SCSI signal modeling study group (SSM) 00-254r1
August 15, 2000
Colorado Springs, CO

Subject: Approved minutes for the SSM working group on June 13-14, 2000 in Lisle, IL

This was the next meeting to address the general subject of modeling for parallel SCSI. In the absence of Dean Wallace, Paul Aloisi of TI led the meeting. Bill Ham of Compaq took these minutes. There was a good attendance from a broad spectrum of the industry. Martin O. of Molex hosted the meeting.

Last approved minutes: 00-218r1.

1. AGENDA SSM MEETING (Milpitas, CA)

2. Introductions

Paul Aloisi opened the meeting and conducted the introductions and reviewed the meeting purpose. He thanked Martin O. of Molex for hosting the meeting.

3. Attendance

Attendance at working group meetings does not count toward attendance requirements for T10 plenaries.

The following folks were present:

Name	Company	E-Mail
Paul Aloisi	TI	Paul_Aloisi@TI.com
Larry Barnes	LSI	larry.barnes@lsil.com
Bob Canniff	Hitachi	rcanniff@hcm.hitachi.com
Umesh Chandra	Seagate	umesh_chandra@notes.seagate.com
Dave Chapman	Amphenol	dave.chapman@aipc.fabrik.com
Zane Daggett	Hitachi	zdaggett@hcm.hitachi.com
Jie Fan	Madison Cable	jfan@madisoncable.com
Bob Gannon	JPM	rgannnon@jpmco.com
Bill Ham	Compaq	bill_ham@ix.netcom.com
Lee Hearn	Adaptec	lee_hearn@corp.adaptec.com
Clint Heiser	Hitachi	cheiser@hcm.hitachi.com
Thom Kreusel	HP	thom_kreusel@hp.com
Martin Ogbuokiri	Molex	mogbuokiri@molex.com
Augusto Panella	Molex	
Greg Vaupotic	Amphenol Spectra-Strip	greg.vaupotic@snet.net

4. Agenda development

The agenda shown was that used.

5. 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 the draft minutes be

approved. Motion passed unanimously. This document will be posted as document 00-218r1.

6. Action item review

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

7. 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.

8. 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 June meeting be used mainly for editing the document (assuming that significant new input is received by Larry).

9. Presentations

9.1 PIP status - Dave Chapman / Ham

Bill Ham reviewed the work done in the PIP group on Tuesday. See the minutes for the SPIP meeting for the details. There is very significant

interaction needed between the PIP and SSM groups especially in the areas of resonance and interoperability points.

9.2 Industry overview - Ham

See 00-253r0 for the details.

9.3 Multidrop cable assemblies - group

Deferred to the June meeting.

9.4 IBIS Connector Modeling Specification - Augusto Panella, Molex

Augusto (Gus) went thru a presentation that shows how to use a modified IBIS approach for application to connectors. This approach uses a matrix methodology that holds the promise of greatly decreasing the time and complexity of modeling cross talk effects. It also allow physical parsing of “sections” of the connector based on its properties and the frequency of the signals being used.

One risk is how the simulator actually uses the input file. Another risk is whether different model creators will use the same formats.

A list of short term goals for the IBIS effort was given.

Martin will put the connector IBIS model on the T10 web site.

It was the sense of the SSM group that this approach could be valuable for use with SCSI connectors. The approach might also be useful for cable media and cable assembly transition regions.

The question of the connector modeling scheme to recommend for these applications will be placed on the agenda for the August meeting.

9.5 Modeling of twisted flat cable assemblies - Umesh Chandra, Seagate

Umesh showed some results from attempts to simulate a twisted flat construction used in a complete SCSI segment.

His simulations were SPICE based and used 0.1 inch sections.

An attempt to model a simple transmitter was made. Credible agreement between the simulation results and lab measurements were shown. However, important disagreement in the detail was found.

His cross talk results suggested very strong effects (detailed data was not shown).

When losses were calculated for single isolated lines the results did not agree well at all. When neighboring lines were added much better agreement was found. This result suggests that significant losses occur due to coupling to neighboring lines. Perhaps this is a key to making lower loss cables by isolating the signals.

It was also noted that high cross talk cable tend to have higher attenuation.

9.6 Twisted flat modeling (transition region) - Bob Gannon, JPM

Bob went thru a discussion of using the Ansoft tool for twisted flat to flat using an IDC connector. The choice for modeling sections were determined to be non-optimal. Bob will go back and do the model with revised section selections.

Suggestions were made concerning how to construct the configuration to model.

Bob is expected to come back at the next meeting with revised results.

Bob still needs to supply input for the document for the transition region.

There is still no proposal concerning how to approach the round cable to connector transition region.

