IBIS Open Forum Minutes

Meeting Date: November 8, 2019
Meeting Location: Tokyo, Japan

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Zuiki	Kon Kou*

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
November 22, 2019	624 227 121	IBISfriday11

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

http://tinyurl.com/IBISfriday

All teleconference meetings are 8:00 a.m. to 9:55 a.m. US Pacific Time. Meeting agendas are typically distributed seven days before each Open Forum. Minutes are typically distributed within seven days of the corresponding meeting.

NOTE: "AR" = Action Required.

OFFICIAL OPENING

The Asian IBIS Summit took place on Friday, November 8, 2019 at the Akihabara UDX building in Tokyo. About 134 people representing 85 organizations attended.

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

http://www.ibis.org/summits/nov19c/

Randy Wolff opened the summit by welcoming everyone and thanking the sponsors JEITA, Apollo Giken Co., Keysight Technologies, Ricoh, Toshiba Corporation, and Zuken. He noted the good attendance and encouraged questions from participants. He also thanked Bob Ross and Satoshi Nakamizo for the help in organizing the event.

Satoshi Nakamizo welcomed attendees to the meeting. He introduced the work of the JEITA EDA Model Specialty Committee. The group works to improve utilization of technologies for the EDA models, including IBIS, and promoting their distribution. He described the IBIS Summit as offering a platform to present information on new IBIS specifications and to discuss and exchange views with the IBIS Open Forum.

IBIS CHAIR'S REPORT

Randy Wolff (Micron Technology, USA)

Randy described the status and activities of the IBIS Open Forum. There are 26 member companies of IBIS in 2019. The 2019-2020 officers have changed significantly from the previous year. Many IBIS meetings occur weekly to yearly from task groups to Summits around the world. SAE ITC is the parent organization of IBIS, providing financial and legal services. IBIS has four task groups meeting weekly to discuss technical topics, IBIS quality, and the Editorial task group, which meets only as needed to produce new IBIS specification documents.

The latest IBIS milestone is the release of IBIS 7.0 and the ibishchk7 parser to support it.

Beyond IBIS 7.0, there are currently 5 BIRDs in discussion. The interconnect task group is working on an important update to EBD to support IBIS-ISS and Touchstone models. BIRD200 is already approved, and it improves die capacitance modeling. BIRD195.1 is also approved, and it simplifies some AMI input models.

Randy encouraged new contributions to IBIS from the meeting participants to ensure that IBIS continues to meet the needs of new technology, including improving power delivery design. He also described the BIRD process, and he noted that ideas do not need to be written in formal BIRD templates, but first can be presented in task groups for discussion before a BIRD is proposed.

EXPECTATIONS FOR THE NEW PACKAGE MODEL SPECIFICATION OF IBIS VERSION 7.0
Masaki Kirinaka, Akiko Tsukada (Fujitsu Interconnect Technologies Limited, Japan)
[Presented by Masaki Kirinaka (Fujitsu Interconnect Technologies Limited, Japan)]

IBIS 7.0 interconnect modeling is a new specification for package modeling. IBIS package models can now be as simple as RLC elements or complicated SPICE subcircuits with IBIS-ISS or Touchstone models. The expectation for IBIS 7.0 package models is more accurate simulation results and consistent results from all simulator tools.

When using IBIS RLC models, some simulators will use a lumped circuit model and others will use a distributed model such as a W-element. Simulation results were shown to be inconsistent between two simulators. In the same simulators, using the IBIS 7.0 package models (Touchstone or IBIS-ISS), the results were the same. Package crosstalk modeling is made easier through direct use of Touchstone files. Modeling of on-package capacitance is also made simpler, so simulation results are improved with better package PDN modeling.

Kirinaka-san described the functions required for the simulator in post-layout simulation when considering PDN effects.   First is support for local ground references for plotting true receiver waveforms. Simulators must also support Touchstone 2.0 so that the S-parameter port impedance can be one value for signals and a different value for the PDN. Connections of S-parameters with different references is also complicated and requires adding reference nodes to one S-parameter in some cases.

