SCSI signal modeling study group (SSM) 00-164r0
March 01, 2000
Manchester, NH

Subject: Draft minutes for the SSM working group on March 01, 2000

This was the next meeting to address the general subject of modeling for parallel SCSI. Paul Aloisi of TI led the meeting in the absence of Dean Wallace. Bill Ham of Compaq took these minutes. There was a good attendance from a broad spectrum of the industry. Hitachi (Zane Daggett) hosted the meeting.

Last approved minutes: 00-146r1.

1. AGENDA SSM MEETING (Manchester, NH)

2. Introductions

Paul opened the meeting and conducted the introductions and reviewed the meeting purpose. He thanked Zane Daggett of Hitachi for hosting the meeting.

3. Attendance

The following folks were present:

4. Attendance

The following folks were present:

Name	Company	E-Mail
Dave Chapman	Amphenol	dave.chapman@aipc.fabrik.com
Jeff Rosa	Amphenol	jeff.rosa@aipc.fabrik.com
Bill Ham	Compaq	bill_ham@ix.netcom.com
Paul Aloisi	TI	Paul_Aloisi@TI.com
Zane Daggett	Hitachi	zdaggett@hcm.hitachi.com
Martin Ogbuokiri	Molex	mogbuokiri@molex.com
Larry Barnes	LSI	larry.barnes@lsil.com
Bob Gannon	JPM	rgannon@jpmco.com
David MacQuown	Adaptec	david_macquown@corp.adaptec.com
Jason Chou	Foxconn	jasonc@foxconn.com

5. Agenda development

The agenda shown was that used.

6. Approval of previous minutes

The minutes of the last meeting were reviewed and minor changes were made. Bill Ham moved and Paul Aloisi seconded that these revised minutes be approved. Motion passed unanimously. This document will be posted as document 00-146r1.

7. Action item review

The action items were reviewed with the status indicated in the action item section of the minutes.

8. Presentation Policy

This item is included for easy reference and will be retained in future minutes.

It is the policy of the SSM working group that all material presented at the SSM working group shall be made available electronically and posted on the T10 web site.

Material presented at the meeting should be uploaded to the T10 web site two weeks prior to the meeting. Alternatively the material may be electronically supplied to the chair or secretary at the meeting where the material is presented at the discretion of the chair.

Material should be free from any statement of confidentiality or restriction of use and should not contain any pricing or product scheduling information.

9. Document review - Barnes

No specific output since last meeting. Larry has now acquired his very own notebook computer which will be available in future meetings for real time editing.

Some framework editing will be done in the later agenda item relating to the framework for the document.

It was suggested that the next meeting be used mainly for editing the document.

10. Presentations

10.1 Terminator model - Paul Aloisi

Paul presented details of models for single ended and LVD terminators. The Y LVD and the Y multimode IBIS models are available in the Cadence suite now. Mentor graphics will soon have these IBIS models also. The spice models are available from Don Getty. The single ended spice model is available from Don Getty. No support for stacked resistor designs is offered by TI. Paul noted that the switches used for disconnecting the terminators may have severe effects on the frequency response.

Material was submitted to Larry Barnes for inclusion in the document.

10.2 Transition region model plan - Gannon

Bob presented the first thoughts on the transition region modeling. Following is the bulk of his presentation.

JPM plans to move forward- Based on input from Manchester meeting, select first case for transition region model. Use high power microscope and produce analysis of region crossection. Select Ansoft tool and model in 3D and use cascaded model technique to compare both approaches and present to SSM committee at a date TBD. Current JPM tools acquired since Rochester meeting are Ansoft Maxwell 2D and 3D modeler, Microsimm/Cadence PSPICE.

Thoughts on transition region variables: How do we define the transition region and what are the parameters that define the transition region? The region runs from the point of cutting the bulk cable to the point of being loaded on the connector. The shielding is different in transition region than on cable. What is fanout extent?

SCSI Cables- Internal and External, round shielded, round unshielded, flat cable, twist and flat are all different.