9.7 SPI-4 Modeling (00-227r3) - Paul Aloisi, TI

Paul went thru the 00-273r3 document for purposes of discussing the general methodology being used to arrive at a segment level signal budget. Some of the numbers used were provided by Dick Uber of Quantum (who was not present at the meeting). There was an important discussion concerning whether the numbers assumed for attenuation were even close to those presently in the SPI-3 document for attenuation.

It was pointed out that the fundamental frequency component in the launched signal is less than the pulse amplitude. Therefore the attenuation based only on pulse amplitude will understate the attenuation at the fundamental frequency. Sometimes the received pulses look like sinusoids at the fundamental frequency. To account for the error we need to know the Fourier coefficients of the launched pulse. Then a reasonable error factor can be calculated to arrive at a reasonable attenuation number for time domain observations for the special case where the received signal is a sinusoid but the launched signal is not.

Larry Barnes to create a Fourier spectrum from the following pulse: clock-like, with 1ns rise and fall times, and a 80 MHz rep rate

Paul Aloisi to provide the assumptions used to create the system budget for the SPI-3 and SPI-4. 99-196r0 and 00-239r0.

Larry Barnes to take the material in the SPI-3 and SPI-4 document listed above and figure out how to incorporate into the SSM document.

Umesh to check with Gene Milligan to determine if the units for describing the precomp specifications are consistent with the units used in SPI-3.

10. 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.

10.1 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.

10.2 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

10.3 Transceiver board: owners, 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.

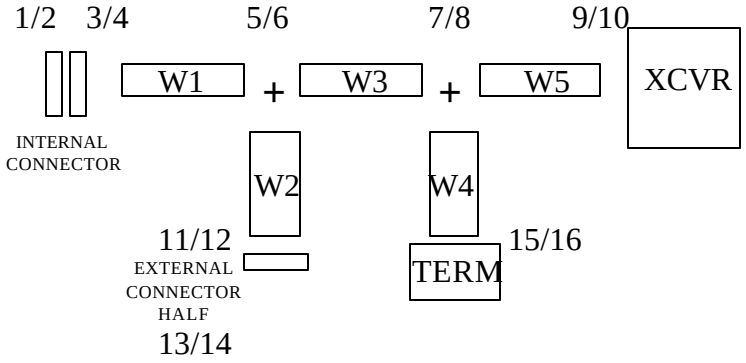

Figure 1 - Architecture of a transceiver board model (no unused connectors)

10.4 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.

10.5 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.

10.6 Uniform cable media: owner, Jie Fan, Zane Daggett

Interfaces are at the beginning of the cable assembly transition region on either end.
Model types: Spice, Maxwell matrix (also now included in IBIS-Cnn)
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.

There was considerable discussion about the way to do these models

10.7 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)

11. Simulation integration strategy

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

12. System configurations

Not discussed but reaffirmed as needed for the document

13. Data patterns

[Retained from the last minutes until transferred into the SSM document]

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
- Resonance sensitivity

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.

14. Data rate

[Retained from the last minutes until transferred into the SSM document]

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	???	???

15. Definitions:

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

16. Tools:

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

17. Document framework (Barnes)

[This section was not discussed in the meeting but is retained in the minutes until the document review has been completed for this item.]

Larry Barnes, editor of the SSM document [presently not posted], 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
3. Resources
3.2.1 Publications (Jonathan Fasig - 100%)
3.3 Tools (group - 80%)
4. DEFINITIONS, ACRONYMS, SYMBOLS, KEYWORDS, AND CONVENTIONS (group)
4.1 Definitions (20%)
4.2 Acronyms (80%)
4.3 Symbols and Abbreviations (100%)
4.4 Keywords (100%)
4.5 Conventions (100%)
4.6
5.0 General / Overview (Bill Ham - 50%)
6. Methodology
7. MODELS
7.1 General recommendations (Larry Barnes - 10%)
7.1.1 Supporting documentation
7.1.2 Behavioral models
7.1.3 Circuit Models
7.2 Cables
7.2.1 Cable media (bulk cable) (Jie Fan / Zane Daggett - 10%)
7.2.2 Transition region (Bob Gannon, Greg Vaupotic - 10%)
7.3 Connectors (Martin O. - 5%)
7.3.1 Cable connectors
7.3.2 Non-cable connectors
7.3.2.1 RLC transmission line matrix
7.4 Printed circuit boards (Matt S., Tariq A. - 30%)
7.4.1 Traces
7.4.1.1 Microstrip
7.4.1.2 Stripline
7.4.1.3 Broad coupled stripline
7.4.1.4 Offset broad coupled stripline
7.4.2 Discontinuities
7.4.2.1 Vias
7.4.2.2 Pads
7.5 Devices
7.5.1 Terminators (Paul Aloisi / Don Getty - ?)
7.5.2 Transceivers (Dean Wallace - 5%)
7.5.3 Packages (Larry Barnes - 5%)
8. STANDARD MODEL CONSTRUCTIONS
8.1 Host bus adapter / target board (Tariq / Matt S. - 70%)
8.2 Point to point cable assemblies (Dima Smolyansky - 40%)
8.3 Multidrop cable assemblies (TBD)
8.4 Backplane (Larry Barnes - 10%)
8.5 System model (group - 2%)
9. VALIDATION PROCEDURES
9. Physical measurement points (Greg Vaupotic)
9.1 Access to measurement points (Larry Barnes / Martin O.)
9.2. device connector

