

SCSI signal modeling study group (SSM)  
February 10, 2000  
Huntington Beach, CA

00-111r1

Subject: Approved minutes for the SSM working group on December 01, 1999  
in Rochester, MN

This was the next meeting to address the general subject of modeling for parallel SCSI. Jonathan Fasig of Western Digital 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. Western Digital (Jonathan Fasig) hosted the meeting.

Last approved minutes: 99-329r1.

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## 2. Introductions

Jonathan Fasig, substituting for Dean Wallace, opened the meeting and conducted the introductions and reviewed the meeting purpose. Bill Ham thanked Jonathan for hosting the meeting.

## 3. Attendance

The following folks were present:

Martin Ogbuokiri, Molex, mogbuokiri@molex.com  
Larry Barnes, LSI Logic, larry.barnes@lsil.com  
Jonathan Fasig, Western Digital, jonathan.L.Fasig@wdc.com  
Tariq Abou-Jeyab, Adaptec, tajeyab@corp.adaptec.com  
Bill Ham, Compaq, bill\_ham@ix.netcom.com  
Andrew Bishop, Quantum, andrew.bishop@quantum.com  
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Dan Smith, Seagate, daniel\_f\_smith@notes.seagate.com  
Greg Doyle, Mentor Graphics, greg-doyle@mentor.com  
Larry Stanley, Mentor Graphics, larry\_stanley@mentor.com  
Dima Smolyansky, TDA systems, dima@tdasystems.com  
Rollie O'Groske, JPM, Jit2pan3@us.ibm.com  
Jeff Rosa, Amphenol Interconnect, Jeff.rosa@aipc.fabrik.com

## 4. Agenda development

The agenda shown was that used.

## 5. Call for vice chair

It being recognized that Dean is not always available and that further administrative energy may be needed from time to time a call was made for folks interested in being vice chair of the SSM working group. This call will remain open until the next meeting at which time a permanent appointment will be made.

At this meeting only Jonathan Fasig indicated an interest. This subject will be readdressed at the next meeting but Jonathan will be acting as vice chair for this meeting.

#### 6. Approval of previous minutes

The minutes of the last meeting were reviewed and minor changes were made. Bill Ham moved and Tariq seconded that these revised minutes be approved. Motion passed unanimously.

#### 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. SSM project proposal - Ham

The SSM project was approved at the last T10 plenary. A project number will be available shortly.

#### 10. Presentations

##### 10.1 IBIS status (Larry Barnes) (10 min)

Larry gave the following presentation relating to an attempt to include the ISI and multilevel signals into IBIS:

```
=====
| Keyword: [Driver Schedule]
| Required: No
```

Description: Describes the relative model switching sequence for referenced models to produce a multi-staged driver.

Usage Rules: The [Driver schedule] keyword establishes a hierarchical order between models and should be placed under the [Model] which acts as the top-level model. The scheduled models are then referenced from the top-level model by the [Driver Schedule] keyword.

When a multi-staged buffer is modeled using the [Driver Schedule] keyword, all of its stages (including the first stage, or normal driver) have to be modeled as scheduled models.

If there is support for this feature in a simulator, the [Driver Schedule] keyword will cause it to use the [Pulldown], [Pulldown Reference], [Pullup], [Pullup Reference], [Voltage Range], [Ramp], [Rising Waveform] and [Falling Waveform] keywords from the scheduled models instead of the top-level model, according to the timing relationships described in the [Driver Schedule] keyword. Consequently, the keywords in the above list will be ignored in the top-level model. Also, all other keywords not shown in the above list will be ignored in the scheduled model(s).

However, both the top-level and the scheduled model(s) have to be complete models, i.e. all of the required keywords must be present and follow the syntactical rules.

For backwards compatibility reasons and for simulators which do not support multi-staged switching, the keywords in the above list can be used in the top-level [Model] to describe the overall characteristics of the buffer as if it was a composite model. It is not guaranteed, however, that such a top-level model will yield the same simulation results as a full multi-stage model. It is recommended that a "golden waveform" for the device consisting of a [Rising Waveform] table and a [Falling Waveform] table be supplied in the top-level model to serve as a reference for validation.

Even though some of the keywords are ignored in the scheduled model, it may still make sense in some cases to supply correct data with them. One such situation would arise when a [Model] is used both as a regular top-level model as well as a scheduled model.

