IBIS Open Forum Minutes

Meeting Date: **May 12, 2010**
Meeting Location: **European IBIS Summit with SPI 2010, Hildesheim, Germany**

VOTING MEMBERS AND 2010 PARTICIPANTS

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ARM	(Nirav Patel)
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Hitachi ULSI Systems	Yutaka Uematsu*
Huawei Technologies	(Jinjun Li)
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Intel Corporation	Michael Mirmak, Myoung (Joon) Choi, Vishram Pandit, Richard Mellitz
IO Methodology	Lance Wang*
LSI	Brian Burdick
Mentor Graphics	Arpad Muranyi, Neil Fernandes, Zhen Mu
Micron Technology	Randy Wolff
Nokia Siemens Networks GmbH	Eckhard Lenski*
Samtec	(Corey Kimble)
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Sigrity	Brad Brim, Kumar Keshavan, Srdjan Djordjevic*, Ben Franklin*
Synopsys	Ted Mido
Teraspeed Consulting Group	Bob Ross*, Tom Dagostino
Toshiba	(Yasumasa Kondo)
Xilinx	Mike Jenkins
ZTE	(Huang Min)
Zuken	Michael Schaeder*, Ralf Bruening*

OTHER PARTICIPANTS IN 2010

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Altera	John Oh, Hui Fu
Avago	Razi Kaw
Bosch Car Multimedia	Rene Steinberg*, Patric Kessler*
Broadcom	Mohammad Ali
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Politecnico di Torino	Igor Stievano*, Stefano Grivet-Talocia*, Piero Triverio*, Flavio Canavero*
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Siemens, AG.	Manfred Maurer*, Michael Flint*
Simberian	Yuriy Shlepnev
Span Systems Corporation	Vidya (Viddy) Amirapu
Summit Computer Systems	Bob Davis
Tabula	David Banas
TechAmerica	(Chris Denham)
Texas Instruments	Bonnie Baker
Independent	AbdulRahman (Abbey) Rafiq, Robert Badal

In the list above, attendees at the meeting are indicated by *. Principal members or other active members who have not attended are in parentheses. Participants who no longer are in the organization are in square brackets.

UPCOMING MEETINGS

The bridge numbers for future IBIS teleconferences are as follows:

Date	Meeting Number	Meeting Password
May 21, 2010	205 608 932	IBIS

For teleconference dial-in information, use the password at the following website:

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NOTE: "AR" = Action Required.

WELCOME AND INTRODUCTIONS

The IBIS Open Forum Summit was held at the Van der Valk Hotel, Hildesheim, Germany following the IEEE Workshop on Signal Propagation on Interconnects (SPI 2010). About 22 people representing 14 organizations attended.

The notes below capture some of the content and discussions. The meeting presentations and other documents are available at:

http://www.eda-stds.org/ibis/summits/may10/

Ralf Bruening welcomed everyone and thanked the two US IBIS officers for attending. He also thanked Professor Hartmut Grabinski for the opportunity to hold the IBIS meeting in conjunction with SPI 2010. It is a win-win situation for both meetings and with several people attending both meetings.

The following companies are sharing the cost of the event as co-sponsors: Agilent Technologies, Mentor Graphics, Sigrity, Sintecs, and Zuken.

Bob Ross thanked Ralf for the arrangements and welcomed the attendees. He asked people in the room to briefly introduce themselves. Bob asked how many people were model makers, EDA software developers, and model consumers. He stated that the agenda first dealt with standard IBIS modeling issues, then M(pi)log extensions for power integrity, quality of tabulated S-parameters, and then concluding with several IBIS-AMI presentations. Bob noted that several presenters were also presenters at the SPI 2010 meeting.

IBIS ACTIVITIES

Bob Ross, Teraspeed Consulting Group, USA

Bob showed the list of officers and pointed out that Bob, Lance Wang and Anders Ekholm were present. Bob also showed the committees. He then gave a few details on additions or features on the two recent parsers: ibischk5 (AMI extension and error numbers) and tschk2 (conversions between Touchstone 1.0 and 2.0). Bob indicated that the next presentation would provide a broader coverage of IBIS activities while discussing quality issues.