Connectors- 25 position std SCSI, 34 position std SCSI, 25 & 34 position .8 mm, Internal IDC, Straddlemount, 0.8 mm, Offset 0.8mm each have different physical parameters

IDC- Insulation pierce, deformation of plastic, stress on contacts, flaking of tin, change in conductivity may affect the performance

Paddlecard attach- Reflow of solder, wire to solder pad attach, different solder characteristics

Crimp and poke- Crimp tools/applicators, plating thickness of contacts, applicator geometry, points of contact to wire, pull force versus resistivity

Model Options:

Ansoft Maxwell 2D and 3D Modeler

Pacific Numerix/Ansoft

HP ADS

IFS Connect/Interaction Products

Cascaded Models

Concerns- Frequency characteristics of dielectrics, accuracy of lumped parameter models, Changes in lumped parameters with respect to frequency. This has to be a distributed model for all cases except possibly IDC to flat.

Other Resources- Outside consultants, Pre-existing work
Action Items- Produce matrix of transition regions and issues with each.
Moving Forward- What should be timetable, Action items for next meeting

10.3 Positioning of SSM in the industry - Ham

Bill noted that there is probably going to be a similar group starting in FC that is following the paradigm being developed here. Ron Miller of Brocade is presently the facilitator for this new effort and a project proposal is being prepared.

11. Matrix development for SSM

The following summarizes the present position for the SSM matrix. This matrix is a concise description of the methodology to be used for the respective areas of the point to point SCSI bus segment. Several of the areas were significantly modified at this meeting. Note that the multidrop areas have not yet been identified.

This section contains some repeated information from the last minutes as it continues to be relevant and current.

11.1 Transceiver chips: owner, Dean Wallace

No new content info this meeting.

Interface is at packaging pins
Model types: Spice, IBIS, HDL, table spice – details TBD
Data patterns: TBD
ISI compensation: required but not presently believed compatible with IBIS capability – this means that IBIS will have to be enhanced and that only SPICE models will be effective until the new IBIS techniques are available.
Single line required - cross talk from non SCSI sources not considered in the model, SCSI line cross talk is not significant within the transceiver. Therefore multiline models are not required for transceivers.

Action Item: Dean to email folks who have open action items relating to transceivers.

11.2 Bus segment termination: owner, Paul Aloisi / Don Getty

No new content information.

Interface is at package pins
Model types: Spice, IBIS details TBD
Terminator type: multimode
Single line only

11.3 Transceiver board: owners, Tariq Abou-Jeyab and Matt Schumacher

No new content information.

Interface is at transceiver board connectors, transceiver chip pins, terminator chip pins
Model types: Spice
PCB construction: edge, broadside, dielectric type / thickness, vias, pads, discontinuities
Single line, multiline

The present paradigm for this component follows:

Listed are some key datapoints to consider for HSPICE simulation of a simple LVD SCSI PCB. Initial simulations will be used to optimize PCB routing topologies. Simulating worst case scenarios will be discussed

in a later document, as it will require SPICE model correlation, process corners, multiline SPICE models for cross talk etc.

Request SPICE models:

check for a driver and a receiver model
Ask for single line models and multiline models of connectors. Multiline models may take much longer to arrive if you can get them at all. If single line models are used, signal integrity investigation will not include crosstalk.
Are models for unmated connectors necessary?
Required models must work for various edge rates (slow, typ, fast)
Keep the models in a centralized/secure location. Vendors usually distribute them under NDA.
Some correlation of the models is recommended (compare simulation and lab data)
Request models well in advance of need

Obtain transmission line geometries from PCB data / design requirements

These parameters are required: trace width, copper weight of trace and planes, dielectric constants, dielectric spacing within the differential pair, dielectric spacing to the planes and trace lengths of the nets to be simulated.

Generate RLGC matrices for transmission line segments(cline):

Using a field solver, obtain the RLGC matrices for the transmission line geometries.
Compare the field solver impedance with the TDR measurement of the coupon.
Note: the coupon will provide a controlled environment with minimal discontinuities for accurate trace characterization.

