Further Stat Eye Analyses

IEEE 802.3ap Meeting

Ottawa

Sept 28, 2004

Stephen D. Anderson

Xilinx, Inc.

stevea@xilinx.com

Objective

- **Apply Stat Eye to**
  - **Tyco Case 2**
    - **S-Parameter Plots Previously Presented to 802.3ap (Reference D'Ambrosia_01_0904.pdf)**
  - **Backplane Vendor-Provided Data**
    - **40 inch, 2 connectors, 4000-13SI**
    - **S-Parameter Plots Previously Presented to 802.3ap (Reference Anderson_01_0904.pdf)**
  - **Updated (September, 2004) Synthesized Channel**
    - **S-parameters and S-parameter Plots Yet to Be Presented and Uploaded**
- **Show and Compare Results**

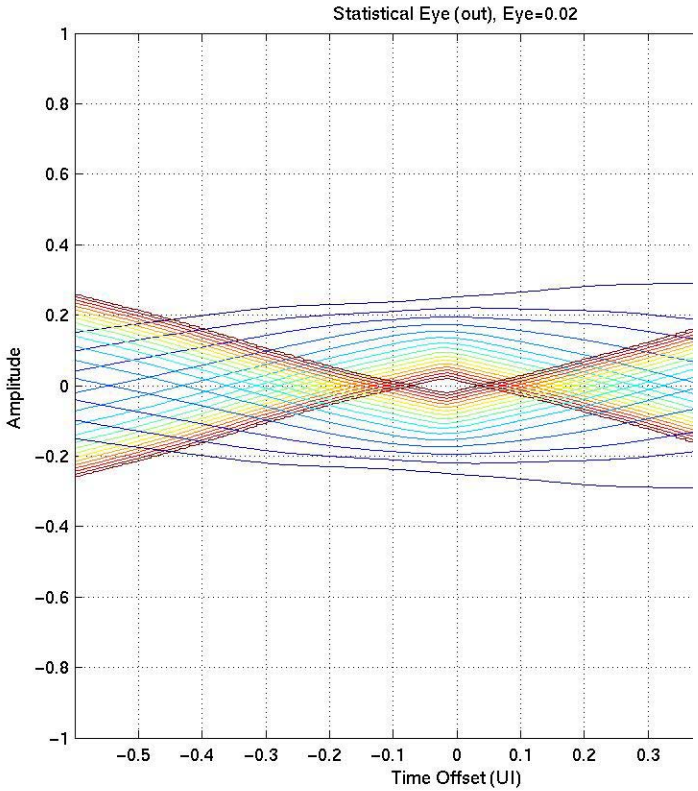
Analysis Conditions

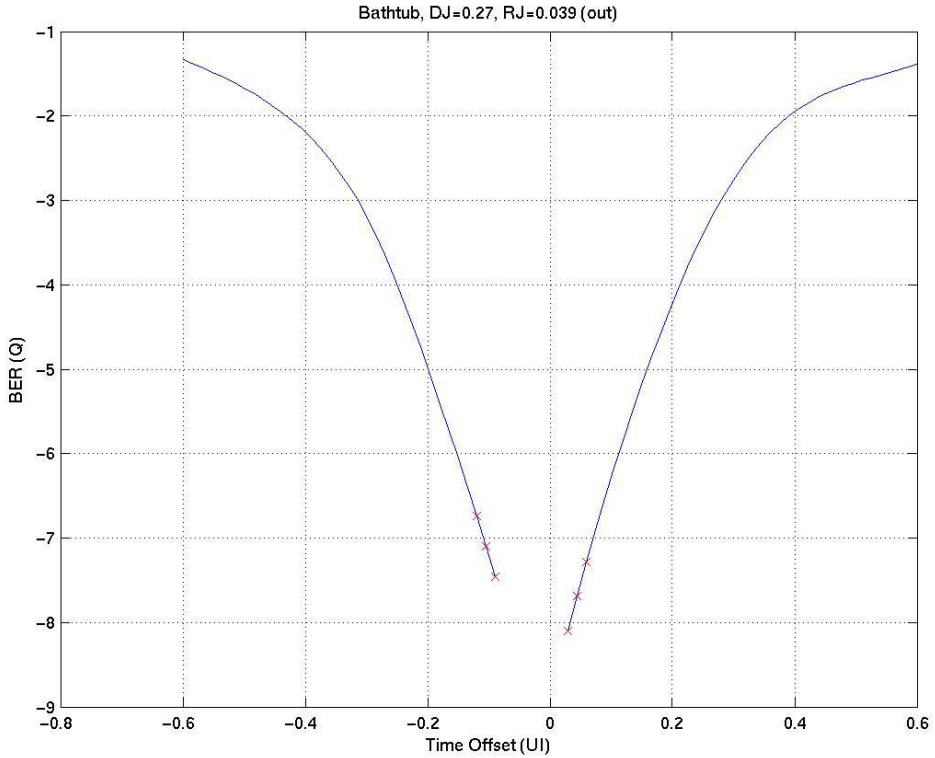
- End-to-End (includes Receiver)
- Equalization
  - Varied number of DFE taps
  - Two Forms of Emphasis:
    - One Tx pre-tap (removes precursor)
    - One Tx pre-tap and One Tx post-tap
  - No Continuous-Time Equalization
- Tx DJ 0.15 UIpp + Rx DJ 0.15 UIpp = 0.3 UIpp
- Tx RJ 0.01 UI RMS + Rx RJ 0.01 UI RMS = 0.01*sqrt(2) UI RMS
- Tx Amplitude 1.0
- 10.0 Gbps