Ted Mido asked what is in the works for a future version of Touchstone. Randy Wolff responded that a survey was recently taken asking for input from users of Touchstone. Results of the survey are available on the IBIS website. The Interconnect task group plans to hold a special meeting in the future to invite non-IBIS participants to discuss their ideas.

Ted noted that the presentation indicated issues with supporting multiple reference ports for a Touchstone model in IBIS. Randy responded that the shortcut for Touchstone support in IBIS 7.0 supports only a signal reference port, but support for multiple reference ports is available using the IBIS-ISS S-element to link the Touchstone model into IBIS.

THE ON DIE DECAP MODELING PROPOSAL (BIRD198)
Megumi Ono*, Atsushi Tomishima** (*Socionext Inc., **Toshiba Electronic Devices & Storage Corporation; Japan)
[Presented by Megumi Ono (Socionext Inc., Japan)]

Ono-san summarized the importance of modeling the on-die decoupling capacitance as part of PDN modeling. A first proposal for modeling on die de-cap was described at the IBIS Summit in Japan in 2017. BIRD198 was officially submitted to the IBIS Open Forum on March 11, 2019. The original proposal models the on die de-cap as three elements, capacitance, series resistance, and leakage resistance, following the example of the Series Model. The proposed simple model correlates well with measurements.

Since introduction of the BIRD, the BIRD authors and members of the IBIS Open Forum Advanced Technology Modeling task group have been reviewing and discussing several syntax proposals to be incorporated in a draft 2 revision of BIRD198. The authors have also been looking at possible interactions between on die de-cap modeling described using BIRD198 and on die de-cap modeling that could be included using BIRD189 [Interconnect Model] syntax. They will continue working on a new draft and addressing comments from the IBIS Open Forum.

Ono-san requested feedback from Japanese users of IBIS to help make the proposal the best it can be.

Tadashi Arai commented that the proposal is very good, and he generally agrees with it. He noted that the model is different for each I/O buffer. For example, in PCIe, when the associated logic is large or small, the PDN capacitance changes, so it makes sense to switch it from under [Model] to under [Component]. It is surprising that the result of simulation and measurement agree. In large-scale ICs, on-die capacitors do not match the designed values. Since the PDN designers have difficulty in predicting the 'C' of the logic part, they are designed without considering it. So, there is only the design value of on-die PDN, but the block that implemented SRAM has large C. If the on-die capacitance is large, the current consumption increases, so adjustments are made to minimize it as much as possible. What scale of LSI was used in this talk? Megumi Ono responded that the validity of the equivalent circuit was evaluated by modeling the measured values, not the design values.

Tadashi Arai commented that since LSI vendors have design data, it should be modeled based on the data. If creating the model from the actual measurement, we should decide who will do the task. So, it seems to be easier to create the model from the design data, however the fitting(matching) is rather difficult. Megumi Ono responded that fitting (matching) the design value and measured value are a difficult task. But it is not an issue of IBIS.

Ken Saito asked when incorporating the PDN model into the IBIS model, is the reason to ensure the confidentiality? Megumi Ono responded that ensuring confidentiality is one of the main reasons. We have already confirmed that it is easy to understand if modeled by the simple method like this, even if it is constructed of a slightly more complicated circuit, and it is also valid as an equivalent circuit. Since it is troublesome for the user to connect the PDN model separately, if it is included in the IBIS model, it is easier to handle.

Ken Saito commented that in DRAM, VDDQ is divided into multiple dies, so if you map by

power supply name, it may cause some difference between the real one. Megumi Ono responded that currently it is proposed to define for each power domain. Ken Saito added that internally, there is a die for each VDDQ pin, and from the viewpoint of simultaneous switching and power integrity, we cannot represent it with a single VDDQ. Megumi Ono responded that they will consider this topic.

Masahiko Banno commented that as design information, the capacitance of the die is kind of know-how, so it may not be described. He asked is it better to have some kind of encryption method? Megumi Ono responded that since it is IBIS, it is necessary to discuss whether encryption is appropriate. It is necessary to discuss whether it should be encrypted like IBIS-AMI or whether it should be supplied like interconnect models.

Masahiko Banno commented that how to place the capacitor in the load should be discussed. When considering SSO, it is better not to describe the number of capacitors for one power supply but to define it accurately. He hopes we can use them properly and it becomes quite convenient.