Draft a trace topology from the known trace segments and components:

Draft the transmission line topology
the drawing below is an example of a simple transceiver board in host bus adapter

Build a spice netlist for the trace topology:

Do not forget the process variations.

Simulate and review data:

Time domain simulation is sufficient for optimizing topologies.

W’s are SPICE element numbers. All other numbers are node locations.

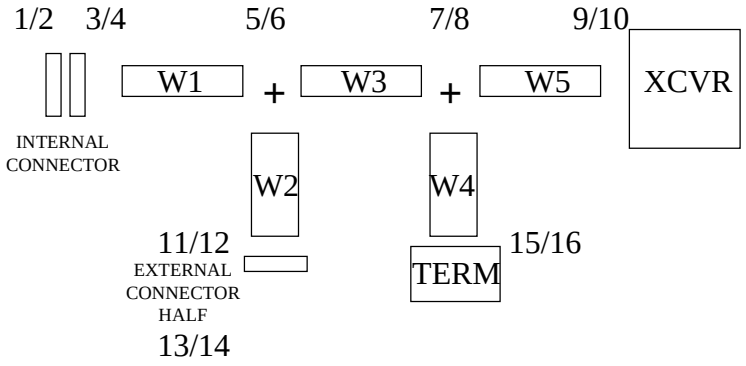


Figure 1 - Architecture of a transceiver board model (no unused connectors)

11.4 Mated connectors: owner, Martin Ogbuokiri

No new content information.

Interface is at transceiver board and the cable assembly transition region
Model types: Spice
Connector types: VHDCI, SCA-2, HD68
Mounting style: thru hole, SMT,
single line, multiline

Connector models are in place at the Molex web site and pointers are now in place on the T10 site.

11.5 Cable assembly transition region: owners, Bob Gannon, Greg Vaupotic

Interfaces are at the connector termination and the uniform media
Model types: Spice same as connector
Construction types: twisted flat, round fanout, laminated round, IDC flat?
Single line multi-line

A start was made in this area – see Bob Gannon presentation above.

11.6 Uniform cable media: owner, Jie Fan

Interfaces are at the beginning of the cable assembly transition region on either end.
Model types: Spice
Cable types: flat, round shielded, round unshielded twisted flat?
Single line, multiline

Hitachi agreed to become a co-owner of this matrix element.

Action item: Jie to provide a cable media model to the web site.

11.7 Backplane: owner, Larry Barnes

Interfaces: connectors mounted on the backplane, directly mounted components,
Model types: SPICE
PCB construction: edge, broadside, dielectric type / thickness, vias, pads, discontinuities
Single line, multiline

Issue: how to handle the unmated connectors on the backplane. Two sub issues: (1)lack of existence of unmated connector models and (2) convergence of the simulation with dangling open circuits. The latter can be handled by adding a high value resistance to the open circuit to "fool" the simulator.

Action item: Larry Barnes to supply component definition and a graphical representation for the backplane (should not contradict the transceiver board if possible)

12. Simulation integration strategy

Further discussion pending progress on the component level simulation work. This will be addressed at the next meeting.

13. System configurations

Not discussed but reaffirmed as needed for the document

14. Data patterns

A preliminary discussion of the issues involving data patterns was held. The following resulted:

Data patterns need to consider the following properties:

- Intersymbol interference effects on single lines
- Cross talk from other SCSI lines
- driver release effects (driven to hi Z)
- Residual jitter (clock like patterns)
- Word patterns as well as individual patterns
- SSO
- Worst case digital patterns
- Sinusoidal patterns

A spirited discussion concerning how to deal with receivers that modify the input signal (either adaptively or not) was held. Is this part of the signal path or not?

A more general concept of data pattern is possible with simulation because the inputs can be selected in the model. For example, skew from line to line and skew within the same line can be introduced. This latter was not considered in any detail but promises to be a significant benefit of modeling.

15. Data rate

Data transfer rates in SCSI are determined by more than the highest frequency content of the signals. Specifically, single transition, double transition, width, specific protocol variant and adaptive filtering affect the data rate. Therefore one must be careful in simulation to ensure that the relationship between the analog signals and the application is understood.