The [Driver Schedule] table consists of five columns. The first column contains the model names of other models that exists in the .ibs file. The remaining four columns describe delays: Rise\_on\_dly, Rise\_off\_dly, Fall\_on\_dly, and Fall\_off\_dly. The t=0 time of each delay is the event when the simulator's internal pulse initiates a rising or falling transition. All specified delay values must be equal to or greater than 0. There are only five valid combinations in which these delay values can be defined:

- 1) Rise\_on\_dly with Fall\_on\_dly
- 2) Rise\_off\_dly with Fall\_off\_dly
- 3) Rise\_on\_dly with Rise\_off\_dly
- 4) Fall\_on\_dly with Fall\_off\_dly
- 5) All four delays defined  
(be careful about correct sequencing)

The four delay parameters have the meaning as described below. (Note that this description applies to buffer types which have both pullup and pulldown structures. For those buffer types which have only a pullup or pulldown structure, the description for the missing structure can be omitted.)

Rise\_on\_dly is the amount of time that elapses from the internal simulator pulse initiating a RISING edge to the t=0 time of the waveform or ramp that turns the I-V table of the PULLUP device ON, and the t=0 time of the waveform or ramp that turns the I-V table of the PULLDOWN device OFF (if they were not already turned ON and OFF, respectively, by another event).

Rise\_off\_dly is the amount of time that elapses from the internal simulator pulse initiating a RISING edge to the t=0 time of the waveform or ramp that turns the I-V table of the PULLUP device OFF, and the t=0 time of the waveform or ramp that turns the I-V table of the PULLDOWN device ON (if they were not already turned ON and OFF, respectively, by another event).

Fall\_on\_dly is the amount of time that elapses from the internal simulator pulse initiating a FALLING edge to the t=0 time of the waveform or ramp that turns the I-V table of the PULLDOWN device ON, and the t=0 time of the waveform or ramp that turns the I-V table of the PULLUP device OFF (if they were not already turned ON and OFF, respectively, by another event).

Fall\_off\_dly is the amount of time that elapses from the internal simulator pulse initiating a FALLING edge to the t=0 time of the waveform or ramp that turns the I-V table of the PULLDOWN device OFF, and the t=0 time of the waveform or ramp that turns the I-V table of the PULLUP device ON (if they were not already turned ON and OFF, respectively, by another event).

Note that some timing combinations may only be possible if the two halves of a complementary buffer are modeled separately as two open\_\* models.

Use 'NA' when no delay value is applicable. For each scheduled model the transition sequence must be complete, i.e., the scheduled model must return to its initial state.

No [Driver Schedule] table may reference a model which itself has within it a [Driver Schedule] keyword.

Other Notes: The added models typically consist of Open\_sink (Open\_drain) or Open\_source models to provide sequentially increased drive strengths. The added drive may be removed within the same transition for a momentary boost or during the opposite transition.

The syntax also allows for reducing the drive strength.

Note that the Rise\_on\_dly, Rise\_off\_dly, Fall\_on\_dly, Fall\_off\_dly parameters are single value parameters, so typical, minimum and maximum conditions cannot be described with them directly. In order to account for those effects, one can refer to the fastest waveform table with the delay number and then insert an appropriate amount of horizontal lead in section in those waveforms which need more delay.

Notice that the C\_comp parameter of a multi-stage buffer is defined in the top-level model. The value of C\_comp therefore includes the total capacitance of the entire buffer, including all of its stages. Since the rising and falling waveform measurements include the effects of C\_comp, each of these waveforms must be generated with the total C\_comp present, even if the various stages of the buffer are characterized individually.

Note: In a future release, the [Driver Schedule] keyword may be replaced by a newer method of specification that is consistent with some other planned extensions. However, the [Driver Schedule] syntax will continue to be supported.