8.2.2 chip to board interface
9.2.3 terminator connector
9.3 Instrumentation input models (Jason Chou - 5%)
9.3.1 scope probe models
9.3.2 network analyzer models
9.3.3 test port cables
9.3.4 instrument transfer function
9.4 Use of frequency / time domain for validating elements of component models (
9.5 Distributed vs lumped resonance issues
9.6 Behavioral
9.7 Circuit
10. SIMULATION INTEGRATION STRATEGY (Dean Wallace)
10.1 System configurations
10.2 Data patterns
10.3 Data rates

18. New business

No new business was conducted.

19. Next meetings

Scheduled meetings:

August 15-16, 2000, 1:30PM to 6 PM 8/15, 9AM to 6 PM 8/16, Embassy Suites, Colorado Springs (LSI logic)

Requested meetings:

October 11-12, 2000, 1:30PM to 6PM 10/11, 9AM to 6:00PM 10/12, Santa Cruz, CA (Seagate)
December 13-14, 2000, 1:30PM to 6PM 12/13, 9AM to 6:00PM 12/14, Manchester, NH (Hitachi)

20. Action Items:

20.1 Action items from previous meetings

Status as of the June 13, 2000 meeting is shown.

Larry Barnes will hatch a BIRD at IBIS to incorporate ISI compensation as defined by SPI-4 when SPI-4 stabilizes.
Status: transformed from old action item - on hold pending SPI-4 resolution -- carried over

Action item: Dan Smith to provide access information for the Seagate transceiver models to the web site.
Status: IBIS models are intended to be made available but there is concern about the accuracy of the model in its present state – see Larry Barnes action item below -- carried over

Larry Lamers to provide access information for the Adaptec transceiver models to the web site.
Status: IBIS models now exist but there is reluctance within Adaptec to release the models to the T10 web site because of concern about the IP contained in the model, Adaptec intends to provide appropriate models after due internal consideration within Adaptec -- carried over

Larry Barnes to provide access information for the LSI transceiver models to the web site.
Status: Model is available internally within LSI Logic and will be made available to T10 web site as soon as the internal LSI web site is on line -- carried over

Jie Fan, Madison Cable to provide a cable media model to the web site.
Status: model is done and will be made available in HSPICE form -- carried over

Bob Gannon to provide a plan to get a model for the transition regions.
Status: done

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

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

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

Larry Barnes to provide information and techniques to allow generation of an IBIS model. This information will take the form of a section in the SSM document and is expected to be used by SSM folks in creating their transceiver models. This will be part of a rev of the SSM document and is expected to be placed on the T10 web site before the end of May 2000.
Status: carried over

Dean Wallace to direct an action item to address the methodology for incorporating ISI precompensation into an IBIS model.
Status: carried over

Tariq to facilitate contact between Adaptec and Bruce Manildi of Seagate to explain the nature and purpose of the IBIS modeling methodologies and its relationship to IP.

Status: overcome by events

Hitachi cable to provide cable media models to the SSM web site (per last meeting minutes).
Status: carried over

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

20.2 New action items from present meeting

Martin will put the connector IBIS model on the T10 web site.
Status: new

Paul A to send emails to all folks with open action items on Tuesday of each week (until the action item is completed).
Status: new

Paul Aloisi to contact J. Lohmeyer to determine why the pointer to Don Getty (TI stuff) as provided by Paul Aloisi months ago is not on the T10 modeling web site.
Status: new

Larry Barnes to put rev0 of SMM on the T10 web site

Paul Aloisi to put the subject of the IBIS connector model on the agenda for the August meeting

Paul Aloisi to provide the assumptions used to create the system budget for the SPI-3 and SPI-4.
Status: done 99-196r0 and 00-239r0

Larry Barnes to take the material in the SPI-3 and SPI-4 document relating to the signal budget and figure out how to incorporate into the SSM document
Status: new

Umesh to check with Gene Milligan to determine if the units for describing the precomp specifications are consistent with the units used in SPI-3
Status: new

Larry Barnes to create a Fourier spectrum from the following pulse: clock-like, with 1ns rise and fall times, and a 80 MHz rep rate.
Status: new

21. Adjourn

The meeting adjourned at 6:00 PM