SAS-2 Internal Channel Modeling (05-276r0)

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Project Goals

- Provide industry with data to better understand customer (hp and other OEMs) applications.
- Provide suppliers with internal interconnect channel models that can be used with simulation tools

To Do List

- Determine appropriate measurement requirements
- Select instrumentation methods and tools
- Construct fixturing
- Acquire test apparatus
- Gather data (insertion loss, return loss, NEXT and FEXT)
- Process data

Architectural Design Permutations

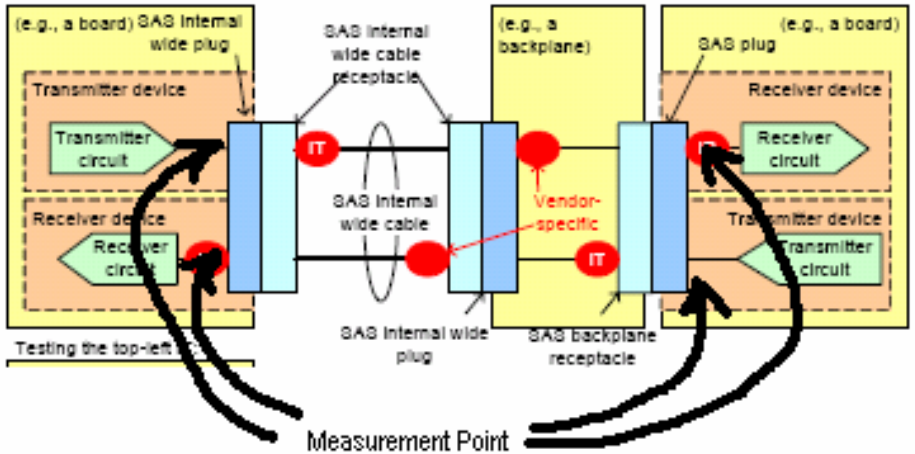
- Host bus adapter / cable / board / drive
- Host bus adapter / cable / drive
- Motherboard / cable / board / drive
- Controller / board / board / drive
- Boards noted in last item could be backplane, daughter board on controller, interposer board or midplane

Measurement Points

- Material presented at the Houston face-to-face was based off of reference designs. Probing functional hardware is far less ideal
- A probing method must be selected for each type of measurement point. Actual position of point will help determine what probing method can or should be used
- Not sure if all fixturing and test cable effects can be removed from the measurements.
- Zero-length test fixturing is not zero loss and also contains a non-ideal return loss.

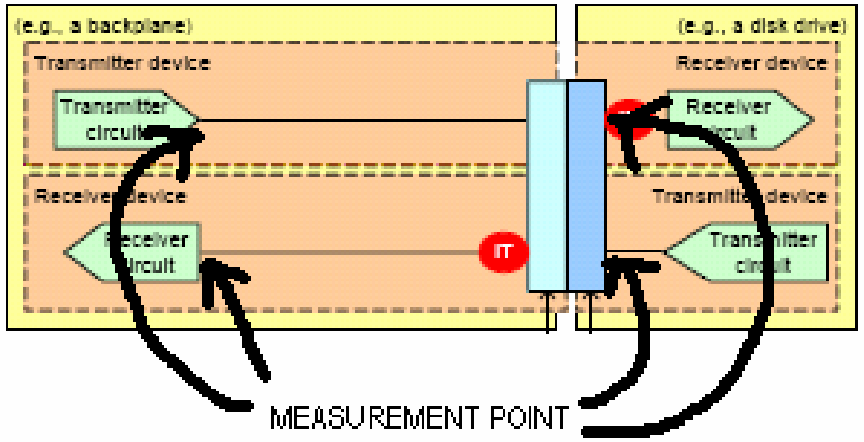
Measurement Points

- For modeling purposes, an end-to-end link from transmitter to receiver is required
- This doesn't necessarily correlate with compliance points
- For the internal wide cable option measuring at the outer side of both mated connectors interfaces is the simplest
- Additional effects of trace routing on boards at the ends can be modeled by cascading the S-parameter blocks