-----  
[Driver Schedule]

Model_name	Rise_on_dly	Rise_off_dly	Fall_on_dly	Fall_off_dly
MODEL_OUT	0.0ns	NA	0.0ns	NA

Examples of added multi-staged transitions

M_O_SOURCE1	0.5ns	NA	0.5ns	NA
	low (high-Z) to high		high to low (high-Z)	
M_O_SOURCE2	0.5n	1.5n	NA	NA
	low to high to low		low (high-Z)	

M_O_DRAIN1	1.0n	NA	1.5n	NA
	low to high (high-Z)		high (high-Z) to low	
M_O_DRAIN2	NA	NA	1.5n	2.0n
	high (high-Z)		high to low to high	

Larry noted that it may require inclusion of certain logic paths that define the signals for ISI compensation in the modeling methodology. This will be a new capability for any present tool since it for

## 10.2 Network parameters annex proposal (Larry Barnes) (10 min)

Larry offered the following material that explains the situation with network parameters. This material will become an informative annex in the document.

### 10.2.1 Networks

#### 10.2.1.1 N-port networks

N-port networks relate the voltages and currents at various points in a transmission network through the use of impedance or admittance matrices of circuit theory. They describe a matrix equivalent of the network. A port is the term used to replace the more cumbersome phrase “two-terminal pair”. The ports in Figure 10-1 may be any transmission line or equivalent propagating a single mode. Multiple propagation modes need not be considered in the SCSI environment, since multiple propagation modes are only supported in waveguides. A terminal plane,  $t_n$ , is defined along with the incident and reflected wave’s equivalent voltages and currents. At the  $n$ th terminal plane the total voltage and current is given by

$$V_n = V_n^+ + V_n^-$$

$$I_n = I_n^+ + I_n^-$$

**Equation 10-1 N-port voltage and current**

when  $z=0$ .

These voltages and currents are then related through an impedance  $[Z]$  matrix, Equation 10-2, and admittance  $[Y]$  matrix, for the N-port network.

$$\begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ V_N \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} & \cdots & Z_{1N} \\ Z_{21} & Z_{22} & \cdots & \cdots & Z_{2N} \\ Z_{31} & \vdots & & & \vdots \\ \vdots & \vdots & \vdots & & \vdots \\ Z_{N1} & Z_{N2} & \cdots & \cdots & Z_{NN} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ \vdots \\ I_N \end{bmatrix}$$

**Equation 10-2 N-port impedance matrix**

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ \vdots \\ I_N \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} & \cdots & Y_{1N} \\ Y_{21} & Y_{22} & \cdots & \cdots & Y_{2N} \\ Y_{31} & \vdots & & & \vdots \\ \vdots & \vdots & & & \vdots \\ Y_{N1} & Y_{N2} & \cdots & \cdots & Y_{NN} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ \vdots \\ V_N \end{bmatrix}$$

**Equation 10-3 N-port admittance matrix**

In general the impedance and admittance matrices are symmetric. For example,

$$Z_{ij} = Z_{ji}$$

**Figure 10-1 Arbitrary N-port network**

In general it is difficult to define voltages and currents for non-TEM modes of propagation. Fortunately SCSI interconnects presently only support TEM and quasi-TEM modes of propagation. A practical problem exists when trying to measure voltages and currents at high frequencies because of the relationships between magnitude and phase of the signal. The scattering matrix [S] solves this problem. The scattering parameters relate the incident and reflected voltage waves at the ports, Equation 10-4, and does not necessarily need be symmetric. They can be directly obtained with a vector network analyzer. Other N-port matrix parameters are easily obtained through conversion.

$$\begin{bmatrix} V_1^- \\ V_2^- \\ V_3^- \\ \vdots \\ V_N^- \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & S_{13} & \cdots & S_{1N} \\ S_{21} & S_{22} & \cdots & \cdots & S_{2N} \\ S_{31} & \vdots & & & \vdots \\ \vdots & \vdots & & & \vdots \\ S_{N1} & S_{N2} & \cdots & \cdots & S_{NN} \end{bmatrix} \begin{bmatrix} V_1^+ \\ V_2^+ \\ V_3^+ \\ \vdots \\ V_N^+ \end{bmatrix}$$

**Equation 10-4 N-port scattering matrix**

An n-port network can be characterized by Y, Z, and S parameters, but in general most networks consist of a cascade of two-port networks. The one main exception is the place a stub attaches to the bus.