Current and future projects include:

- IBIS Version 5.1 with AMI improvements and related ibischk5 bug fixes and improvements
- Touchstone Version 2.1 with sparse matrix mapping and a binary format and related tschk2
- IBIS Interconnect Subcircuit Spice (IBIS-ISS)
- Model Connection Protocol (MCP)
- Quality group correlation specification

Bob also thanked Ralf Bruening and Eckhard Lenski for handling the European IBIS Summit arrangements for many years.

IBIS MODEL VERIICATION

Hans Klos, Sintecs BV, The Netherlands

Hans indicated that his company has been involved with IBIS model production and checking for many years. Models are checked with five steps:

- IBIS golden parser
- Graphical inspection
- IBIS quality checks
- Simulation with standard test load
- Comparisons with measured results

Hans also showed the Quality Specification quality levels.

Non-monotonic waveforms were illustrated as part of the graphical inspection, but the I-V tables could be combined to make them monotonic. Clamping also needs to be represented correctly. Hans noted that C_comp values are not checked by ibischk5. If the values are too large, the simulations will not capture the faster edges.

Full model verification can take a lot of time when using the Quality Specification spreadsheet for a large number of models. One device had 300 different buffer models and could take weeks to check everything with the data sheet and test loads.

Hans introduced IBIS AMI for analyzing SERDES channels, but indicated that no verification can be done. He briefly mentioned checking other models including Touchstone, ICM and their related parsers. He also commented on the separate package model format within IBIS and the EBD formats and cited their advantages.

Hans concluded that verification is needed for accurate SI analysis and different types of models are available. Detailed verification of IBIS models takes time, and automation is needed for accurate and fast model verification.

A question was asked related to the currents in clamping diodes or ESD diodes. The data sheet might be used for finding the maximum currents.

MORE ON C_COMP: HOW TO REPRESENT C_COMP IN IBIS BUFFER MODEL

Lance Wang, IO Methodology, USA

Lance stated that the die C_comp value can influence simulation accuracy, especially at higher frequencies. He reviewed the time domain (ramp up and ramp down) and frequency domain (resonant circuit) methods of extracting C_comp from previous presentations. He favors a frequency domain method.

The C_comp values are different for driving and non-driving modes. In non-driving mode, the C_comp values are relatively constant with frequency since they are mostly impacted by the clamps. However, for driving mode, the C_comp values do change with frequency. Also, the

buffer state (high or low) is a factor.

Lance suggested that the actual ramp values of the buffer be used to select an optimal frequency for extraction of C_comp based on Foutput = 1 / (Rising_dt + Falling_dt). The extraction would be done using the .ac command in Spice. Lance showed such an extraction over several output voltages and two frequencies. He suggested that the best values were obtained at the mid-voltage Vdd/2. The higher frequency extraction showed a lower C_comp value. This was validated with some test circuits.

Lance also concluded that C_comp to global GND is not as accurate as specifying the parts of C_comp_*** for the various contributions, but not all simulators may handle this. He suggested picking the C_comp values depending on the applications. C_comp to GND is ok for non-driving cases, but it is better to have C_comp_*** for driving applications.

In response to a question concerning which C_comp value to use, Lance suggested having three C_comp values: one for receiving, one for driving and an average value. Another compromise would be to use the Vdd/2 average value.

Also, he responded that C_comp values will not change significantly up to 200 MHz, but at higher frequencies such as at a data rate of 6.25 Gbps, a difference of 0.1pF can influence the results.

IBIS [DRIVER SCHEDULE] MODELING

Eckhard Lenski, Nokia Siemens Networks, Germany

Eckhard reviewed the main blocks for driver schedule operation: top-level model tables, the driver-schedule models for timing, and the scheduled models and their tables. He illustrated their operation.

Eckhard continued with three examples for modeling pre-emphasis behavior. The first example contained two Open-sink models. Four static levels existed for Low-Pre, Low, High, and High-Pre. The second example showed a pullup/pulldown and individual Open-sink and Open-source boost models. The third example started with a pullup/pulldown and a boost model with pullup and pulldown tables. All examples had four static levels and correct pre-emphasis switching in the time-domain, but the third example used inverse currents.

For checking these models, Eckhard stated that ibischk5 only checks the individual models. While load lines can be used to check static levels, a golden waveform is needed for checking the dynamic behavior.