The following table will be added to the document that shows some of the relationships:

SCSI variant	REQ/ACK maximum frequency (MHz)	Data line maximum frequency (MHz)	Minimum rise / fall time (ns) (20-80%)	Maximum launch amplitude
SCSI-1 SE	async - NA	NA	NA	5.25V
SCSI-2 SE	5 MHz	2.5 MHz	NA	5.25V
SPI-1 SE	10 MHz	5 MHz	5 ns	5.25v
Ultra SE	20 MHz	10 MHz	5 ns	3.7v
Ultra2 LVD	40 MHz	20 MHz	1 ns	2.2 V DFpp
Ultra 160 LVD	40 MHz	40 MHz	1 ns	2.2 V DFpp
Ultra 320 LVD	80 MHz	80 MHz	1 ns	2.2 V DFpp
Ultra 640 LVD	160 MHz	160 MHz	???	???

16. Definitions:

A comprehensive set of definitions has been created in the draft document. Definitions from IEEE standard dictionary are used if available.

17. Model database strategy (Wallace)

The revised proposed a specific summary of the present plans for the web based database:

- List of companies with existing models.
- What type of models are they. Connector media, transceiver etc.

- Description / intended use
- Path to the model, is an nda required for the model
- Contact info for model support
- What type of model, SPICE, IBIS, HDL.
- Revision history on site.

Martin noted that he intends to use a no fee license rather than an NDA for access to Molex models identified by the T10 web site.

Larry called for drafting a generic no fee license for all suppliers of models. Martin agreed that the SSM group may use their no fee license as a starting point.

18. Tools:

This item refers to software tools that may be useful for SSM.

Note that IBIS is not a tool but rather is a behavioral specification for I/O buffers and other stuff such as terminators and connectors. IBIS is described separately.

Following is a list of the major tools and the basic relationship between them:

Simulation tools:

SPICE-like
- HSPICE
- Berkeley SPICE
- Contec SPICE
- PSPICE

Behavioral
- HDL
- VHDL
- Verilog
- Hyperlynx
- Viewlogic XTK

High frequency structural simulator
- Ansoft
- HP-ADS (advanced design simulator)