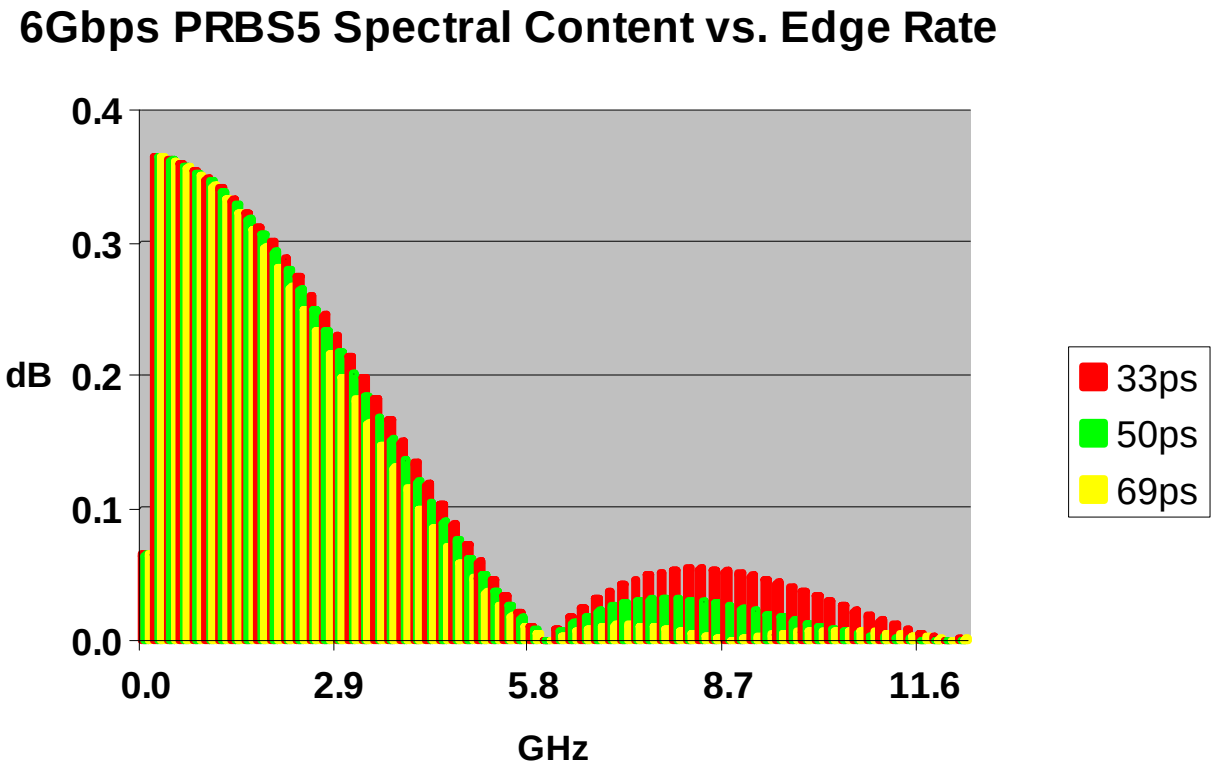
Measurement Points

- For the internal option with no cable, compliance points only exist at the drive side
- The measurement can be made from the transmitter / receiver component pads on the host side
- Additional effects of trace routing on drive side boards can be modeled by cascading the S-parameter blocks



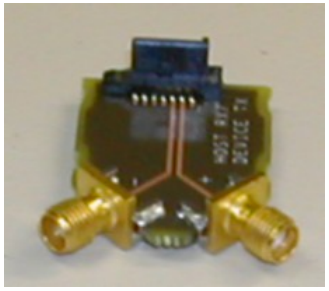
Measurement Setup – Frequency Span

- For 3Gbps, the TCTF knee occurs at 3GHz. If this changes, will characterization be required at a frequency higher than 6GHz?



Probing Methods - SMA Paddle Card

- Useful when mated interface required. Note that board is part of the electrical characteristics of the connector (footprint)
- Evaluating measurement and mathematical methods to model paddle card for de-embedding



