Post-CAD Validation of High-Speed Serial Designs

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ANSOFT

Overview

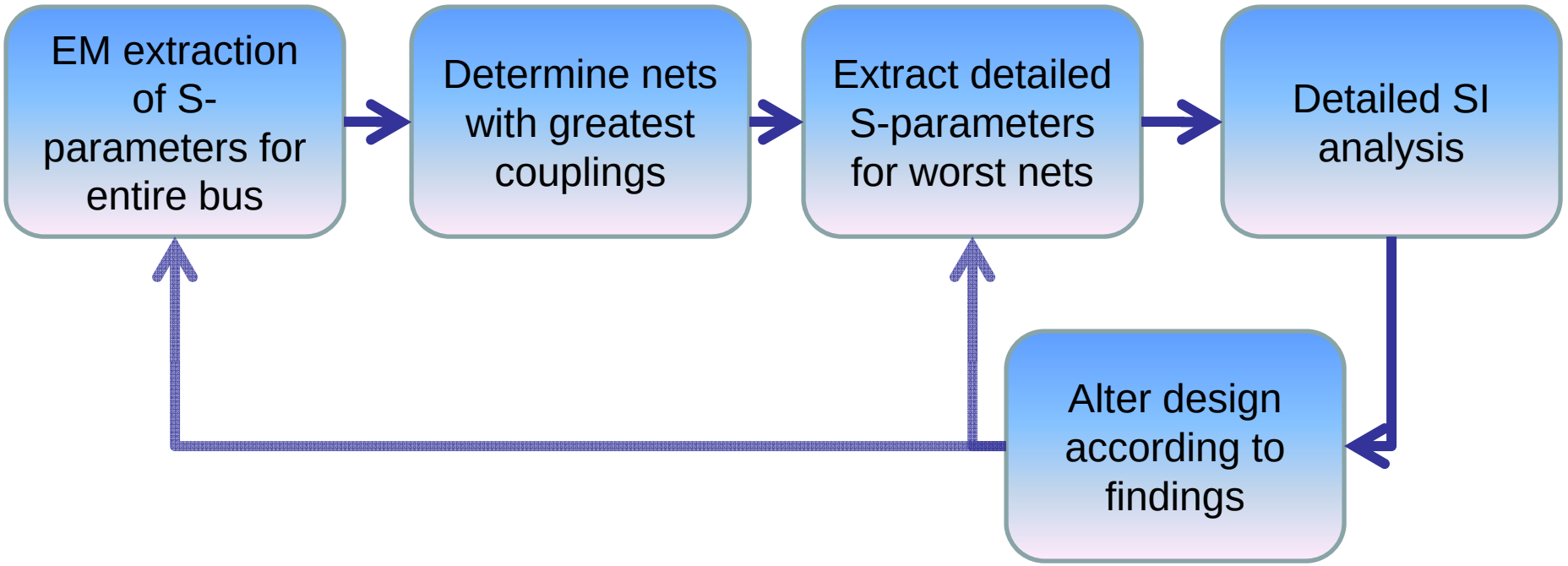
- Design Flow Introduction
- Crosstalk Wizard
- SATA 3 Gbps Design
- Conclusion

Problem Statement

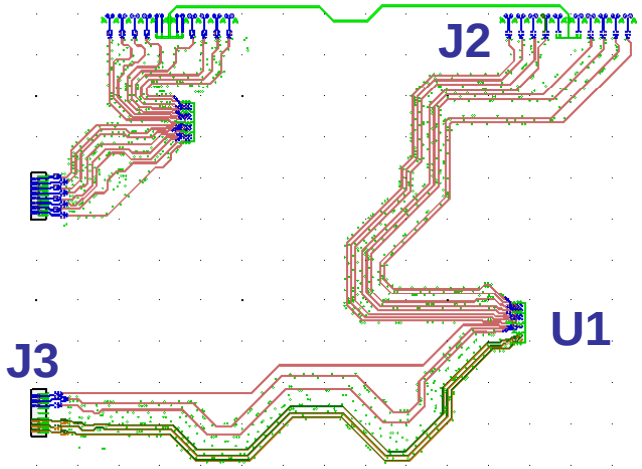
- Today's parallel and multi-lane serial buses use large numbers of signal lines
- Design flow must handle large numbers of measurement points and guide the detailed analysis of "worst" differential pairs