Extraction tools

Maxwell
- Maxwell-2D
- Maxwell-3D

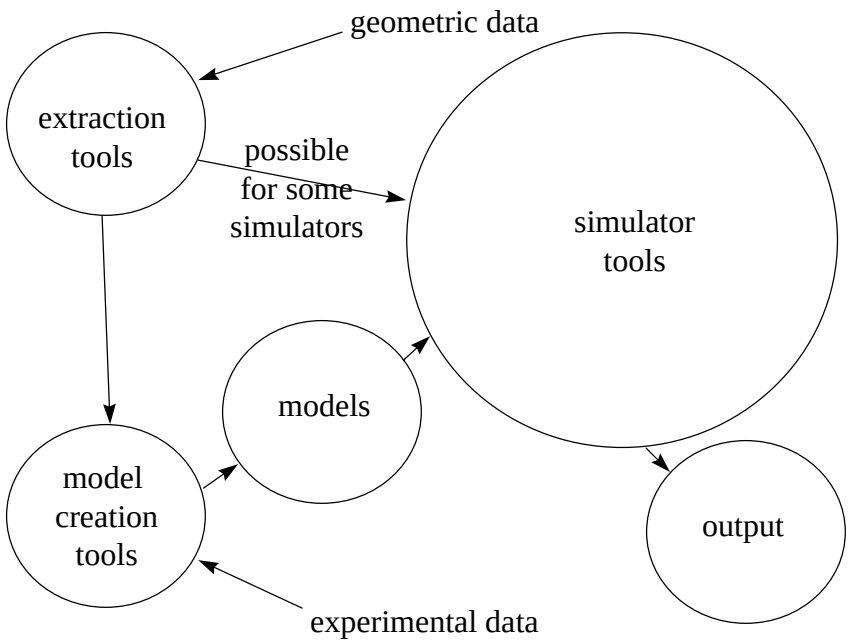
Pacific Numerix

Model creation tools

Mentor Graphics
Cadence

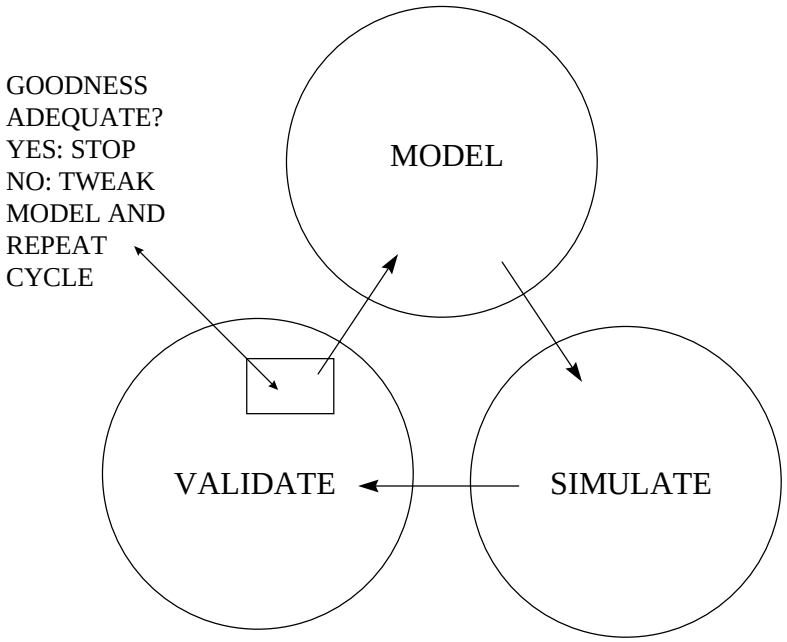
HP suite

The following figure shows the relationship between the different tool classes:



19. General methodology

The following figure shows the general methodology expected to be used for all SSM efforts.



20. Document framework (Barnes)

Larry Barnes, editor of the SSM document presently posted as 99-204r0, reviewed the present state and organization of the document. Following is the result of this discussion cast in the form of a table of contents with owners assigned. The numbering may not be accurate in the list below. Note the addition of Dima to the cable assemblies section.

Section owners are to create basic material and submit to Larry Barnes before the next meeting.

1. SCOPE ((Larry Barnes - 100%)
2. REFERENCES
2.1 Approved references
2.1.1 References under development
2.2 Resources
2.2.1 Publications (Jonathan Fasig - 100%)
2.2.2 Online bookstores & publishers - deleted for legal reasons
2.2.3 Other online resources - deleted for legal reasons
2.3 Tools (group - 80%)
3. DEFINITIONS, ACRONYMS, SYMBOLS, KEYWORDS, AND CONVENTIONS (group)
3.1 Definitions (20%)
3.2 Acronyms (80%)
3.3 Symbols and Abbreviations (100%)
3.4 Keywords (100%)
3.5 Conventions (100%)
4.0 Overview (Bill Ham - 25%)
6. MODELS
6.1 General recommendations (Larry Barnes - 10%)
6.1.1 Supporting documentation
6.1.2 Behavioral models
6.1.3 Circuit Models