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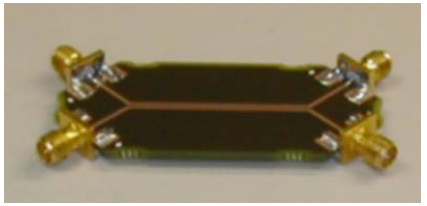
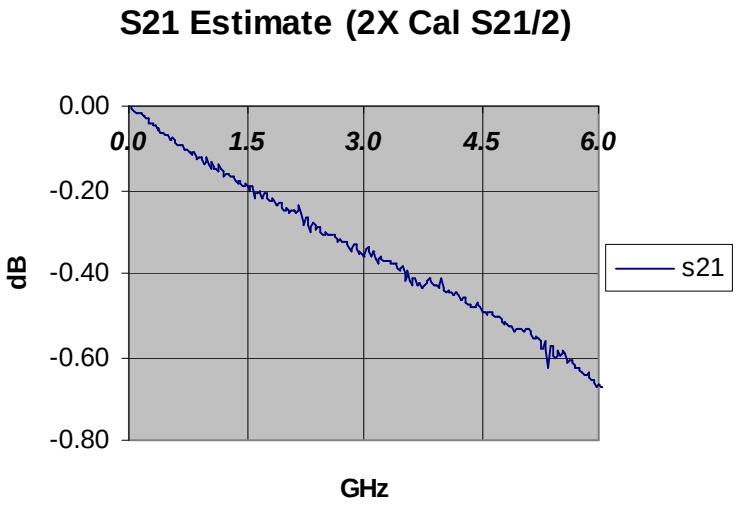
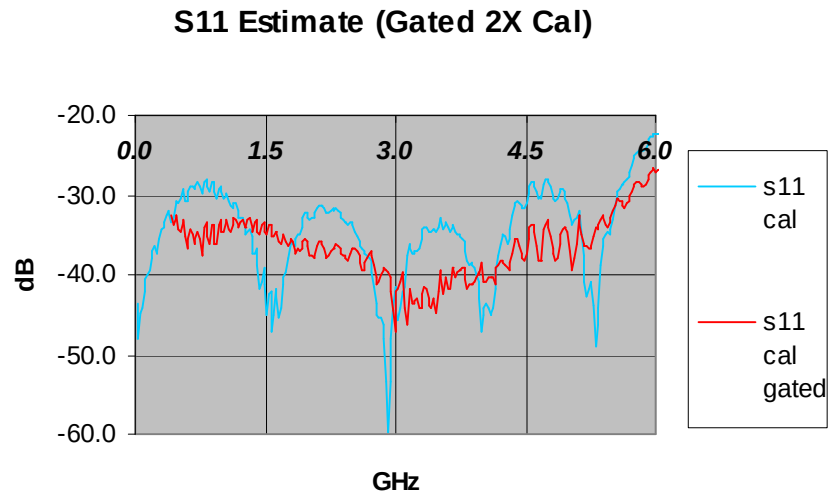
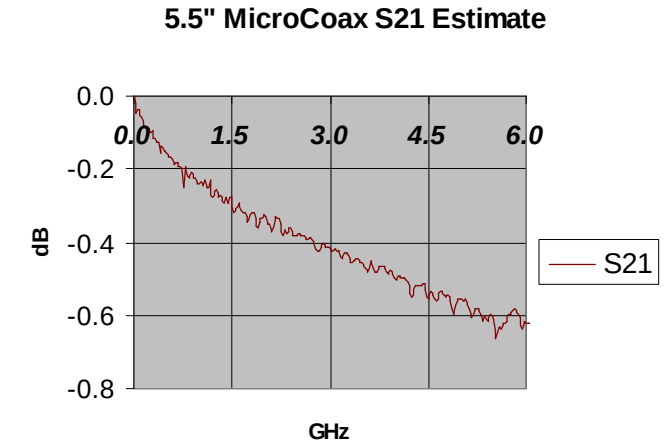