IBIS FILE FORMAT LINKS
Bob Ross (Teraspeed Labs, USA)
[Presented by Randy Wolff (Micron Technology, USA)]

Randy presented an overview of the evolution in the number and types of file formats supported by IBIS. IBIS now directly or indirectly supports over 17 formats ranging from IBIS defined formats (ebd, ibs, pkg, ami, Touchstone, etc.) to formats managed by other standards bodies (VHDL_AMS, Berkley SPICE, etc.). Electrical Module Description (EMD) is a future format that is under development in the Interconnect task group.

Tadashi Arai asked about the usefulness of the new EMD format in development. Randy described the limitations of current EBD models including no coupling and no loss. EMD will allow for coupling and broadband models using IBIS-ISS or Touchstone. He noted that these new formats were introduced for packages in IBIS 7.0, but it is limited to packages with a single die connection. EMD should be in the next IBIS specification release, and it will be useful for modeling new multi-chip packages and circuit boards such as modules. It will be a very good improvement for the accuracy of models.

HOW TO OBTAIN BUFFER IMPEDANCE FROM IBIS
Lance Wang (Zuken, USA)

Lance explained that matching output buffer impedance to interconnect impedance is a necessary task for the SI engineer. Impedance is represented as a complex quantity Z. He showed how to measure input and output impedance of an I/O buffer. Example I-V curves for input and output buffers were shown, including inputs with ODT. Obtaining impedance from an IBIS model starts with overlaying a load line on the Pullup or Pulldown I-V curves. Operating point impedance is the intersection of the load line and the I-V curve. I/O impedance may vary for different loads.

A POTENTIAL APPLICATION OF IBIS MODELS TO CISPR25 BASED EMI ANALYSIS OF DCDC CONVERTER

Kazuyuki Sakata*, Koji Ichikawa**, Miyoko Goto***, Toshiki Kanamoto****
(Renesas Electronics Corporation*, DENSO Corp.**, Ricoh Corp.***, Hirosaki University****;
Japan)
[Presented by Kazayuki Sakata (Renesas Electronics Corporation, Japan)]

Sakata-san described the motivation of the study was to try modeling a DCDC converter using IBIS. Impedance measurements across several pins of the device were made, and the data was fit to some simple equivalent circuit models. Time domain measurements were also made of the device, and results were shown. At first simulation results compared to measurement results were very different, with large ringing appearing in simulation for both open and resistive loads. Adjustments to Composite Current and rising/falling waveforms were made to improve matching to measurements. A possible source of error in the simulation is large ringing induced by instantly switching MOS transistors. A possible improvement is obtaining Rising/Falling Waveform and Composite Current data directly from measurement.

Ted Mido commented that in the circuit simulation, inductors or nearby elements are lumped constants, but in actual machines, if they are in a dispersional state like distributed constants, it may become one of the causes. For example, the distributed constant converges when the transmission line is expressed as a ladder and when the transmission line is expressed as a distributed constant. We may find the solution from this fact.

Kazuyuki Sakata asked if he should use a dynamic model for the inductor model. Ted Mido responded that for the dynamic model or the distribution constant, I don't know which is more appropriate, but some knowledge may be obtained.

Kazuki Murata noted that this time, PMOS and NMOS are modeled as IBIS model, but he recognizes that the original SPICE model exists. In board model simulation, did you use a SPICE model instead of an IBIS model? Has ringing occurred at that time? Kazuyuki Sakata responded that it was confirmed that ringing occurred. It is difficult to prevent ringing that occurs in SPICE from occurring in IBIS.

Kazuki Murata asked is it correct to recognize this as an external problem, not a model problem? Kazuyuki Sakata responded that there may be an external cause. However, it may be because SPICE does not perform actual load extraction. It may be most accurate to use [Rising Waveform] and [Composite Current]. Of course, we would like to consider the distribution of inductors proposed by Tetsuhisa Mido.