Eckhard also showed that the eye diagram voltage opening simulations are sensitive by as much as 50% to actual package model values for a particular differential driver/receiver measurement.

ENHANCED M(PI)LOG MODELS FOR POWER INTEGRITY ANALYSIS: MODELING FROM SIMULATION AND MEASUREMENT, IBIS DATA EXTRACTION, CROSSVALIDATION

Antonio Girardi*, Igor Stievano**, Roberto Izzi*, T. Lessio*, Flavio Canavero**, Ivan Maio**, and

Luca Rigazio**; *Micron(Numonyx) and **Politecnico di Torino, Italy

Igor Stievano initially showed the background of the European project, MOCHA (Modeling and Characterization) for SiP (Signal and Power Integrity Analysis). Its goals are to develop reliable modeling and simulation solutions for SiP design verification. The M(PI)log model is used to describe the port behavior mathematically regardless of the structure of the model.

The project succeeded in providing an improved response for an eye-diagram with 2.5% error compared to standard IBIS model simulation of 9.5%. The M(PI)log Version 5.3 provides a step-by-step modeling procedure and even has an IBIS model extraction option based on the estimated model. Igor presented some comparisons. The C_comp values were almost identical, and the I-V table data were overlaying. The V-t comparison of M(PI)log compared with measurement. The IBIS model was not compared under the same conditions.

Several questions were raised. Igor stated that the min and max models could be created by fitting the algorithmic functions. Pre-emphasis has been modeled by M(PI)log. The fixture values shown in the comparison were included in the model.

QUALIFICATION OF TABULATED SCATTERING PARAMETERS

Stefano Grivet-Talocio, Politecnico di Torino and IdemWorks, Italy

Stefano stated that although S-parameters are widely used, they still need to be checked for correctness. Lumped elements can be described by real rational functions. For tabulated data, the impulse response can be found by the inverse discrete Fourier transform or by fitting a model and performing an analytical Fourier or Laplace inversion.

However, for both methods, the greatest problem is resolution or sampling rate. This could create problems with causality and passivity of the S-parameters. A simple view of passivity is that a reflection coefficient for a one-port model must not exceed 1 at all frequencies. Otherwise, the signal becomes unbounded with multiple reflections. However, if the violation is very small (such as 1.000001) then this would not normally be a problem. The mathematics is more complicated for matrices, but singular violations can still be checked at all frequencies. Causality is necessary for passivity.

There are several sources for passivity violations. For measured data, this can be due to calibration and de-embedding, human mistakes, and noise. Data from simulations can also have errors from poor meshing, inaccurate solvers, bad models or assumptions on material properties, poor data post processing algorithms, human mistakes, and combining results from two solvers. A very small violation (such as 1.000001) should not cause problems. Some other problems can be fixed, and Stefano illustrated several cases.

Causality can be formally defined in the time domain as no response prior to the input, and in the frequency domain by the Kramers-Kronig relationships. In the frequency domain, the Hilbert transform can be used. But the reconstruction is difficult because of truncation errors and discretization errors. Truncation error can be reduced.

Causality violations can occur for the same reasons as passivity violations. If non-casual, the model can be fitted with stable poles. For large causality violations, the accuracy will be sacrificed, even with a large number of poles. Stefano illustrated under-sampling as another source for causality violations.

Stefano concluded that tabulated S-parameter data may hide serious issues of passivity violations, causality violations, and insufficient sampling. Any of these issues can lead to simulation problems.

Stefano confirmed in response to a question that the polar display, counter clock-wise phase rotation versus frequency would indicate a causality violation.

IBIS-AMI AND MODELING RECOMMENDATIONS

Kumar Keshavan and Ken Willis, Sigrity, USA

(Presented by Srdjan Djordjevic, Sigrity, Germany)

Srdjan stated that IBIS-AMI is not required for all SERDES applications such as when fixed pre-emphasis is used. But it is required when adaptive filtering is done by the TX or RX.

Srdjan introduced IBIS-AMI modeling. An IBIS-AMI model consists of three parts: A normal IBIS file, the IBIS-AMI file and the .dll file containing the algorithmic content. The three components of an analysis path are the TX algorithmic part, the analog channel portion, and the RX algorithmic part. These parts are decoupled by assuming a high impedance connection between them. Tap terminology was illustrated. The data flow consists of AMI_INIT (impulse response), AMI_GetWave (equalized waveform and clock ticks) and AMI_Close (free memory).