6.2 Cables
6.2.1 Cable media (bulk cable) (Jie Fan / Zane Daggett - 10%)
6.2.2 Transition region (Bob Gannon, Greg Vaupotic - 10%)
6.3 Connectors (Martin O. - 5%)
6.3.1 Cable connectors
6.3.2 Non-cable connectors
6.3.2.1 RLC transmission line matrix
6.4 Printed circuit boards (Matt S., Tariq A. - 30%)
6.4.1 Traces
6.4.1.1 Microstrip
6.4.1.2 Stripline
6.4.1.3 Broad coupled stripline
6.4.1.4 Offset broad coupled stripline
6.4.2 Discontinuities
6.4.2.1 Vias
6.4.2.2 Pads
6.5 Devices
6.5.1 Terminators (Paul Aloisi / Don Getty - ?)
6.5.2 Transceivers (Dean Wallace - 5%)
6.5.3 Packages (Larry Barnes - 5%)
7. STANDARD MODEL CONSTRUCTIONS
7.1 Host bus adapter / target board (Tariq / Matt S. - 70%)
7.2 Point to point cable assemblies (Dima Smolyansky - 40%)
7.3 Multidrop cable assemblies (TBD)
7.4 Backplane (Larry Barnes - 10%)
7.5 System model (group - 2%)
8. VALIDATION PROCEDURES
8.1 Physical measurement points (Greg Vaupotic - ?)
8.2 Access to measurement points (Larry Barnes / Martin O.)
8.2.1 device connector
8.2.2 chip to board interface
8.2.3 terminator connector
8.3 Instrumentation input models (Jason Chou - 5%)
8.3.1 scope probe models
8.3.2 network analyzer models
8.3.3 test port cables
8.3.4 instrument transfer function
8.4 Use of frequency / time domain for validating elements of component models (
8.5 Distributed vs lumped resonance issues
8.6 Behavioral
8.7 Circuit
9. SIMULATION INTEGRATION STRATEGY (Dean Wallace)
9.1 System configurations
9.2 Data patterns
9.3 Data rates

21. New business

No new business was conducted.

22. Next meetings

Scheduled meetings:
Mar 01, 2000 Manchester, NH (Hitachi) 9AM to 5PM
April 12, 2000 Milpitas, CA (Adaptec) 9AM to 5PM

Requested meetings:
June 13-14, 2000 1:30PM to 5PM 6/13 9AM to 5:00PM 6/14, Lisle, IL (Molex)
August 15-16, 2000 1:30PM to 5 PM 8/15 9AM to 5PM 8/16, Colorado Spgs (LSI logic)

23. Action Items:

23.1 Action items from previous meetings

Status as of the March 01, 2000 meeting is shown.

Larry Barnes to propose a multilevel output capability for IBIS to allow for ISI compensation.
Status: done for multilevel, ISI compensation on hold pending resolution of transmitter ISI compensation by SPI-4

All matrix element (document section) owners to provide draft input for the respective sections to Larry Barnes by November 19, 1999. (Provide input in Word 6/7 format) send to larry.barnes@lsil.com
Status: overcome by events - replaced by new action item below.

Action item: Dan Smith to provide access information for the Seagate transceiver models to the web site.
Status: carried over

Action item: Tariq to provide access information for the Adaptec transceiver models to the web site.
Status: carried over

Action item: Larry Barnes to provide access information for the LSI transceiver models to the web site.
Status: progress made but internal logistics still needs attention - carried over

Action item: Paul A. to provide web site info for the TI terminator models.
Status: done but Don Getty (donald_getty@ti.com) is the source - a pointer to Don will be placed on the web site

Jie to provide a cable media model to the web site.
Status: carried over

Action item: Rollie O'Groske to provide a plan to get a model for the transition regions.
Status: transferred to Bob Gannon - plan will be presented at the March 01 meeting

Dean to send emails to all folks with open action items on Tuesday of each week (until the action item is completed).
Status: done - action item will be retained for all meetings if any open action items exist.

Ham to post the draft minutes of the February 08 meeting after review by Dean and the approved minutes of the December meeting.

Status: done

Larry Barnes to supply component definition and a graphical representation for the backplane (should not contradict the transceiver board if possible)
Status: carried over

23.2 New action items from present meeting

Paul Aloisi to provide Don Getty contact info to J. Lohmeyer for the T10 modeling web site.
Status: new

Tariq to provide hotel info for the April meeting in Milpitas ASAP
Status: new

Paul Aloisi to contact Tariq to expedite the April meeting announcement
Status: new

Paul Aloisi to place multidrop cable assemblies on the agenda for the next meeting.
Status: new

Bob Gannon to produce matrix of transition regions and issues with each.
Status: new

24. Adjourn

The meeting adjourned at 6:00 PM