### 10.2.1.1.1 Conversion between two-port network parameters

<b>S</b>		<b>Z</b>	<b>Y</b>	<b>ABCD</b>
$S_{11}$	$S_{11}$	$\frac{(Z_{11} - Z_0)(Z_{22} + Z_0) - Z_{12}Z_{21}}{\Delta Z}$	$\frac{(Y_0 - Y_{11})(Y_0 + Y_{11}) + Y_{12}Y_{21}}{\Delta Y}$	$\frac{A + B/Z_0 - CZ_0 - D}{A + B/Z_0 + CZ_0 + D}$
$S_{12}$	$S_{12}$	$\frac{2Z_{12}Z_0}{\Delta Z}$	$\frac{-2Y_{12}Y_0}{\Delta Y}$	$\frac{2(AD - BC)}{A + B/Z_0 + CZ_0 + D}$
$S_{21}$	$S_{21}$	$\frac{2Z_{21}Z_0}{\Delta Z}$	$\frac{-2Y_{12}Y_0}{\Delta Y}$	$\frac{2}{A + B/Z_0 + CZ_0 + D}$
$S_{22}$	$S_{22}$	$\frac{(Z_{11} + Z_0)(Z_{22} - Z_0) - Z_{12}Z_{21}}{\Delta Z}$	$\frac{(Y_0 + Y_{11})(Y_0 - Y_{22}) + Y_{12}Y_{21}}{\Delta Y}$	$\frac{-A + B/Z_0 - CZ_0 + D}{A + B/Z_0 + CZ_0 + D}$
$Z_{11}$	$Z_0 \frac{(1 + S_{11})(1 - S_{22}) + S_{12}S_{21}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$Z_{11}$	$\frac{Y_{22}}{ Y }$	$\frac{A}{C}$
$Z_{12}$	$Z_0 \frac{2S_{12}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$Z_{12}$	$\frac{-Y_{12}}{ Y }$	$\frac{AD - BC}{C}$
$Z_{21}$	$Z_0 \frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$Z_{21}$	$\frac{-Y_{21}}{ Y }$	$\frac{1}{C}$
$Z_{22}$	$Z_0 \frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$Z_{22}$	$\frac{Y_{11}}{ Y }$	$\frac{D}{C}$
$Y_{11}$	$Y_0 \frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{(1 + S_{11})(1 + S_{22}) - S_{12}S_{21}}$	$\frac{Z_{22}}{ Z }$	$Y_{11}$	$\frac{D}{B}$
$Y_{12}$	$Z_0 \frac{2S_{12}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$\frac{-Z_{12}}{ Z }$	$Y_{12}$	$\frac{BC - AD}{B}$
$Y_{21}$	$Z_0 \frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$\frac{-Z_{21}}{ Z }$	$Y_{21}$	$\frac{-1}{B}$
$Y_{22}$	$Z_0 \frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{(1 - S_{11})(1 - S_{22}) - S_{12}S_{21}}$	$\frac{Z_{11}}{ Z }$	$Y_{22}$	$\frac{A}{B}$
$A$	$\frac{(1 + S_{11})(1 - S_{22}) + S_{12}S_{21}}{2S_{21}}$	$\frac{Z_{11}}{Z_{21}}$	$\frac{-Y_{22}}{Y_{21}}$	$A$
$B$	$Z_0 \frac{(1 + S_{11})(1 + S_{22}) - S_{12}S_{21}}{2S_{21}}$	$\frac{ Z }{Z_{21}}$	$\frac{-1}{Y_{21}}$	$B$
$C$	$\frac{1}{Z_0} \frac{(1 - S_{11})(1 - S_{22}) + S_{12}S_{21}}{2S_{21}}$	$\frac{1}{Z_{21}}$	$\frac{- Y }{Y_{21}}$	$C$
$D$	$\frac{(1 - S_{11})(1 + S_{22}) + S_{12}S_{21}}{2S_{21}}$	$\frac{Z_{22}}{Z_{21}}$	$\frac{-Y_{11}}{Y_{21}}$	$D$

$$|Z| = Z_{11}Z_{22} - Z_{12}Z_{21}$$

$$|Y| = Y_{11}Y_{22} - Y_{12}Y_{21}$$

$$\Delta Z = (Z_{11} + Z_0)(Z_{22} + Z_0) - Z_{12}Z_{21} \quad \Delta Y = (Y_{11} + Y_0)(Y_{22} + Y_0) - Y_{12}Y_{21}$$

$$Y_0 = 1/Z_0$$

### 10.3 Methodology for extracting model parameters from TDR data (Dima Smolyansky - TDA systems) (1 hour)

A major presentation by TDA described a methodology for extracting RLGC parameters from actual passive SCSI interconnect assemblies. This presentation is available on the T10 web site as it is too large to fit in these minutes.