IBIS-AMI AND COM CO-DESIGN FOR 25G SERDES

Nan Hou*, Amy Zhang*, Guohua Wang*, David Zhang**, Anders Ekholm** (Ericsson, *PRC, **Sweden)
[Presented by Anders Ekholm (Ericsson, Sweden)]

Anders started with an overview of the IBIS-AMI flow. Channel operating margin (COM) is related to the ratio of a calculated signal amplitude to a calculated noise amplitude. He described the COM flow, the channel transfer function, and the method for determining the

optimal EQ settings. He noted that the channel transfer function combines frequency domain calculations with a time domain calculation to include DFE.

Two cases were shown of simulating COM results, followed by IBIS-AMI simulation with the recommended COM parameter settings. He stressed that COM is only useful for optimizing signal to noise ratio, if other types of optimization are needed, then other methods must be used. In a co-design simulation flow, COM is used for channel optimization followed by IBIS-AMI simulation.

CLOSING REMARKS

Randy Wolff closed the Summit, thanking the sponsors, the authors and presenters, and all participants. He encouraged all to consider proposing their ideas for IBIS through the BIRD process. The summit was adjourned.

NEXT MEETING

The next IBIS Open Forum teleconference meeting will be held on November 22, 2019. The following IBIS Open Forum teleconference meeting is tentatively scheduled on December 13, 2019.

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NOTES

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This meeting was conducted in accordance with ANSI guidance.

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- To obtain general information about IBIS.
- To ask specific questions for individual response.
- To subscribe to the official ibis@freelists.org and/or ibis-users@freelists.org email lists (formerly ibis@eda.org and ibis-users@eda.org).
- To subscribe to one of the task group email lists: ibis-macro@freelists.org, ibis-interconn@freelists.org, or ibis-quality@freelists.org.
- To inquire about joining the IBIS Open Forum as a voting Member.
- To purchase a license for the IBIS parser source code.
- To report bugs or request enhancements to the free software tools: ibischk6, tschk2, icmchk1, s2ibis, s2ibis2 and s2iplt.

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

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

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

http://www.ibis.org/bugs/s2ibis/bugs2i.txt
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http://www.ibis.org/bugs/s2iplt/bugsplt.txt

Information on IBIS technical contents, IBIS participants and actual IBIS models are available on the IBIS Home page:

http://www.ibis.org/

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

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

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SAE STANDARDS BALLOT VOTING STATUS

Organization	Interest Category	Standards Ballot Voting Status	October 18, 2019	November 1, 2019	November 4, 2019	November 8, 2019
ANSYS	User	Active	X	X	X	X
Applied Simulation Technology	User	Inactive	-	-	-	-
Broadcom Ltd.	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	-	X	X	X
Cisco Systems	User	Inactive	-	X	-	-
Dassault Systemes	User	Inactive	-	-	-	-
Ericsson	Producer	Active	-	X	X	X
GLOBALFOUNDRIES	Producer	Inactive	X	-	-	-
Google	User	Inactive	-	-	-	-
Huawei Technologies	Producer	Inactive	-	X	-	-
Infineon Technologies AG	Producer	Inactive	-	-	-	-
Instituto de Telecomunicações	User	Inactive	-	-	-	-
IBM	Producer	Inactive	X	-	-	-
Intel Corp.	Producer	Active	X	X	X	-
Keysight Technologies	User	Active	-	X	X	X
Maxim Integrated	Producer	Inactive	-	-	-	-
Mentor, A Siemens Business	User	Inactive	X	-	-	X
Micron Technology	Producer	Active	X	X	X	X
NXP	Producer	Inactive	-	-	-	-
SiSoft	User	Inactive	X	-	-	-
SPISim	User	Inactive	X	-	-	-
Synopsys	User	Active	X	X	-	X
Teraspeed Labs	General Interest	Inactive	X	-	-	-
Xilinx	Producer	Inactive	-	-	-	-
ZTE Corp.	User	Inactive	-	X	-	-
Zuken	User	Active	X	X	X	X

Criteria for SAE member in good standing:
- Must attend two consecutive meetings to establish voting membership
- Membership dues current
- Must not miss two consecutive meetings

Interest categories associated with SAE standards ballot voting are:
- Users - members that utilize electronic equipment to provide services to an end user.
- Producers - members that supply electronic equipment.
- General Interest - members are neither producers nor users. This category includes, but is not limited to, government, regulatory agencies (state and federal), researchers, other organizations and associations, and/or consumers.