Srdjan provided some general recommendations. Treat the parasitics as part of the impulse response. Keep it simple and use AMI_Init to modify the impulse response. Only if needed, use AMI_GetWave to modify the raw waveforms. Only limited statistical analysis is possible such as for post processing time domain data.

Ibischk5 should be used for checking the .ibs and .ami files for vendor interchangeability.

Srdjan then showed some examples of a feed forward equalizer (FFE) block and a decision feedback equalizer (DFE) block and an advanced DFE block.

Srdjan responded to a question that the impulse response could be created by using a normal IBIS file and a customer-specific channel/transmission line. Also, the DFE and FFE blocks are modeled in the compiled .dll.

MATLAB CO-SIMULATION FOR IBIS-AMI MODELS

Danil Kirsanov, Ansys, USA

Danil gave a brief overview by defining that the compiled library (.dll for Windows) is controlled by AMI_Init(), AMI_Getwave() and AMI_Close(). The parameter (.ami) file contains parameters in tree structure syntax. The IBIS file (.ibs) specifies which libraries to use.

Danil stated that Matlab is a perfect tool for prototyping/developing/verifying AMI models, because these models are often implemented with high-level signal processing algorithms. He gave some advantages for using Matlab and stated that models are much easier to develop and debug than with C++. The speed is only about 10-15% slower. Intellectual property is still preserved with compiled code accessed through proxy libraries to exchange data with the Matlab engine. Danil discussed and showed some of the details in this implementation.

Anders Ekholm raised the concern that the method required extra files and that the compiled MatLab code might work only for MatLab with the same version number. No MatLab license is needed, but different compiled libraries might be needed. Danil was not aware of a MatLab to C++ compiler which could be an option.

AUTOMATING AMI MODEL-GENERATION USING ESL (ELECTRONIC-SYSTEM-LEVEL) DESIGN FLOW

Amolak Badesha*, Jose Luis Pino*, Manuel Luschas, and Antonis Orphanou**, *Agilent Technologies and **NetLogic Microsystems, USA

To introduce the topic, Amolak showed the relationships between the SERDES vendor for creating the AMI model, the EDA vendor for providing the simulator, and the system company for processing the model.

As a barrier, AMI-Model generation takes considerable time and resources. Models may take up to 18 months and come late and be useful only for validation, not design. Amolak discussed several challenges related to converting the algorithmic design code into the AMI format.

A solution to speed up the process is to use a top-down electronic-system-level (ESL) design methodology to automate code generation. Amolak illustrated the flow and process with several steps: the FIR/IIR filter - Unity Gain - Blind FFE blocks define the TX path, and the FIR filter needs a high sampling rate for accuracy. The blind FFE code is brought into a visual interface to be customized in MatLab or C++. Then, the .ami file parameters can be entered with another interface. All the code modules can be generated automatically. Amolak showed an example for a particular channel.

This process saves time and starts with basic building blocks such as FIR/IIR filters, FFE, DFE, CDR blocks, etc. These blocks are easily customized by C++ or MatLab code.

In response to questions, Amolak stated that process variation can be done by creating multiple .dll's for different corners and with different .ami parameters. He responded that 8b-10b decoding for an LTI model needs both AMI_Init and AMI_GetWave.

CONCLUDING REMARKS

Ralf Bruening said that this was a successful meeting and thanked everyone for coming to Hildesheim.

Bob Ross thanked the sponsors and the presenters for making this a big success. He thanked Ralf for his work coordinating with Professor Grabinski and the SPI 2010 committee. The meeting finished ahead of schedule and there was time to chat.

The next IBIS Summit is at the Design Automation Conference in June, and several other summits are being planned in Asia in November.

NEXT MEETING

The next IBIS Open Forum teleconference will be held May 21, 2010 from 8:00 to 10:00 AM US Pacific Standard Time.