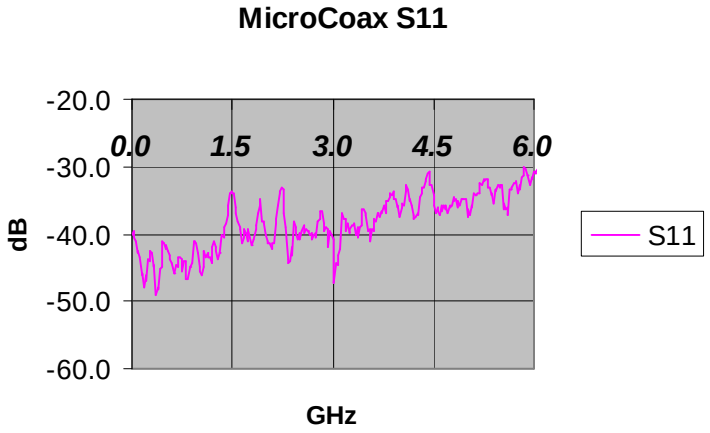




Probing Methods – Formable MicroCoax

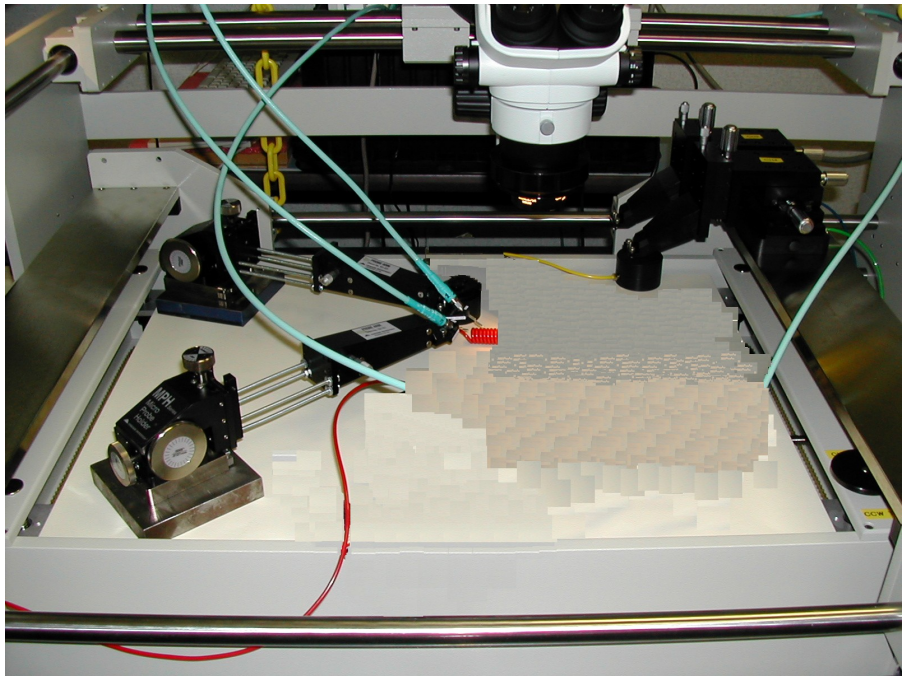
- No additional fixturing required
- Attachment point will alter launch characteristics (both S11 and S21)
- Leads must be carefully cut, formed and attached to minimize differences

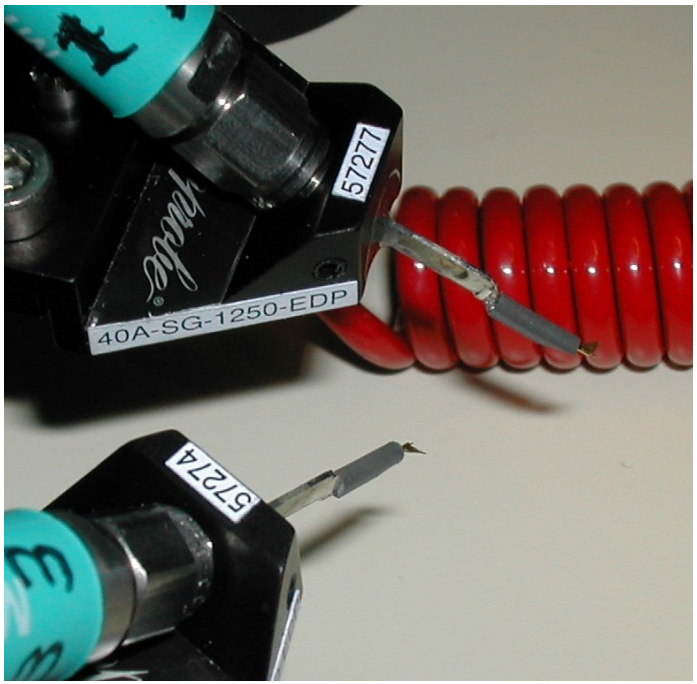




Probing Methods – Micro Probing

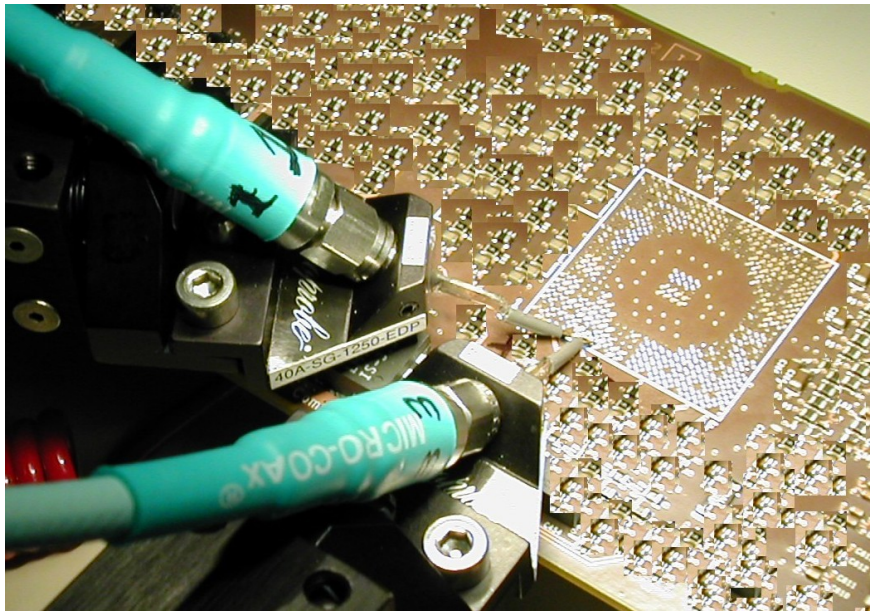
- Each probe must a pressure contact both signal and ground
- Typical insertion loss spec'd at less than 0.5 db to 6 GHz
- Typical return loss spec'd less than 30 db to 4 GHz