Crosstalk Analysis Flow

Finding the needle in the haystack



Extract Limited S-parameters for Entire Bus

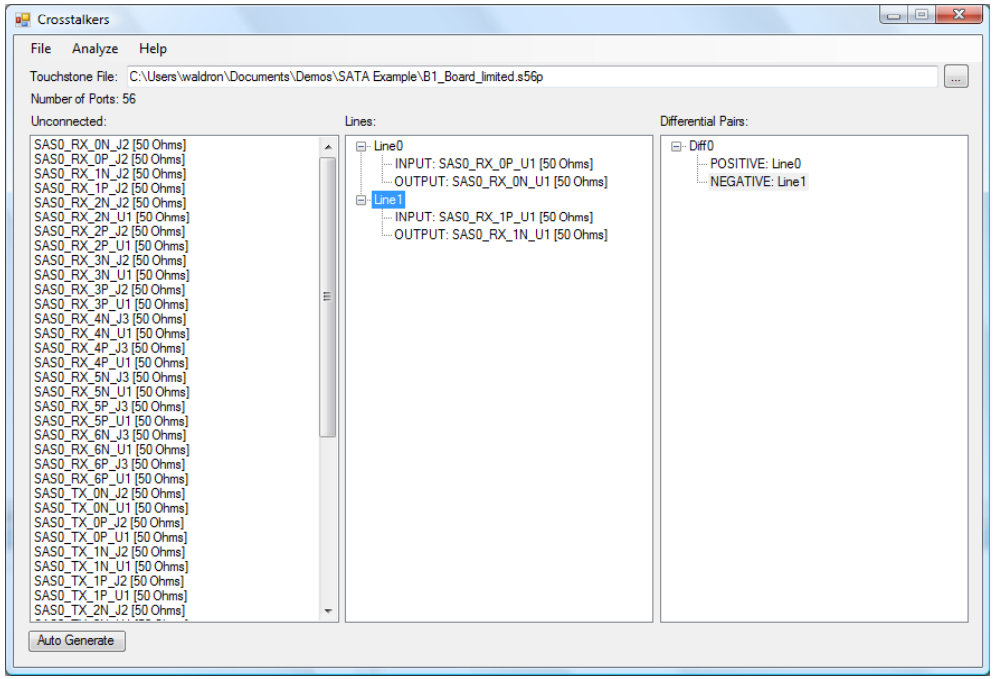


1.5 GHz
4.5 GHz
7.5 GHz

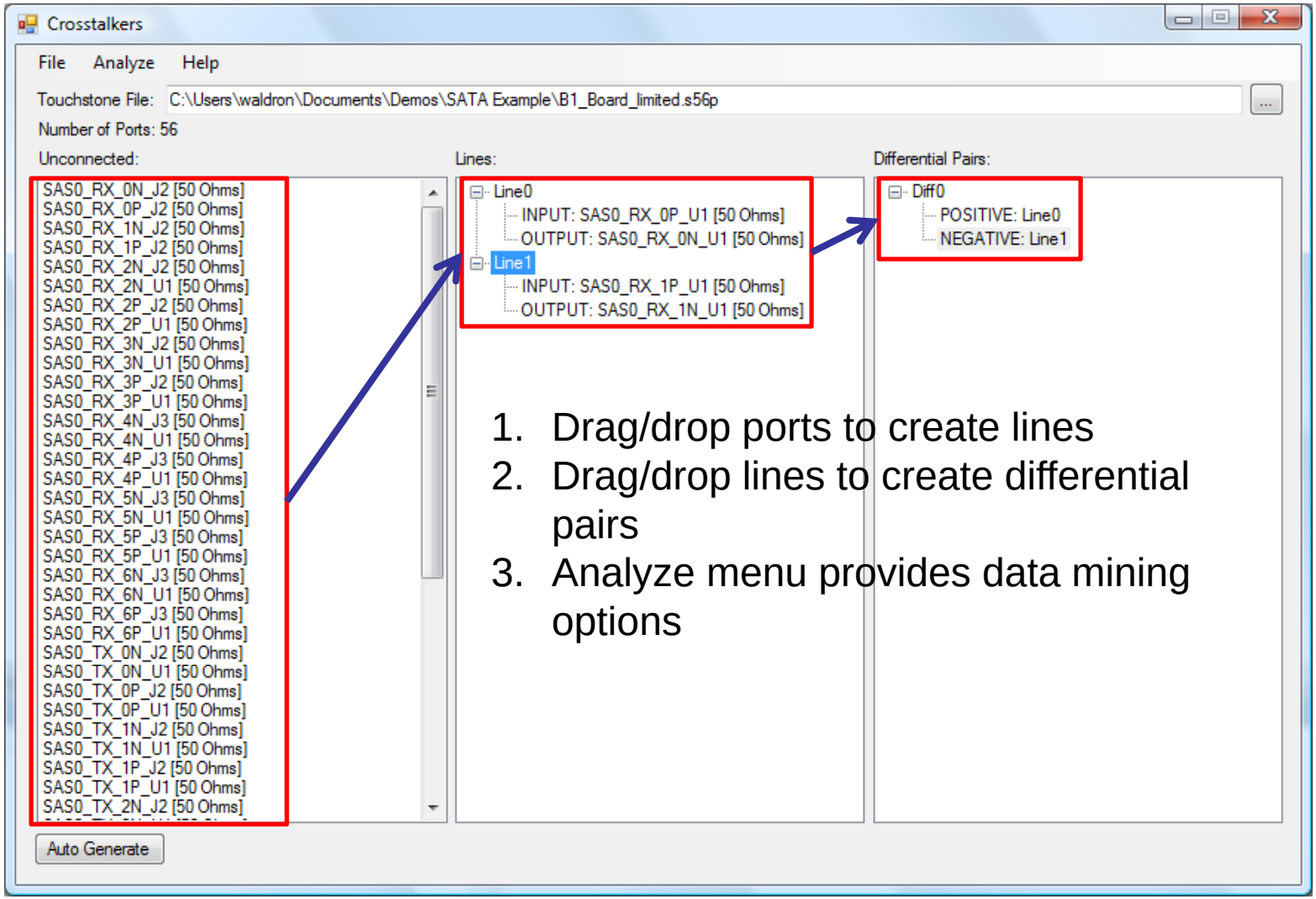
- SATA controller to external conector
- 14 differential pairs in total
- Extract S-parameters for entire bus, from data fundamental (1.5 GHz) to 10th harmonic

Determine Nets with Greatest Coupling

- Using S-parameters extracted for entire bus
- Crosstalk wizard “Crosstalkers” developed by Isaac Waldron and Chris Herrick
  - Determines which nets exceed crosstalk threshold

