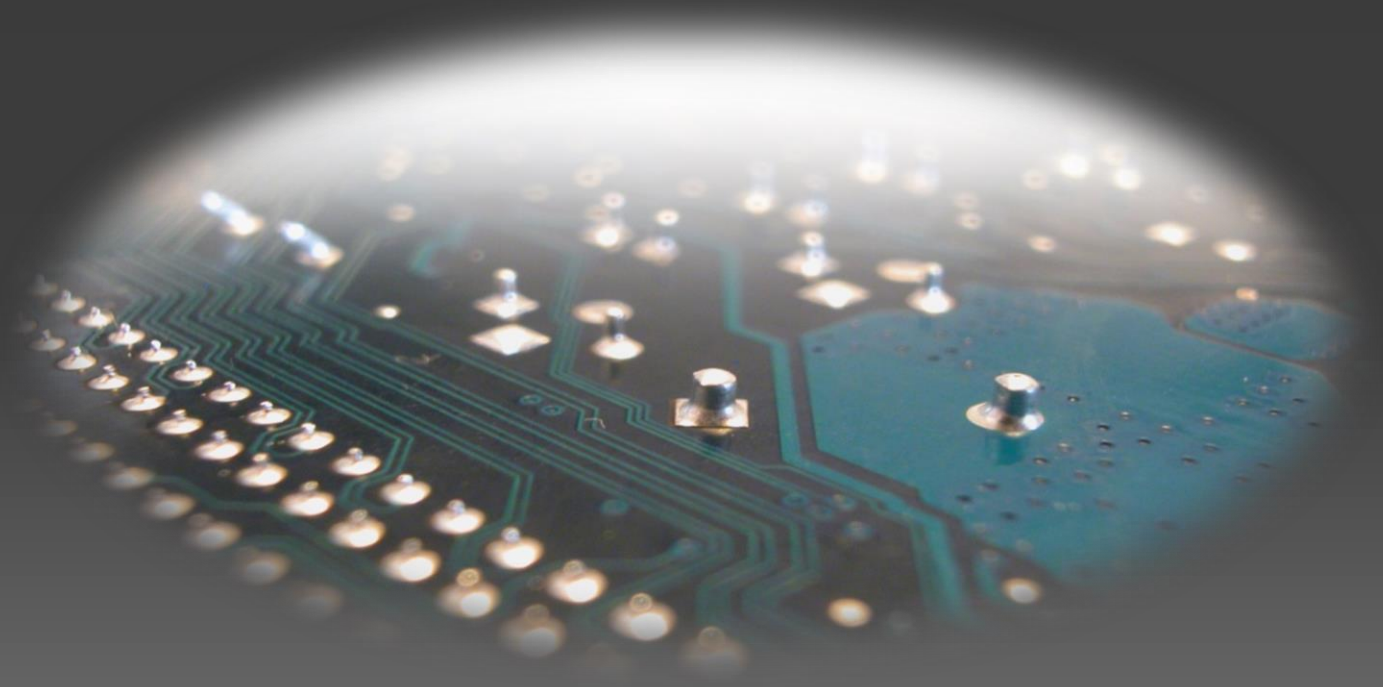


Summary

- SI / PI – still plenty of problems to solve
- Some go unresolved
  - Lack of partnership, creativity, …
- We all are part of the solution

SI GUYS

THANK YOU



Questions ?