Analysis Conditions Continued

- **Crosstalk**
  - **All Analyses Include NEXT Only Crosstalk**
  - **Measured Channels include 0, 2, and 8 Aggressors**
  - **Synthesized Channel uses 1 Aggressor at Maximum of Channel Ad Hoc Template**
  - **Worst (Highest) Crosstalk Transfer Chosen and Applied For All Aggressors**
- **Pass/Fail Criterion**
  - **Any Amount of Positive Eye Opening (No Rx Threshold Assumed) at 1e-15 Contour**
- **Stat Eye Version**
  - **Version 2.0e (This is Not the Latest One)**

Example Stat Eye Plots





Stat Eye Results

- **Spreadsheet Uploaded**
  - **Contains All But a Few of the Less Interesting Analyses**
  - **Shows Tap Weights, Stat Eye Output Values**
  - **Parameter Generator File Available on Request**
- **Presented Here**
  - **Only Minimum Conditions to Pass Stat Eye**

Stat Eye Results Continued

- Tyco Case 2
  - One Emphasis Tap (Two total)
    - 0 Aggressors Requires 9 DFE Taps
    - 2 Aggressors Requires 11 DFE Taps
    - 8 Aggressors Not Done
  - Two Emphasis Taps (Three total)
    - 0 Aggressors Requires 5 DFE Taps
    - 2 Aggressors Requires 7 DFE Taps
    - 8 Aggressors Requires 9 DFE Taps

Stat Eye Results Continued

- Vendor
  - One Emphasis Tap
    - 0 Aggressors Requires 3 DFE Taps
    - 2 Aggressors Requires 3 DFE Taps
    - 8 Aggressors Requires 3 DFE Taps
  - Two Emphasis Taps
    - 0 Aggressors Requires 2 DFE Taps
    - 2 Aggressors Requires 2 DFE Taps
    - 8 Aggressors Requires 2 DFE Taps

Stat Eye Result Continued

- Old Synthesized Channel (Data Previously Presented)
  - One Emphasis Tap
    - Full NEXT Crosstalk Requires 5 DFE Taps
  - Two Emphasis Taps
    - Not Analyzed
- Revised Synthesized Channel (Using Sept, 2004 SDD21 Curve)
  - One EmphasisTap
    - Full NEXT Crosstalk Requires 11 DFE Taps
  - Two Emphasis Taps
    - Full NEXT Crosstalk Requires 6 DFE Taps

Conclusions and Observations

- **Stat Eye Analyses Are Presented**
  - **For Measured Channels of Interest**
  - **For the Synthesized Channel**
  - **With Different Combinations of Number of Aggressors, Emphasis Taps, and DFE Taps**
- **Compare Tyco Case 2 Versus Vendor**
  - **Simpler Equalization for Vendor (2 to 3 DFE taps) Versus Tyco (5 to 11 DFE taps)**
- **Compare Tyco Case 2 Versus New Synthesized**
  - **Relative Agreement – Synth (6 to 11 DFE taps) Versus Tyco (5 to 11 DFE taps)**
- **Compare New and Old Synthesized Channels**
  - **Simpler Equalization for Old (5 DFE taps) Versus New (6 to 11 DFE taps)**

Conclusions and Observations Continued

- **Synthesized Channel – Compare New and Old**
  - **New and Old Channels have about the same attenuation at 5 GHz → Implies comparable equalization**
  - **But …**
    - **New Channel has large Skin Effect, Old Channel had little or no Skin Effect**
    - **Skin Effect causes slow tail in pulse response – Means that New Channel requires more equalization than Old Channel**

Reference and Acknowledgements

- **Statistical Eye Software is provided by StatEye.org Open Forum. The Statistical Eye scripts were originally written by Anthony Sanders, Infineon.**
- **Measured backplane data was provided by Tyco**
- **Further Measured backplane data and help in Using the Data was provided by a major Connector and Backplane Vendor**
- **Help was provided by Bob Davidov of Acuid and by other UXPI Member Companies**