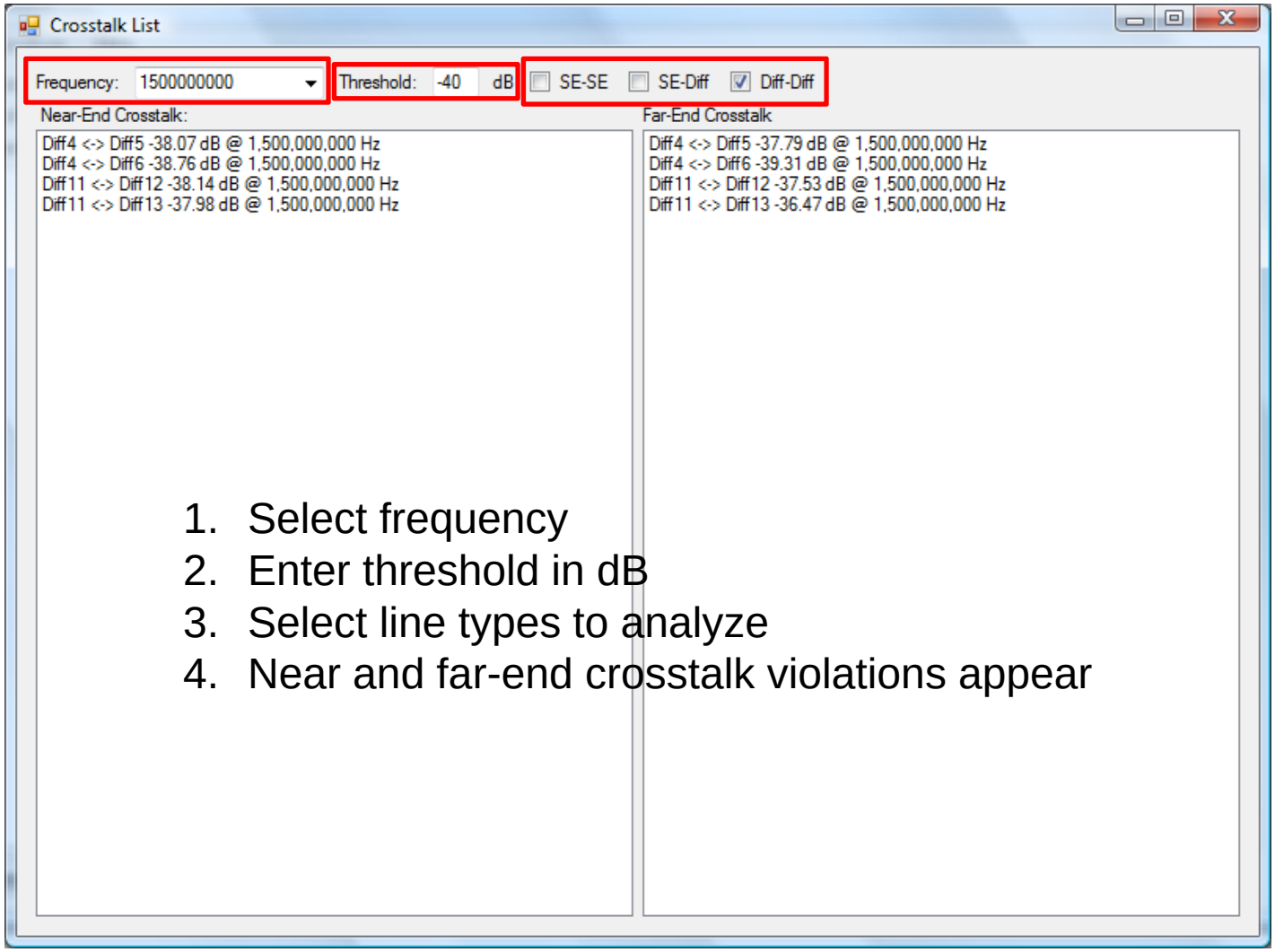


Crosstalkers



1. Drag/drop ports to create lines
2. Drag/drop lines to create differential pairs
3. Analyze menu provides data mining options