### 10.4 Tool Presentation (Mentor Graphics) (1 hour)

This presentation described some tools available from Mentor Graphics. This presentation will be available on the T10 web site as it is too large to fit in these minutes.

### 10.5 Modeled cable parameters (Greg Vaupotic) (10 min)

Greg presented a set of data where used a physical description of a cable media with inputs consisting of geometry, dielectric constant, loss tangent, and metals conductivity with the Ansoft Maxwell EX2D (inexpensive) field solver packages. He extracted inductance, capacitance, resistance, conductance (dielectric) parameters (as a function of frequency) to produce a simulated attenuation result that closely matched the experimental results.

This stands in contrast to a simpler modeling technique where the dielectric loss (conductance) and inductance were represented as square root of frequency dependencies.

The excellent agreement between the modeling results and the first principles simulation was better than expected. This result shows that it may be possible to get reliable results from interconnect simulations even for fairly sophisticated behavior.

### 10.6 Draft of proposal for modeling passive interconnects (Jonathan Fasig) (30 min)

In satisfaction of an action item from the last meeting Jonathan produced a document containing a proposal for a set of requirements on models. These requirements will be placed in the document in a section to be determined.

This work places requirements on the form and content of models so that they can be more easily used with different tools.

The text of this proposal is available on the T10 web site.

## 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.

The following people agreed to attempt to make their transceiver models available:

Action item: Dan Smith to provide Seagate transceiver models to the web site.

Action item: Tariq to provide Adaptec transceiver models to the web site.

Action item: Larry Barnes to provide LSI transceiver models to the web site.

### 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

The following people agreed to attempt to make their terminator models available:

Action item: Paul A. to provide web site info for the TI terminator models.

### 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

Further detail was provided by Matt in this area as transcribed below:

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.

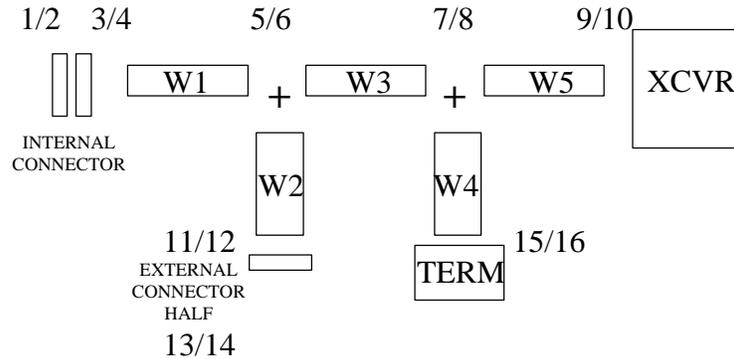


Figure 2 - Architecture of a transceiver board model (no unused connectors)

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

A source for connector models is in place at Molex and the information guiding to this site will be given to J. Lohmeyer.

Action item: Martin to provide models to the web site for SCA-2, HD68, and VHDCI

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 multiline

Although there was no new specific content for this matrix element it was noted that the parameter extraction methods described by Dima in his presentation may be excellent for extracting RGC for the cable transition region.

Action item: Rollie O’Groske to provide a plan to get a model for the transition regions.

#### 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

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

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

Not discussed but reaffirmed as needed for the document

#### 15. Data rate

Not discussed, but reaffirmed as needed for the document

#### 16. Definitions:

A comprehensive set of definitions has been created in the draft document.

SPICE, IBIS, model, validation, cable assembly, transition region, verification, accuracy, HDL, VHDL, ASM, ASCM, Verilog, PCB, backplane, microstrip, stripline, via, discontinuity, cline, lossy, lossless, uniform, attenuation, gain, differential, planar, skin effect, dielectric constant, dielectric loss, loss tangent, conductivity, resistivity, convergence, phase velocity, group velocity, group delay, phase delay, multiline, single line, SLM, MLM, single ended, balanced, unbalanced, mode, element, RLGC, netlist, admittance, transmittance, coupling(K), matrix, S parameters, scattering matrix, ABCD, Y parameters, two-port parameters, and others to be suggested later.