Probing Methods – Micro Probing

- Flatness of probed surface may be an issue
- Commonly used for wafer testing
- Measuring point-to-point connections on thicker board designs has proven successful
- More difficult to used for board-to-board designs with multi-axis orientation of boards



Probing Methods - Tradeoffs

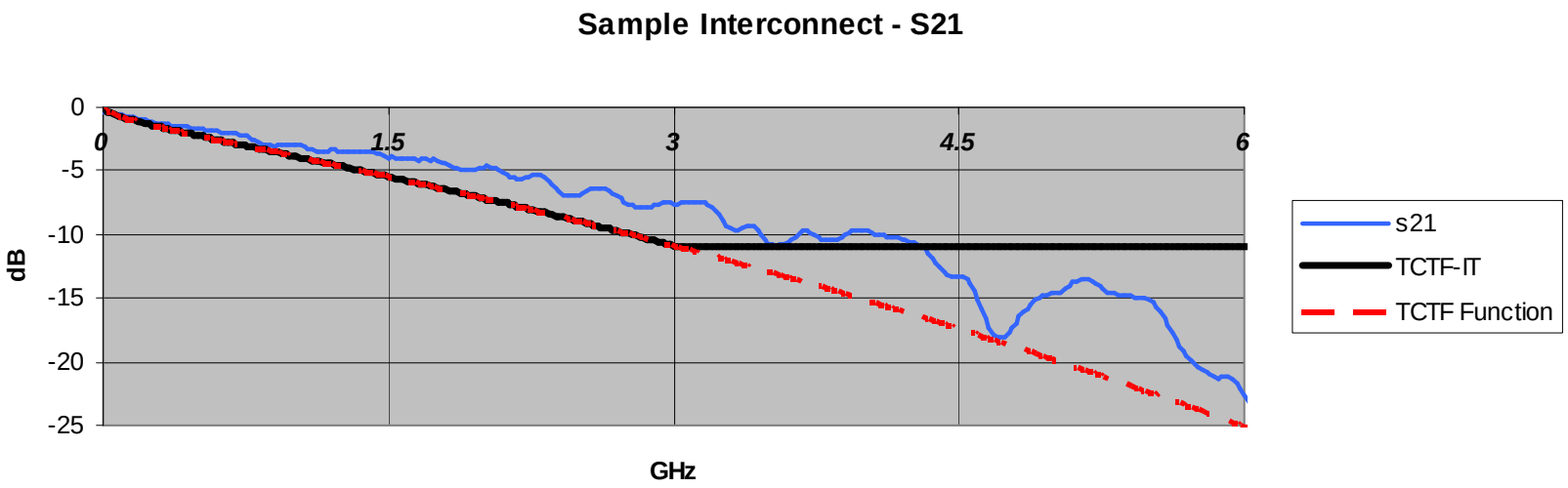
- Direct attached micro-coax will likely alter the return and insertion loss characteristics. Variability of the process would make it very difficult to characterize and de-embed from measurements.
- Micro-probing is challenging on configurations where probing is required in multiple planes
- Paddle boards are a good choice for measurements at mated connector interfaces. This approach is not practical for measurement at a BGA pad. However, a non-functional version could be constructed to emulate traces structures and various lengths of interest.

Probing Methods - Conclusion

- Plan is to characterize paddle card and de-embed from drive side of interconnect. Host side will require a micro-probing station whose effects will also need to be de-embedded. Number of measurements obtained may be limited by setup time of probing station.
- Will also compare results to those obtained by direct micro-coax termination to BGA pads.

Sample Data

- Below is the insertion loss measurement of one sample design displayed
- Also included is the TCTF-IT as defined in SAS-1.1 and the TCTF function
- Insertion loss of fixturing was manually removed



Conclusions / Discussion

- We believe a feasible measurement process can be developed with an acceptable level of error. However, it is apparent that all phases of this effort will consume a considerable amount of resources and time.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