Crosstalkers

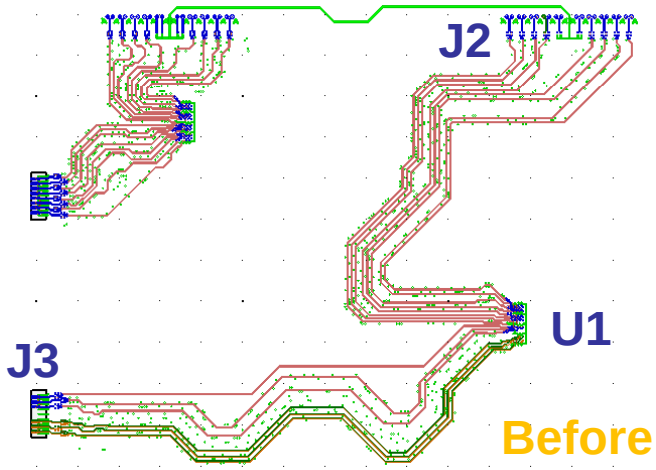


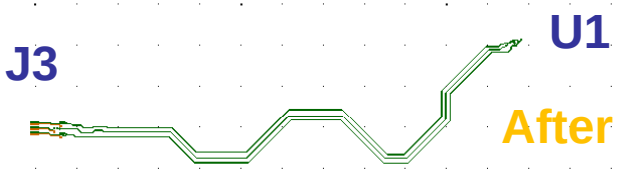
1. Select frequency
2. Enter threshold in dB
3. Select line types to analyze
4. Near and far-end crosstalk violations appear

Crosstalk Wizard Results

- RX5 and RX6 are potential aggressors to RX4
  - RX5 → RX4 -37.79 dB FEXT
  - RX6 → RX4 -39.31 dB FEXT
- Need to extract these lines in more detail and simulate in the time domain

Extract Detailed S-parameters for worst nets/planes





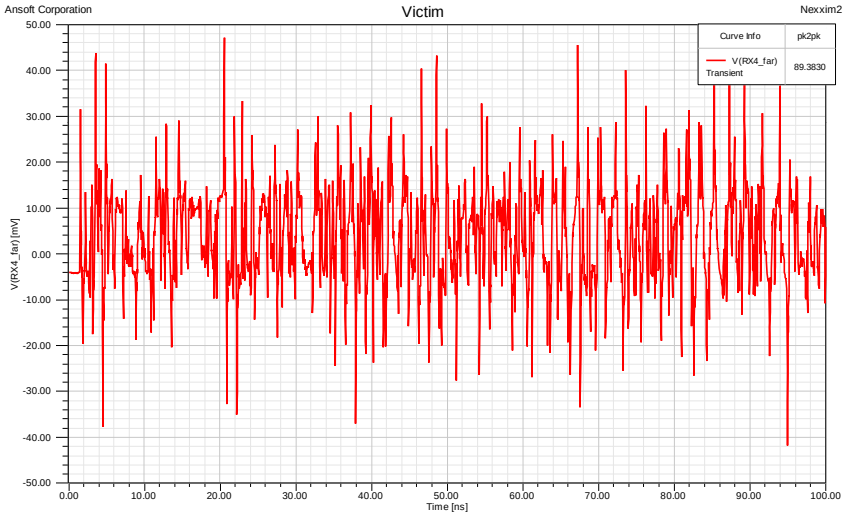
- Extraction reduced from 28 to 6 lines
  - *Directs attention for more detailed SI analysis*
- Next step: extract detailed S-parameters (DC to 15 GHz)