#### 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.

#### 18. Tools:

This topic refers to identification and properties of specific modeling tools. It was not discussed at this meeting.

##### 18.1 Document framework (Barnes)

Larry Barnes, editor of the SSM document, 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)
2. REFERENCES(Jonathan Fasig)
  - 2.1 Approved references
    - 2.1.1 References under development
  - 2.2 Resources
    - 2.2.1 Publications
    - 2.2.2 Online bookstores & publishers
    - 2.2.3 Other online resources
  - 2.3 Tools
3. DEFINITIONS, ACRONYMS, SYMBOLS, KEYWORDS, AND CONVENTIONS (group)
  - 3.1 Definitions
  - 3.2 Acronyms
  - 3.3 Symbols and Abbreviations
  - 3.4 Keywords
  - 3.5 Conventions
4. GENERAL
  - 4.1 Overview (Bill Ham)
5. METHODOLOGIES
6. MODELS
  - 6.1 General recommendations (Larry Barnes)
    - 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)
    - 6.2.2 Transition region (Bob Gannon, Greg Vaupotic)
  - 6.3 Connectors (Martin O.)
    - 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.)
    - 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)
    - 6.5.3 Packages
7. STANDARD MODEL CONSTRUCTIONS
  - 7.1 Host bus adapter / target board (Tariq / Matt S.)
  - 7.2 Point to point / multidrop (TBD)
  - 7.3 Cable assemblies (Dima Smolyansky)
  - 7.4 Backplane (Larry Barnes)
  - 7.5 System model (TBD)
8. MEASUREMENT AND VALIDATION
  - 8.1 Access to measurement points
  - 8.2 Physical measurement points (Greg Vaupotic)
  - 8.3 Behavioral
  - 8.4 Circuit
9. SIMULATION INTEGRATION STRATEGY (Dean Wallace)
  - 9.1 System configurations

- 9.2 Data patterns
- 9.3 Data rates

## 19. New business

No new business was conducted.

## 20. Next meetings

### Scheduled meetings:

Feb 08, 2000 Huntington Beach, CA (Qlogic) 9AM to 5PM  
Mar 01, 2000 Manchester, NH (Hitachi) 9AM to 5PM

### Future requested meetings:

April 12, 2000 Monterey, CA (Adaptec) 9AM to 5PM

## 21. Action Items:

### 21.1 Action items from previous meetings

Status as of the October 28, 1999 meeting is shown.

Martin O. to supply an RGL transmission line matrix (circuit type of specification) for VHDCI, SCA-2, and HD68 connectors.  
Status: done except for HD68

Larry Barnes to do an overview presentation of the IBIS transceiver model specification.  
Status: carried over - handouts provided but presentation still needed

Ham to post the draft minutes of the October 01 meeting after review by Dean  
Status: done

Larry Barnes to propose a multilevel output capability for IBIS to allow for ISI compensation.  
Status: done for multilevel, ongoing for ISI compensation

Jonathan Fasig to draft a proposal for model requirements for passive interconnects.  
Status: done

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: input received from Jonathan F and Don Getty - others have not yet responded - action item carried over to next meeting.

Dean Wallace to contact Bob Gannon to determine how he wishes to proceed with the cable assembly transition region.  
Status: Done by Ham - Bob will continue in this role (along with Greg V.)

## 21.2 New action items from present meeting

Larry Barnes to contact John Lohmeyer to expedite the creation of the SCSI modeling web site.  
Status: new

Ham to post the draft minutes of the December 01 meeting after review by Dean and the approved minutes of the October meeting.  
Status: new

Action item: Dan Smith to provide Seagate transceiver models to the web site.  
Status: new

Action item: Tariq to provide Adaptec transceiver models to the web site.  
Status: new

Action item: Larry Barnes to provide LSI transceiver models to the web site.  
Status: new

Action item: Paul A. to provide web site info for the TI terminator models.  
Status: new

Action item: Rollie O'Groske to provide a plan to get a model for the transition regions.  
Status: new

## 22. Adjourn

The meeting adjourned at 6:00 PM