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NOTES

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This meeting was conducted in accordance with the GEIA Legal Guides and GEIA Manual of

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In the body, for the IBIS Users' Group Reflector:
subscribe ibis-users <your e-mail address>

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ibis-request@eda.org

To join, change, or drop from either or both:
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IBIS Users' Group Reflector (ibis-users@eda.org)
State your request.

ibis-info@eda.org

To obtain general information about IBIS, to ask specific questions for individual response, and to inquire about joining the EIA-IBIS Open Forum as a full Member.

ibis@eda.org

To send a message to the general IBIS Open Forum Reflector. This is used mostly for IBIS Standardization business and future IBIS technical enhancements. Job posting information is not permitted.

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To send a message to the IBIS Users' Group Reflector. This is used mostly for IBIS clarification, current modeling issues, and general user concerns. Job posting information is not permitted.

ibis-bug@eda.org

To report ibischk parser BUGs as well as tschk2 parser BUGs. The BUG Report Form for ibischk resides along with reported BUGs at:

http://www.eda.org/ibis/bugs/ibischk/
http://www.eda.org/ibis/bugs/ibischk/bugform.txt

The BUG Report Form for tschk2 resides along with reported BUGs at:

http://www.eda.org/ibis/tschk_bugs/
http://www.eda.org/ibis/tschk_bugs/bugform.txt

icm-bug@eda.org

To report icmchk1 parser BUGs. The BUG Report Form resides along with reported BUGs at:

http://www.eda.org/ibis/icm_bugs/
http://www.eda.org/ibis/icm_bugs/icm_bugform.txt

To report s2ibis, s2ibis2 and s2iplt bugs, use the Bug Report Forms which reside at:

http://www.eda.org/ibis/bugs/s2ibis/bugs2i.txt
http://www.eda.org/ibis/bugs/s2ibis2/bugs2i2.txt
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Information on IBIS technical contents, IBIS participants and actual IBIS models are available on the IBIS Home page:

http://www.eigroup.org/ibis/ibis.htm

Check the IBIS file directory on eda.org for more information on previous discussions and results:

http://www.eda.org/ibis/directory.html

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IBIS CURRENT MEMBER VOTING STATUS

I/O Buffer Information Specification Committee (IBIS)

Organization	Interest Category	Standards Ballot Voting Status	March 12, 2010	April 2, 2010	April 23, 2010	May 12, 2010
Actel	Producer	Inactive	-	-	-	-
Advanced Micro Devices	Producer	Active	-	X	X	-
Agilent Technologies	User	Active	-	-	X	X
Ansys	User	Inactive	-	-	-	X
Apple Computer	User	Inactive	-	-	-	-
Applied Simulation Technology	User	Inactive	-	-	-	-
ARM	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	X	X	X	-
Cisco Systems	User	Active	X	X	X	-
Ericsson	Producer	Active	X	X	X	X
Freescale	Producer	Inactive	-	-	-	-
Green Streak Programs	General Interest	Inactive	-	-	-	-
Huawei Technologies	Producer	Inactive	-	-	-	-
Hitachi ULSI Systems	Producer	Inactive	-	-	-	X
IBM	Producer	Active	X	-	X	-
Infineon Technologies AG	Producer	Inactive	-	-	-	-
Intel Corp.	Producer	Inactive	-	-	X	-
IO Methodology	User	Active	X	X	X	X
LSI	Producer	Active	X	X	X	-
Mentor Graphics	User	Active	X	X	X	-
Micron Technology	Producer	Active	X	X	X	-
Nokia Siemens Networks	Producer	Active	X	-	X	-
Samtec	Producer	Inactive	-	-	-	-
Signal Integrity Software	User	Active	X	X	X	-
Sigrity	User	Inactive	-	-	-	X
Synopsys	User	Inactive	-	-	-	-
Teraspeed Consulting	General Interest	Active	X	X	X	X
Toshiba	Producer	Inactive	-	-	-	-
Xilinx	Producer	Inactive	-	-	-	-
ZTE	User	Inactive	-	-	-	-
Zuken	User	Inactive	-	-	-	X

CRITERIA FOR MEMBER IN GOOD STANDING:

- MUST ATTEND TWO CONSECUTIVE MEETINGS TO ESTABLISH VOTING MEMBERSHIP
- MEMBERSHIP DUES CURRENT
- MUST NOT MISS TWO CONSECUTIVE MEETINGS

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