SI Analyses

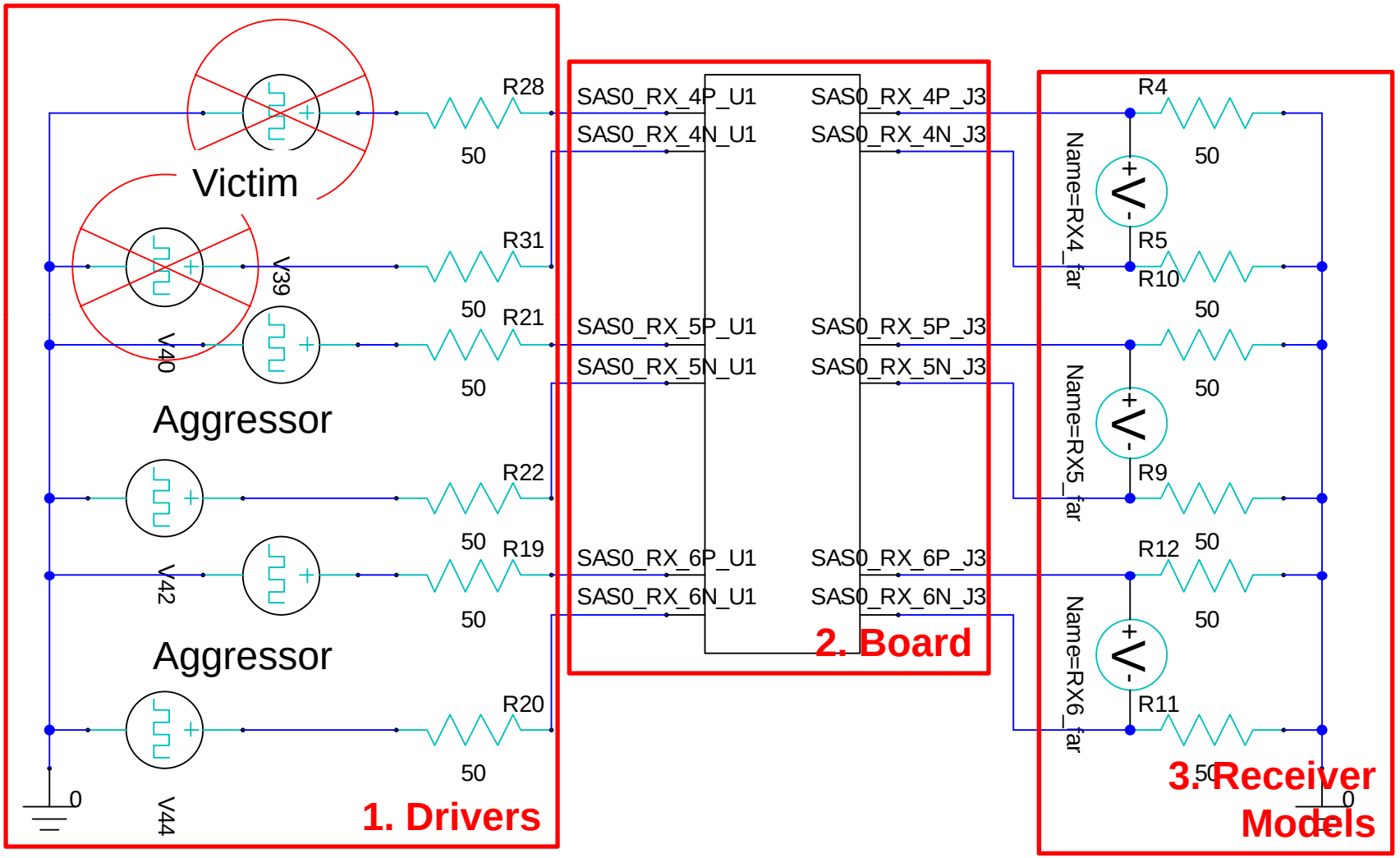
- S-parameters are useful in all types of signal integrity analysis:
  - Insertion and return loss
  - **Crosstalk**
  - Simultaneous switching noise (SSN)
  - Eye diagram analysis
  - Bit error rate (BER) analysis
- Circuit simulation offers ability to subject channel to various conditions:
  - Jitter (random, deterministic, periodic)
  - Duty-cycle distortion

Crosstalk Analysis

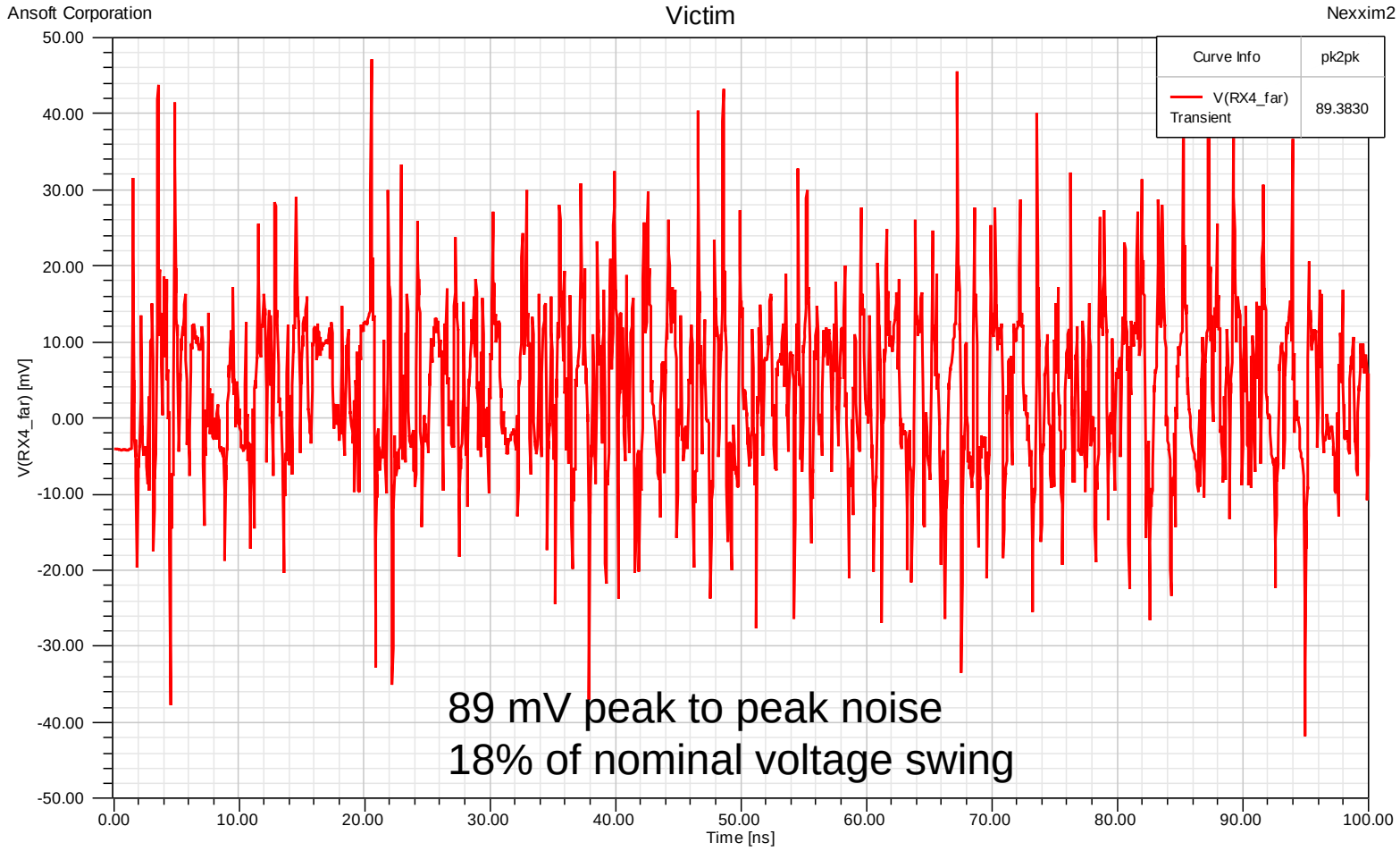
- Time-domain crosstalk analysis is performed by driving a signal onto one or more aggressors and observing the response on a terminated victim line
- Ensures that noise on victims will be sufficiently low



Crosstalk Schematic



Noise on RX4 (Victim)



Crosstalkers Demo

Conclusion

- Design flows for today's high speed serial challenges must handle large numbers of measurement points and guide the detailed analysis of "worst" differential pairs
- Ansoft provides a design flow that includes Crosstalkers, a utility for determining the most strongly coupled differential pairs in a design
- Ansoft's state of the art electromagnetic extraction and circuit simulation enable high speed serial design

Getting Crosstalkers

- Crosstalkers is available now
- E-mail Isaac Waldron at iwaldron@ansoft.com for more information